GEND-INF-078

GEND-INF--078

DE88 007710

ICBC VERSION 3.1
TMI-2 INITIAL AND BOUNDARY CONDITIONS DATA BASE

Ronne W. Brower
Larry J. Fackrell
Daniel W. Golden
Mary L. Harris
Carol L. Olaveson

January 1988

EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U. S. Department of Energy
Idaho Operations Office
Under DOE Contract No. DE-AC07-76ID01570

Abstract

The TMI-2 initial and boundary conditions data base is a micro computer data base which provides the required initial and boundary conditions to simulate the TMI-2 accident. Additionally, other time series plant measurements related to the accident are included in the data base. Major features of the data base are the ability to plot, manipulate and list data as well as to enter user supplied data (e.g. results of simulations). The user guide provides the instructions for installation and operation of the data base.

CONTENTS

FIGURES

ICBC VERSION 3.1
TMI-2 INITIAL AND BOUNDARY CONDITIONS
DATA BASE

1.0 INTRODUCTION

The Initial and Boundary Conditions data base (ICBC) has been developed by EG&G Idaho's Three Mile Island (TMI) Accident Evaluation Program (AEP) to support the Department of Energy (DOE) sponsored TMI-2 Standard Problem[1]. The ICBC contains the best available data of those initial and boundary conditions that affected the progression of the accident in the TMI Unit 2 (TMI-2) reactor coolant systems for the first 16 hours following the initiating turbine trip event at 04:00:37 hours on March 28, 1979.

Initial conditions consist of plant operational parameters, status of operating systems and burnup condition of the nuclear fuel at accident initiation. Conditions that occurred in the pressurizer, mass transfers within the primary system, reactor coolant pump operations, and steam generator conditions constitute the reported boundary conditions data. All data in the ICBC have been reviewed by AEP's Data Integrity Review Committee (DIRC), which assigned qualification categories and has approved uncertainty estimates developed through analyses of plant data. The procedures followed by DIRC have been written into a methodology (to be published) based largely on methods proposed by Abernathy[1]. Published analyses of plant ICBC data are contained in other referenced reports. By convention, all data within ICBC are stored in units commonly used in the TMI-2 plant and existing literature (predominately English). SI units are available to users.

This data base has been developed to operate on an IBM personal computer system (PC, XT, AT or PS/2) or on a 100% compatible system. An EG&G Idaho scientific data base product, SAGE, has been chosen as the data base management system. Applications routines are written (using overlay segmentation) in the Modula-2 structured programming language.

This report emphasizes user interaction with the data base. Section 2.0 addresses the acquisition of the ICBC and how to install it, including hardware requirements. Section 3.0 is a brief description of the data base structure. User interaction with the data base to produce outputs of the contained data are discussed in Section 4.0.

Version 3.1 of the ICBC includes all features of the previously distributed Version 3.0 with improvements or additions in the following areas:

addition of a PC configuration table (also in Version 3.0);

inclusion of more TMI-2 data functions reviewed by DIRC (compare listing in Appendix B with that from Version 3.0);

revised decimation of 14 reactimeter data channels to preserve frequency structure lost in previous ICBC versions where every 10th point was recorded (see Appendix D);

extension of the data manipulation capability to include integration and differentiation plus ability to exercise a <F>ind option from the manipulation form and to execute manipulations (including delete) from the form produced;

addition of power peaking factor data at 0 and 100 minutes (ORIGEN calculation in the same format as the core burnup data) and the Los Alamos Scientific Laboratory (LASL) decay heat curve;

further improvements in the procedures which permit users to enter time series functions; and

addition of a capability to rebuild user data files plus ability to load

---

1. Standard Problem - A formal exercise in which participants will apply their analytic methods to the TMI-2 accident using common data (i.e., initial and boundary conditions, plant configuration, etc.) to benchmark accident analyses techniques to estimate the source term from low-probability severe accidents.

ICBC Version 3.1 files from diskettes and merge existing user data files already within the \ICBC subdirectory of the hard disk.

A discussion of these new features is presented in the appropriate sections of this user manual. In several cases, forms have been altered to provide improved ICBC capabilities.

2.0 ICBC INSTALLATION

2.1 Data Base Acquisition

The TMI-2 Initial and Boundary Conditions data base may be acquired free of charge to agencies connected with DOE sponsored TMI-2 research by written request to:

J. M. Broughton
Manager, DOE Severe Accident Research Programs
EG&G Idaho, Inc.
P. O. Box 1625
Idaho Falls, Idaho, 83415

2.2 Personal Computer Hardware Requirements

The personal computer system on which ICBC Version 3.1 is to be installed must be an IBM system (PC, XT, AT or PS/2) or a 100% IBM compatible system. The host PC system must be operated under IBM Disk Operating System Version 2.1 (DOS 2.1) or newer software. In addition, the following hardware features are necessary:

a diskette drive, double sided (320/360KB) or high capacity (1.2MB); Note: ICBC is not available 3.5" diskettes

a display with graphics adapter (color preferred). Note that use of an IBM enhanced graphics adapter also requires that the system have a 16 color IBM memory expansion card (P/N 1501201)

a 20MB internal fixed (hard) disk unit

640KB memory

a math co-processor (8087 for PC, XT; 80287 for AT, PS/2)

dependent. The data bases support those devices that are in common use at EG&G Idaho. In particular, plotted hardcopy output of ICBC data requires:

a. an EPSON FX series plotter (or 100% compatible unit), and/or

b. a Hewlett-Packard plotter (Model HP7450, HP7470, HP7475, or HP7550).

The data base software routines for output generation require that PC system hardware be defined in a file (PCSYS.CFG) located within the \DOS directory of the system on which they operate. When a user attempts to perform any output option, this file is interrogated to determine if the user's PC system has an acceptable output device. Appropriate error indications are issued if the operation is not permitted.

The user is required to generate the configuration file using two configuration forms prior to their initial attempt to use a TMI-2 SAGE data base product. The two forms are shown in Figures 1 and 2. Once the file exists, it need not be regenerated for installation of additional TMI-2 data bases. Should the hardware configuration change, the user may select an option from the main menu that will permit a change to the PCSYS.CFG file.

Note that ICBC 3.1 plotting requires considerable memory (approximately 570KB) and will not, for example, operate on a system with 640KB of memory and the IBM network program, version 1.0 running at the same time.

2.3 Data Base Installation

ICBC 3.1 is transported on ten, double sided (320/360KB) diskettes or on three, high capacity (1.2MB) diskettes. The descriptions of each diskette content are included in Appendix E.

If you already have ICBC, Version 3.0 resident on your PC system, do not remove files from the \ICBC subdirectory before proceeding with the installation. Observe the special instructions below to retain your user data files within the UDATA.BLK, UDATA.DAT and UDATA.IDX files.

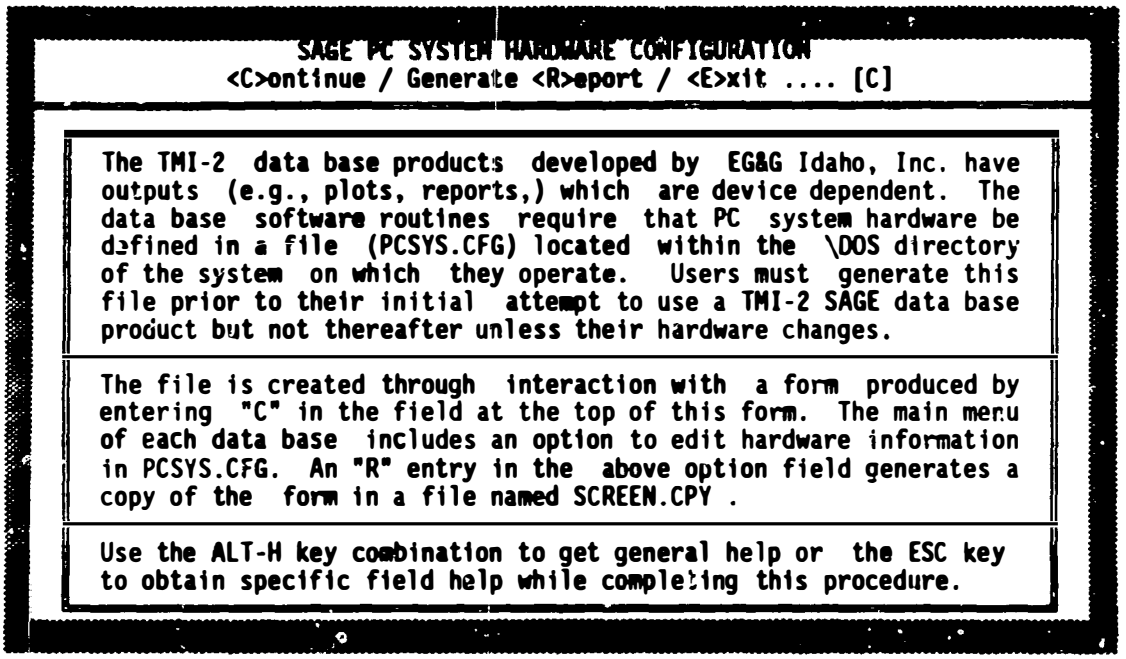


Figure 1. Instructions to Generate the PCSYS.CFG File

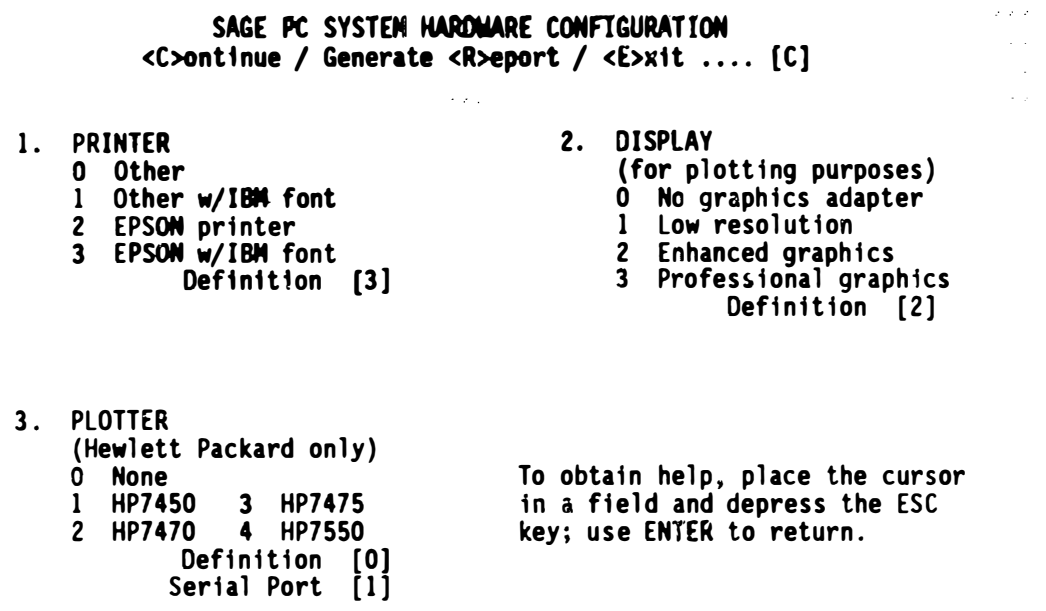


Figure 2. Identification of PC Hardware

The file named INSTALL.BAT on diskette 1 is used to install ICBC on the user's fixed disk system. To perform this installation, insert diskette 1 into the diskette drive (hereafter termed drive A:) and type the command 'A:INSTALL'. The installation batch file, INSTALL, will create a \ICBC directory on the fixed drive (hereafter termed drive C:) and will copy all files from diskette 1 onto drive C:. Following the transfer from diskette 1, the user will be instructed to remove it and insert the second diskette for transfer of its contents to C:. A second subdirectory, \HALO, will be created to contain all of the ICBC plotting routines. This directory is necessary for plotting; other TMI-2 SAGE data bases will use this same area for plotting.

If you previously have created user time series data files which you wish to retain, you must take the following actions:

Enter the ICBC data base environment by typing "ICBC" and proceed to the main menu.

Choose option 5, 'Enter Data From Disk'.

Select data entry option 3, 'Put New Descriptions in Meas Relation'. This action will properly rebuild access to your user time series functions stored in the UDATA files.

Total storage requirement for ICBC Version 3.1 is 2.7 MB. The '.DAT' files contain the Initial and Boundary Conditions data; the '.IDX' files are associated indices; the '.BLK' files are storage structures for time series functions or large textual records. The ICBC.DFL file contains the forms (screens), including online help messages, through which the data base is operated. M2.EXE is the Modula-2 executable driver and the '.LOD' files are overlay routines that contain the applications software to operate the data base. Those files with 'HALO' in the filename are for plotting of time series data.

The ICBC data base operates from ICBC.BAT in the PC batch area and can be executed by typing 'ICBC' from any directory. All files (default RPT.RPT or user defined) produced by ICBC will be located on disk in the \ICBC

subdirectory. Since the normal return from ICBC will invoke the batch menu function, the user will be required to change directories (CD\ICBC) to direct output of ICBC created files. It is recommended that 'ICBC - Initial and Boundary Conditions data base' be added to the bootup software menu of the user's PC system.

3.0 ICBC STRUCTURE

The ICBC data base uses three major software systems; SAGE, Modula-2 and MPG. SAGE, an EG&G Idaho product, is a scientific oriented development utility with versatile relational data base tools, including a convenient schema and form development package (THOR). Modula-2, an applications language used in connection with the SAGE software, is a state-of-the-art, structured language developed to overcome the shortcomings of PASCAL. MPG is an in-house plotting package built expressly for SAGE personal computer applications.

The ICBC data base has four principal data areas as follows:

COND - Contains plant conditions data by type, value, associated time, description, uncertainty, physical unit code, and applicable note reference(s). This area contains time series boundary conditions stored in block form within the data base. These functions have attributes that include measurement identification descriptions, uncertainty estimates, data qualification categories, and statements.

TIMSER - Contains time series functions that have been reviewed by DIRC.

USER - An area provided for data base users to enter functions into ICBC. This area is also used to contain functions which have been transformed using the data manipulation capabilities within the data base.

FUEL BURNUP - Contains original enrichment and location of all fuel assemblies within the TMI-2 core, the total burnup and peaking factors in each assembly at each of seven axial elevations within the core and reference(s) to applicable notes.

User interface with ICBC is through a hierarchical system of menus and forms. A typical system structure based on forms is contained in Figure 3. User interaction is accomplished via fill-in-the-blank selections which determine data base operation. The forms and operations are discussed in detail in the next section.

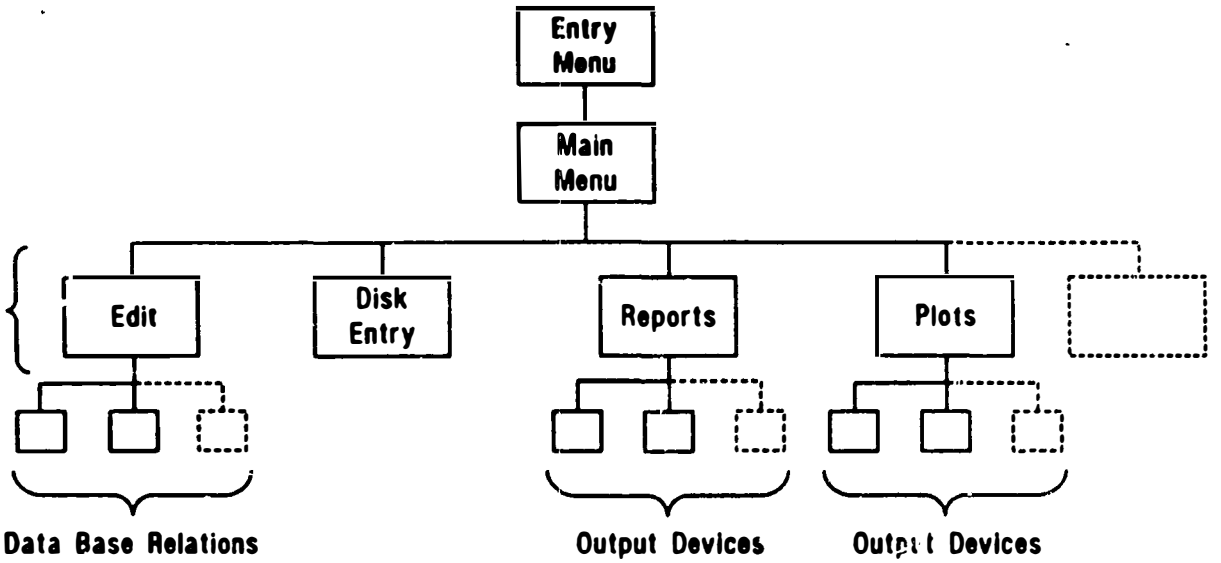


Figure 3. Form Configuration for TMI-2 Data Bases

4.0 USER INTERACTIONS

This section discusses the main ICBC forms (Figure 3), explaining the options available to the user and the actions that result from execution of each. The fields in which the user is expected to input his operational commands are shown in reverse video on a monochrome display and in a different color on a color monitor. A cursor (blinking dash) is used to identify position within the form.

Movement between input fields is accomplished by: (1) completely filling in a field or by depressing the <TAB> key that causes a sequential transfer to the next field; (2) by using the backtab keys <Shift/TAB> to move to the previous field; (3) by use of the four arrow keys in the numeric pad section of the keyboard; or, (4) by selecting the <HOME> key to transfer to the primary form field. A carriage return <CR> entry causes the user supplied information to be interpreted by the data base software and requested operations to be performed. In one instance (custom reports form) multiple <CR> operations are required, first to transfer the cursor to the form entry field and then to execute user requests.

User entries are processed for legitimate response. When an error is detected (such as an incorrect format, an entry out of range, or <CR> when cursor is not in an entry field), a bell is sounded and a brief error statement displayed at the bottom of the display screen.

On-line help is available from the various fields of the forms by striking the <ESC> key. This causes a brief message to be printed that describes the options available/information to be entered for the field in which the cursor is currently located. Should the cursor not be located within an input field, the form entry position message is displayed. A <CR> is used to return from help messages to the original position within the form (note that when multiple <ESC> key operations are required to complete a user help request, an equivalent number of <CR> operations are required to return to the form). In most instances, the help forms will also contain

the same entry fields as the area of the form from which help is requested; information may be entered from the help screens. Some general form options provided by SAGE are available in ICBC; these options can be reviewed at any time by depressing the <ALT> and <H> keys simultaneously.

4.1 Entry Form

The entry form (Figure 4) provides fields for the user to enter a set of initials and a password for entry into the data base environment. The data base logs the number of times each user/password entry pair is exercised. Users are divided into two classes: 'M'aster users who have permission to edit data base relations and must enter a legitimate user-ID/password combination to alter the data base or 'R'egular users who cannot edit data and are not required to fill in the user-ID and password fields if they so desire. Master user status is reserved to only those individuals responsible for the update and maintenance of the ICBC in accordance with established policy.

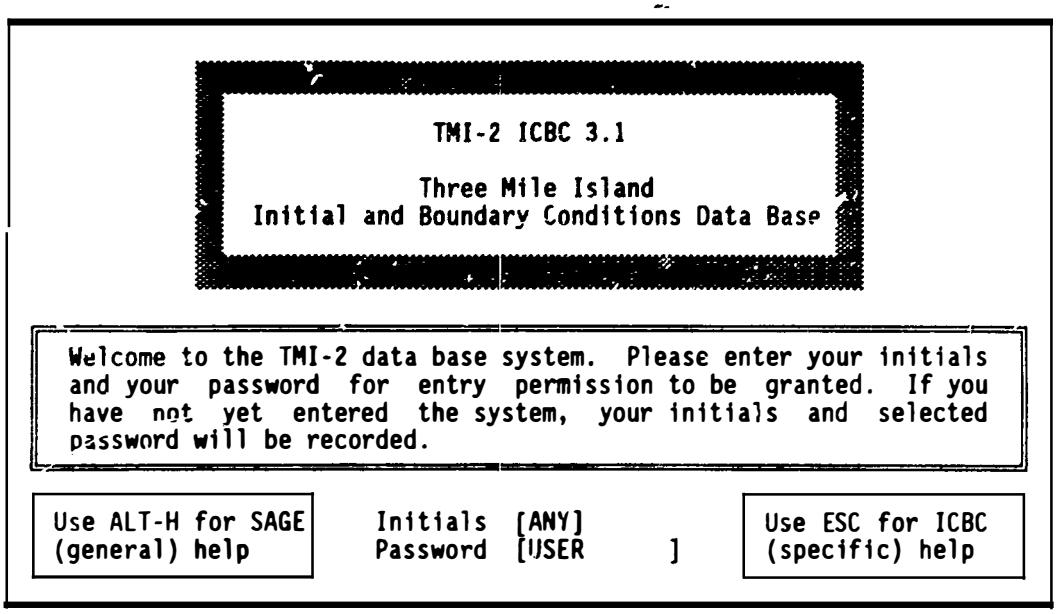


Figure 4. ICBC Entry Form

4.2 ICBC Main Menu

The main menu (Figure 5) gives the user options to edit data base records, to generate data outputs, to enter data from a disk file, to manipulate time series data with simple mathematical operators, or to change the PC system configuration table. All users are permitted to select the edit option and to inspect, but not modify, record contents (see below). Regular user entry of data is restricted to the USER area.

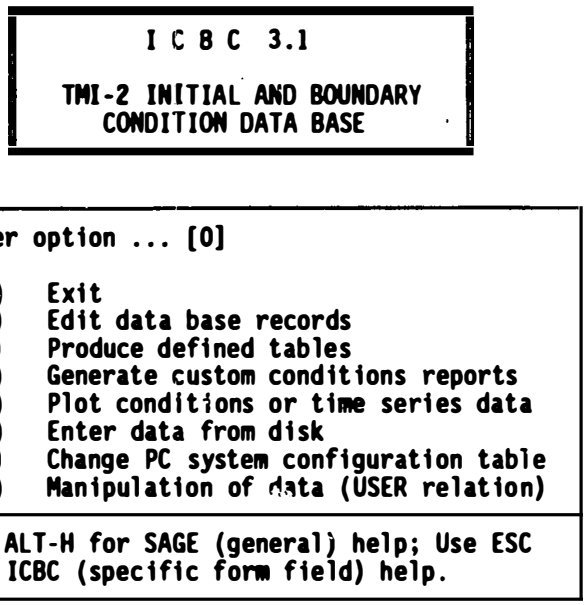


Figure 5. Main ICBC Option Menu

4.3 Edit Menu

Edit selections (Figure 6) allow all users to browse through data records and master users to change data records. Options available in the edit menus are described in boxes at the top of the edit forms. The <A>dd, <M>odify and <D>elete options require master status; others are available to all users. The options are described in help messages associated with the forms. An example of an ICBC editing form (plant boundary conditions, option 1) is shown in Figure 7.

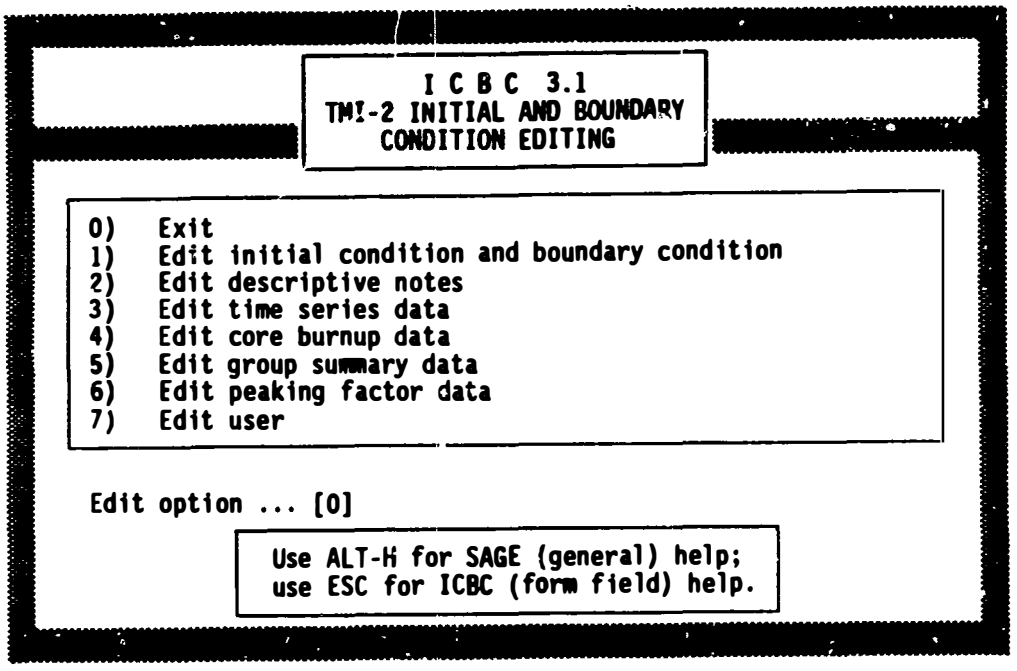


Figure 6. ICBC Edit Menu

PLANT BOUNDARY CONDITIONS

<L>ocate / <N>ext / <P>revious / <A>dd / <M>odify / <D>elete
<E>xit ..... [L]

Condition name	[COLD LEG TEMP1A]
Condition description	[COLD LEG TEMPERATURE 1A, RC-5A-TE2]
Time	[04:00:37]
Data physical unit code	[1] F
Low value	[5.506E+002]
Qualification Status	[QUALIFIED]
Low uncertainty	[1.910E+000]
High uncertainty	[1.910E+000]
Notes	[32] [34] [--] [--] [--]

Figure 7. Display of Plant Conditions Record for Editing

4.4 Plant Conditions Report Form

ICBC has provision for generation of nine conditions reports (plus explanatory notes), a time series summary report and six reports which describe the conditions of the fuel at the time of the accident. These reports are accessed through option 2 from the main menu (figure 5). Selection of the 'produce defined reports' option produces the screen shown in Figure 8. From it, the user can generate the following reports:

Plant conditions reports (Figure 8) - tabulations of important plant conditions at accident initiation, at 100 and at 174 minutes (key times in the accident scenario, available as report options 3, 4, or 5); history of the pressurizer block and spray valve operations (report options 7 and 8); the pressurizer heater operations (option 11); the primary coolant pumps operations (option 9) and makeup and HPI injection rates (option 11). In addition, ICBC makes available to the user a set of notes relative to the last conditions report generated (report from option 1) or a complete set of conditions notes (option 2).

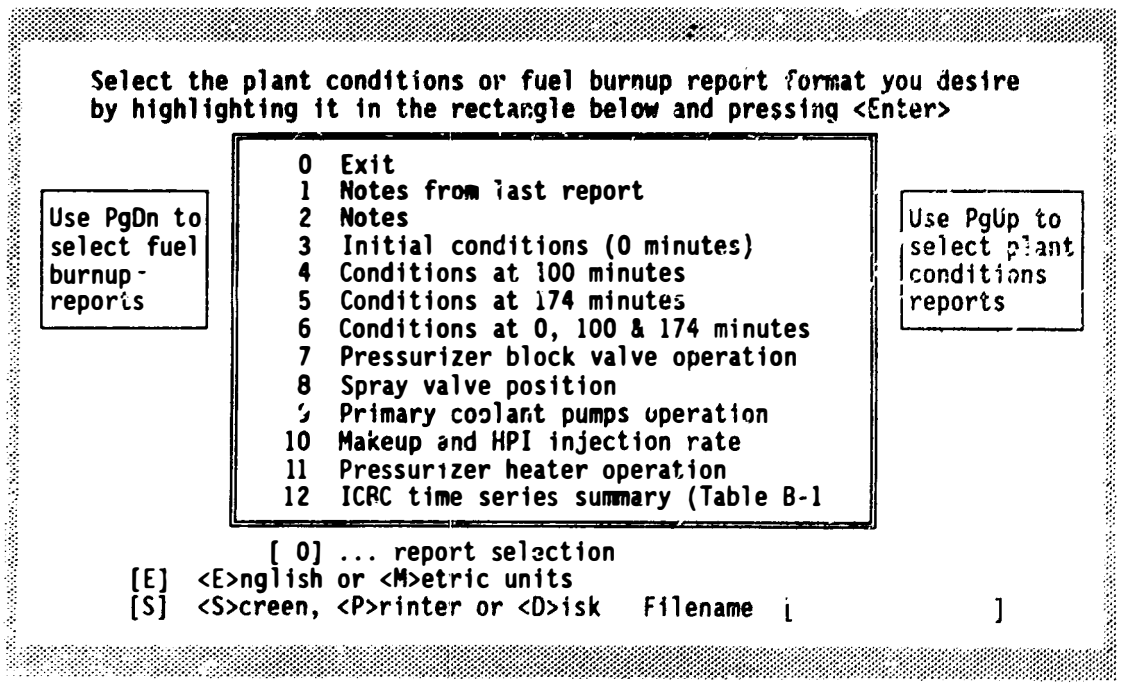


Figure 8. ICBC Fixed Report Generation Menu (Screen 1)

ICBC Time Series Function Summary (Figure 8) - The user can also generate a report of the time series data within ICBC by selecting report number 12. This will produce a tabulation containing the function identification, type, the reactor system to which the measurement pertains, the measurement description, its qualification category, uncertainty and comments needed to interpret the function. As an example: Measurement RC-58-TE2-R is a temperature measurement within the Reactor Coolant B loop; it is stored in ICBC in the COND relation; its associated description is 'Cold Leg Temperature - Loop 18'; it has been reviewed by the AEP DIRC and assigned a category of 'QUALIFIED' with an uncertainty of 1.91 Deg F.; and it is 'QUALIFIED UP TO 100 AND AT 174 MIN.'

When the user strikes the <PgDn> key while the report generation menu in Figure 8 is on his PC screen, a second report screen is displayed as shown in Figure 9. From this screen, he has option to select any of six reports which pertain to TMI-2 fuel conditions at the start of the accident.

ICBC Fuel Conditions Reports (Figure 9) - Fuel condition calculations have been generated using the isotopic generation and depletion code ORIGEN2 and a generic PWR cross section library. These calculations were performed by dividing the core into 12 fuel groups and calculating core inventory data at 7 axial levels in the core for each of the 177 fuel elements. Information in ICBC includes a group summary report (option 12), an element location and fuel enrichment table (option 15), initial conditions fuel burnup data in tabular (option 14) or diagram (option 16) format and core peaking factor data in tabular (option 17) or diagram (option 18) format. Fuel diagram outputs are provided in two forms; one uses the IBM extended character set to generate square rectangle corners.

The user may direct report output to the <S>creen, to an attached <P>rinter or to <D>isk. While reports are being generated, the message "Generating Report" is output at the bottom of the monitor screen. The ICBC system default is the screen. The user is given the ability to page up and down through a report sent to the screen using the <PgUp>, <PgDn> plus the up and down arrow keys. Information sent to the screen is buffered; a

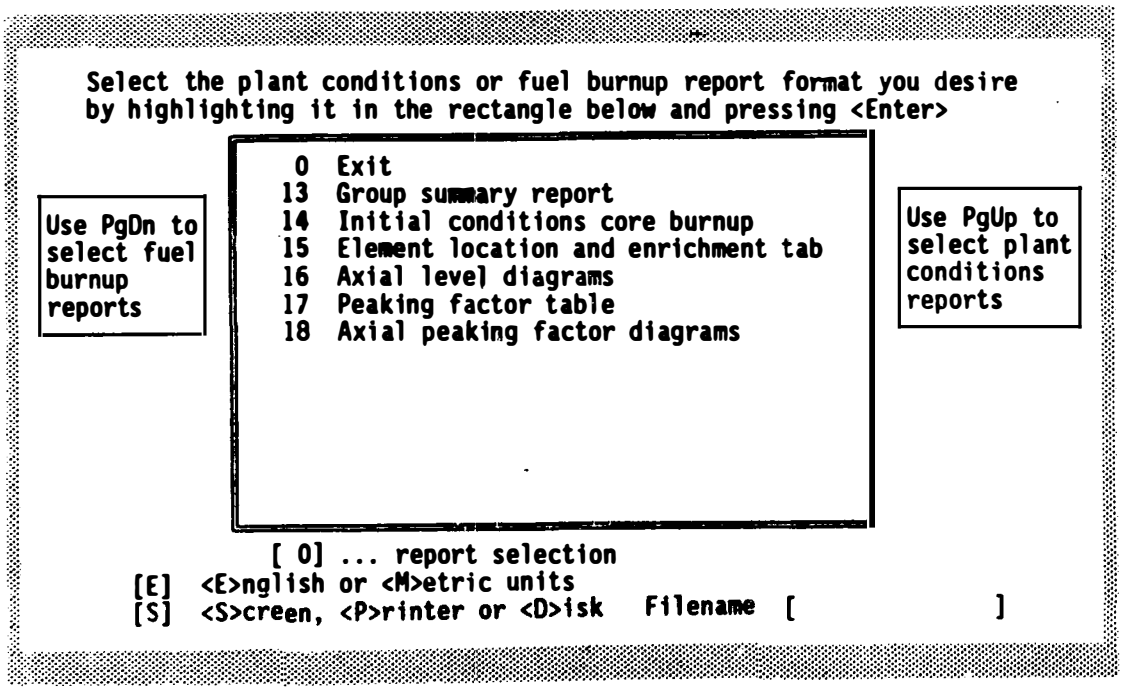


Figure 9. ICBC Fixed Report Generation Menu (Screen 2)

<Ctrl><Z> command is used to control the buffers. When an end to the current buffer is reached, the <Ctrl><Z> command produces a message inquiring whether the user desires to move <F>orward or <B>ackward through additional buffers or <E>nd the screen report display. A <Ctrl><Z> command is required to return control to the ICBC screen menus when the last buffer of a report is displayed. All reports sent to the screen are also written in the ICBC subdirectory on the default disk device under a scratch filename 'RPT.RPT'.

When a report is sent to a system printer, a pause is executed to ask user if the printer is ready to receive a print file. When the user responds 'Y'es, the report is printed.

If the <D>isk option is selected, the user may specify any system disk desired for report generation and may select any filename desired by typing <DEV:FILENAME> in the appropriate field (example - A:MYREPORT entry creates a file MYREPORT.RPT on diskette device A:).

As a convenience, all reports which can be generated from the report forms (figures 8 and 9) are included in this user's document within Appendix B.

4.5 Custom User Reports

User defined reports can be generated containing selected combinations of conditions data at 0, 100 or 174 minutes through use of the report generation form shown in Figure 10.

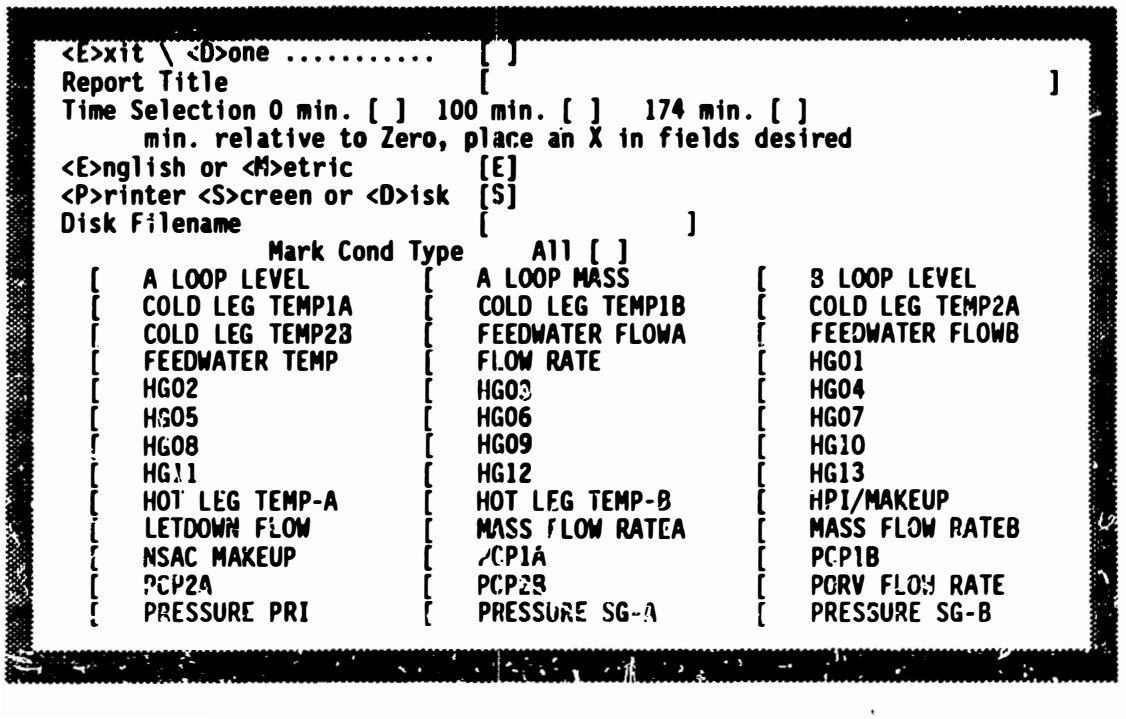


Figure 10. User Selected Conditions Report Menu

This menu permits the user to specify a report title, select data output at 0, and/or 100 and/or 174 minutes, and to choose <E>nglish (default) or <M>etric units. As in the fixed report generation operations described above, he can direct his output to the <P>rinter, <S>creen or <D>isk. He may select output of any of the listed data by placing the cursor in the fields at the left of the desired conditions and striking the <Enter> key which places an 'X' to mark the condition for report output.

Marking the 'All' field with a character will list all of the conditions data on his report. The <Home> key will transfer cursor control to the Exit/Done field, an <E> exits the option 3 form to the main ICBC menu without any report generation action, a <D>one entry generates a report as defined by user entered criteria. Warning - The <D> option leaves the user in the option 3 menu where he can generate other reports. When the <S>creen output is exercised each report is sent to the default scratch file RPT.RPT which is continuously written over. If you wish to save the reports please use the <P>rinter or <D>isk file output options.

The data listed on the form depicted in Figure 10 comes from discontinuous functions (i.e., binary ON/OFF primary coolant pumps, etc.) single or tabular data sources (i.e., initial reactor power) or from time series functions ('A' hot leg temperature). Values of these functions at these three key accident times have been placed in an ICBC conditions relation. The discontinuous and time series functions may be plotted or listed using ICBC capabilities discussed in the following user interaction subsections.

4.6 Plotting Capabilities

Within the ICBC data base, users may plot:

1. COND data- Certain plant operations data (piecewise discontinuous - such as HPI flow or primary coolant pump operation) or time series data containing boundary conditions defining accident parameters;

2. TIMSER data- Functions that have been reviewed by the AEP DIRC;

3. USER data - Time series data functions entered by regular data base users.

Plot generation is started by selecting Option 4 from the main menu (Figure 5). This action will produce a plot format selection menu as shown in Figure 11.

Four plot formats are selectable from the plot menu: single variable time series plots with linear or semi-log ordinates; multiple (up to five) plots of time series functions of the same physical type on a common set of X, Y axes; and, two time series functions with individual ordinates on a common time axis. On the plot selection screen, the user may set flags which will produce outputs in <M>etric units (default is <E>nglish), <G>rids at major divisions on the plots (default is <N>one), or <R>etain user time and ordinate axes scaling between successive plotted functions (default is to <N>ot retain scaling).

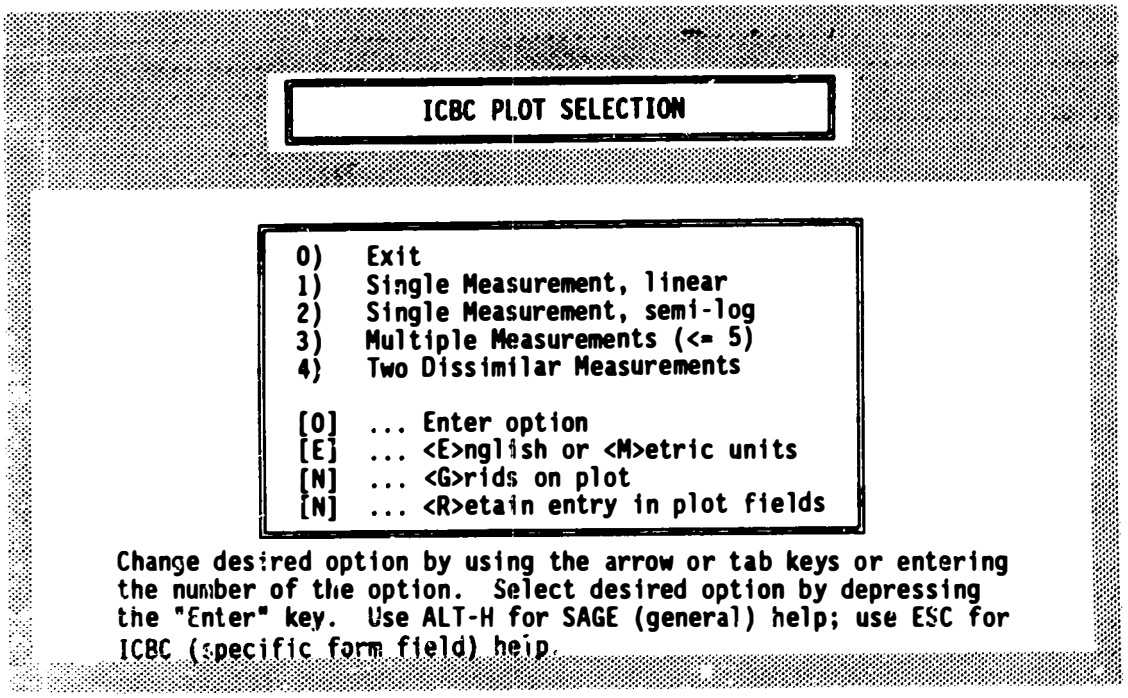


Figure 11. ICBC Plot Selection Menu

ICBC plot operations will be illustrated using Option 4 and plotting the composite primary pressure function together with its associated uncertainty. Exercising Option 4 brings up another menu on which the user specifies the data identifications, time and amplitude window, and labelling desired on a plot (Figure 12). If the user does not elect to specify ranges for the axes, the program defaults to the entire data set (note that ordinate ranges and a time range were specified). Default labels are also supplied for the time and ordinate axes if not specified (note that no ordinate label was specified in the example).

At the top of the plot setup menus are some options available to the user in determining what time series functions are available in the data base. The first (the <F>ind option) produces another form on which the user is able to locate functions. When the form is initially entered, the identification and description fields are blank and an 'F' appears in the lower right field. The user moves to the double lined box at the top

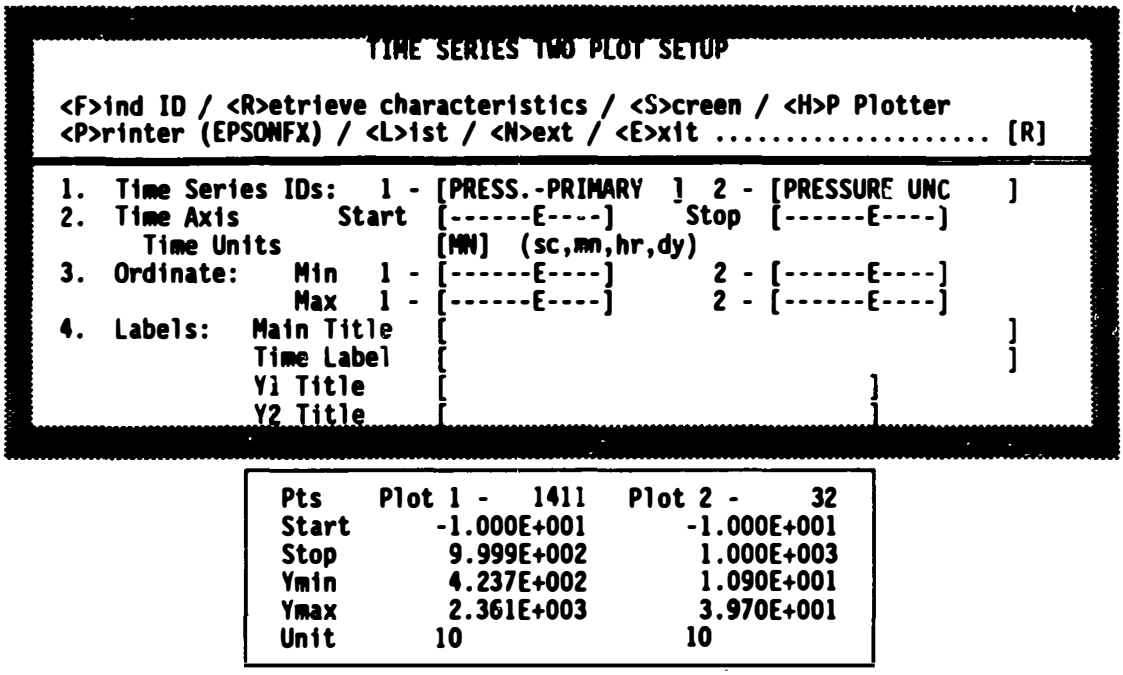


Figure 12. Option 4 Plot Setup Menu

(using the 'Home', tab or arrow keys) and specifies the data functions to be listed by entering information in the fields for:

1. Function type

2. System

3. Leading parameter name characters (example = RC-15A*, where * is a wild card character)

4. <C>OND, <T>IMSER, <U>SER, or <A>LL (the default condition) for data base area selection.

These four fields are logically .AND.ed together for retrieval of data base functions. NOTE: Refer to the help messages for these fields by striking <Esc> for legitimate search criteria when the cursor is within one of these fields. Identifications and descriptions are then retrieved and displayed (seven at a time) on the form. The retrieved information is sent to the scratch RPT.RPT file in the \ICBC\ subdirectory of the PC system (note that RPT.RPT is used in many data base output situations and is written over frequently).

The user may page through the screen list using <N>ext and <P>revious options. The user may also select data to be plotted by marking the select boxes to the left of the function IDs. Up to 10 functions may be selected at one time; they must be numbered 1 - 10 if <F>ind is executed from the single plot menus, from 1 - 5 in pairs if <F>ind is selected from the two plot menu (example case), or in two groups, 1 or 2 for the multiple selection form. In Figure 13, we have requested time series functions from COND that have the type attribute = 'PRESSURE' and have marked them with a '1' which, upon return to a two plot format menu, would produce a screen like Figure 12 with the pair 1 identifications and data characteristics filled in.

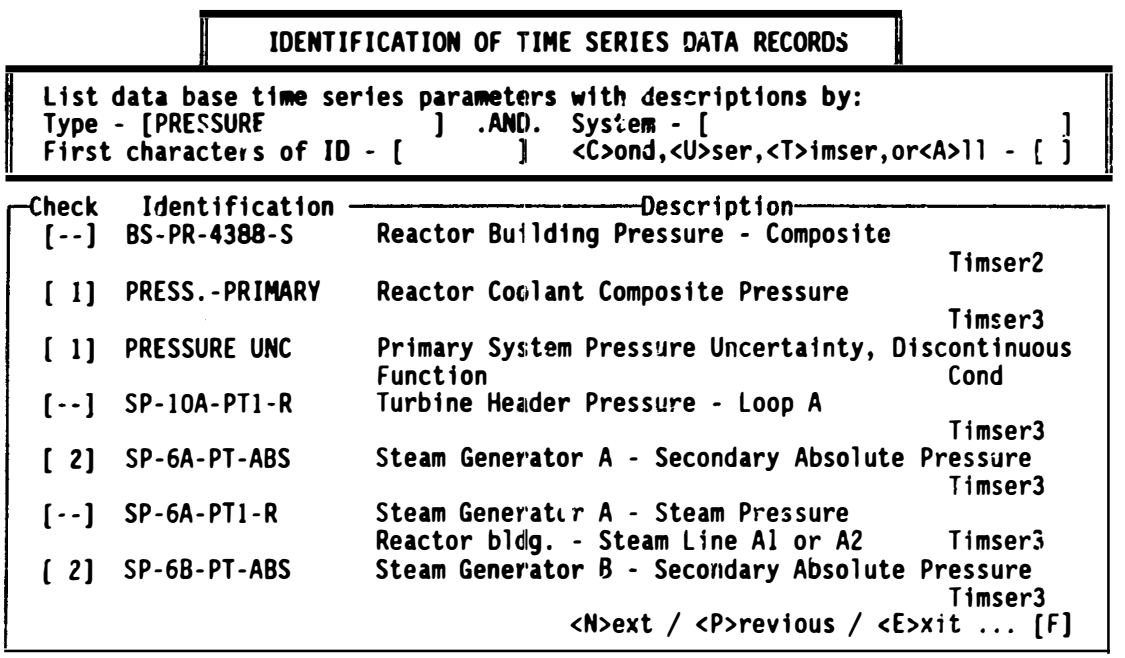


Figure 13. Find Time Series Function Menu

The <R>etrieve characteristics option (default when entering a plot generation form) causes the named function(s) to be accessed on disk to determine the time and amplitude ranges, number of points, and the unit code. These data are placed in the box at the bottom of the screen (see figure 12).

The <S>creen, <H>P Plotter and <P>rinter selections direct a defined plot file to a desired output device. Error messages are displayed at the bottom of the screen if the user attempts to send a plot file to a device not specified in the PCSYS.CFG file. Messages, presented at the bottom of the plot setup screen when a plot is sent to a specified device, remind the user of actions to be performed (for example, if the output selected was <P>rinter, the message "Is printer ready (Y/N)?" is shown and the program pauses waiting for the appropriate response). The plot specified in Figure 13 was output to an HP 7475 plotter and reproduced as Figure 14. Data are decimated with a minimum/maximum algorithm in ICBC when plotting is requested for functions (or portion thereof) exceed 1000 points in length. Each function to be displayed on a single or two plot format is decimated to <1000 points prior to display; each function displayed in a multiple plot format is decimated to <750 points. These reduced numbers are placed in the attribute boxes when the setup forms are redisplayed following a plot operation.

The <L>ist data option produces an overlay screen on the plot selection forms as shown in Figure 15. On the two plot selection menu, functions SG-A-LEVEL and SG-B-LEVEL have been retrieved (their identifications are hidden under the overlay list menu but their characteristics can be seen in the display only fields at the bottom of the figure). The user is given the option to select a list format and a decimation algorithm.

In the Figure 15 example, we have selected format 1 and a decimation of every 99th point. Format 2 listings are useful when the user wishes to extract time series data from ICBC and process it in some other software package. Note that an entry in the single heading field will produce only an initial list heading and data rather than a paginated output with a heading on each page. The 'P' decimation algorithm uses an iterative min/max file compaction routine in which the least and greatest of each consecutive three points are chosen until the number of points in the file

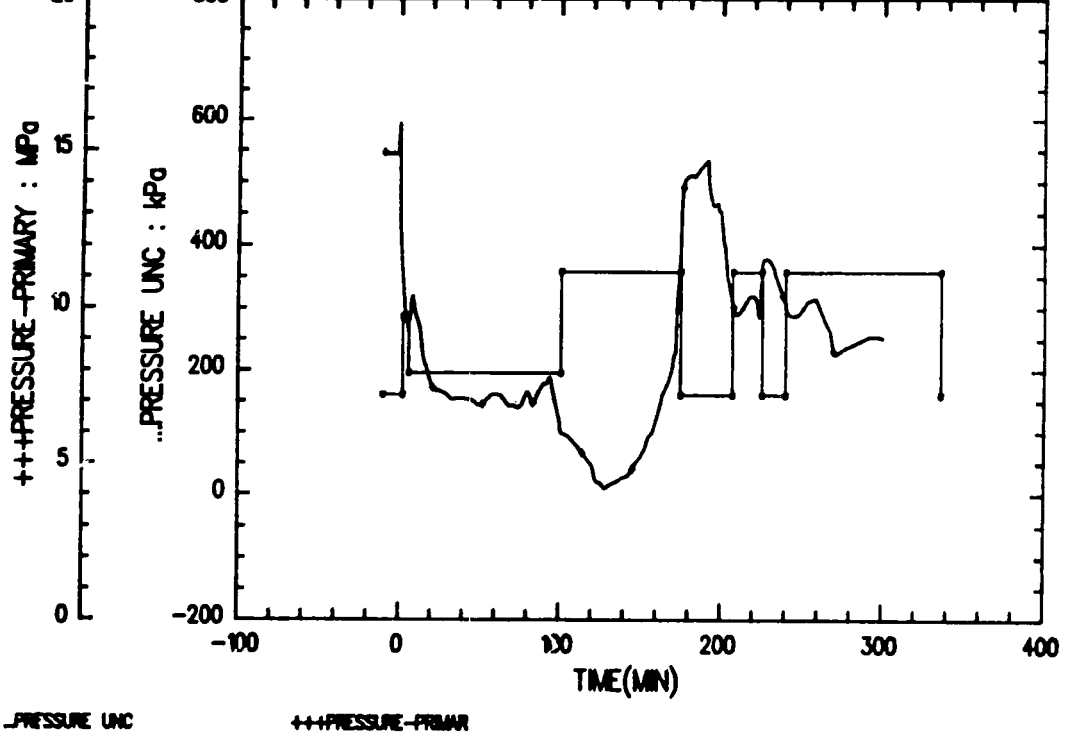


Figure 14. Plot of Composite Primary Pressure with Uncertainty Function

TIME SERIES TWO PLOT SETUP

<F>ind ID / <R>etrieve ch
<P>rinter (EPSONFX) / <L>

SELECT LIST OPTIONS [L]

1. Time Series IDs: 1
2. Time Axis Start
   Time Units
3. Ordinate: Min 1
   Max 1
4. Labels: Main Title
   Time Label
   Y1 Title
   Y2 Title

Format:
1 = 3 time/value pairs per line (reports)
2 = 1 time/value pair per line
[ ] ... Select Format
[ ] ... Single Heading

Decimation:
[--] Enter n to list every nth point
[ ] Enter P to obtain plot min/max
[---] decimation (below 1000 pts)

Pts	Pl	
Start	-1.000E+001	-1.000E+001
Stop	9.313E+002	9.313E+002
Ymin	1.078E+001	1.468E+002
Ymax	1.089E+003	1.067E+003
Unit	10	10

Figure 15. Two Plot Selection Form with List Screen Overlay

is less than a default of 1000 (further compaction is provided by entering an integer in the range 1-999 in the decimation field). The listings of time series functions are sent to file RPT.RPT in the /ICBC subdirectory. Figure 16 is a reproduction of the list generated by executing the options selected in Figure 15 (16 points/function are produced since there were 1550 points per function and every 99th value was selected).

Data Listing for SG-B-LEVEL

Time Period -1.000E+001 to 2.998E+002 MN
Decimation: Every 99th point; - Plot min/max

Time	Value	Time	Value	Time	Value
-1.00E+01	5.38E+02	9.80E+00	8.00E+00	2.96E+01	1.04E+02
4.94E+01	9.43E+01	6.92E+01	1.87E+02	8.90E+01	2.32E+02
1.09E+02	2.74E+02	1.29E+02	2.76E+02	1.48E+02	2.77E+02
1.68E+02	5.08E+02	1.88E+02	7.10E+02	2.08E+02	7.29E+02
2.28E+02	7.38E+02	2.47E+02	7.42E+02	2.67E+02	7.45E+02
2.87E+02	7.48E+02				

Data Listing for SG-B-LEVEL

Time Period -1.000E+001 to 2.998E+002 MN
Decimation: Every 99th point; - Plot min/max

Time	Value	Time	Value	Time	Value
-1.00E+01	5.38E+02	9.80E+00	8.00E+00	2.96E+01	1.04E+02
4.94E+01	9.43E+01	6.92E+01	1.87E+02	8.90E+01	2.32E+02
1.09E+02	2.74E+02	1.29E+02	2.76E+02	1.48E+02	2.77E+02
1.68E+02	5.08E+02	1.88E+02	7.10E+02	2.08E+02	7.29E+02
2.28E+02	7.38E+02	2.47E+02	7.42E+02	2.67E+02	7.45E+02
2.87E+02	7.48E+02				

Figure 16. Listings of Steam Generator Level Functions

4.7 User Entry of Time Series Functions

The ICBC data base provides an area (USER) in which a user can enter his own time series functions (such as the results of calculations) for comparison with similar functions contained within the data base. To enter time series functions into the data base, the user must:

1. Prepare a formatted disk file containing the time, value pairs.

less 13-character fields per card. The data may be in fixed point or exponential format. A data frame may consist of multiple channels with an associated common time channel (refer to the diagram in Figure 17).

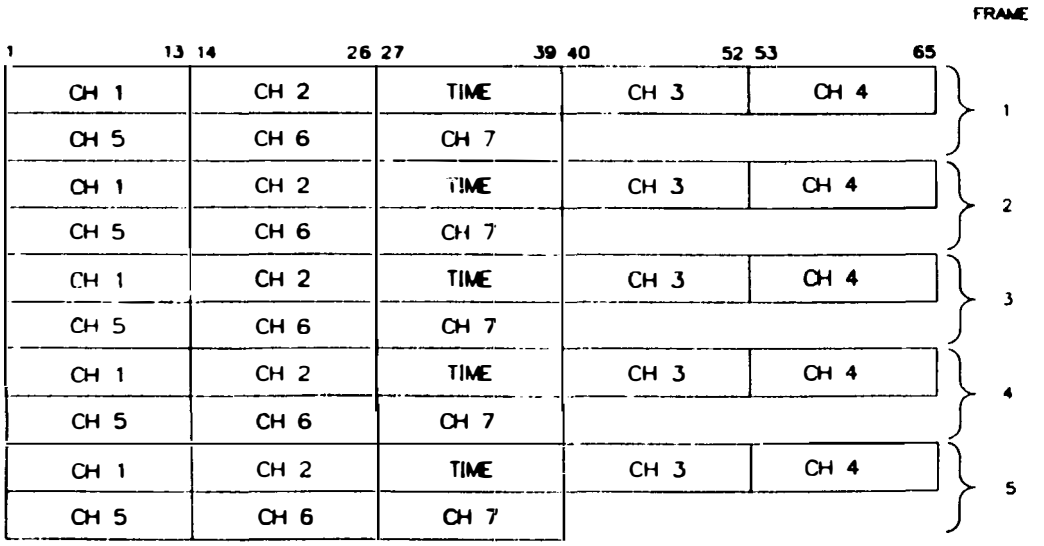


Figure 17. Model ICBC Time Series Entry File

If input data are multiplexed in this manner the following rules must be observed -

a. Each new frame of data must begin on a new card, and

b. If some time series functions have more values than others, the shorter channels must contain blank filled fields within the data frames to preserve position for correct interpretation.

The Figure 17 diagram depicts five frames from a model entry file in which there is one time channel (third position) and seven time series functions per frame.

2. Enter the formatted data (from a PC system disk) through selection of option 5 from the main menu (Figure 5). This action produces a disk entry menu (Figure 18) on which the user enters the time series data one channel at a time. The user must enter -

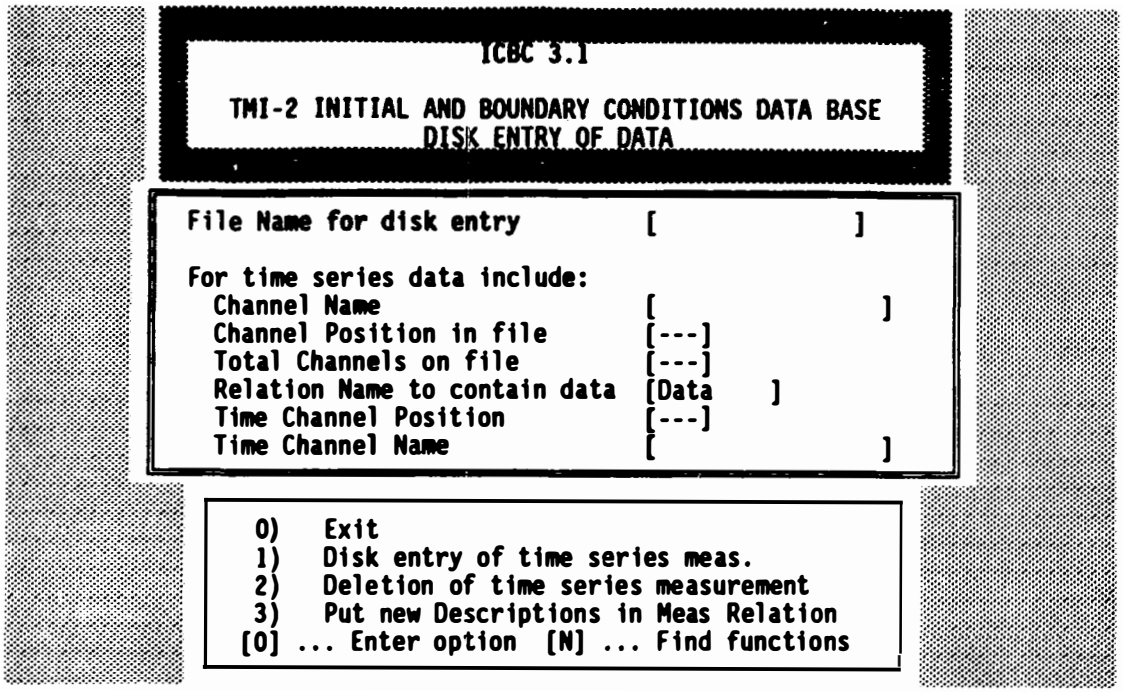


Figure 18. ICBC Disk Entry Form

a. The disk filename (DEV:FILENAME.EXT), 'A:MODEL.DAT' in the example,

b. Channel identification must be unique among the COND, TIMSER and USER areas, 'CHANNEL 6' assumed unique,

c. Channel position in the file data frame (the data function being entered is in the 2nd position of the 2nd card in each frame, so the proper entry for channel 6 is '7'),

d. Total channels in the frame (there are 7 functions in our hypothesized file plus the time channel so the correct entry is '8'),

e. Relation name in which the data is to be deposited (NOTE: This name must be 'Data' as other time series data areas in ICBC are password protected); and,

f. The associated time channel position in the frame, '3', and its name ,'TIMECH6', which also must be unique in ICBC.

3. Describe the entered function by completing the form in Figure 19 that is automatically displayed upon successful completion of the disk entry process. Help messages are available that list the function types, unit codes, systems, and locations associated with functions in the COND and TIMSER data base areas. Wherever possible, it is recommended that user functions be given these same attributes.

```
                    DESCRIBE USER FUNCTION

1. MEASUREMENT DESCRIPTION:
   Measurement ID  [LETDOWN FLOW    ]
   Description     [                                              ]
                   [                                              ]
   Meas Type       [                  ]   Unit Code  [--]
   System          [                   ]
   Location        [                   ]
```

Figure 19. Description of User Functions

Maintenance of the user defined data base functions becomes the data base owners responsibility. A well conceived plan for the identification, usage and maintenance of these data is essential. In the following section of the report information is presented to delete user functions; Appendix C describes a utility to rebuild user data files.

4.8 Manipulation of Time Series Functions

The ICBC contains a capability for manipulation of time series data functions from the COND, TIMSER and USER areas. It can be used by anyone and is accessed by entering Option 7 from the main menu. A menu of mathematical operators is presented on the manipulation screen shown in Figure 20.

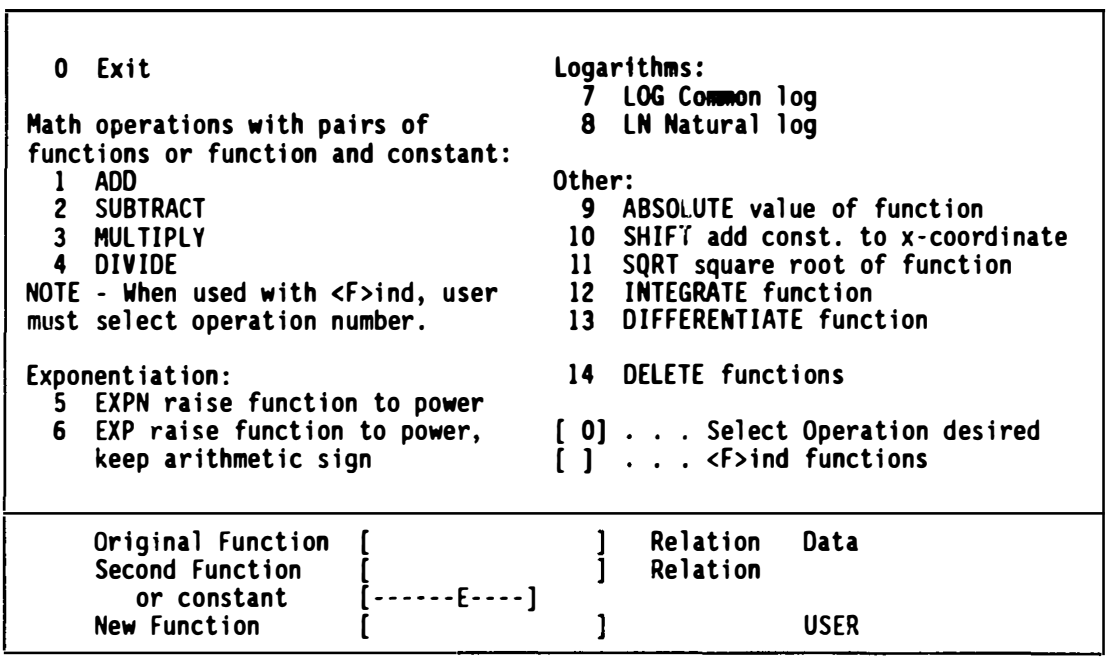


Figure 20. ICBC Time Series Function Manipulations

The simple mathematical operators (add, subtract, multiply, or divide) may transform a selected function using a specified constant or another selected function. Functions may be raised to a power; the common or natural logarithm of functions may be obtained. Other manipulations include (1) taking the absolute value of a function, (2) shifting the function time base by specification of a value (remember that the ICBC time values are assumed to be in minutes), (3) taking the square root of a function, or (4)

integration or differentiation of a function. The results of these data manipulations are written into the USER relation. They must be identified in the ICBC with a unique identification in the new function field.

For convenience, a <F>ind option is provided which will produce a form (Figure 21, much like the one in Figure 12) that identifies data functions in the USER area of ICBC. All manipulations may be exercised from the form through identification of the functions involved. To perform manipulations involving two functions, choose the number of the operation on the

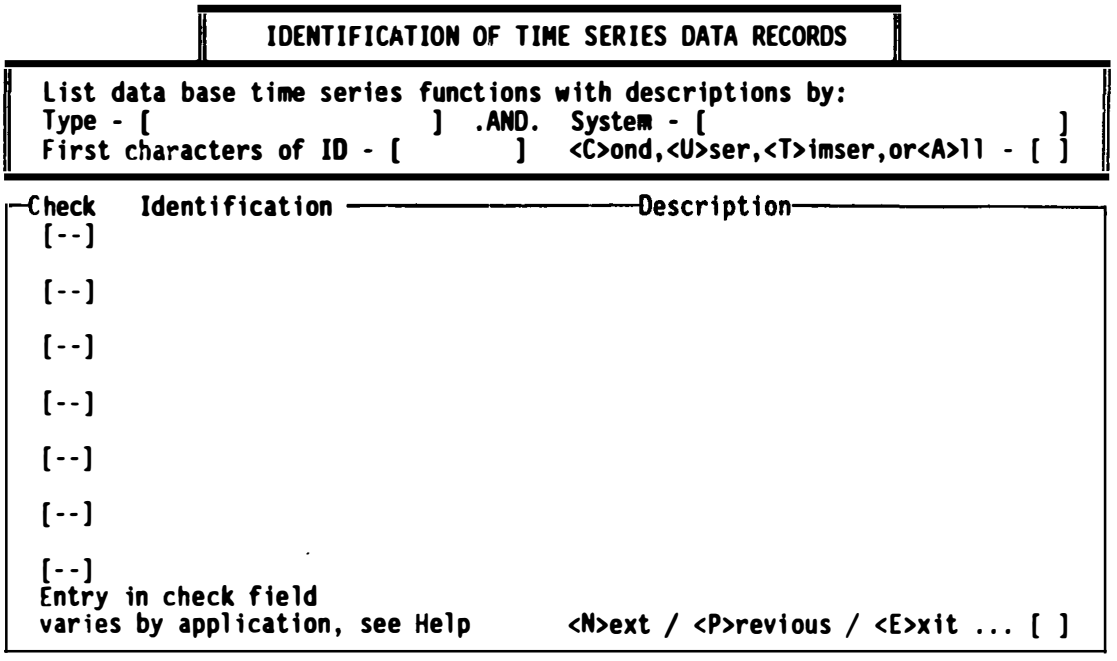


Figure 21. Form for Identification of USER Functions

manipulation form (Figure 20) and mark the check box to the left of the desired functions on Figure 21 with a '1' and a '2'; the '2' function will be the subtrahend, multiplier or divisor. To perform other operations, choose the operation and check the functions to be manipulated with the numbers 1 - 10 in the check fields. Upon exit from the <F>ind form, each marked function will be presented on the manipulation form in the 'original function' field and the user is required to enter any constants involved and the 'new function' name to execute the manipulation. The user delete option

5.0 DATA QUALITY

The quality of the data provided as initial and boundary conditions has been established. The review process involves a thorough review of the measurement system, its operation and calibration. Computational models, methods and assumptions were also evaluated. From this review and analyses of the measurement systems, uncertainties in the data are determined. Based on the review process the measurements were then categorized on the basis of data quality.

The sources of data for the accident are the reactimeter, alarm printer, utility printer, analog strip charts, multipoint recorders, plant manuals and procedures, other analyses and reports on the accident, and operator interviews. The reactimeter was an online digital data acquisition system and is the most reliable source of information about the accident. However, only a small number (24 of the more than 3000 data channels) were recorded on this system at a sampling rate of 20 per minute. The utility printer provides the hourly logs; specific digital measurement groupings requested by the operators at various times and other automatic data printouts. The alarm printer provides a printed record of plant alarms as they occurred. These data were lost from 73.3 to 159.5 minutes since the printer was running behind and the operators flushed the buffer so they could get more current information. The alarm and utility printer are also considered to be reliable sources of information.

Analog strip charts and multipoint recorders are quite useful, but the uncertainties in these data sources are in general larger than the digital data recorded on the reactimeter, alarm printer, or utility printer. The remaining sources of information provide a background for understanding the context in which the data were recorded and a basis to test the consistency of the data.

The formal review process started with an analyst reviewing the data for consistency with other available data sources and performing any required calculations. The analyst's work was then presented to and reviewed by an internal peer review committee (the Data Integrity Review Committee). Based on the analyst's recommendation and the committee review, the quality level of the data was established.

Qualified data are that which have valid magnitudes and whose uncertainties are sufficiently small to represent data from a typical experimental facility. TMI-2 data that typically fit this category are the reactimeter data, except when specific measurements were out of range.

Trend data are those for which the validity of the data magnitudes can not be assured due to unacceptably high uncertainties or inability to determine the uncertainties. Lack of a recent calibration for a measurement is one reason for data to be categorized as trend data. Inability to accurately read the recorded data (e.g.,.poorly printed multipoint strip charts) is another. Enigmas in the data represent a common reason for categorizing data as trend.

Composite data are assembled using data from more than one measurement channel. TMI-2 composite data may be composed from reactimeter, strip chart and/or utility printer sources. As an example, the primary system pressure during the accident has been constructed from three measurement channels depending on the time during the accident. The reactimeter recorded the primary system pressure from a narrow range transmitter (RC-3B-PT1-R). Up to about 2 minutes after the turbine trip, the reactimeter data were used. At this time, the pressure fell below the range for this instrument. Transmitter RC-3A-PT3 being recorded on the utility printer (-15 to +15 minutes) and on a strip chart was then used for the primary pressure. During this period of time, the system pressure rose high enough several times so that the narrow range instrument could be used. Composite data may contain both qualified and trend data depending on the source for any specific time period.

Computed parameters are the result of post accident manipulation of a measurement or set of measurements. Computed parameters are based on computational models for which the output is clearly related to the data. The best estimate steam generator levels, for example, are computed parameters based on the level measurements. The start-up, operating and full range level measurements were put on a common basis using a computational model. The results from the computational model provide a better level estimate than do the values from any one measurement. Computed parameters may be categorized as either qualified or trend depending on the quality of the data and the computational model.

Estimates are based on calculations that rely on assumptions about the plant operation and behavior; they may require considerable manipulation of data or use of plant modeling techniques.

6.0 SUMMARY

The Initial and Boundary Conditions data base has been developed by the EG&G TMI-2 Accident Evaluations Branch using information from many sources. Those that have (at the time of this report) received report status are included in the references to this document.

The data base product may be acquired by any agency connected with TMI-2 research programs sponsored by DOE. Corrections to the data base or comments on its content or operation are welcomed. Please contact the EG&G TMI-2 Accident Evaluations Programs manager at the address given in Section 2.

REFERENCES

1. R. B. Abernathy, R. P. Benedict, Measurement Uncertainty: A Standard Methodology, ISA Transactions, Volume 24, Number 1, 1985.

2. Stephen R. Behling, Computer Code Calculations of the TMI-2 Accident: Initial and Boundary Conditions, EG&G Idaho Inc., Informal Report EGG-TMI-6859, May 1985.

3. B. G. Schnitzler and J. B. Briggs, TMI-2 Isotopic Inventory Calculations, EG&G Idaho Inc., Informal Report EGG-PBS-6798.

4. J. L. Anderson, Analysis of TMI-2 Pressurizer Level Indications, EG&G Idaho Inc., Informal Report EGG-TMI-7100, January 1986.

5. R. B. McCormick, Determination of Void Fraction from Source Range Monitor and Mass Flow Rate Data, EG&G Idaho Inc., EG&G-TMI-7324, September 1986.

6. J. L. Anderson, TMI-2 Once Through Steam Generator Secondary Level Analysis, EG&G Idaho Inc., Informal Report EG&G-TMI-7359, January 1987.

7. J. L. Anderson, TMI-2 Once Through Steam Generator Auxiliary Feedwater Injection Rates, EG&G Idaho Inc., Informal Report EGG-TMI-7481, January 1987.

8. J. L. Anderson, Steam Generator Secondary Side Effects Upon Primary Side Thermal-Hydraulics During the TMI-2 Accident, EG&G Idaho Inc., Informal Report EG&G-TMI-7482, January 1987.

9. R. D. McCormick, TMI-2 Primary Coolant Mass Flowrate Data Report, EG&G Idaho Inc., Informal Report EG&G-TMI-7485, December 1986.

10. R. D. McCormick, TMI-2 Radiation Monitor Data Report, EG&G Idaho Inc., Informal Report EG&G-TMI-7376, 1986.

APPENDIX A

SAMPLE REPORT OUTPUTS FROM ICBC REPORTS

APPENDIX A

CONTENTS

TABLE A-1

TMI-2 PLANT CONDITIONS: INITIAL

CONDITION	VALUE		NOTES
AUX FEEDWATER INJECTION SG-A, AFW-SG-A	0.00E+00	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
AUX FEEDWATER INJECTION SG-B, AFW-SG-B	0.00E+00	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
CALCULATED PARAMETER PORV FLOW RATE	5.70E+00	lbm/s	32
Uncertainty estimates: Low:	1.14E+00	High:	1.14E+00
COLD LEG TEMPERATURE 1A, RC-5A-TE2	5.51E+02	F	32 34
Uncertainty estimates: Low:	1.91E+00	High:	1.91E+00
COLD LEG TEMPERATURE 1B, RC-5B-TE2	5.57E+02	F	32 34
Uncertainty estimates: Low:	1.91E+00	High:	1.91E+00
COLD LEG TEMPERATURE 2A, RC-15A-TE3	5.26E+02	F	33 35
Uncertainty estimates: Low:	none	High:	none
COLD LEG TEMPERATURE 2B, RC-15B-TE3	5.57E+02	F	33 35
Uncertainty estimates: Low:	none	High:	none
HOT LEG TEMPERATURE A-LOOP, TE-HL-A	6.06E+02	F	32 50
Uncertainty estimates: Low:	1.14E+00	High:	1.14E+00
HOT LEG TEMPERATURE B-LOOP, TE-HL-B	6.06E+02	F	32 50
Uncertainty estimates: Low:	1.14E+00	High:	1.14E+00
HPI/MakeUp Baseds on expected results	1.20E+01	lbm/s	
Uncertainty estimates: Low:	none	High:	none
LETDOWN FLOW	9.22E+00	lbm/s	4 32
Uncertainty estimates: Low:	1.84E+00	High:	1.84E+00
MAIN STEAM TEMPERATURE A, SP-4A-TE-P	5.95E+02	F	32
Uncertainty estimates: Low:	2.10E+00	High:	2.10E+00
MAIN STEAM TEMPERATURE B, SP-4B-TE-P	5.94E+02	F	32
Uncertainty estimates: Low:	2.10E+00	High:	2.10E+00
PRESSURE-PRIMARY, PRESS.-PRIMARY	2.21E+03	psia	32 34 38
Uncertainty estimates: Low:	1.09E+01	High:	1.09E+01
PRESSURIZER LEVEL, RC-1-LT1-L-R	2.27E+02	in	32 34
Uncertainty estimates: Low:	2.40E+01	High:	2.40E+01

TABLE A-1

TMI-2 PLANT CONDITIONS: INITIAL

CONDITION		VALUE		NOTES
PRIMARY COOLANT PUMP OPERATION 1A		ON		14
Uncertainty estimates:	Low:	none	High:	none
PRIMARY COOLANT PUMP OPERATION 1B		ON		14
Uncertainty estimates:	Low:	none	High:	none
PRIMARY COOLANT PUMP OPERATION 2A		ON		14
Uncertainty estimates:	Low:	none	High:	none
PRIMARY COOLANT PUMP OPERATION 2B		ON		14
Uncertainty estimates:	Low:	none	High:	none
RC FLOW RATE LOOP A RC-14A-FT-CALC		6.57E+01	MPPH	32
Uncertainty estimates:	Low:	1.41E+00	High:	1.41E+00
RC FLOW RATE LOOP B RC-14B-FT-CALC		6.79E+01	MPPH	32
Uncertainty estimates:	Low:	1.46E+00	High:	1.46E+00
REACTOR POWER		2.70E+03	MW	32
Uncertainty estimates:	Low:	3.90E+01	High:	3.90E+01
STEAM GEN. A FEEDWATER FLOW, SP-8A-FT-R		5.74E+00	MPPH	32 34
Uncertainty estimates:	Low:	1.06E-01	High:	1.06E-01
STEAM GEN. B FEEDWATER FLOW, SP-8B-FT-R		5.69E+00	MPPH	32 34
Uncertainty estimates:	Low:	1.06E-01	High:	1.06E-01
STEAM GEN. FEEDWATER TEMP, SP-5A-TE1/2-R		4.64E+02	F	32 34
Uncertainty estimates:	Low:	1.78E+00	High:	1.78E+00
STEAM GENERATOR A PRESSURE, SP-6A-PT-ABS		1.06E+03	psia	32 50 49
Uncertainty estimates:	Low:	1.62E+01	High:	1.62E+01
STEAM GENERATOR B PRESSURE, SP-6B-PT-ABS		1.05E+03	psia	32 50 49
Uncertainty estimates:	Low:	1.62E+01	High:	1.62E+01
TOTAL PRESSURIZER HEATER GROUP POWER		1.39E+03	kw	33
Uncertainty estimates:	Low:	none	High:	none

TABLE A-1

TMI-2 PLANT CONDITIONS: INITIAL NOTES

NOTE NUMBER	TEXT
4	System leakage was 6 gpm liquid equivalent prior to the accident; when the PORV failed open, this leakage can be ignored.
14	Only events which resulted in fluid being pumped are included in pump operation table. Operators started pumps at other times, but because they were steam filled, they developed no head, used very little current, and were quickly turned off.
32	QUALIFIED DATA: These data (a) have had all calibration corrections applied; (b) agree with independent redundant data to within specified uncertainty limits; (c) have been verified to represent the physical parameter being measured; (d) have engineering unit conversions applied; and (e) have uncertainties established for the 95% confidence level.
33	TREND DATA: These data (a) have been verified to represent the relative changes in the physical phenomenon they represent but not the absolute level because of one or more of the following: (a) calibrations do not adequately represent the envirnoment; (b) uncertainty limits cannot be adequately quantified; (c) there are some anomalies in the data; or (d) envirnomental effects cannot be adequately compensated. TREND data are considered to contain some useful information.
34	Measurement recorded on plant reactimeter - The TMI-2 plant reactimeter contained 24 channels of digital measurement information recorded at one sample/three seconds.
35	Measurement recorded on strip chart recorder - Data were recorded as an analog signal in one of two forms: (a) continuous trace or (b) pen points at specified intervals. Digitized data from the strip charts were converted to engineering units based on recorded measurement ranges. Time base for strip chart measurements were checked against known digital events and adjusted as necessary to preserve time redundancy.

TABLE A-1

TMI-2 PLANT CONDITIONS: INITIAL NOTES

NOTE NUMBER	TEXT
38	PRESSURE-PRIMARY is a composite of measurements (a) RC-3B-PT1-R (reactimeter) -10 - 2.15, 174.35 - 203.6, 225.35 - 233.3, 336 - 463.55, 870.85 - 932.75, 934.75 - 950.2 min; (b) RC-3A-PT3-P (utility printer) 2.4 - 5.65, 570.3 - 869.6, 933.55, 950.75 - 1000 min; (c) RC-4A-TE1-R (reactimeter sat press) 6.0 - 100 min.; and (d) RC-3A-PT3-S (strip chart) 100.6 - 172.5, 207 - 223.5, 240 - 326.6, 464 - 568 min.
49	Qualification Statement for SP-6A-PT-ABS, SP-6B-PT-ABS - These functions composited from secondary pressures SP-6A-PT1-R, SP-6B-PT1-R, reactor building pressure BS-PR-4388-S and atmospheric pressure (14.7 psia assumed). Times between the secondary gage pressures (reactimeter) and the R.B. pressure (strip chart) were normalized at H2 burn time (589.9 min); an artificial spike remains. Elsewhere, timing of small pressure changes (<5 psia) may be affected by large strip chart uncertainty (1.2 min.).
50	Data in this time series function has been composited from multiple TMI-2 measurements after DIRC review to provide a best representation.

TABLE A-2

TMI-2 PLANT CONDITIONS: 100 MIN

CONDITION	VALUE		NOTES
A LOOP WATER LEVEL FROM BOTTOM OF FUEL	1.81E+01	ft	33
Uncertainty estimates: Low:	none	High:	none
AUX FEEDWATER INJECTION SG-A, AFW-SG-A	4.37E+01	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
AUX FEEDWATER INJECTION SG-B, AFW-SG-B	0.00E+00	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
B LOOP WATER LEVEL FROM BOTTOM OF FUEL	1.90E+01	ft	33
Uncertainty estimates: Low:	none	High:	none
CALCULATED PARAMETER PORV FLOW RATE	1.95E+01	lbm/s	32
Uncertainty estimates: Low:	3.88E+00	High:	3.88E+00
COLD LEG TEMPERATURE 1A, RC-5A-TE2	5.35E+02	F	32 34
Uncertainty estimates: Low:	1.91E+00	High:	1.91E+00
COLD LEG TEMPERATURE 1B, RC-5B-TE2	5.36E+02	F	32 34
Uncertainty estimates: Low:	1.91E+00	High:	1.91E+00
COLD LEG TEMPERATURE 2A, RC-15A-TE3	5.40E+02	F	33 35
Uncertainty estimates: Low:	none	High:	none
COLD LEG TEMPERATURE 2B, RC-15B-TE3	5.43E+02	F	33 35
Uncertainty estimates: Low:	none	High:	none
HOT LEG TEMPERATURE A-LOOP, TE-HL-A	5.35E+02	F	32 50
Uncertainty estimates: Low:	1.10E+00	High:	1.10E+00
HOT LEG TEMPERATURE B-LOOP, TE-HL-A	5.37E+02	F	32 50
Uncertainty estimates: Low:	1.14E+00	High:	1.14E+00
HPI/MakeUp Based on expected results	8.79E+00	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
LETDOWN FLOW	1.94E+01	lbm/s	32
Uncertainty estimates: Low:	3.88E+00	High:	3.88E+00
NSAC MAAP V2.0 CALCULATION OF HPI/MAKEUP	1.76E+01	lbm/s	
Uncertainty estimates: Low:	none	High:	none
PRESSURE-PRIMARY, PRESS.-PRIMARY	9.25E+02	psia	32 34 38
Uncertainty estimates: Low:	1.60E+01	High:	1.60E+01

TABLE A-2

TMI-2 PLANT CONDITIONS: 100 MIN

CONDITION		VALUE		NOTES
PRESSURIZER BLOCK VALVE POSITION		OPEN		1 2 29
Uncertainty estimates:	Low:	31 3none	High:	none
PRESSURIZER COOLANT MASS @100 MIN.		6.02E+04	lbm	33
Uncertainty estimates:	Low:	none	High:	none
PRESSURIZER HEATER RESPONSE		ON		
Uncertainty estimates:	Low:	none	High:	none
PRESSURIZER LEVEL, RC-1-LT1-L-R		3.64E+02	in	32 34
Uncertainty estimates:	Low:	2.40E+01	High:	2.40E+01
PRIMARY COOLANT PUMP OPERATION 1A		ON		
Uncertainty estimates:	Low:	none	High:	none
PRIMARY COOLANT PUMP OPERATION 1B		OFF		40
Uncertainty estimates:	Low:	none	High:	none
PRIMARY COOLANT PUMP OPERATION 2A		ON		40
Uncertainty estimates:	Low:	none	High:	none
PRIMARY COOLANT PUMP OPERATION 2B		OFF		40
Uncertainty estimates:	Low:	none	High:	none
RC FLOW RATE LOOP A RC-14A-FT-CALC		1.50E+01	MPPH	32
Uncertainty estimates:	Low:	4.60E+00	High:	3.00E+00
REACTOR COOLANT FLOW RATE		2.70E+01	MPPH	33
Uncertainty estimates:	Low:	none	High:	none
REACTOR VESSEL COOLANT MASS @100 MIN.		9.15E+04	lbm	33
Uncertainty estimates:	Low:	none	High:	none
RV A LOOP COOLANT MASS @100 MIN.		5.86E+04	lbm	33
Uncertainty estimates:	Low:	none	High:	none
SPRAY VALVE POSITION		CLOSED		29
Uncertainty estimates:	Low:	.none	High:	none
STEAM GENERATOR A PRESSURE, SP-6A-PT-ABS		8.62E+02	psia	32 50 49
Uncertainty estimates:	Low:	1.62E+01	High:	1.62E+01
STEAM GENERATOR B PRESSURE, SP-6B-PT-ABS		1.90E+02	psia	32 50 49
Uncertainty estimates:	Low:	1.62E+01	High:	1.62E+01

TABLE A-2

TMI-2 PLANT CONDITIONS: 100 MIN NOTES

NOTE NUMBER	TEXT
1	At the time of the turbine trip, the pressurizer was being operated in manual mode; all other major systems were in automatic mode.
2	It should be assumed that the PORV failed open on its first challenge when the pressure exceeded 2270 psia (16.65 MPa) and remained open throughout the accident.
29	Operation time uncertainty is plus or minus 0.05 min. (3 sec.).
31	Reference: Anderson, J. L., Informal Report EGG-TMI-7100, "Analysis of TMI-2 Pressurizer Level Indications", EG&G Idaho, Inc., Jan 1986.
32	QUALIFIED DATA: These data (a) have had all calibration corrections applied; (b) agree with independent redundant data to within specified uncertainty limits; (c) have been verified to represent the physical parameter being measured; (d) have engineering unit conversions applied; and (e) have uncertainties established for the 95% confidence level.
33	TREND DATA: These data (a) have been verified to represent the relative changes in the physical phenomenon they represent but not the absolute level because of one or more of the following: (a) calibrations do not adequately represent the envirnoment; (b) uncertainty limits cannot be adequately quantified; (c) there are some anomalies in the data; or (d) envirnomental effects cannot be adequately compensated. TREND data are considered to contain some useful information.
34	Measurement recorded on plant reactimeter - The TMI-2 plant reactimeter contained 24 channels of digital measurement information recorded at one sample/three seconds.
35	Measurement recorded on strip chart recorder - Data were recorded as an analog signal in one of two forms: (a)

TABLE A-2

TMI-2 PLANT CONDITIONS: 100 MIN NOTES

NOTE NUMBER	TEXT
	continuous trace or (b) pen points at specified intervals. Digitized data from the strip charts were converted to engineering units based on recorded measurement ranges. Time base for strip chart measurements were checked against known digital events and adjusted as necessary to preserve time redundancy.
38	PRESSURE-PRIMARY is a composite of measurements (a) RC-3B-PT1-R (reactimeter) -10 - 2.15, 174.35 - 203.6, 225.35 - 233.3, 336 - 463.55, 870.85 - 932.75, 934.75 - 950.2 min; (b) RC-3A-PT3-P (utility printer) 2.4 - 5.65, 570.3 - 869.6, 933.55, 950.75 - 1000 min; (c) RC-4A-TE1-R (reactimeter sat press) 6.0 - 100 min.; and (d) RC-3A-PT3-S (strip chart) 100.6 - 172.5, 207 - 223.5, 240 - 326.6, 464 - 568 min.
40	Surmised from hot leg mass flow.
49	Qualification Statement for SP-6A-PT-ABS, SP-6B-PT-ABS - These functions composited from secondary pressures SP-6A-PT1-R, SP-6B-PT1-R, reactor building pressure BS-PR-4388-S and atmospheric pressure (14.7 psia assumed). Times between the secondary gage pressures (reactimeter) and the R.B. pressure (strip chart) were normalized at H2 burn time (589.9 min); an artificial spike remains. Elsewhere, timing of small pressure changes (<5 psia) may be affected by large strip chart uncertainty (1.2 min.).
50	Data in this time series function has been composited from multiple TMI-2 measurements after DIRC review to provide a best representation.

TABLE A-3

TMI-2 PLANT CONDITIONS: 174 MIN

CONDITION	VALUE		NOTES
AUX FEEDWATER INJECTION SG-A, AFW-SG-A	1.45E+01	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
AUX FEEDWATER INJECTION SG-B, AFW-SG-B	0.00E+00	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
CALCULATED PARAMETER PORV FLOW RATE	0.00E+00	lbm/s	32
Uncertainty estimates: Low:	none	High:	none
COLD LEG TEMPERATURE 1A, RC-5A-TE2	4.06E+02	F	32 34
Uncertainty estimates: Low:	1.91E+00	High:	1.91E+00
COLD LEG TEMPERATURE 1B, RC-5B-TE2	4.47E+02	F	32 34
Uncertainty estimates: Low:	1.91E+00	High:	1.91E+00
COLD LEG TEMPERATURE 2A, RC-15A-TE3	4.53E+02	F	33 35
Uncertainty estimates: Low:	none	High:	none
COLD LEG TEMPERATURE 2B, RC-15B-TE3	4.45E+02	F	33 35
Uncertainty estimates: Low:	none	High:	none
HOT LEG TEMPERATURE A-LOOP, TE-HL-A	7.88E+02	F	33 50
Uncertainty estimates: Low:	none	High:	none
HOT LEG TEMPERATURE B-LOOP, TE-HL-B	7.66E+02	F	33 50
Uncertainty estimates: Low:	none	High:	none
HPI/MakeUp Based on expected results	8.79E+00	lbm/s	33
Uncertainty estimates: Low:	none	High:	none
LETDOWN FLOW	2.30E+01	lbm/s	32
Uncertainty estimates: Low:	4.60E+00	High:	4.60E+00
PRESSURE-PRIMARY, PRESS.-PRIMARY	1.98E+03	psia	32 34 38
Uncertainty estimates: Low:	3.97E+01	High:	3.97E+01
PRESSURIZER BLOCK VALVE POSITION	CLOSED		30
Uncertainty estimates: Low:	none	High:	none
PRESSURIZER LEVEL, RC-1-LT1-L-R	3.57E+02	in	32 34
Uncertainty estimates: Low:	2.40E+01	High:	2.40E+01
SPRAY VALVE POSITION	CLOSED		29
Uncertainty estimates: Low:	none	High:	none

TABLE A-3

TMI-2 PLANT CONDITIONS: 174 MIN

CONDITION	VALUE		NOTES
STEAM GENERATOR A PRESSURE, SP-6A-PT1-R	3.70E+02	psia	32 50 49
Uncertainty estimates: Low:	1.62E+01	High:	1.62E+01
STEAM GENERATOR B PRESSURE, SP-6B-PT-ABS	6.23E+02	psia	32 50 49
Uncertainty estimates: Low:	1.62E+01	High:	1.62E+01

TABLE A-3

TMI-2 PLANT CONDITIONS: 174 MIN NOTES

NOTE NUMBER	TEXT
29	Operation time uncertainty is plus or minus 0.05 min. (3 sec.).
30	Operation time uncertainty is plus or minus 0.5 min (30 sec).
32	QUALIFIED DATA: These data (a) have had all calibration corrections applied; (b) agree with independent redundant data to within specified uncertainty limits; (c) have been verified to represent the physical parameter being measured; (d) have engineering unit conversions applied; and (e) have uncertainties established for the 95% confidence level.
33	TREND DATA: These data (a) have been verified to represent the relative changes in the physical phenomenon they represent but not the absolute level because of one or more of the following: (a) calibrations do not adequately represent the envirnoment; (b) uncertainty limits cannot be adequately quantified; (c) there are some anomalies in the data; or (d) envirnomental effects cannot be adequately compensated. TREND data are considered to contain some useful information.
34	Measurement recorded on plant reactimeter - The TMI-2 plant reactimeter contained 24 channels of digital measurement information recorded at one sample/three seconds.
35	Measurement recorded on strip chart recorder - Data were recorded as an analog signal in one of two forms: (a) continuous trace or (b) pen points at specified intervals. Digitized data from the strip charts were converted to engineering units based on recorded measurement ranges. Time base for strip chart measurements were checked against known digital events and adjusted as necessary to preserve time redundancy.
38	PRESSURE-PRIMARY is a composite of measurements (a) RC-3B-PT1-R (reactimeter) -10 - 2.15, 174.35 - 203.6,

TABLE A-3

TMI-2 PLANT CONDITIONS: 174 MIN NOTES

NOTE NUMBER	TEXT
	225.35 - 233.3, 336 - 463.55, 870.85 - 932.75, 934.75 - 950.2 min; (b) RC-3A-PT3-P (utility printer) 2.4 - 5.65, 570.3 - 869.6, 933.55, 950.75 - 1000 min; (c) RC-4A-TE1-R (reactimeter sat press) 6.0 - 100 min.; and (d) RC-3A-PT3-S (strip chart) 100.6 - 172.5, 207 - 223.5, 240 - 326.6, 464 - 568 min.
49	Qualification Statement for SP-6A-PT-ABS, SP-6B-PT-ABS - These functions composited from secondary pressures SP-6A-PT1-R, SP-6B-PT1-R, reactor building pressure BS-PR-4388-S and atmospheric pressure (14.7 psia assumed). Times between the secondary gage pressures (reactimeter) and the R.B. pressure (strip chart) were normalized at H2 burn time (589.9 min); an artificial spike remains. Elsewhere, timing of small pressure changes (<5 psia) may be affected by large strip chart uncertainty (1.2 min.).
50	Data in this time series function has been composited from multiple TMI-2 measurements after DIRC review to provide a best representation.

TABLE A-4

PRESSURIZER BLOCK VALVE OPERATION

TIME (rel. to turbine trip) HH:MM:SS	MINUTES	VALVE OPERATION	NOTES
04:00:40	0.0	OPEN	1 2 29 31
06:19:37	139.0	CLOSED	30
07:12:13	191.6	OPEN	29
07:15:25	194.8	CLOSED	29
07:18:31	197.9	OPEN	29
07:19:01	198.4	CLOSED	29
07:40:37	220.0	OPEN	30
08:20:37	260.0	CLOSED	30
08:36:37	276.0	OPEN	30
09:18:37	318.0	CLOSED	30
09:43:37	343.0	OPEN	18 30
11:38:37	458.0	OPEN	30
13:14:37	554.0	CLOSED	30
13:20:37	560.0	OPEN	30
13:30:37	570.0	CLOSED	30
14:01:37	601.0	OPEN	30
15:12:37	672.0	CLOSED	30
16:34:37	754.0	OPEN	30
16:43:37	763.0	CLOSED	30
16:52:37	772.0	OPEN	30
17:15:37	795.0	CLOSED	30

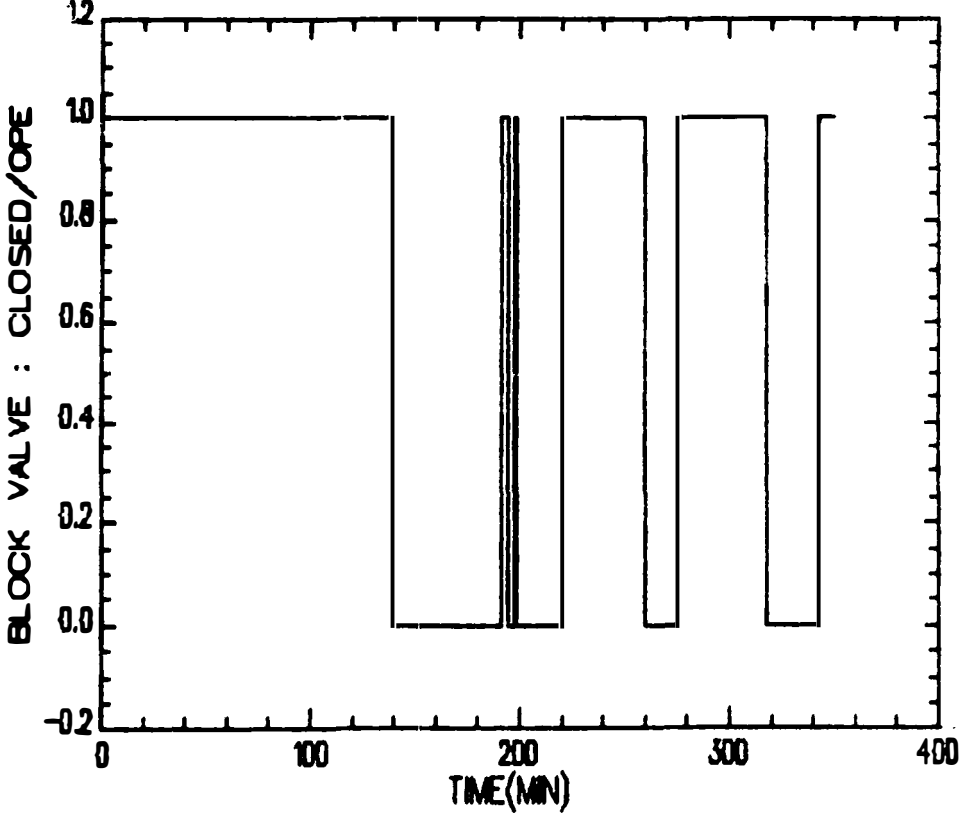

BLOCK VALVE : CLOSED/OPE
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
0
100
200
300
400
TIME(MIN)

TABLE A-4

PRESSURIZER BLOCK VALVE OPERATION NOTES

NOTE NUMBER	TEXT
1	At the time of the turbine trip, the pressurizer was being operated in manual mode; all other major systems were in automatic mode.
2	It should be assumed that the PORV failed open on its first challenge when the pressure exceeded 2270 psia (16.65 MPa) and remained open throughout the accident.
18	Cycled open and closed to maintain pressure between 1915 and 2165 psia (13.2 and 14.9 MPa) from 05:40 and 07:38.
29	Operation time uncertainty is plus or minus 0.05 min. (3 sec.).
30	Operation time uncertainty is plus or minus 0.5 min (30 sec).
31	Reference: Anderson, J. L., Informal Report EGG-TMI-7100, "Analysis of TMI-2 Pressurizer Level Indications", EG&G Idaho, Inc., Jan 1986.

TABLE A-5

SPRAY VALVE POSITION

TIME (rel. to turbine trip) HH:MM:SS	MINUTES	VALVE OPERATION	NOTES
04:00:38	0.0	OPEN	1 12 13 28
04:00:49	0.2	CLOSED	29
06:55:37	175.0	OPEN	39 43
07:14:01	193.4	CLOSED	39 43
07:45:49	225.2	OPEN	39 43
08:22:01	261.4	CLOSED	39 43
11:58:49	478.2	OPEN	39 43
13:07:37	547.0	CLOSED	39 43
14:05:13	604.6	OPEN	39 43
16:06:01	725.4	CLOSED	39 43
22:30:49	1110.2	OPEN	39 43
22:31:37	1111.0	CLOSED	39 43
22:51:37	1131.0	OPEN	39 43
22:53:13	1132.6	CLOSED	39 43
23:13:13	1152.6	OPEN	39 43
23:14:01	1153.4	CLOSED	39 43
23:56:25	1195.8	OPEN	39 43
23:57:13	1196.6	CLOSED	39 43

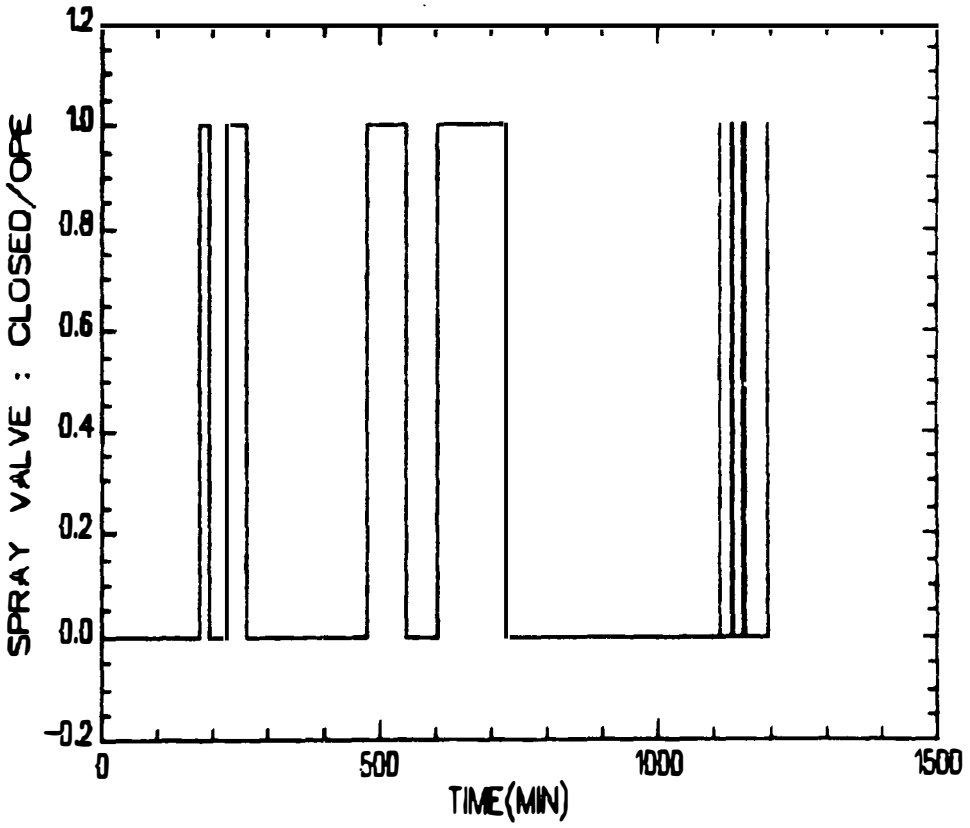

SPRAY VALVE : CLOSED/OPE
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
0
500
1000
1500
TIME(MIN)

TABLE A-5

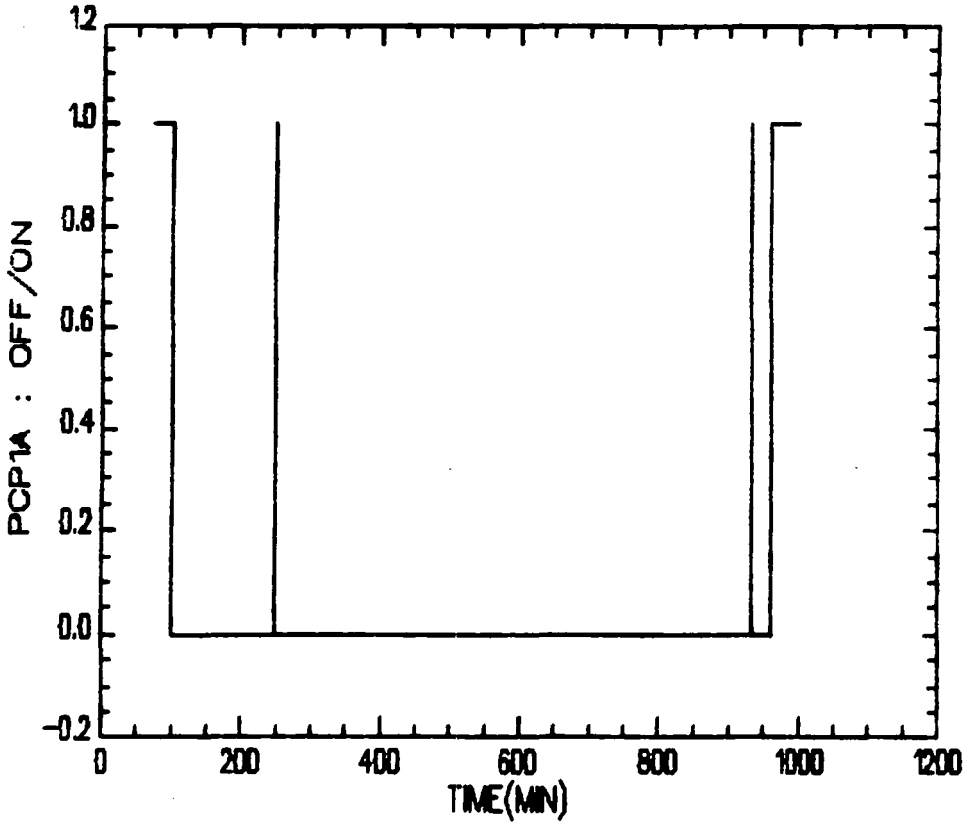
SPRAY VALVE POSITION NOTES

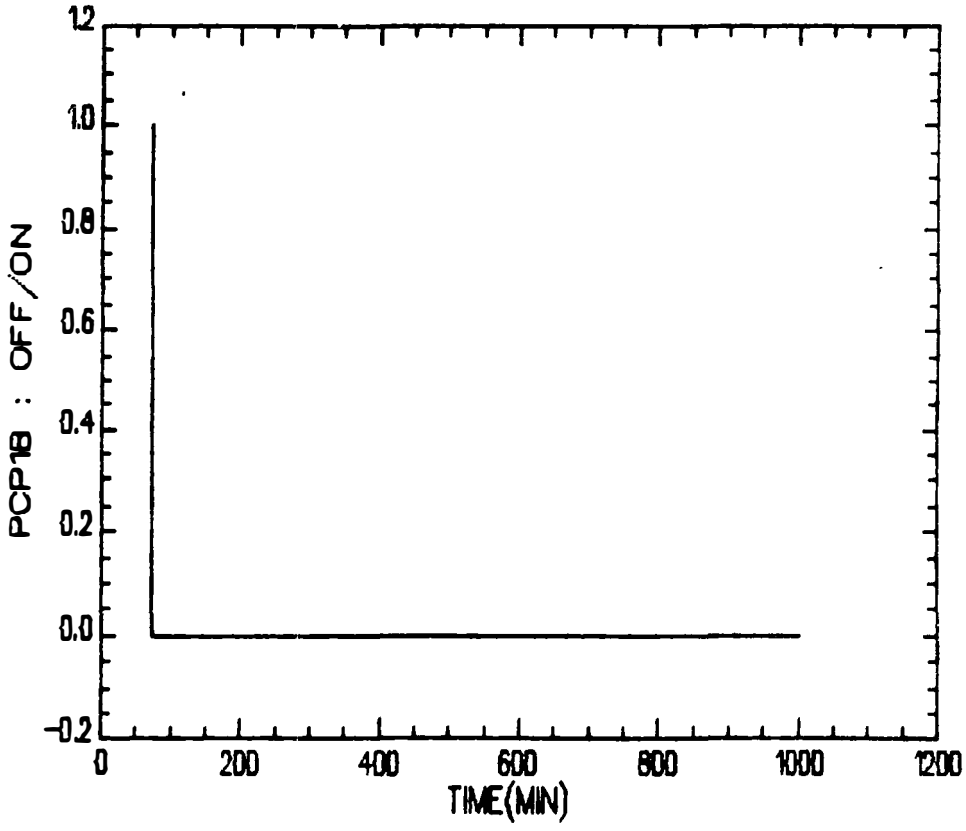
NOTE NUMBER	TEXT
1	At the time of the turbine trip, the pressurizer was being operated in manual mode; all other major systems were in automatic mode.
12	Pressurizer spray is effective only when the 2A pump is running.
13	Pressurizer spray valve setpoints - Opens when hot leg pressure greater than 2205 psig (2220 psia or 15.31 MPa); closes whenever pressure decreases below 2155 psig (2170 psia or 14.96 MPa).
28	From 8 s to 11 min, reactimeter data indicates that the spray valve is opening and closing. These indications are felt to be false and are attributed to spurious noise somewhere in the measurement systems.
29	Operation time uncertainty is plus or minus 0.05 min. (3 sec.).
39	Operation time uncertainty is plus or minus 0.4 min. (24 seconds).
43	Manual mode.

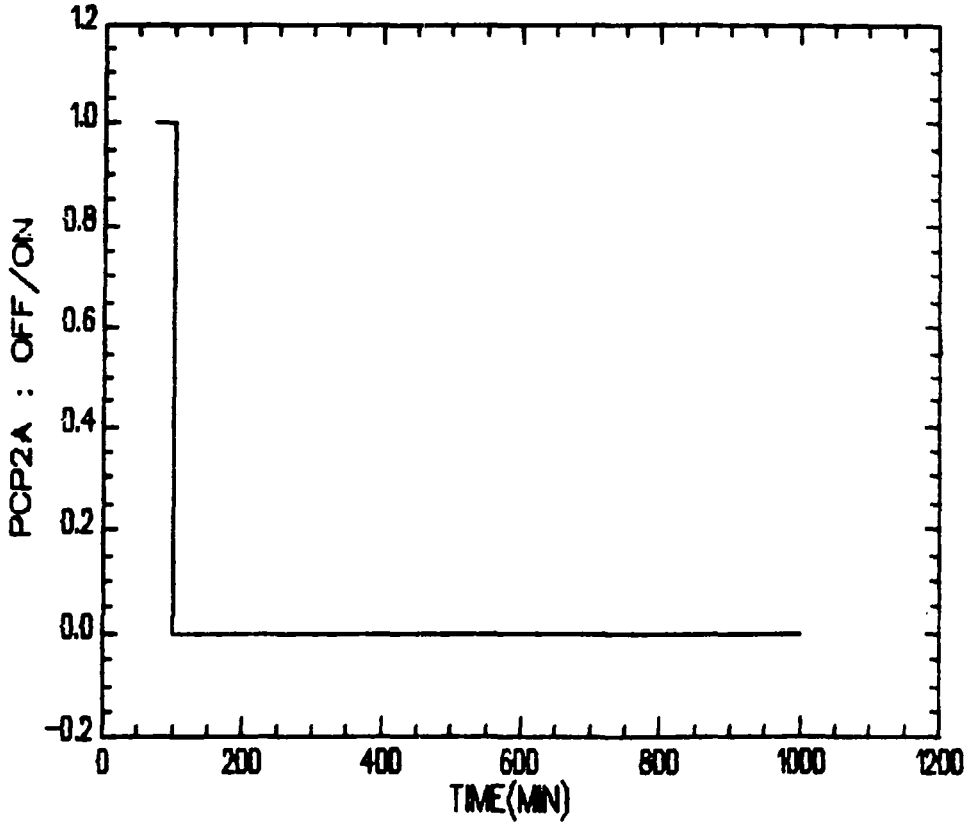
TABLE A-6

PRIMARY COOLANT PUMP OPERATION

TIME		PUMP DESIGNATION				
HH:MM:SS	MIN	PCP1A	PCP1B	PCP2A	PCP2B	NOTES
04:00:37	0.0	ON	ON	ON	ON	14
05:14:07	73.5	ON	ON	ON	OFF	40 14
05:14:19	73.7	ON	OFF	ON	OFF	40
05:41:13	100.6	ON	OFF	OFF	OFF	
05:41:25	100.8	OFF	OFF	OFF	OFF	
06:54:43	174.1	OFF	OFF	OFF	ON	
07:13:31	192.9	OFF	OFF	OFF	OFF	14
08:09:14	248.6	ON	OFF	OFF	OFF	41
08:09:49	249.2	OFF	OFF	OFF	OFF	41
19:33:13	932.6	ON	OFF	OFF	OFF	
19:33:23	932.7	OFF	OFF	OFF	OFF	
20:00:37	960.0	ON	OFF	OFF	OFF	
20:40:37	1000.0	ON	OFF	OFF	OFF	


PCP1A : OFF/ON
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
0
200
400
600
800
1000
1200
TIME(MIN)


1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
PCP1B : OFF/ON
0
200
400
600
800
1000
1200
TIME(MIN)


1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
PCP2A : OFF/ON
0
200
400
600
800
1000
1200
TIME(MIN)

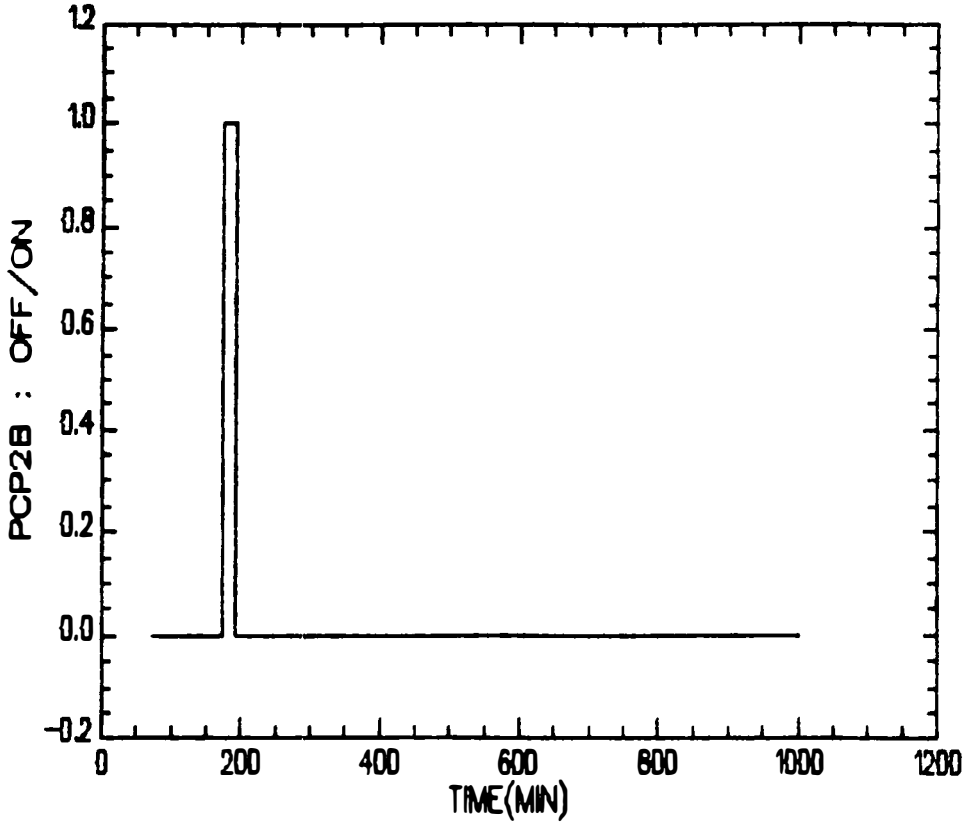

1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
PCP2B : OFF/ON
0
200
400
600
800
1000
1200
TIME(MIN)

TABLE A-6

PRIMARY COOLANT PUMP OPERATION NOTES

NOTE NUMBER	TEXT
14	Only events which resulted in fluid being pumped are included in pump operation table. Operators started pumps at other times, but because they were steam filled, they developed no head, used very little current, and were quickly turned off.
40	Surmised from hot leg mass flow.
41	The only significant result of this pump restart was an approximate 25 deg F increase in the 1A cold leg pump suction temperature. From alarm printer.

TABLE A-7

HEATER OPERATION

TIME		OPERATION OF HEATER GROUP						
HH:MM:SS	MIN	1	2	3	4	5	6	7
		8	9	10	11	12	13	
04:00:38	0.0	ON	ON	ON	ON	ON	OFF	OFF
		ON	ON	ON	ON	ON	ON	
Notes: 21 42								
04:00:45	0.1	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	OFF	OFF	OFF	OFF	OFF	
Notes:								
04:00:51	0.2	ON	ON	ON	ON	ON	OFF	OFF
		ON	ON	ON	ON	ON	ON	
Notes:								
06:54:56	174.3	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	OFF	OFF	OFF	OFF	OFF	
Notes: 23								
08:24:31	263.9	ON	ON	ON	ON	ON	OFF	OFF
		ON	ON	ON	ON	ON	ON	
Notes: 26 27								
08:31:07	270.5	ON	ON	ON	ON	ON	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes: 24								
08:46:55	286.3	ON	ON	ON	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes: 25								
09:31:13	330.6	ON	ON	OFF	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes: 26								
10:14:19	373.7	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes:								
10:14:43	374.1	ON	ON	OFF	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes:								

TABLE A-7

HEATER OPERATION

TIME		OPERATION OF HEATER GROUP						
HH:MM:SS	MIN	1	2	3	4	5	6	7
		8	9	10	11	12	13	
11:44:21	463.7	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes:								
11:44:25	463.8	ON	ON	OFF	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes:								
11:50:55	470.3	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		ON	ON	OFF	ON	ON	ON	
Notes:								
13:55:49	595.2	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes: 27								
14:06:02	605.4	ON	ON	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
14:07:56	607.3	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
14:33:13	632.6	ON	ON	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
14:39:37	639.0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
14:40:31	639.9	ON	ON	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
15:29:19	688.7	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
15:45:54	705.2	ON	ON	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								

TABLE A-7

HEATER OPERATION

TIME		OPERATION OF HEATER GROUP						
HH:MM:SS	MIN	1	2	3	4	5	6	7
		8	9	10	11	12	13	
17:26:49	806.2	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	ON	OFF	ON	ON	ON	
Notes:								
18:26:05	865.4	ON	ON	OFF	OFF	OFF	OFF	OFF
		OFF	OFF	OFF	OFF	OFF	OFF	
Notes:								

TABLE A-7

HEATER OPERATION NOTES

NOTE NUMBER	TEXT
21	All heaters (groups 1 - 13) operated in automatic; groups 6 and 7 were inoperational throughout the accident.
23	Groups 1 - 7 (heater banks 4 and 5) are in the upper elevation heater bundles.
24	Group 10 off; remains off hereafter, assumed to be failed.
25	Groups 4 and 5 off; remain off hereafter, assumed to be failed.
26	Group 3 off; remains off hereafter, assumed to be failed.
27	Group 8 off; remains off hereafter, assumed to be failed.
42	Timing uncertainty is -1. second to +0. seconds.

TABLE A-8

TMI-2 FUEL GROUP SUMMARY

Fuel Group	Number of Fuel Nodes	Initial Enrichment (wt %)	Initial Uranium (tonnes)	Average Burnup (MWd/MTU)	Minimum Burnup (MWd/MTU)	Maximum Burnup (MWd/MTU)
1	72	1.9	4.768	1863	1436	2240
2	68	1.9	4.503	2746	2488	3158
3	152	1.9	10.067	3637	3190	4021
4	100	1.9	6.622	4391	4087	4905
5	105	2.6	6.954	2239	1647	2741
6	76	2.6	5.033	3552	2810	3890
7	230	2.6	15.233	4315	3907	4952
8	16	2.6	1.057	5465	5227	6213
9	136	2.9	9.007	1548	910	2020
10	164	2.9	10.861	2644	2100	3143
11	76	2.9	5.033	3554	3261	4192
12	44	2.9	2.914	4878	4453	5572

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
1	A-06	2.9%	966	2186	2632	2617	2522	2290	1416
			9	10	10	10	10	10	9
2	A-07	2.9%	1031	2260	3053	3380	3321	2970	1984
			9	10	10	11	11	10	9
3	A-08	2.9%	1334	3050	3738	3794	3717	3410	2134
			9	10	11	11	11	11	10
4	A-09	2.9%	1032	2260	3054	3381	3321	2971	1984
			9	10	10	11	11	10	9
5	A-10	2.9%	967	2186	2632	2618	2523	2290	1416
			9	10	10	10	10	10	9
6	B-04	2.9%	912	1807	2107	2101	2020	1845	1205
			9	9	10	10	9	9	9
7	B-05	2.9%	1456	2975	3401	3347	3295	3075	1936
			9	10	11	11	11	10	9
8	B-06	2.9%	1724	3854	4603	4567	4455	4163	2681
			9	11	12	12	12	11	10
9	B-07	2.6%	1650	3649	4387	4384	4264	3966	2582
			5	6	7	7	7	7	5
10	B-08	2.9%	1832	4507	5551	5572	5500	5163	3263
			9	10	12	12	12	12	11
11	B-09	2.6%	1650	3649	4387	4385	4264	3966	2582
			5	6	7	7	7	7	5
12	B-10	2.9%	1724	3854	4603	4568	4456	4163	2682
			9	11	12	12	12	11	10
13	B-11	2.9%	1457	2975	3402	3348	3296	3075	1936
			9	10	11	11	11	10	9
14	B-12	2.9%	912	1807	2108	2102	2021	1845	1205
			9	9	10	10	9	9	9

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
15	C-03	2.9%	1003	1973	2220	2170	2131	1996	1279
			9	9	10	10	10	9	9
16	C-04	2.9%	1416	2741	3142	3122	3040	2837	1895
			9	10	10	10	10	10	9
17	C-05	1.9%	1589	3219	3630	3478	3361	3194	2125
			1	3	3	3	3	3	1
18	C-06	2.6%	1848	3928	4342	4016	3906	3856	2591
			5	7	7	7	7	6	5
19	C-07	1.9%	1872	3801	4370	4264	4106	3840	2548
			1	3	4	4	4	3	2
20	C-08	2.6%	1974	4101	4832	4794	4811	4261	2811
			5	7	7	7	7	7	6
21	C-09	1.9%	1872	3601	4371	4264	4106	3840	2548
			1	3	4	4	4	3	2
22	C-10	2.6%	1914	3864	4303	4063	3926	3811	2612
			5	6	7	7	7	6	5
23	C-11	1.9%	1590	3220	3630	3479	3362	3194	2125
			1	3	3	3	3	3	1
24	C-12	2.9%	1417	2742	3143	3124	3041	2838	1895
			9	10	10	10	10	10	9
25	C-13	2.9%	1003	1973	2220	2171	2131	1997	1279
			9	9	10	10	10	9	9
26	D-02	2.9%	912	1807	2108	2102	2020	1845	1205
			9	9	10	10	9	9	9
27	D-03	2.9%	1417	2741	3142	3123	3040	2837	1895
			9	10	10	10	10	10	9
28	D-04	1.9%	1580	3158	3560	3413	3265	3064	2039
			1	2	3	3	3	2	1

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
29	D-05	2.6%	1804	3806	4188	3818	3645	3615	2514
			5	6	7	6	6	5	5
30	D-06	1.9%	1781	3964	3862	2925	2855	3419	2582
			1	3	3	2	2	3	2
31	D-07	2.6%	2072	4060	4480	4224	4067	3939	2726
			5	7	7	7	7	7	5
32	D-08	1.9%	1708	3347	3920	3790	3401	3061	2240
			1	3	3	3	3	2	1
33	D-09	2.6%	2072	4060	4480	4225	4067	3940	2726
			5	7	7	7	7	7	5
34	D-10	1.9%	1781	3964	3862	2925	2855	3419	2582
			1	3	3	2	2	3	2
35	D-11	2.6%	1804	3807	4189	3819	3646	3615	2515
			5	6	7	6	6	6	5
36	D-12	1.9%	1581	3158	3560	3413	3266	3065	2039
			1	2	3	3	3	2	1
37	D-13	2.9%	1417	2742	3143	3124	3041	2838	1895
			9	10	10	10	10	10	9
38	D-14	2.9%	912	1807	2108	2102	2021	1845	1205
			9	9	10	10	9	9	9
39	E-02	2.9%	1457	2975	3402	3347	3295	3075	1936
			9	10	11	11	11	10	9
40	E-03	1.9%	1597	3251	3604	3401	3310	3192	2107
			1	3	3	3	3	3	1
41	E-04	2.6%	1908	3879	4127	3712	3612	3625	2454
			5	6	7	6	6	6	5
42	E-05	1.9%	1438	3644	4197	3805	3635	3646	2489
			1	3	4	3	3	3	2

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
43	E-06	2.6%	1885	4121	4589	4207	4049	4014	2741
			5	7	7	7	7	7	5
44	E-07	1.9%	2020	3929	4421	4301	4167	3891	2547
			1	3	4	4	4	3	2
45	E-08	2.6%	2153	4161	4774	4723	4529	4147	2735
			5	7	7	7	7	7	5
46	E-09	1.9%	1931	3925	4485	4350	4186	3909	2569
			1	3	4	4	4	3	2
47	E-10	2.6%	1885	4121	4589	4208	4050	4014	2741
			5	7	7	7	7	7	5
48	E-11	1.9%	1439	3644	4198	3806	3636	3646	2489
			1	3	4	3	3	3	2
49	E-12	2.6%	1909	3880	4128	3713	3612	3625	2454
			5	6	7	6	6	6	5
50	E-13	1.9%	1597	3251	3604	3401	3311	3192	2108
			1	3	3	3	3	3	1
51	E-14	2.9%	1457	2975	3402	3348	3295	3075	1936
			9	10	11	11	11	10	9
52	F-01	2.9%	967	2186	2632	2618	2523	2290	1416
			9	10	10	10	10	10	9
53	F-02	2.9%	1727	3917	4666	4598	4479	4192	2633
			9	11	12	12	12	11	10
54	F-03	2.6%	1850	3845	4301	4035	3890	3790	2593
			5	6	7	7	6	6	5
55	F-04	1.9%	1736	3902	3794	2867	2829	3416	2569
			1	3	3	2	2	3	2
56	F-05	2.6%	2025	4036	4470	4195	4024	3921	2740
			5	7	7	7	7	7	5

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
57	F-06	1.9%	2042	4021	4559	4435	4263	3950	2586
			1	3	4	4	4	3	2
58	F-07	2.6%	2141	4212	4933	4936	4714	4274	2819
			5	7	7	7	7	7	6
59	F-08	1.9%	1802	3845	4675	4748	4572	4148	2689
			1	3	4	4	4	4	2
60	F-09	2.6%	2141	4212	4933	4936	4714	4274	2819
			5	7	7	7	7	7	6
61	F-10	1.9%	2042	4021	4559	4436	4263	3950	2586
			1	3	4	4	4	3	2
62	F-11	2.6%	2026	4036	4470	4195	4025	3921	2740
			5	7	7	7	7	7	5
63	F-12	1.9%	1737	3902	3794	2867	2830	3416	2569
			1	3	3	2	2	3	2
64	F-13	2.6%	1872	3883	4267	3984	3920	3854	2548
			5	6	7	7	7	6	5
65	F-14	2.9%	1727	3917	4667	4598	4479	4192	2683
			9	11	12	12	12	11	10
66	F-15	2.9%	967	2186	2633	2618	2523	2290	1416
			9	10	10	10	10	10	9
67	G-01	2.9%	1032	2260	3053	3380	3321	2970	1984
			9	10	10	11	11	10	9
68	G-02	2.6%	1699	3587	4276	4324	4252	3949	2552
			5	6	7	7	7	7	5
69	G-03	1.9%	1868	3838	4395	4265	4133	3907	2594
			1	3	4	4	4	3	2
70	G-04	2.6%	2060	4078	4494	4208	4036	3925	2728
			5	7	7	7	7	7	5

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
71	G-05	1.9%	2076	3915	4393	4294	4147	3878	2606
			1	3	4	4	4	3	2
72	G-06	2.6%	2184	4237	4921	4952	4804	4384	2847
			5	7	7	7	7	7	6
73	G-07	1.9%	2053	4089	4836	4904	4739	4270	2735
			1	4	4	4	4	4	2
74	G-08	2.6%	2105	4284	5236	5421	5228	4678	3042
			5	7	8	8	8	7	6
75	G-09	1.9%	2053	4089	4836	4904	4739	4270	2734
			1	4	4	4	4	4	2
76	G-10	2.6%	2184	4237	4921	4952	4805	4385	2847
			5	7	7	7	7	7	6
77	G-11	1.9%	1939	3888	4439	4314	4145	3875	2578
			1	3	4	4	4	3	2
78	G-12	2.6%	2060	4077	4494	4208	4036	3925	2728
			5	7	7	7	7	7	5
79	G-13	1.9%	1868	3838	4395	4265	4133	3907	2593
			1	3	4	4	4	3	2
80	G-14	2.6%	1699	3587	4276	4324	4252	3949	2552
			5	6	7	7	7	7	5
81	G-15	2.9%	1032	2260	3053	3381	3321	2970	1984
			9	10	10	11	11	10	9
82	H-01	2.9%	1334	3050	3738	3794	3717	3409	2134
			9	10	11	11	11	11	10
83	H-02	2.9%	1832	4507	5550	5572	5500	5163	3262
			9	12	12	12	12	12	11
84	H-03	2.6%	1974	4100	4831	4793	4611	4260	2811
			5	7	7	7	7	7	6

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
85	H-04	1.9%	1708	3346	3919	3789	3400	3060	2240
			1	3	3	3	3	2	1
86	H-05	2.6%	2152	4160	4773	4722	4528	4146	2735
			5	7	7	7	7	7	5
87	H-06	1.9%	1801	3844	4674	4747	4572	4147	2688
			1	3	4	4	4	4	2
88	H-07	2.6%	2104	4283	5235	5421	5228	4678	3042
			5	7	8	8	8	7	6
89	H-08	2.6%	2057	4799	6009	6213	6117	5571	3464
			5	7	8	8	8	8	6
90	H-09	2.6%	2104	4283	5235	5421	5228	4678	3042
			5	7	8	8	8	7	6
91	H-10	1.9%	1801	3844	4674	4747	4572	4147	2688
			1	3	4	4	4	4	2
92	H-11	2.6%	2152	4160	4773	4722	4528	4146	2735
			5	7	7	7	7	7	5
93	H-12	1.9%	1707	3346	3919	3789	3400	3060	2240
			1	3	3	3	3	2	1
94	H-13	2.6%	1973	4100	4831	4793	4611	4260	2811
			5	7	7	7	7	7	6
95	H-14	2.9%	1832	4507	5550	5572	5500	5163	3262
			9	12	12	12	12	12	11
96	H-15	2.9%	1334	3050	3737	3794	3717	3409	2134
			9	10	11	11	11	11	10
97	K-01	2.9%	1032	2260	3053	3380	3321	2970	1984
			9	10	10	11	11	10	9
98	K-02	2.6%	1699	3587	4276	4324	4252	3949	2552
			5	6	7	7	7	7	5

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
99	K-03	1.9%	1868	3838	4394	4265	4132	3907	2593
			1	3	4	4	4	3	2
100	K-04	2.6%	2059	4077	4494	4208	4036	3925	2728
			5	7	7	7	7	7	5
101	K-05	1.9%	2002	3911	4418	4315	4185	3904	2553
			1	3	4	4	4	3	2
102	K-06	2.6%	2183	4236	4920	4951	4804	4384	2847
			5	7	7	7	7	7	6
103	K-07	1.9%	2053	4088	4835	4904	4738	4270	2734
			1	4	4	4	4	4	2
104	K-08	2.6%	2104	4283	5234	5421	5227	4677	3041
			5	7	8	8	8	7	6
105	K-09	1.9%	2052	4088	4834	4904	4738	4270	2734
			1	4	4	4	4	4	2
106	K-10	2.6%	2183	4236	4920	4951	4804	4384	2846
			5	7	7	7	7	7	6
107	K-11	1.9%	1977	3952	4487	4320	4121	3865	2603
			1	3	4	4	4	3	2
108	K-12	2.6%	2059	4076	4493	4207	4035	3924	2728
			5	7	7	7	7	7	5
109	K-13	1.9%	1867	3837	4394	4265	4132	3907	2593
			1	3	4	4	4	3	2
110	K-14	2.6%	1698	3586	4275	4324	4252	3949	2552
			5	6	7	7	7	7	5
111	K-15	2.9%	1031	2259	3053	3380	3321	2970	1984
			9	10	10	11	11	10	9
112	L-01	2.9%	987	2186	2632	2618	2523	2290	1416
			9	10	10	10	10	10	9

Note - 2nd line of element entry is nodal fuel group assignment

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
113	L-02	2.9%	1726	3916	4666	4597	4478	4191	2683
			9	11	12	12	12	11	10
114	L-03	2.6%	1789	3792	4212	3927	3839	3796	2565
			5	6	7	7	6	6	5
115	L-04	1.9%	1735	3901	3792	2866	2828	3416	2568
			1	3	3	2	2	3	2
116	L-05	2.6%	2025	4034	4468	4193	4023	3920	2739
			5	7	7	7	7	7	5
117	L-06	1.9%	2040	4019	4557	4434	4261	3949	2585
			1	3	4	4	4	3	2
118	L-07	2.6%	2139	4210	4931	4934	4713	4273	2819
			5	7	7	7	7	7	6
119	L-08	1.9%	1800	3843	4673	4746	4571	4147	2688
			1	3	4	4	4	4	2
120	L-09	2.6%	2139	4209	4931	4934	4713	4273	2819
			5	7	7	7	7	7	6
121	L-10	1.9%	2040	4019	4557	4433	4261	3949	2585
			1	3	4	4	4	3	2
122	L-11	2.6%	2024	4033	4468	4193	4023	3919	2739
			5	7	7	7	7	7	5
123	L-12	1.9%	1734	3899	3792	2865	2828	3415	2568
			1	3	3	2	2	3	2
124	L-13	2.6%	1862	3775	4245	4046	3917	3784	2583
			5	6	7	7	7	6	5
125	L-14	2.9%	1725	3915	4665	4597	4478	4191	2683
			9	11	12	12	12	11	10
126	L-15	2.9%	966	2186	2632	2618	2523	2290	1416
			9	10	10	10	10	10	9

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-5

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
127	M-02	2.9%	1456	2974	3401	3347	3295	3075	1936
			9	10	11	11	11	10	9
128	M-03	1.9%	1596	3249	3602	3400	3309	3191	2107
			1	3	3	3	3	3	1
129	M-04	2.6%	1907	3878	4126	3711	3611	3624	2453
			5	6	7	6	6	6	5
130	M-05	1.9%	1437	3642	4195	3804	3634	3645	2488
			1	3	4	3	3	3	2
131	M-06	2.6%	1883	4118	4586	4205	4047	4012	2740
			5	7	7	7	7	7	5
132	M-07	1.9%	1992	3943	4452	4295	4124	3870	2580
			1	3	4	4	4	3	2
133	M-08	2.6%	2151	4157	4771	4720	4527	4145	2734
			5	7	7	7	7	7	5
134	M-09	1.9%	1970	3986	4473	4286	4157	3932	2567
			1	3	4	4	4	3	2
135	M-10	2.6%	1882	4117	4585	4205	4047	4012	2740
			5	7	7	7	7	7	5
136	M-11	1.9%	1436	3641	4195	3804	3634	3645	2488
			1	3	4	3	3	3	2
137	M-12	2.6%	1906	3877	4125	3710	3610	3623	2453
			5	6	7	6	6	6	5
138	M-13	1.9%	1595	3249	3602	3400	3309	3191	2107
			1	3	3	3	3	3	1
139	M-14	2.9%	1455	2973	3400	3346	3294	3074	1936
			9	10	11	11	11	10	9
140	N-02	2.9%	911	1806	2107	2101	2020	1844	1204
			9	9	10	10	9	9	9

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
141	N-03	2.9%	1416	2740	3141	3122	3039	2837	1894
			9	10	10	10	10	10	9
142	N-04	1.9%	1579	3155	3558	3411	3264	3064	2038
			1	2	3	3	3	2	1
143	N-05	2.6%	1802	3803	4186	3816	3644	3613	2514
			5	6	7	6	6	6	5
144	N-06	1.9%	1779	3960	3859	2922	2853	3417	2581
			1	3	3	2	2	3	2
145	N-07	2.6%	2069	4056	4476	4222	4064	3937	2725
			5	7	7	7	7	7	5
146	N-08	1.9%	1705	3342	3916	3787	3398	3058	2240
			1	3	3	3	3	2	1
147	N-09	2.6%	2069	4055	4476	4221	4064	3937	2725
			5	7	7	7	7	7	5
148	N-10	1.9%	1779	3960	3858	2922	2852	3417	2581
			1	3	3	2	2	3	2
149	N-11	2.6%	1801	3802	4185	3815	3643	3612	2513
			5	6	7	6	6	6	5
150	N-12	1.9%	1578	3154	3557	3411	3264	3063	2039
			1	2	3	3	3	2	1
151	N-13	2.9%	1415	2738	3140	3121	3038	2836	1895
			9	10	10	10	10	10	9
152	N-14	2.9%	911	1805	2106	2101	2020	1844	1204
			9	9	10	10	9	9	9
153	O-03	2.9%	1002	1971	2218	2170	2130	1996	1278
			9	9	10	10	10	9	9
154	O-04	2.9%	1415	2739	3141	3121	3039	2836	1894
			9	10	10	10	10	10	9

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
155	O-05	1.9%	1587	3216	3627	3476	3359	3192	2124
			1	3	3	3	3	3	1
156	O-06	2.6%	1787	3805	4279	4010	3872	3788	2589
			5	6	7	7	6	6	5
157	O-07	1.9%	1869	3797	4367	4261	4103	3838	2547
			1	3	4	4	4	3	2
158	O-08	2.6%	1971	4096	4828	4790	4609	4258	2810
			5	7	7	7	7	7	6
159	O-09	1.9%	1869	3796	4367	4261	4103	3838	2547
			1	3	4	4	4	3	2
160	O-10	2.6%	1752	3756	4237	3982	3864	3796	2593
			5	6	7	7	6	6	5
161	O-11	1.9%	1587	3216	3626	3476	3359	3192	2124
			1	3	3	3	3	3	1
162	O-12	2.9%	1414	2738	3139	3120	3038	2836	1894
			9	10	10	10	10	10	9
163	O-13	2.9%	1002	1971	2218	2169	2130	1995	1278
			9	9	10	10	10	9	9
164	P-04	2.9%	911	1805	2106	2100	2109	1844	1204
			9	9	10	10	9	9	9
165	P-05	2.9%	1455	2972	3399	3545	3293	3074	1935
			9	10	11	11	11	10	9
166	P-06	2.9%	1722	3850	4599	4565	4453	4161	2680
			9	11	12	12	12	11	10
167	P-07	2.6%	1648	3645	4383	4382	4262	3964	2581
			5	6	7	7	7	7	5
168	P-08	2.9%	1829	4503	5547	5569	5498	5161	3261
			9	12	12	12	12	12	11

Note - 2nd line of element entry is nodal fuel group assignment

TABLE A-9

CORE BURNUP DATA AT START OF ACCIDENT

Element Number	Grid Loc.	Fuel	Fuel Burnup Data (MWd/MTU) 1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
169	P-09	2.6%	1647	3645	4383	4381	4261	3964	2581
			5	6	7	7	7	7	5
170	P-10	2.9%	1721	3850	4599	4565	4453	4161	2680
			9	11	12	12	12	11	10
171	P-11	2.9%	1454	2971	3398	3344	3293	3073	1935
			9	10	11	11	11	10	9
172	P-12	2.9%	910	1804	2105	2100	2019	1843	1204
			9	9	10	10	9	9	9
173	R-06	2.9%	965	2183	2630	2616	2521	2288	1416
			9	10	10	10	10	10	9
174	R-07	2.9%	1029	2256	3050	3379	3319	2969	1983
			9	10	10	11	11	10	9
175	R-08	2.9%	1332	3046	3734	3791	3715	3408	2133
			9	10	11	11	11	11	10
176	R-09	2.9%	1029	2256	3050	3379	3319	2969	1983
			9	10	10	11	11	10	9
177	R-10	2.9%	964	2183	2629	2615	2521	2288	1415
			9	10	10	10	10	10	9

Note - 2nd line of element entry is nodal fuel group assignment

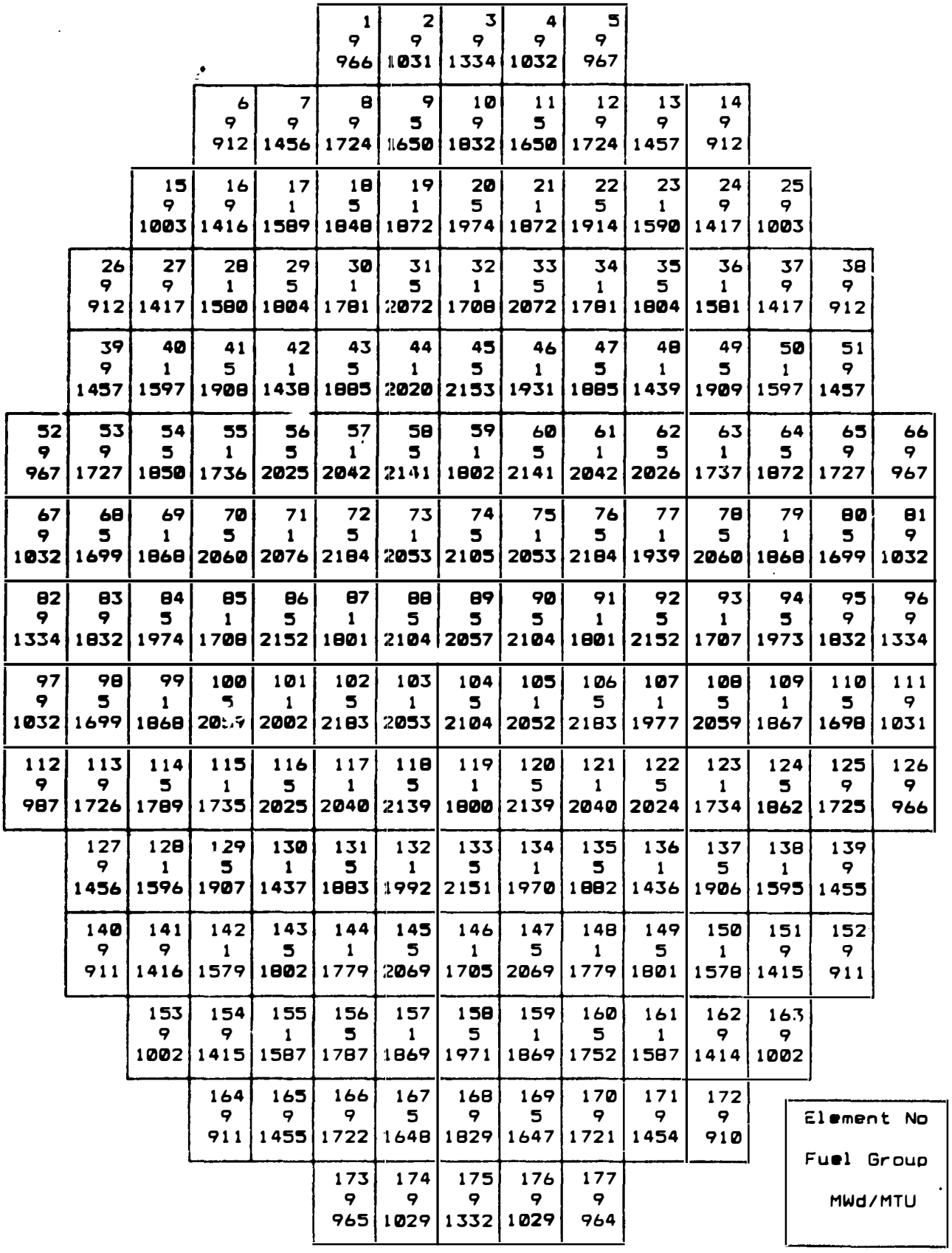
ELEMENT LOCATION AND ENRICHMENT MAP

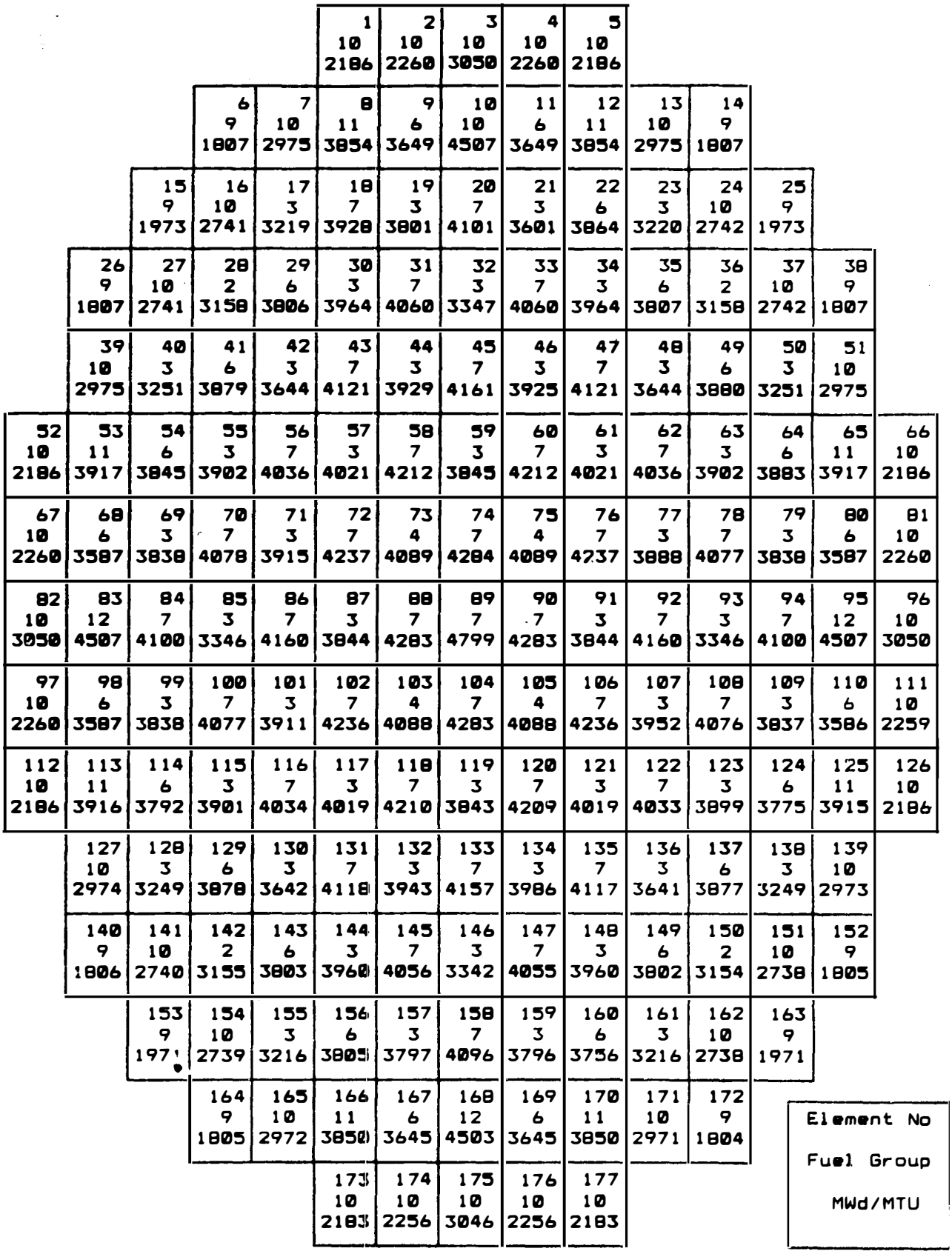
				1 A-06 2.96	2 A-07 2.96	3 A-08 2.96	4 A-09 2.96	5 A-10 2.96						
			6 B-04 2.96	7 B-05 2.96	8 B-06 2.96	9 B-07 2.64	10 B-08 2.96	11 B-09 2.64	12 B-10 2.96	13 B-11 2.96	14 B-12 2.96			
		15 C-03 2.96	16 C-04 2.96	17 C-05 1.98	18 C-06 2.64	19 C-07 1.98	20 C-08 2.64	21 C-09 1.98	22 C-10 2.64	23 C-11 1.98	24 C-12 2.96	25 C-13 2.96		
	26 D-02 2.96	27 D-03 2.96	28 D-04 1.98	29 D-05 2.64	30 D-06 1.98	31 D-07 2.64	32 D-08 1.98	33 D-09 2.64	34 D-10 1.98	35 D-11 2.64	36 D-12 1.98	37 D-13 2.96	38 D-14 2.96	
	39 E-02 2.96	40 E-03 1.98	41 E-04 2.64	42 E-05 1.98	43 E-06 2.64	44 E-07 1.98	45 E-08 2.64	46 E-09 1.98	47 E-10 2.64	48 E-11 1.98	49 E-12 2.64	50 E-13 1.98	51 E-14 2.96	
52 F-01 2.96	53 F-02 2.96	54 F-03 2.64	55 F-04 1.98	56 F-05 2.64	57 F-06 1.98	58 F-07 2.64	59 F-08 1.98	60 F-09 2.64	61 F-10 1.98	62 F-11 2.64	63 F-12 1.98	64 F-13 2.64	65 F-14 2.96	66 F-15 2.96
67 G-01 2.96	68 G-02 2.64	69 G-03 1.98	70 G-04 2.64	71 G-05 1.98	72 G-06 2.64	73 G-07 1.98	74 G-08 2.64	75 G-09 1.98	76 G-10 2.64	77 G-11 1.98	78 G-12 2.64	79 G-13 1.98	80 G-14 2.64	81 G-15 2.96
82 H-01 2.96	83 H-02 2.96	84 H-03 2.64	85 H-04 1.98	86 H-05 2.64	87 H-06 1.98	88 H-07 2.64	89 H-08 2.64	90 H-09 2.64	91 H-10 1.98	92 H-11 2.64	93 H-12 1.98	94 H-13 2.64	95 H-14 2.96	96 H-15 2.96
97 K-01 2.96	98 K-02 2.64	99 K-03 1.98	100 K-04 2.64	101 K-05 1.98	102 K-06 2.64	103 K-07 1.98	104 K-08 2.64	105 K-09 1.98	106 K-10 2.64	107 K-11 1.98	108 K-12 2.64	109 K-13 1.98	110 K-14 2.64	111 K-15 2.96
112 L-01 2.96	113 L-02 2.96	114 L-03 2.64	115 L-04 1.98	116 L-05 2.64	117 L-06 1.98	118 L-07 2.64	119 L-08 1.98	120 L-09 2.64	121 L-10 1.98	122 L-11 2.64	123 L-12 1.98	124 L-13 2.64	125 L-14 2.96	126 L-15 2.96
	127 M-02 2.96	128 M-03 1.98	129 M-04 2.64	130 M-05 1.98	131 M-06 2.64	132 M-07 1.98	133 M-08 2.64	134 M-09 1.98	135 M-10 2.64	136 M-11 1.98	137 M-12 2.64	138 M-13 1.98	139 M-14 2.96	
	140 N-02 2.96	141 N-03 2.96	142 N-04 1.98	143 N-05 2.64	144 N-06 1.98	145 N-07 2.64	146 N-08 1.98	147 N-09 2.64	148 N-10 1.98	149 N-11 2.64	150 N-12 1.98	151 N-13 2.96	152 N-14 2.96	
		153 O-03 2.96	154 O-04 2.96	155 O-05 1.98	156 O-06 2.64	157 O-07 1.98	158 O-08 2.64	159 O-09 1.98	160 O-10 2.64	161 O-11 1.98	162 O-12 2.96	163 O-13 2.96		
			164 P-04 2.96	165 P-05 2.96	166 P-06 2.96	167 P-07 2.64	168 P-08 2.96	169 P-09 2.64	170 P-10 2.96	171 P-11 2.96	172 P-12 2.96			
					173 R-06 2.96	174 R-07 2.96	175 R-08 2.96	176 R-09 2.96	177 R-10 2.96					

Element No

Grid Loc

Enrichment


1 9 966
2 9 1031
3 9 1334
4 9 1032
5 9 967
6 9 912
7 9 1456
8 9 1724
9 5 1650
10 9 1832
11 5 1650
12 9 1724
13 9 1457
14 9 912
15 9 1003
16 9 1416
17 1 1589
18 5 1848
19 1 1872
20 5 1974
21 1 1872
22 5 1914
23 1 1590
24 9 1417
25 9 1003
26 9 912
27 9 1417
28 1 1580
29 5 1804
30 1 1781
31 5 2072
32 1 1708
33 5 2072
34 1 1781
35 5 1804
36 1 1581
37 9 1417
38 9 912
39 9 1457
40 1 1597
41 5 1908
42 1 1438
43 5 1885
44 1 2020
45 5 2153
46 1 1931
47 5 1885
48 1 1439
49 5 1909
50 1 1597
51 9 1457
52 9 967
53 9 1727
54 5 1850
55 1 1736
56 5 2025
57 1 2042
58 5 2141
59 1 1802
60 5 2141
61 1 2042
62 5 2026
63 1 1737
64 5 1872
65 9 1727
66 9 967
67 9 1032
68 5 1699
69 1 1868
70 5 2060
71 1 2076
72 5 2184
73 1 2053
74 5 2105
75 1 2053
76 5 2184
77 1 1939
78 5 2060
79 1 1868
80 5 1699
81 9 1032
82 9 1334
83 9 1832
84 5 1974
85 1 1708
86 5 2152
87 1 1801
88 5 2104
89 5 2057
90 5 2104
91 1 1801
92 5 2152
93 1 1707
94 5 1973
95 9 1832
96 9 1334
97 9 1032
98 5 1699
99 1 1868
100 5 2059
101 1 2002
102 5 2183
103 1 2053
104 5 2104
105 1 2052
106 5 2183
107 1 1977
108 5 2059
109 1 1867
110 5 1698
111 9 1031
112 9 987
113 9 1726
114 5 1789
115 1 1735
116 5 2025
117 1 2040
118 5 2139
119 1 1800
120 5 2139
121 1 2040
122 5 2024
123 1 1734
124 5 1862
125 9 1725
126 9 966
127 9 1456
128 1 1596
129 5 1907
130 1 1437
131 5 1883
132 1 1992
133 5 2151
134 1 1970
135 5 1882
136 1 1436
137 5 1906
138 1 1595
139 9 1455
140 9 911
141 9 1416
142 1 1579
143 5 1802
144 1 1779
145 5 2069
146 1 1705
147 5 2069
148 1 1779
149 5 1801
150 1 1578
151 9 1415
152 9 911
153 9 1002
154 9 1415
155 1 1587
156 5 1787
157 1 1869
158 5 1971
159 1 1869
160 5 1752
161 1 1587
162 9 1414
163 9 1002
164 9 911
165 9 1455
166 9 1722
167 5 1648
168 9 1829
169 5 1647
170 9 1721
171 9 1454
172 9 910
173 9 965
174 9 1029
175 9 1332
176 9 1029
177 9 964
Element No
Fuel Group
MWd/MTU


1 10 2186
2 10 2260
3 10 3050
4 10 2260
5 10 2186
6 9 1807
7 10 2975
8 11 3854
9 6 3649
10 10 4507
11 6 3649
12 11 3854
13 10 2975
14 9 1807
15 9 1973
16 10 2741
17 3 3219
18 7 3928
19 3 3801
20 7 4101
21 3 3601
22 6 3864
23 3 3220
24 10 2742
25 9 1973
26 9 1807
27 10 2741
28 2 3158
29 6 3806
30 3 3964
31 7 4060
32 3 3347
33 7 4060
34 3 3964
35 6 3807
36 2 3158
37 10 2742
38 9 1807
39 10 2975
40 3 3251
41 6 3879
42 3 3644
43 7 4121
44 3 3929
45 7 4161
46 3 3925
47 7 4121
48 3 3644
49 6 3880
50 3 3251
51 10 2975
52 10 2186
53 11 3917
54 6 3845
55 3 3902
56 7 4036
57 3 4021
58 7 4212
59 3 3845
60 7 4212
61 3 4021
62 7 4036
63 3 3902
64 6 3883
65 11 3917
66 10 2186
67 10 2260
68 6 3587
69 3 3838
70 7 4078
71 3 3915
72 7 4237
73 4 4089
74 7 4284
75 4 4089
76 7 4237
77 3 3888
78 7 4077
79 3 3838
80 6 3587
81 10 2260
82 10 3050
83 12 4507
84 7 4100
85 3 3346
86 7 4160
87 3 3844
88 7 4283
89 7 4799
90 7 4283
91 3 3844
92 7 4160
93 3 3346
94 7 4100
95 12 4507
96 10 3050
97 10 2260
98 6 3587
99 3 3838
100 7 4077
101 3 3911
102 7 4236
103 4 4088
104 7 4283
105 4 4088
106 7 4236
107 3 3952
108 7 4076
109 3 3837
110 6 3586
111 10 2259
112 10 2186
113 11 3916
114 6 3792
115 3 3901
116 7 4034
117 3 4019
118 7 4210
119 3 3843
120 7 4209
121 3 4019
122 7 4033
123 3 3899
124 6 3775
125 11 3915
126 10 2186
127 10 2974
128 3 3249
129 6 3878
130 3 3642
131 7 4118
132 3 3943
133 7 4157
134 3 3986
135 7 4117
136 3 3641
137 6 3877
138 3 3249
139 10 2973
140 9 1806
141 10 2740
142 2 3155
143 6 3803
144 3 3960
145 7 4056
146 3 3342
147 7 4055
148 3 3960
149 6 3802
150 2 3154
151 10 2738
152 9 1805
153 9 1971
154 10 2739
155 3 3216
156 6 3805
157 3 3797
158 7 4096
159 3 3796
160 6 3756
161 3 3216
162 10 2738
163 9 1971
164 9 1805
165 10 2972
166 11 3850
167 6 3645
168 12 4503
169 6 3645
170 11 3850
171 10 2971
172 9 1804
173 10 2183
174 10 2256
175 10 3046
176 10 2256
177 10 2183
Element No
Fuel Group
MWd/MTU

				1 10 2632	2 10 3053	3 11 3738	4 10 3054	5 10 2632						
		6 10 2107	7 11 3401	8 12 4603	9 7 4387	10 12 5551	11 7 4387	12 12 4603	13 11 3402	14 10 2108				
	15 10 2220	16 10 3142	17 3 3630	18 7 4342	19 4 4370	20 7 4832	21 4 4371	22 7 4303	23 3 3630	24 10 3143	25 10 2220			
26 10 2108	27 10 3142	28 3 3560	29 7 4188	30 3 3862	31 7 4480	32 3 3920	33 7 4480	34 3 3862	35 7 4189	36 3 3560	37 10 3143	38 10 2108		
39 11 3402	40 3 3604	41 7 4127	42 4 4197	43 7 4589	44 4 4421	45 7 4774	46 4 4485	47 7 4589	48 4 4198	49 7 4128	50 3 3604	51 11 3402		
52 10 2632	53 12 4666	54 7 4301	55 3 3794	56 7 4470	57 4 4559	58 7 4933	59 4 4675	60 7 4933	61 4 4559	62 7 4470	63 3 3794	64 7 4267	65 12 4667	66 10 2633
67 10 3053	68 7 4276	69 4 4395	70 7 4494	71 4 4393	72 7 4921	73 4 4836	74 8 5236	75 4 4836	76 7 4921	77 4 4439	78 7 4494	79 4 4395	80 7 4276	81 10 3053
82 11 3738	83 12 5550	84 7 4831	85 3 3919	86 7 4773	87 4 4674	88 8 5235	89 8 6009	90 8 5235	91 4 4674	92 7 4773	93 3 3919	94 7 4831	95 12 5550	96 11 3737
97 10 3053	98 7 4276	99 4 4394	100 7 4494	101 4 4418	102 7 4920	103 4 4835	104 8 5234	105 4 4834	106 7 4920	107 4 4487	108 7 4493	109 4 4394	110 7 4275	111 10 3053
112 10 2632	113 12 4666	114 7 4212	115 3 3792	116 7 4468	117 4 4557	118 7 4931	119 4 4673	120 7 4931	121 4 4557	122 7 4468	123 3 3792	124 7 4245	125 12 4665	126 10 2632
	127 11 3401	128 3 3602	129 7 4126	130 4 4195	131 7 4586	132 4 4452	133 7 4771	134 4 4473	135 7 4585	136 4 4195	137 7 4125	138 3 3602	139 11 3400	
	140 10 2107	141 10 3141	142 3 3558	143 7 4186	144 3 3859	145 7 4476	146 3 3916	147 7 4476	148 3 3858	149 7 4185	150 3 3557	151 10 3140	152 10 2106	
		153 10 2218	154 10 3141	155 3 3627	156 7 4279	157 4 4367	158 7 4828	159 4 4367	160 7 4237	161 3 3626	162 10 3139	163 10 2218		
			164 10 2106	165 11 3399	166 12 4599	167 7 4383	168 12 5547	169 7 4383	170 12 4599	171 11 3398	172 10 2105			
					173 10 2630	174 10 3050	175 11 3734	176 10 3050	177 10 2629					

Element No

Fuel Group

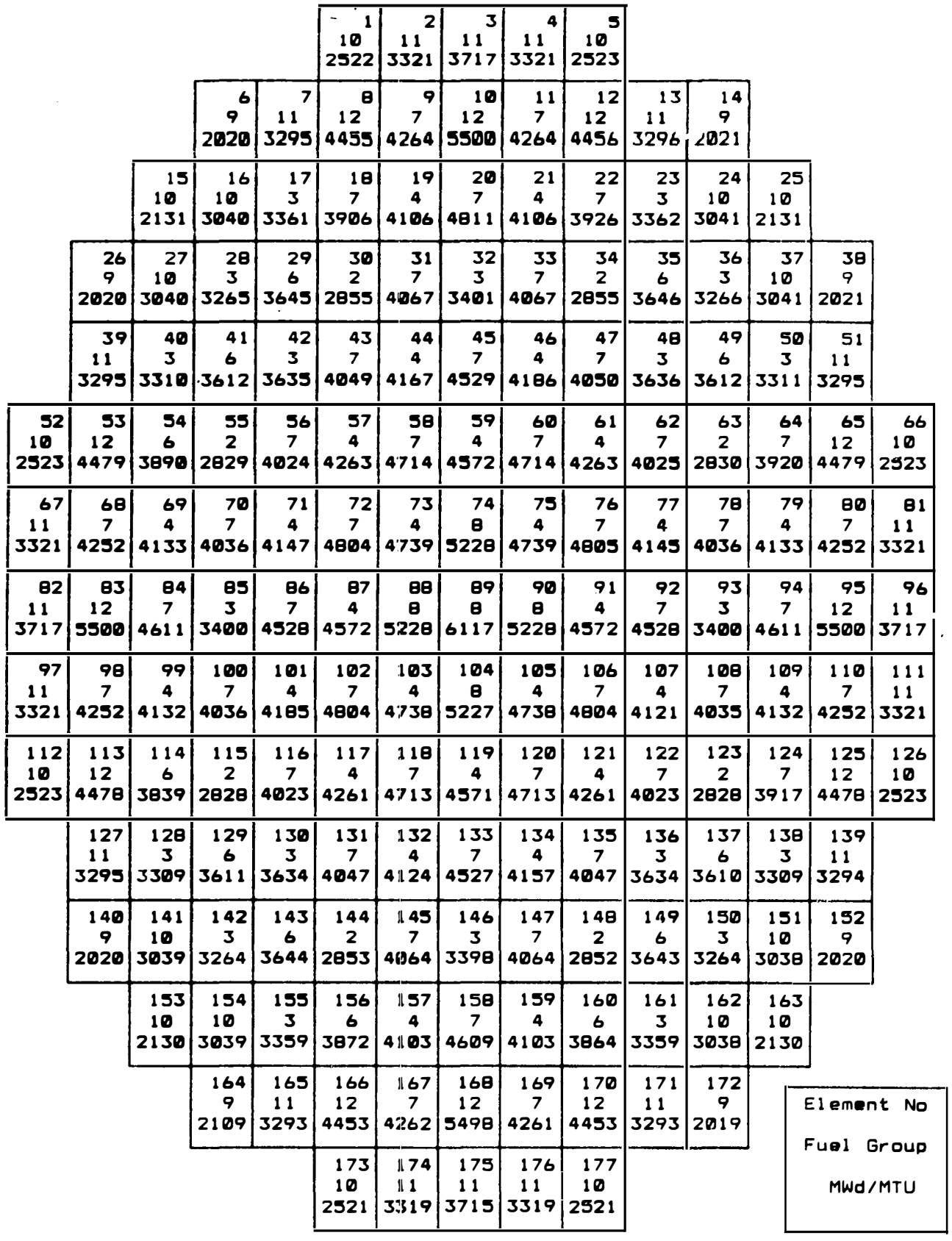
MWd/MTU

				1 10 2617	2 11 3380	3 11 3794	4 11 3381	5 10 2618						
		6 10 2101	7 11 3347	8 12 4567	9 7 4384	10 12 5572	11 7 4385	12 12 4568	13 11 3348	14 10 2102				
	15 10 2170	16 10 3122	17 3 3478	18 7 4016	19 4 4264	20 7 4794	21 4 4264	22 7 4063	23 3 3479	24 10 3124	25 10 2171			
26 10 2102	27 10 3123	28 3 3413	29 6 3818	30 2 2925	31 7 4224	32 3 3790	33 7 4225	34 2 2925	35 6 3819	36 3 3413	37 10 3124	38 10 2102		
39 11 3347	40 3 3401	41 6 3712	42 3 3805	43 7 4207	44 4 4301	45 7 4723	46 4 4350	47 7 4208	48 3 3806	49 6 3713	50 3 3401	51 11 3348		
52 10 2618	53 12 4598	54 7 4035	55 2 2867	56 7 4195	57 4 4435	58 7 4936	59 4 4748	60 7 4936	61 4 4436	62 7 4195	63 2 2867	64 7 3984	65 12 4598	66 10 2618
67 11 3380	68 7 4324	69 4 4265	70 7 4208	71 4 4294	72 7 4952	73 4 4904	74 8 5421	75 4 4904	76 7 4952	77 4 4314	78 7 4208	79 4 4265	80 7 4324	81 11 3381
82 11 3794	83 12 5572	84 7 4793	85 3 3789	86 7 4722	87 4 4747	88 8 5421	89 8 6213	90 8 5421	91 4 4747	92 7 4722	93 3 3789	94 7 4793	95 12 5572	96 11 3794
97 11 3380	98 7 4324	99 4 4265	100 7 4208	101 4 4315	102 7 4951	103 4 4904	104 8 5421	105 4 4904	106 7 4951	107 4 4320	108 7 4207	109 4 4265	110 7 4324	111 11 3380
112 10 2618	113 12 4597	114 7 3927	115 2 2866	116 7 4193	117 4 4434	118 7 4904	119 4 4746	120 7 4934	121 4 4433	122 7 4193	123 2 2865	124 7 4046	125 12 4597	126 10 2618
	127 11 3347	128 3 3400	129 6 3711	130 3 3804	131 7 4205	132 4 4295	133 7 4720	134 4 4286	135 7 4205	136 3 3804	137 6 3710	138 3 3400	139 11 3346	
	140 10 2101	141 10 3122	142 3 3411	143 6 3816	144 2 2922	145 7 4222	146 3 3787	147 7 4221	148 2 2922	149 6 3815	150 3 3411	151 10 3121	152 10 2101	
		153 10 2170	154 10 3121	155 3 3476	156 7 4010	157 4 4261	158 7 4790	159 4 4261	160 7 3982	161 3 3476	162 10 3120	163 10 2169		
			164 10 2100	165 11 3345	166 12 4565	167 7 4382	168 12 5569	169 7 4381	170 12 4565	171 11 3344	172 10 2100			
					173 10 2616	174 11 3379	175 11 3791	176 11 3379	177 10 2615					

Element No

Fuel Group

MWd/MTU


1 10 2522
2 11 3321
3 11 3717
4 11 3321
5 10 2523
6 9 2020
7 11 3295
8 12 4455
9 7 4264
10 12 5500
11 7 4264
12 12 4456
13 11 3296
14 9 2021
15 10 2131
16 10 3040
17 3 3361
18 7 3906
19 4 4106
20 7 4811
21 4 4106
22 7 3926
23 3 3362
24 10 3041
25 10 2131
26 9 2020
27 10 3040
28 3 3265
29 6 3645
30 2 2855
31 7 4067
32 3 3401
33 7 4067
34 2 2855
35 6 3646
36 3 3266
37 10 3041
38 9 2021
39 11 3295
40 3 3310
41 6 3612
42 3 3635
43 7 4049
44 4 4167
45 7 4529
46 4 4186
47 7 4050
48 3 3636
49 6 3612
50 3 3311
51 11 3295
52 10 2523
53 12 4479
54 6 3890
55 2 2829
56 7 4024
57 4 4263
58 7 4714
59 4 4572
60 7 4714
61 4 4263
62 7 4025
63 2 2830
64 7 3920
65 12 4479
66 10 2523
67 11 3321
68 7 4252
69 4 4133
70 7 4036
71 4 4147
72 7 4804
73 4 4739
74 8 5228
75 4 4739
76 7 4805
77 4 4145
78 7 4036
79 4 4133
80 7 4252
81 11 3321
82 11 3717
83 12 5500
84 7 4611
85 3 3400
86 7 4528
87 4 4572
88 8 5228
89 8 6117
90 8 5228
91 4 4572
92 7 4528
93 3 3400
94 7 4611
95 12 5500
96 11 3717
97 11 3321
98 7 4252
99 4 4132
100 7 4036
101 4 4185
102 7 4804
103 4 4738
104 8 5227
105 4 4738
106 7 4804
107 4 4121
108 7 4035
109 4 4132
110 7 4252
111 11 3321
112 10 2523
113 12 4478
114 6 3839
115 2 2828
116 7 4023
117 4 4261
118 7 4713
119 4 4571
120 7 4713
121 4 4261
122 7 4023
123 2 2828
124 7 3917
125 12 4478
126 10 2523
127 11 3295
128 3 3309
129 6 3611
130 3 3634
131 7 4047
132 4 4124
133 7 4527
134 4 4157
135 7 4047
136 3 3634
137 6 3610
138 3 3309
139 11 3294
140 9 2020
141 10 3039
142 3 3264
143 6 3644
144 2 2853
145 7 4064
146 3 3398
147 7 4064
148 2 2852
149 6 3643
150 3 3264
151 10 3038
152 9 2020
153 10 2130
154 10 3039
155 3 3359
156 6 3872
157 4 4103
158 7 4609
159 4 4103
160 6 3864
161 3 3359
162 10 3038
163 10 2130
164 9 2109
165 11 3293
166 12 4453
167 7 4262
168 12 5498
169 7 4261
170 12 4453
171 11 3293
172 9 2019
173 10 2521
174 11 3319
175 11 3715
176 11 3319
177 10 2521
Element No
Fuel Group
MWd/MTU

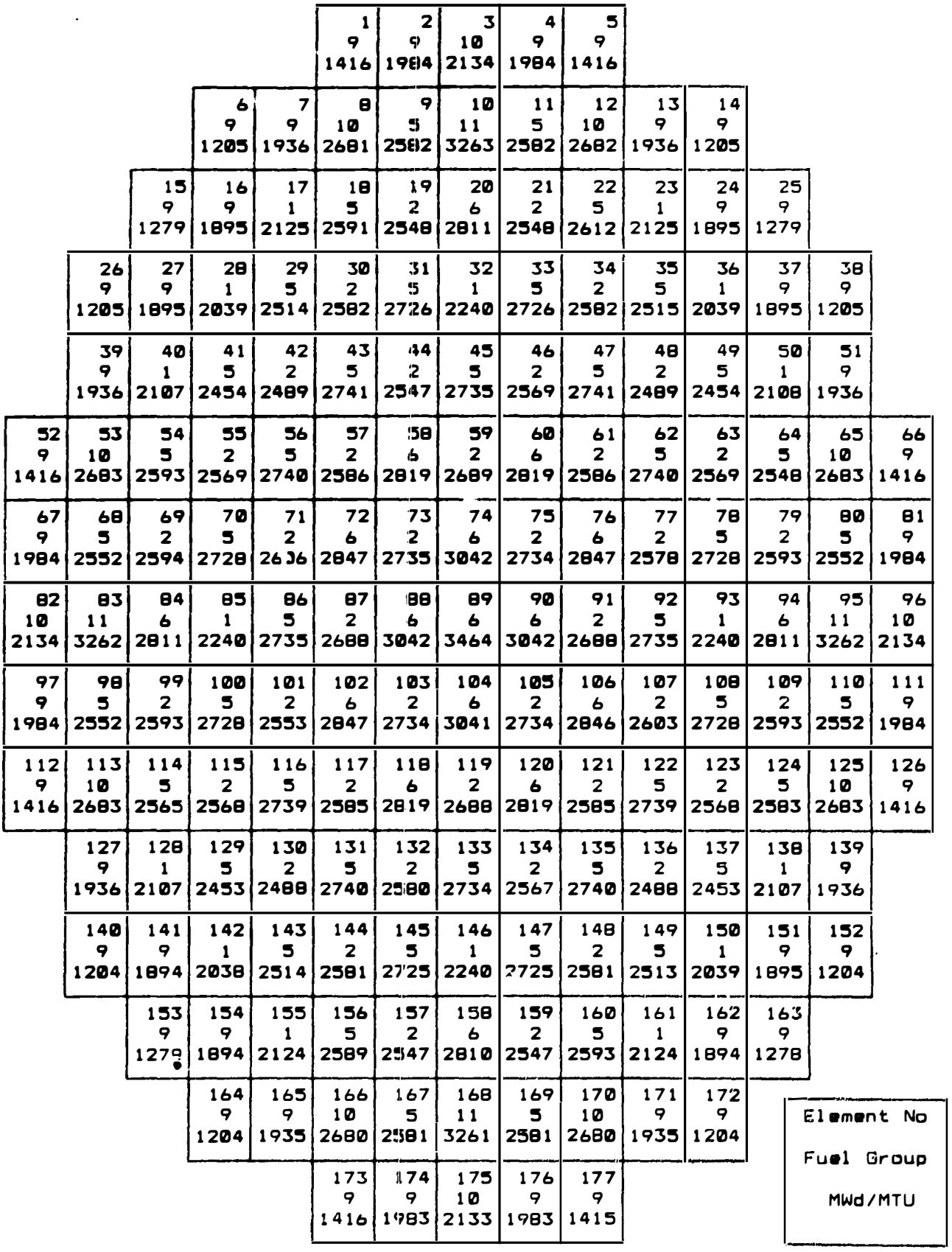

1 9 1416
2 9 1984
3 10 2134
4 9 1984
5 9 1416
6 9 1205
7 9 1936
8 10 2681
9 5 2582
10 11 3263
11 5 2582
12 10 2682
13 9 1936
14 9 1205
15 9 1279
16 9 1895
17 1 2125
18 5 2591
19 2 2548
20 6 2811
21 2 2548
22 5 2612
23 1 2125
24 9 1895
25 9 1279
26 9 1205
27 9 1895
28 1 2039
29 5 2514
30 2 2582
31 5 2726
32 1 2240
33 5 2726
34 2 2582
35 5 2515
36 1 2039
37 9 1895
38 9 1205
39 9 1936
40 1 2107
41 5 2454
42 2 2489
43 5 2741
44 2 2547
45 5 2735
46 2 2569
47 5 2741
48 2 2489
49 5 2454
50 1 2108
51 9 1936
52 9 1416
53 10 2683
54 5 2593
55 2 2569
56 5 2740
57 2 2586
58 6 2819
59 2 2689
60 6 2819
61 2 2586
62 5 2740
63 2 2569
64 5 2548
65 10 2683
66 9 1416
67 9 1984
68 5 2552
69 2 2594
70 5 2728
71 2 2636
72 6 2847
73 2 2735
74 6 3042
75 2 2734
76 6 2847
77 2 2578
78 5 2728
79 2 2593
80 5 2552
81 9 1984
82 10 2134
83 11 3262
84 6 2811
85 1 2240
86 5 2735
87 2 2688
88 6 3042
89 6 3464
90 6 3042
91 2 2688
92 5 2735
93 1 2240
94 6 2811
95 11 3262
96 10 2134
97 9 1984
98 5 2552
99 2 2593
100 5 2728
101 2 2553
102 6 2847
103 2 2734
104 6 3041
105 2 2734
106 6 2846
107 2 2603
108 5 2728
109 2 2593
110 5 2552
111 9 1984
112 9 1416
113 10 2683
114 5 2565
115 2 2568
116 5 2739
117 2 2585
118 6 2819
119 2 2688
120 6 2819
121 2 2585
122 5 2739
123 2 2568
124 5 2583
125 10 2683
126 9 1416
127 9 1936
128 1 2107
129 5 2453
130 2 2488
131 5 2740
132 2 2580
133 5 2734
134 2 2567
135 5 2740
136 2 2488
137 5 2453
138 1 2107
139 9 1936
140 9 1204
141 9 1894
142 1 2038
143 5 2514
144 2 2581
145 5 2725
146 1 2240
147 5 2725
148 2 2581
149 5 2513
150 1 2039
151 9 1895
152 9 1204
153 9 1278
154 9 1894
155 1 2124
156 5 2589
157 2 2547
158 6 2810
159 2 2547
160 5 2593
161 1 2124
162 9 1894
163 9 1278
164 9 1204
165 9 1935
166 10 2680
167 5 2581
168 11 3261
169 5 2581
170 10 2680
171 9 1935
172 9 1204
173 9 1416
174 9 1983
175 10 2133
176 9 1983
177 9 1415
Element No
Fuel Group
MWd/MTU

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
1	A-06	2.96%	.303	.679	.815	.811	.782	.711	.442
2	A-07	2.96%	.323	.701	.944	1.041	1.024	.918	.619
3	A-08	2.96%	.419	.942	1.149	1.166	1.142	1.050	.665
4	A-09	2.96%	.323	.703	.944	1.041	1.024	.918	.619
5	A-10	2.96%	.303	.679	.815	.811	.782	.712	.442
6	B-04	2.96%	.286	.564	.655	.654	.630	.575	.378
7	B-05	2.96%	.455	.920	1.048	1.032	1.015	.949	.604
8	B-06	2.96%	.538	1.184	1.408	1.397	1.364	1.276	.830
9	B-07	2.64%	.516	1.122	1.342	1.342	1.305	1.217	.800
10	B-08	2.96%	.571	1.379	1.689	1.695	1.674	1.573	1.006
11	B-09	2.64%	.518	1.122	1.342	1.342	1.305	1.217	.800
12	B-10	2.96%	.538	1.184	1.408	1.397	1.364	1.276	.830
13	B-11	2.96%	.455	.920	1.048	1.032	1.017	.949	.604
14	B-12	2.96%	.286	.564	.655	.654	.630	.575	.378
15	C-03	2.96%	.316	.615	.690	.676	.663	.622	.400
16	C-04	2.96%	.442	.848	.969	.964	.938	.878	.591
17	C-05	1.98%	.501	.993	1.114	1.070	1.035	.986	.665
18	C-06	2.64%	.578	1.206	1.329	1.232	1.199	1.184	.804
19	C-07	1.98%	.588	1.166	1.333	1.302	1.256	1.177	.793
20	C-08	2.64%	.617	1.258	1.474	1.463	1.408	1.305	.870
21	C-09	1.98%	.588	1.166	1.333	1.302	1.256	1.177	.793

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
22	C-10	2.64%	.599	1.186	1.316	1.247	1.204	1.171	.810
23	C-11	1.98%	.501	.993	1.114	1.070	1.035	.986	.665
24	C-12	2.96%	.444	.848	.971	.964	.940	.878	.591
25	C-13	2.96%	.316	.615	.690	.676	.663	.622	.400
26	D-02	2.96%	.286	.564	.655	.654	.630	.575	.378
27	D-03	2.96%	.442	.848	.969	.964	.940	.878	.591
28	D-04	1.98%	.498	.975	1.094	1.050	1.006	.947	.639
29	D-05	2.64%	.564	1.170	1.283	1.173	1.122	1.113	.780
30	D-06	1.98%	.560	1.214	1.184	.905	.885	1.052	.802
31	D-07	2.64%	.646	1.245	1.370	1.294	1.247	1.210	.845
32	D-08	1.98%	.538	1.032	1.201	1.162	1.046	.946	.699
33	D-09	2.64%	.646	1.245	1.370	1.294	1.247	1.210	.845
34	D-10	1.98%	.560	1.214	1.184	.905	.885	1.052	.802
35	D-11	2.64%	.564	1.170	1.283	1.173	1.122	1.113	.780
36	D-12	1.98%	.498	.975	1.094	1.050	1.006	.947	.639
37	D-13	2.96%	.444	.848	.971	.964	.940	.878	.591
38	D-14	2.96%	.286	.564	.655	.654	.630	.575	.378
39	E-02	2.96%	.455	.920	1.048	1.032	1.015	.949	.604
40	E-03	1.98%	.503	1.002	1.107	1.046	1.021	.986	.659
41	E-04	2.64%	.597	1.192	1.265	1.142	1.111	1.114	.762
42	E-05	1.98%	.453	1.120	1.281	1.166	1.116	1.120	.775

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
43	E-06	2.64%	.589	1.263	1.403	1.289	1.241	1.232	.850
44	E-07	1.98%	.632	1.203	1.348	1.313	1.272	1.192	.791
45	E-08	2.64%	.670	1.276	1.456	1.441	1.384	1.270	.848
46	E-09	1.98%	.606	1.203	1.366	1.327	1.278	1.197	.799
47	E-10	2.64%	.589	1.263	1.403	1.289	1.241	1.228	.850
48	E-11	1.98%	.453	1.120	1.281	1.168	1.116	1.120	.775
49	E-12	2.64%	.597	1.192	1.265	1.142	1.111	1.114	.762
50	E-13	1.98%	.503	1.002	1.107	1.046	1.021	.986	.659
51	E-14	2.96%	.455	.920	1.048	1.032	1.017	.949	.604
52	F-01	2.96%	.303	.675	.815	.811	.782	.712	.442
53	F-02	2.96%	.540	1.203	1.427	1.406	1.370	1.285	.832
54	F-03	2.64%	.578	1.181	1.316	1.237	1.193	1.164	.804
55	F-04	1.98%	.545	1.195	1.164	.889	.876	1.052	.799
56	F-05	2.64%	.632	1.237	1.368	1.285	1.234	1.204	.848
57	F-06	1.98%	.639	1.230	1.388	1.351	1.302	1.210	.804
58	F-07	2.64%	.666	1.291	1.504	1.505	1.439	1.309	.874
59	F-08	1.98%	.565	1.179	1.423	1.443	1.392	1.267	.835
60	F-09	2.64%	.666	1.291	1.504	1.505	1.439	1.309	.874
61	F-10	1.98%	.639	1.230	1.388	1.351	1.302	1.210	.804
62	F-11	2.64%	.632	1.237	1.368	1.285	1.234	1.204	.848
63	F-12	1.98%	.545	1.195	1.164	.889	.878	1.052	.799

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
64	F-13	2.64%	.586	1.192	1.307	1.223	1.203	1.184	.791
65	F-14	2.96%	.540	1.203	1.427	1.406	1.371	1.285	.832
66	F-15	2.96%	.303	.679	.815	.811	.782	.712	.442
67	G-01	2.96%	.323	.703	.944	1.041	1.024	.918	.619
68	G-02	2.64%	.532	1.103	1.309	1.324	1.302	1.212	.793
69	G-03	1.98%	.586	1.177	1.340	1.302	1.263	1.197	.806
70	G-04	2.64%	.643	1.250	1.373	1.289	1.237	1.204	.846
71	G-05	1.98%	.650	1.199	1.340	1.311	1.267	1.188	.810
72	G-06	2.64%	.679	1.298	1.500	1.509	1.467	1.342	.881
73	G-07	1.98%	.643	1.250	1.469	1.489	1.441	1.304	.848
74	G-08	2.64%	.655	1.311	1.594	1.649	1.592	1.428	.940
75	G-09	1.98%	.643	1.250	1.469	1.489	1.441	1.304	.848
76	G-10	2.64%	.679	1.298	1.500	1.509	1.467	1.342	.881
77	G-11	1.98%	.608	1.192	1.353	1.316	1.267	1.188	.800
78	G-12	2.64%	.643	1.250	1.375	1.289	1.237	1.204	.846
79	G-13	1.98%	.586	1.177	1.340	1.302	1.263	1.197	.806
80	G-14	2.64%	.532	1.103	1.309	1.324	1.302	1.212	.793
81	G-15	2.96%	.323	.701	.944	1.041	1.024	.918	.619
82	H-01	2.96%	.419	.942	1.149	1.166	1.142	1.050	.665
83	H-02	2.96%	.571	1.379	1.689	1.695	1.674	1.573	1.006
84	H-03	2.64%	.617	1.258	1.474	1.463	1.408	1.305	.870

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
85	H-04	1.98%	.538	1.030	1.201	1.162	1.046	.946	.699
86	H-05	2.64%	.670	1.274	1.456	1.441	1.384	1.270	.848
87	H-06	1.98%	.565	1.179	1.423	1.443	1.392	1.267	.835
88	H-07	2.64%	.655	1.311	1.594	1.649	1.592	1.428	.940
89	H-08	2.64%	.641	1.465	1.821	1.873	1.854	1.693	1.067
90	H-09	2.64%	.655	1.311	1.594	1.649	1.592	1.428	.940
91	H-10	1.98%	.565	1.179	1.423	1.443	1.392	1.267	.835
92	H-11	2.64%	.670	1.274	1.456	1.441	1.384	1.270	.848
93	H-12	1.98%	.536	1.030	1.201	1.162	1.046	.946	.699
94	H-13	2.64%	.615	1.258	1.474	1.463	1.408	1.305	.870
95	H-14	2.96%	.571	1.379	1.689	1.695	1.674	1.573	1.006
96	H-15	2.96%	.419	.942	1.149	1.166	1.142	1.050	.665
97	K-01	2.96%	.323	.701	.944	1.041	1.024	.918	.619
98	K-02	2.64%	.532	1.103	1.309	1.324	1.302	1.212	.793
99	K-03	1.98%	.586	1.177	1.340	1.302	1.263	1.197	.806
100	K-04	2.64%	.643	1.250	1.373	1.289	1.237	1.204	.845
101	K-05	1.98%	.628	1.197	1.348	1.316	1.278	1.195	.793
102	K-06	2.64%	.679	1.298	1.500	1.509	1.465	1.342	.881
103	K-07	1.98%	.643	1.250	1.469	1.489	1.441	1.304	.848
104	K-08	2.64%	.655	1.311	1.594	1.649	1.592	1.428	.940
105	K-09	1.98%	.643	1.250	1.469	1.489	1.441	1.304	.848

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
106	K-10	2.64%	.679	1.298	1.500	1.509	1.465	1.342	.881
107	K-11	1.98%	.619	1.210	1.368	1.318	1.259	1.184	.810
108	K-12	2.64%	.643	1.250	1.373	1.289	1.237	1.204	.845
109	K-13	1.98%	.586	1.177	1.340	1.302	1.263	1.197	.806
110	K-14	2.64%	.532	1.103	1.309	1.324	1.302	1.212	.791
111	K-15	2.96%	.323	.701	.944	1.041	1.024	.918	.619
112	L-01	2.96%	.303	.679	.815	.811	.782	.711	.442
113	L-02	2.96%	.538	1.203	1.427	1.406	1.370	1.285	.832
114	L-03	2.64%	.560	1.166	1.291	1.204	1.179	1.166	.797
115	L-04	1.98%	.545	1.195	1.162	.889	.876	1.052	.799
116	L-05	2.64%	.632	1.237	1.366	1.285	1.234	1.203	.848
117	L-06	1.98%	.639	1.230	1.388	1.351	1.302	1.210	.804
118	L-07	2.64%	.666	1.289	1.504	1.504	1.439	1.309	.872
119	L-08	1.98%	.565	1.177	1.421	1.443	1.392	1.267	.834
120	L-09	2.64%	.666	1.289	1.504	1.504	1.439	1.309	.872
121	L-10	1.98%	.639	1.230	1.388	1.351	1.302	1.208	.804
122	L-11	2.64%	.632	1.237	1.366	1.285	1.234	1.203	.848
123	L-12	1.98%	.545	1.195	1.162	.887	.876	1.052	.799
124	L-13	2.64%	.582	1.160	1.300	1.241	1.203	1.162	.802
125	L-14	2.96%	.538	1.203	1.427	1.406	1.370	1.285	.832
126	L-15	2.96%	.303	.679	.815	.811	.782	.711	.442

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
127	M-02	2.96%	.455	.920	1.048	1.032	1.015	.949	.604
128	M-03	1.98%	.503	1.002	1.107	1.046	1.021	.984	.659
129	M-04	2.64%	.597	1.192	1.265	1.140	1.111	1.114	.762
130	M-05	1.98%	.453	1.118	1.281	1.166	1.116	1.120	.775
131	M-06	2.64%	.588	1.263	1.401	1.289	1.241	1.230	.850
132	M-07	1.98%	.624	1.208	1.357	1.311	1.261	1.186	.802
133	M-08	2.64%	.670	1.274	1.456	1.441	1.384	1.270	.848
134	M-09	1.98%	.617	1.221	1.364	1.309	1.270	1.204	.799
135	M-10	2.64%	.588	1.261	1.401	1.289	1.241	1.230	.848
136	M-11	1.98%	.453	1.118	1.281	1.166	1.116	1.120	.775
137	M-12	2.64%	.595	1.190	1.265	1.140	1.111	1.114	.762
138	M-13	1.98%	.503	1.002	1.107	1.046	1.019	.984	.659
139	M-14	2.96%	.455	.920	1.048	1.032	1.015	.949	.604
140	N-02	2.96%	.286	.564	.655	.654	.630	.575	.378
141	N-03	2.96%	.442	.848	.969	.964	.938	.878	.591
142	N-04	1.98%	.498	.975	1.094	1.050	1.006	.947	.639
143	N-05	2.64%	.564	1.168	1.283	1.171	1.120	1.111	.780
144	N-06	1.98%	.558	1.212	1.182	.905	.883	1.052	.802
145	N-07	2.64%	.644	1.243	1.370	1.293	1.247	1.208	.845
146	N-08	1.98%	.536	1.030	1.199	1.160	1.046	.946	.699
147	N-09	2.64%	.644	1.243	1.368	1.293	1.247	1.208	.845

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
148	N-10	1.98%	.558	1.212	1.182	.905	.883	1.052	.802
149	N-11	2.64%	.564	1.168	1.281	1.171	1.120	1.111	.780
150	N-12	1.98%	.498	.973	1.094	1.050	1.006	.947	.639
151	N-13	2.96%	.442	.848	.969	.964	.938	.878	.591
152	N-14	2.96%	.286	.564	.655	.654	.630	.575	.378
153	O-03	2.96%	.314	.613	.690	.676	.663	.622	.400
154	O-04	2.96%	.442	.848	.969	.964	.938	.878	.591
155	O-05	1.98%	.499	.991	1.114	1.069	1.035	.986	.665
156	O-06	2.64%	.560	1.170	1.311	1.230	1.190	1.164	.804
157	O-07	1.98%	.586	1.164	1.331	1.302	1.254	1.177	.791
158	O-08	2.64%	.615	1.256	1.472	1.461	1.408	1.304	.870
159	O-09	1.98%	.586	1.164	1.331	1.302	1.254	1.177	.791
160	O-10	2.64%	.549	1.155	1.298	1.221	1.186	1.166	.804
161	O-11	1.98%	.499	.991	1.114	1.069	1.035	.986	.665
162	O-12	2.96%	.442	.848	.969	.964	.938	.878	.591
163	O-13	2.96%	.314	.613	.690	.674	.663	.621	.400
164	P-04	2.96%	.286	.564	.655	.654	.628	.575	.378
165	P-05	2.96%	.455	.918	1.048	1.032	1.015	.949	.602
166	P-06	2.96%	.538	1.182	1.406	1.395	1.362	1.276	.830
167	P-07	2.64%	.516	1.122	1.342	1.340	1.305	1.217	.800
168	P-08	2.96%	.571	1.377	1.687	1.695	1.673	1.573	1.006

TABLE A-12

PEAKING FACTOR DATA FOR TMI-2 CORE

Element Number	Grid Loc.	Enrich wt.	1 Level	2 Level	3 Level	4 Level	5 Level	6 Level	7 Level
169	P-09	2.64%	.516	1.122	1.342	1.340	1.305	1.217	.800
170	P-10	2.96%	.538	1.182	1.406	1.395	1.362	1.276	.830
171	P-11	2.96%	.455	.918	1.046	1.032	1.015	.949	.602
172	P-12	2.96%	.286	.564	.655	.654	.628	.575	.378
173	R-06	2.96%	.303	.679	.815	.811	.782	.711	.442
174	R-07	2.96%	.323	.701	.942	1.041	1.023	.918	.617
175	R-08	2.96%	.417	.942	1.147	1.166	1.142	1.050	.663
176	R-09	2.96%	.323	.701	.942	1.041	1.023	.918	.617
177	R-10	2.96%	.303	.679	.815	.810	.782	.711	.442

PEAKING FACTORS FOR AXIAL LEVEL 1 OF 1

			1	2	3	4	5						
			.303	.323	.419	.323	.303						
		6	7	8	9	10	11	12	13	14			
		.286	.455	.538	.516	.571	.518	.538	.455	.286			
	15	16	17	18	19	20	21	22	23	24	25		
	.316	.442	.501	.578	.588	.617	.588	.599	.501	.444	.316		
26	27	28	29	30	31	32	33	34	35	36	37	38	
.286	.442	.498	.564	.560	.646	.538	.646	.560	.564	.498	.444	.286	
39	40	41	42	43	44	45	46	47	48	49	50	51	
.455	.503	.597	.453	.589	.632	.670	.606	.589	.453	.597	.503	.455	
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.303	.540	.578	.545	.632	.639	.666	.565	.666	.639	.632	.545	.586	.540	.303
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
.323	.532	.586	.643	.650	.679	.643	.655	.643	.679	.600	.643	.586	.532	.323
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
.419	.571	.617	.538	.670	.565	.655	.641	.655	.565	.670	.536	.615	.571	.419
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
.323	.532	.586	.643	.628	.679	.643	.655	.643	.679	.619	.643	.586	.532	.323
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.303	.538	.560	.545	.632	.639	.666	.565	.666	.639	.632	.545	.582	.538	.303
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	.455	.503	.597	.453	.588	.624	.670	.617	.588	.453	.595	.503	.455	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.286	.442	.498	.564	.558	.644	.536	.644	.558	.564	.498	.442	.286	
		153	154	155	156	157	158	159	160	161	162	163		
		.314	.442	.499	.560	.586	.615	.586	.549	.499	.442	.314		
			164	165	166	167	168	169	170	171	172			
			.286	.455	.538	.516	.571	.516	.538	.455	.286			
					173	174	175	176	177					
					.303	.323	.417	.323	.303					

Element No

Peaking

Factor

PEAKING FACTORS FOR AXIAL LEVEL 2 OF 7

			1	2	3	4	5						
			.679	.701	.942	.703	.679						
		6	7	8	9	10	11	12	13	14			
		.564	.920	1.18	1.12	1.37	1.12	1.18	.920	.564			
	15	16	17	18	19	20	21	22	23	24	25		
	.615	.848	.993	1.20	1.16	1.25	1.16	1.18	.993	.848	.615		
26	27	28	29	30	31	32	33	34	35	36	37	38	
.564	.848	.975	1.17	1.21	1.24	1.03	1.24	1.21	1.17	.975	.848	.564	
39	40	41	42	43	44	45	46	47	48	49	50	51	
.920	1.00	1.19	1.12	1.26	1.20	1.27	1.20	1.26	1.12	1.19	1.00	.920	
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.679	1.20	1.18	1.19	1.23	1.23	1.29	1.17	1.29	1.23	1.23	1.19	1.19	1.20	.679
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
.703	1.10	1.17	1.25	1.19	1.29	1.25	1.31	1.25	1.29	1.19	1.25	1.17	1.10	.701
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
.942	1.37	1.25	1.03	1.27	1.17	1.31	1.46	1.31	1.17	1.27	1.03	1.25	1.37	.942
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
.701	1.10	1.17	1.25	1.19	1.29	1.25	1.31	1.25	1.29	1.21	1.25	1.17	1.10	.701
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.679	1.20	1.16	1.19	1.23	1.23	1.28	1.17	1.28	1.23	1.23	1.19	1.16	1.20	.679
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	.920	1.00	1.19	1.11	1.26	1.20	1.27	1.22	1.26	1.11	1.19	1.00	.920	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.564	.848	.975	1.16	1.21	1.24	1.03	1.24	1.21	1.16	.973	.848	.564	
		153	154	155	156	157	158	159	160	161	162	163		
		.613	.848	.991	1.17	1.16	1.25	1.16	1.15	.991	.848	.613		
			164	165	166	167	168	169	170	171	172			
			.564	.918	1.18	1.12	1.37	1.12	1.18	.918	.564			
					173	174	175	176	177					
					.679	.701	.942	.701	.679					

Element No

Peaking

Factor

TABLE A-13

PEAKING FACTORS FOR AXIAL LEVEL 3 OF 7

			1	2	3	4	5						
			.815	.944	1.14	.944	.815						
		6	7	8	9	10	11	12	13	14			
		.655	1.04	1.40	1.34	1.68	1.34	1.40	1.04	.655			
	15	16	17	18	19	20	21	22	23	24	25		
	.690	.969	1.11	1.32	1.33	1.47	1.33	1.31	1.11	.971	.690		
26	27	28	29	30	31	32	33	34	35	36	37	38	
.655	.969	1.09	1.28	1.18	1.37	1.28	1.37	1.18	1.28	1.09	.971	.655	
39	40	41	42	43	44	45	46	47	48	49	50	51	
1.04	1.10	1.26	1.28	1.40	1.34	1.45	1.36	1.40	1.28	1.26	1.10	1.04	
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.815	1.42	1.31	1.16	1.36	1.30	1.50	1.42	1.50	1.30	1.36	1.16	1.30	1.42	.815
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
.944	1.30	1.34	1.37	1.34	1.50	1.46	1.59	1.46	1.50	1.35	1.37	1.34	1.30	.944
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1.14	1.68	1.47	1.20	1.45	1.42	1.59	1.82	1.59	1.42	1.45	1.20	1.47	1.68	1.14
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
.944	1.30	1.34	1.37	1.34	1.50	1.46	1.59	1.46	1.50	1.36	1.37	1.34	1.30	.944
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.815	1.42	1.29	1.16	1.36	1.30	1.50	1.42	1.50	1.30	1.36	1.16	1.30	1.42	.815
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	1.04	1.10	1.26	1.28	1.40	1.35	1.45	1.36	1.40	1.28	1.26	1.10	1.04	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.655	.969	1.09	1.28	1.18	1.37	1.19	1.36	1.18	1.28	1.09	.969	.655	
		153	154	155	156	157	158	159	160	161	162	163		
		.690	.969	1.11	1.31	1.33	1.47	1.33	1.29	1.11	.969	.690		
			164	165	166	167	168	169	170	171	172			
			.655	1.04	1.40	1.34	1.68	1.34	1.40	1.04	.655			
					173	174	175	176	177					
					.815	.942	1.14	.942	.815					

Element No

Peaking

Factor

PEAKING FACTORS FOR AXIAL LEVEL 4 OF 7

			1	2	3	4	5							
			.811	1.04	1.16	1.04	.811							
		6	7	8	9	10	11	12	13	14				
		.654	1.03	1.39	1.34	1.69	1.34	1.39	1.03	.654				
	15	16	17	18	19	20	21	22	23	24	25			
	.676	.964	1.07	1.23	1.30	1.46	1.30	1.24	1.07	.964	.676			
26	27	28	29	30	31	32	33	34	35	36	37	38		
.654	.964	1.05	1.17	.905	1.29	1.16	1.29	.905	1.17	1.05	.964	.654		
39	40	41	42	43	44	45	46	47	48	49	50	51		
1.03	1.04	1.14	1.16	1.28	1.31	1.44	1.32	1.28	1.16	1.14	1.04	1.03		
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.811	1.40	1.23	.889	1.28	1.35	1.50	1.44	1.50	1.35	1.28	.889	1.22	1.40	.811
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
1.04	1.32	1.30	1.28	1.31	1.50	1.40	1.64	1.40	1.50	1.31	1.28	1.30	1.32	1.04
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1.16	1.69	1.46	1.16	1.44	1.44	1.64	1.87	1.64	1.44	1.44	1.16	1.46	1.69	1.16
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
1.04	1.32	1.30	1.28	1.31	1.50	1.40	1.64	1.40	1.50	1.31	1.28	1.30	1.32	1.04
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.811	1.40	1.20	.889	1.28	1.35	1.50	1.44	1.50	1.35	1.28	.887	1.24	1.40	.811
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	1.03	1.04	1.14	1.16	1.28	1.31	1.44	1.30	1.28	1.16	1.14	1.04	1.03	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.654	.964	1.05	1.17	.905	1.29	1.16	1.29	.905	1.17	1.05	.964	.654	
		153	154	155	156	157	158	159	160	161	162	163		
		.676	.964	1.06	1.23	1.30	1.46	1.30	1.22	1.06	.964	.674		
			164	165	166	167	168	169	170	171	172			
			.654	1.03	1.39	1.34	1.69	1.34	1.39	1.03	.654			
					173	174	175	176	177					
					.811	1.04	1.16	1.04	.810					

Element No
Peaking
Factor

PEAKING FACTORS FOR AXIAL LEVEL 8 OF 9

				1	2	3	4	5						
				.782	1.02	1.14	1.02	.782						
			6	7	8	9	10	11	12	13	14			
			.630	1.01	1.36	1.30	1.67	1.30	1.36	1.01	.630			
		15	16	17	18	19	20	21	22	23	24	25		
		.663	.930	1.03	1.19	1.25	1.40	1.25	1.20	1.03	.940	.663		
	26	27	28	29	30	31	32	33	34	35	36	37	38	
	.630	.940	1.00	1.12	.885	1.24	1.04	1.24	.885	1.12	1.00	.940	.630	
	39	40	41	42	43	44	45	46	47	48	49	50	51	
	1.01	1.02	1.11	1.11	1.24	1.27	1.38	1.27	1.24	1.11	1.11	1.02	1.01	
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.782	1.37	1.19	.876	1.23	1.38	1.43	1.39	1.43	1.38	1.23	.878	1.20	1.37	.782
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
1.02	1.38	1.26	1.23	1.26	1.46	1.44	1.59	1.44	1.46	1.26	1.23	1.26	1.38	1.02
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1.14	1.67	1.40	1.04	1.38	1.39	1.59	1.85	1.59	1.39	1.38	1.04	1.40	1.67	1.14
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
1.02	1.38	1.26	1.23	1.27	1.46	1.44	1.59	1.44	1.46	1.25	1.23	1.26	1.38	1.02
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.782	1.37	1.17	.876	1.23	1.38	1.43	1.39	1.43	1.38	1.23	.876	1.20	1.37	.782
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	1.01	1.02	1.11	1.11	1.24	1.26	1.38	1.27	1.24	1.11	1.11	1.01	1.01	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.630	.930	1.00	1.12	.883	1.24	1.04	1.24	.883	1.12	1.00	.930	.630	
		153	154	155	156	157	158	159	160	161	162	163		
		.663	.930	1.03	1.19	1.25	1.40	1.25	1.18	1.03	.930	.663		
			164	165	166	167	168	169	170	171	172			
			.628	1.01	1.36	1.30	1.67	1.30	1.36	1.01	.628			
					173	174	175	176	177					
					.782	1.02	1.14	1.02	.782					

Element No

Peaking

Factor

			1	2	3	4	5							
			.711	.918	1.05	.918	.712							
		6	7	8	9	10	11	12	13	14				
		.575	.949	1.27	1.21	1.57	1.21	1.27	.949	.575				
	15	16	17	18	19	20	21	22	23	24	25			
	.622	.878	.986	1.18	1.17	1.30	1.17	1.17	.986	.878	.622			
26	27	28	29	30	31	32	33	34	35	36	37	38		
.575	.878	.947	1.11	1.05	1.21	.946	1.21	1.05	1.11	.947	.878	.575		
39	40	41	42	43	44	45	46	47	48	49	50	51		
.949	.986	1.11	1.12	1.23	1.19	1.27	1.19	1.22	1.12	1.11	.986	.949		
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.712	1.20	1.16	1.05	1.20	1.21	1.30	1.26	1.30	1.21	1.20	1.05	1.18	1.20	.712
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
.918	1.21	1.19	1.20	1.18	1.34	1.30	1.42	1.30	1.34	1.18	1.20	1.19	1.21	.918
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1.05	1.57	1.30	.946	1.27	1.26	1.42	1.69	1.42	1.26	1.27	.946	1.30	1.57	1.05
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
.918	1.21	1.19	1.20	1.19	1.34	1.30	1.42	1.30	1.34	1.18	1.20	1.19	1.21	.918
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.711	1.20	1.16	1.05	1.20	1.21	1.30	1.26	1.30	1.20	1.20	1.05	1.16	1.20	.711
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	.949	.984	1.11	1.12	1.23	1.18	1.27	1.20	1.23	1.12	1.11	.984	.949	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.575	.878	.947	1.11	1.05	1.20	.946	1.20	1.05	1.11	.947	.878	.575	
		153	154	155	156	157	158	159	160	161	162	163		
		.622	.878	.986	1.16	1.17	1.30	1.17	1.16	.986	.878	.621		
			164	165	166	167	168	169	170	171	172			
			.575	.949	1.27	1.21	1.57	1.21	1.27	.949	.575			
					173	174	175	176	177					
					.711	.918	1.05	.918	.711					

Element No

Peaking

Factor

TABLE A-13

PEAKING FACTORS FOR AXIAL LEVEL 7 OF 7

			1	2	3	4	5						
			.442	.619	.665	.619	.442						
		6	7	8	9	10	11	12	13	14			
		.378	.604	.838	.888	1.00	.888	.838	.604	.378			
	15	16	17	18	19	20	21	22	23	24	25		
	.400	.591	.665	.804	.793	.870	.793	.810	.665	.591	.400		
26	27	28	29	30	31	32	33	34	35	36	37	38	
.378	.591	.639	.700	.802	.845	.699	.845	.802	.700	.639	.591	.378	
39	40	41	42	43	44	45	46	47	48	49	50	51	
.604	.659	.762	.775	.850	.791	.848	.799	.850	.775	.762	.659	.604	
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
.442	.832	.804	.799	.848	.804	.874	.835	.874	.804	.848	.799	.791	.832	.442
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
.619	.793	.806	.846	.810	.881	.848	.948	.848	.881	.888	.846	.806	.793	.619
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
.665	1.00	.870	.699	.848	.835	.948	1.06	.948	.835	.848	.699	.870	1.00	.665
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
.619	.793	.806	.845	.793	.881	.848	.948	.848	.881	.810	.845	.806	.791	.619
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
.442	.832	.797	.799	.848	.804	.872	.834	.872	.804	.848	.799	.802	.832	.442
	127	128	129	130	131	132	133	134	135	136	137	138	139	
	.604	.659	.762	.775	.850	.802	.848	.799	.848	.775	.762	.659	.604	
	140	141	142	143	144	145	146	147	148	149	150	151	152	
	.378	.591	.639	.700	.802	.845	.699	.845	.802	.700	.639	.591	.378	
		153	154	155	156	157	158	159	160	161	162	163		
		.400	.591	.665	.804	.791	.870	.791	.804	.665	.591	.400		
			164	165	166	167	168	169	170	171	172			
			.378	.602	.838	.888	1.00	.888	.838	.602	.378			
					173	174	175	176	177					
					.442	.617	.663	.617	.442					

Element No
Peaking
Factor

APPENDIX B

SUMMARY OF ICBC TIME SERIES FUNCTIONS

APPENDIX B

CONTENTS

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
AFW-SG-A	FLOW	STEAM GENERATOR A	TIMSER
Description:	Aux Feedwater Secondary Injection Rate based upon secondary mass inventory - SG-A Timser		
Qualification category:	EST TREND	Uncertainty:	
Comments:			
AFW-SG-B	FLOW	STEAM GENERATOR B	TIMSER
Description:	Aux Feedwater Secondary Injection Rate based upon secondary mass inventory - SG-B Timser		
Qualification category:	EST TREND	Uncertainty:	
Comments:			
AH-TE-5011-M	TEMPERATURE	REACTOR BUILDING	TIMSER
Description:	Ambient Temperature, Letdown Cooler Area Timser2		
Qualification category:	QUAL/TREND	Uncertainty:	2.7 OR 3.3 F
Comments:	DATA ARE TREND AT TEMP. PEAK 586 MIN.		
AH-TE-5012-M	TEMPERATURE	REACTOR BUILDING	TIMSER
Description:	Ambient Temperature, Drain Tank Area Timser2		
Qualification category:	QUAL/TREND	Uncertainty:	2.7 OR 3.3 F
Comments:	DATA ARE TREND AT TEMP. PEAK 47-53 & 587-593 MIN.		

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
BS-PR-4388-S	PRESSURE	REACTOR BUILDING	TIMSER
Description:	Reactor Building Pressure - Composite		Timser2
Qualification category:	QUALIFIED	Uncertainty:	.32&2.15PSIA
Comments:	COMPOSITE DATA		
DC-R-3399-M	RADIATION	DECAY HEAT	TIMSER
Description:	Decay Heat Closed A Loop Radiation Monitor		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			
DC-R-3400-M	RADIATION	DECAY HEAT	TIMSER
Description:	Decay Heat Closed B Loop Radiation Monitor		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			
FW-TE-1131-P	TEMPERATURE	FEEDWATER B	TIMSER
Description:	Feedwater Heater B Outlet Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	2.2 DEG F
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
FW-TE-1134-P	TEMPERATURE	FEEDWATER A	TIMSER
Description: Feedwater Heater A Outlet Temperature		Timser	
Qualification category: QUALIFIED	Uncertainty: 2.2 DEG F		
Comments:			
HG01	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 1 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			
HG02	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 2 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			
HG03	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 3 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			

TABLE 8-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HG04	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 4 Operation			Cond
Qualification category: TREND		Uncertainty:	
Comments:			
HG05	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 5 Operation			Cond
Qualification category: TREND		Uncertainty:	
Comments:			
HG06	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 6 Operation			Cond
Qualification category: TREND		Uncertainty:	
Comments:			
HG07	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 7 Operation			Cond
Qualification category: TREND		Uncertainty:	
Comments:			

TABLE 8-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HG08	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 8 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			
HG09	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 9 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			
HG10	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 10 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			
HG11	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 11 Operation		Cond	
Qualification category: TREND	Uncertainty:		
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HG12	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 12 Operation Cond			
Qualification category: TREND	Uncertainty:		
Comments:			
HG13	POWER	PRESSURIZER	COND
Description: Pressurizer Heater Group 13 Operation Cond			
Qualification category: TREND	Uncertainty:		
Comments:			
HP-R-207-M	RADIATION-GM	AUX BUILDING	TIMSER
Description: Intermediate Cooling Pump Area Radiation Monitor - in the Auxiliary Building Timser2			
Qualification category: TREND	Uncertainty: TIME +-10MIN		
Comments:			
HP-R-219-G-M	RADIATION - GAS	AUX BUILDING	TIMSER
Description: Station Vent Radiation Monitor - Gas Timser2			
Qualification category: TREND	Uncertainty: TIME +-2 MIN		
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HP-R-222-G-M	RADIATION - GAS	AUX BUILDING	TIMSER
Description:	Auxiliary Building Purge Air Exhaust Radiation Monitor, Upstream of Filter - Gas		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-222-I-M	RADIATION - IODINE	AUX BUILDING	TIMSER
Description:	Auxiliary Building Purge Air Exhaust Radiation Monitor, Upstream of Filter - Iodine		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-222-P-M	RADIATION - PART.	AUX BUILDING	TIMSER
Description:	Auxiliary Building Purge Air Exhaust Radiation Mon., Upstream of Filter - Particulate		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-225-G-M	RADIATION - GAS	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Air Exhaust, Duct A, Radiation Monitor - Gas		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HP-R-225-I-M	RADIATION - IODINE	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Air Exhaust, Duct A, Radiation Monitor - Iodine		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-225-P-M	RADIATION - PART.	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Air Exhaust, Duct A, Radiation Monitor - Particulate		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-226-G-M	RADIATION - GAS	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Air Exhaust, Duct B, Radiation Monitor - Gas		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-226-I-M	RADIATION - IODINE	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Air Exhaust, Duct B, Radiation Monitor - Iodine		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HP-R-226-P-M	RADIATION - PART.	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Air Exhaust, Duct B, Radiation Monitor - Particulate		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-228-G-M	RADIATION - GAS	AUX BUILDING	TIMSER
Description:	Auxiliary Building Purge Air Exhaust Radiation Monitor, Downstream of Filter - Gas		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-228-I-M	RADIATION - IODINE	AUX BUILDING	TIMSER
Description:	Auxiliary Building Purge Air Exhaust Radiation Monitor, Downstream of Filter - Iodine		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-228-P-M	RADIATION - PART.	AUX BUILDING	TIMSER
Description:	Auxiliary Building Purge Air Exhaust Radiation Mon., Downstream of Filter - Particulate		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HP-R-229-G-M	RADIATION - GAS	REACTOR BUILDING	TIMSER
Description:	Hydrogen Purge Radiation Monitor - Gas Timser		
Qualification category:	TREND	Uncertainty:	TIME +-2 MIN
Comments:			
HP-R-3236-M	RADIATION - GM	REACTOR BUILDING	TIMSER
Description:	Reactor Building Purge Unit Area Radiation Monitor Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-15MIN
Comments:			
HP-R-3238-M	RADIATION - GM	AUX BUILDING	TIMSER
Description:	Auxiliary Building Exhaust Unit Area Radiation Monitor Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-15MIN
Comments:			
HP-R-3240-M	RADIATION - GM	FUEL HANDLING BUILDING	TIMSER
Description:	Fuel Handling Exhaust Unit Area Radiation Monitor Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-15MIN
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
HPI/MAKEUP	FLOW	MAKEUP/LETDOWN	COND
Description:	HPI/Makeup Est. Based on Expected Results, from a mass balance analysis of the Pri. Sys. Cond		
Qualification category:	EST TREND	Uncertainty:	
Comments:			
IC-R-1091-M	RADIATION	REACTOR COOLANT	TIMSER
Description:	Intermediate Coolant Letdown, Cooler B Radiation Monitor Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			
IC-R-1092-M	RADIATION - SCINT.	REACTOR COOLANT	TIMSER
Description:	Intermediate Coolant Letdown, Cooler A Radiation Monitor Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			
IC-R-1093-M	RADIATION	REACTOR COOLANT	TIMSER
Description:	Intermediate Coolant Letdown, Inlet Radiation Monitor Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			

TABLE 8-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
LASL DECAY HEAT	DECAY HEAT	REACTOR CORE	TIMSER
Description: Decay Heat			Timser
Qualification category: QUALIFIED		Uncertainty: 20% READ.	
Comments:			
LETDOWN FLOW	FLOW	MAKEUP/LETDOWN	COND
Description: Letdown Cooler Mass Flowrate			Cond
Qualification category: QUALIFIED		Uncertainty: 24.6% READ.	
Comments: CALCULATED PARAMETER			
MU-R-720H-M	RADIATION	MAKEUP/LETDOWN	TIMSER
Description: Primary Coolant Letdown HI Radiation Monitor			Timser2
Qualification category: TREND		Uncertainty: TIME +-5 MIN	
Comments:			
MU-R-720L-M	RADIATION	MAKEUP/LETDOWN	TIMSER
Description: Primary Coolant Letdown LO Radiation Monitor			Timser2
Qualification category: TREND		Uncertainty: TIME +-5 MIN	
Comments:			

TABLE 8-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
MU-TE-739-M	TEMPERATURE	MAKEUP/LETDOWN	TIMSER

Description: Letdown Cooler 1A Outlet Temperature

Timser

Qualification category: QUALIFIED Uncertainty: 10% READING

Comments:

Function Identification	Function Type	Function System	ICBC Area
MU-TE-740-M	TEMPERATURE	MAKEUP/LETDOWN	TIMSER

Description: Letdown Cooler 1B Outlet Temperature

Timser

Qualification category: QUALIFIED Uncertainty: 10% READING

Comments:

Function Identification	Function Type	Function System	ICBC Area
NI-ND-1-P	NUCLEAR - BF3	REACTOR VESSEL	TIMSER

Description: Source Range Power Level

Timser

Qualification category: QUALIFIED Uncertainty: TIME+0S-30S

Comments:

Function Identification	Function Type	Function System	ICBC Area
NI-ND-1-S	NUCLEAR - BF3	REACTOR VESSEL	TIMSER

Description: Source Range Power Level

Timser

Qualification category: QUALIFIED Uncertainty: TIME+10S-45S

Comments:

TABLE 8-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
NI-ND-2-P	NUCLEAR - BF3	REACTOR VESSEL	TIMSER
Description: Source Range Power Level		Timser	
Qualification category: QUALIFIED	Uncertainty: TIME+0S-30S		
Comments:			
NI-ND-3-S	NUCLEAR - ION	REACTOR VESSEL	TIMSER
Description: Intermediate Range Power Level		Timser	
Qualification category: TREND	Uncertainty: TIME+10S-45S		
Comments:			
NI-ND-4-S	NUCLEAR - ION	REACTOR VESSEL	TIMSER
Description: Intermediate Range Power Level		Timser	
Qualification category: TREND	Uncertainty: TIME+10S-45S		
Comments:			
NSAC MAKEUP	FLOW	MAKEUP/LETDOWN	COND
Description: NSAC MAAP V2.0 Calculation of HPI/Makeups		Cond	
Qualification category: ESTIMATE	Uncertainty:		
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
PCP1A	BINARY	REACTOR COOLANT-A	COND
Description:	Primary Coolant Pump 1A (Start/Stop Times), Binary Function		Cond
Qualification category:	TREND	Uncertainty:	
Comments:			
PCP1B	BINARY	REACTOR COOLANT-B	COND
Description:	Primary Coolant Pump 1B (Start/Stop Times), Binary Function		Cond
Qualification category:	TREND	Uncertainty:	
Comments:			
PCP2A	BINARY	REACTOR COOLANT-A	COND
Description:	Primary Coolant Pump 2A (Start/Stop Times), Binary Function		Cond
Qualification category:	TREND	Uncertainty:	
Comments:			
PCP2B	BINARY	REACTOR COOLANT-B	COND
Description:	Primary Coolant Pump 2B (Start/Stop Times), Binary Function		Cond
Qualification category:	TREND	Uncertainty:	
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
PORV FLOW RATE	FLOW	PRESSURIZER	TIMSER
Description:	Discharge Flow Rate Through the Pressurizer PORV - Calculated Parameter Timser		
Qualification category:	QUALIFIED	Uncertainty:	20% READING
Comments:	CALCULATED PARAMETER, FROM 220 - 318 MIN. UNCERT. IS +50%, - 20%		
PRESS.-PRIMARY	PRESSURE	REACTOR COOLANT	TIMSER
Description:	Reactor Coolant Composite Pressure Timser3		
Qualification category:	QUALIFIED	Uncertainty:	40 PSI (MAX)
Comments:	COMPOSITE DATA		
PRESSURE UNC	PRESSURE	REACTOR COOLANT	COND
Description:	Primary System Pressure Uncertainty, Discontinuous Function Cond		
Qualification category:	QUALIFIED	Uncertainty:	
Comments:			
PZR HEAT POWER	POWER	PRESSURIZER	COND
Description:	Total Pressurizer Heater Group Power		
Qualification category:	TREND	Uncertainty:	
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
RC-1-LT1-L-R	LEVEL	PRESSURIZER	TIMSER
Description: Pressurizer Level			Timser3
Qualification category: QUALIFIED		Uncertainty: 24 IN	
Comments:			
RC-14A-FT-CALC	FLOW	REACTOR COOLANT - LOOP A	TIMSER
Description: Calculated Loop A Mass Flow Rate			Timser
Qualification category: QUALIFIED		Uncertainty: SEE UNC. CH.	
Comments: SEE RC-14A-FT-UNC-U & -L			
RC-14A-FT-UNC-L	FLOW	REACTOR COOLANT - LOOP A	TIMSER
Description: Lower Uncertainty of Function RC-14A-FT-CALC			Timser
Qualification category:		Uncertainty:	
Comments: LOWER UNCERTAINTY FUNCTION FOR RC-14A-FT-CALC			
RC-14A-FT-UNC-U	FLOW	REACTOR COOLANT - LOOP A	TIMSER
Description: Upper Uncertainty of Function RC-14A-FT-CALC			Timser
Qualification category:		Uncertainty:	
Comments: UPPER UNCERTAINTY FUNCTION FOR RC-14A-FT-CALC			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
RC-148-FT-CALC	FLOW	REACTOR COOLANT - LOOP B	TIMSER
Description:	Calculated Loop B Mass Flow Rate Timser		
Qualification category:	QUALIFIED	Uncertainty:	SEE UNC. CH.
Comments:	SEE RC-148-UNC-U & -L		
RC-148-FT-UNC-L	FLOW	REACTOR COOLANT - LOOP B	TIMSER
Description:	Lower Uncertainty of Function RC-14A-FT-CALC Timser		
Qualification category:		Uncertainty:	
Comments:	LOWER UNCERTAINTY FUNCTION FOR RC-14B-FT-CALC		
RC-14B-FT-UNC-U	FLOW	REACTOR COOLANT - LOOP B	TIMSER
Description:	Upper Uncertainty Function of RC-14B-FT-CALC Timser		
Qualification category:		Uncertainty:	SEE UNC. CH.
Comments:	UPPER UNCERTAINTY FUNCTION FOR RC-14B-FT-CALC		
RC-15A-TE3-M	TEMPERATURE	REACTOR COOLANT-A	TIMSER
Description:	Cold Leg Temperature - Pump 2A Inlet : Wide Range (Elev. 310'2") Timser		
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:	USE AS INITIAL CONDITION, CONDITION AT 100 AND 174 MIN.		

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
RC-15B-TE2-M	TEMPERATURE	REACTOR COOLANT-B	TIMSER
Description:	Cold Leg Temperature - Pump 1B Inlet : Wide Range Timser		
Qualification category:	TREND	Uncertainty:	TIME+-2.5MIN
Comments:	DATA ARE TREND		
RC-15B-TE3-M	TEMPERATURE	REACTOR COOLANT-B	TIMSER
Description:	Cold Leg Temperature - Pump 2B Inlet : Wide Range (Elev. 310'2") Timser		
Qualification category:	TREND	Uncertainty:	TIME+-2.5MIN
Comments:	USE AS INITIAL CONDITION, CONDITION AT 100 AND 174 MIN.		
RC-2-TE1/2-P	TEMPERATURE	PRESSURIZER	TIMSER
Description:	Pressurizer Temperature Timser		
Qualification category:	QUALIFIED	Uncertainty:	2.5 DEG F
Comments:			
RC-5A-TE2-R	TEMPERATURE	REACTOR COOLANT - LOOP A	TIMSER
Description:	Cold Leg Temperature - Loop 1A Inlet: Wide Range Timser4		
Qualification category:	QUALIFIED	Uncertainty:	1.91 DEG F
Comments:	QUALIFIED FOR FIRST 1000 MIN.		

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
RC-5B-TE2-R	TEMPERATURE	REACTOR COOLANT - LOOP B	TIMSER
Description: Cold Leg Temperature - Pump 1B Inlet : Wide Range Timser4			
Qualification category: QUALIFIED	Uncertainty: 1.91 DEG F		
Comments: QUALIFIED FOR FIRST 1000 MIN.			
RC-9-TE-P	TEMPERATURE	PRESSURIZER	TIMSER
Description: Pressurizer Surge Line Temperature Timser			
Qualification category: TREND	Uncertainty: TIME +-1 MIN		
Comments:			
RC-V1	BINARY	PRESSURIZER	COND
Description: Pressurizer Spray Valve Position (Open/Closed), Binary Function Cond			
Qualification category: QUALIFIED	Uncertainty: N. A.		
Comments:			
RC-V2	BINARY	REACTOR COOLANT	TIMSER
Description: Pressurizer Block Valve Position (Open/Closed), Binary Function Timser			
Qualification category: QUALIFIED	Uncertainty: TIME+-0.5MIN		
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SF-R-3402-M	RADIATION	SPENT FUEL	TIMSER
Description:	Spent Fuel Cooling Area Radiation Monitor		Timser2
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			
SG-A-LEVEL	LEVEL	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Composite Level		Timser3
Qualification category:	QUALIFIED	Uncertainty:	9 IN
Comments:	COMPOSITE DATA		
SG-B-LEVEL	LEVEL	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Composite Level		Timser3
Qualification category:	QUALIFIED	Uncertainty:	9 IN
Comments:	COMPOSITE DATA		
SP-10A-PT1-R	PRESSURE	STEAM GENERATOR A	TIMSER
Description:	Turbine Header Pressure - Loop A		Timser3
Qualification category:	QUALIFIED	Uncertainty:	8.2 PSI
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-12A-TE1-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Upper Downcomer Temperature Elevation 320'1"		Timser
Qualification category:	QUALIFIED	Uncertainty:	2.2 DEG F
Comments:			
SP-12A-TE2-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Upper Downcomer Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	2.2 DEG F
Comments:			
SP-12B-TE1-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Upper Downcomer Temperature Elevation 320'1"		Timser
Qualification category:	QUALIFIED	Uncertainty:	2.2 DEG F
Comments:			
SP-12B-TE2-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Upper Downcomer Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	2.2 DEG F
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-2A-TE1-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Shell Temperature Elevation 303'2"		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			
SP-2A-TE2-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Shell Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			
SP-2A-TE3-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Shell Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			
SP-2A-TE4-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Shell Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-2A-TE5-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Shell Temperature Elevation 338'3" Steam Outlet		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			
SP-2B-TE1-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator - B - Shell Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			
SP-2B-TE2-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Shell Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			
SP-2B-TE3-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Shell Temperature		Timser
Qualification category:	QUALIFIED	Uncertainty:	8.1 DEG F
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-2B-TE4-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description: Steam Generator B - Shell Temperature Timser			
Qualification category: QUALIFIED		Uncertainty: 8.1 DEG F	
Comments:			
SP-2B-TE5-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description: Steam Generator B - Shell Temperature Elevation 338'3" Steam Outlet Timser			
Qualification category: QUALIFIED		Uncertainty: 8.1 DEG F	
Comments:			
SP-3A-TE1/2-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description: Steam Generator A - Downcomer Temperature Timser			
Qualification category: QUALIFIED		Uncertainty: 2.2 DEG F	
Comments:			
SP-3B-TE1/2-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description: Steam Generator B - Downcomer Temperature Timser			
Qualification category: QUALIFIED		Uncertainty: 2.2 DEG F	
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-4A-TE-P	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Main Steam Temperature Turbine Bldg. - Steam Line A1 Timser		
Qualification category:	QUALIFIED	Uncertainty: 2.1 DEG F	
Comments:	QUALIFIED FOR INITIAL CONDITIONS ONLY		
SP-4B-TE-P	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Main Steam Temperature Turbine Bldg. Timser		
Qualification category:	QUALIFIED	Uncertainty: 2.1 DEG F	
Comments:	QUALIFIED FOR INITIAL CONDITIONS ONLY		
SP-5A-TE1/2-R	TEMPERATURE	FEEDWATER	TIMSER
Description:	Feedwater Temperature Timser		
Qualification category:	QUALIFIED	Uncertainty: 1.78 DEG F	
Comments:	QUALIFIED FOR INITIAL CONDITIONS ONLY		
SP-6A-PT-ABS	PRESSURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Secondary Absolute Pressure Timser3		
Qualification category:	QUALIFIED	Uncertainty: 16.2 PSI	
Comments:	FAILED AFTER 932 MIN. (SEE NOTE 49)		

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-6A-PT1-R	PRESSURE	STEAM GENERATOR A	TIMSER
Description:	Steam Generator A - Steam Pressure Reactor bldg. - Steam Line A1 or A2	Timser3	
Qualification category:	QUALIFIED	Uncertainty:	16.1 PSI
Comments:	FAILED AFTER 932 MIN. (SEE NOTE 48)		
SP-6B-PT-ABS	PRESSURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Secondary Absolute Pressure	Timser3	
Qualification category:	QUALIFIED	Uncertainty:	16.2 PSI
Comments:	FAILED AFTER 932 MIN. (SEE NOTE 49)		
SP-6B-PT1-R	PRESSURE	STEAM GENERATOR B	TIMSER
Description:	Steam Generator B - Steam Pressure Reactor Bldg. - Steam Line A1 or A2	Timser3	
Qualification category:	QUALIFIED	Uncertainty:	16.1 PSI
Comments:	FAILED AFTER 932 MIN. (SEE NOTE 48)		
SP-8A-FT-R	FLOW	FEEDWATER A	TIMSER
Description:	Main Feedwater Flow Rate - Loop A Steam Generator	Timser	
Qualification category:	QUALIFIED	Uncertainty:	.106 MLB/HR
Comments:	QUALIFIED FOR INITIAL CONDITIONS ONLY		

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
SP-8B-FT-R	FLOW	FEEDWATER B	TIMSER
Description:	Main Feedwater Flow Rate - Loop B Steam Generator Timser		
Qualification category:	QUALIFIED	Uncertainty:	.106 MLB/HR
Comments:	QUALIFIED FOR INITIAL CONDITIONS ONLY		
TE-HL-A	TEMPERATURE	REACTOR COOLANT LOOP A	TIMSER
Description:	Reactor Coolant Composite Hot Leg Temperature - Loop A Timser4		
Qualification category:	QUAL/TREND	Uncertainty:	1.14 DEG F
Comments:	COMPOSITE DATA		
TE-HL-B	TEMPERATURE	REACTOR COOLANT LOOP B	TIMSER
Description:	Reactor Coolant Composite Hot Leg Temperature - Loop B Timser4		
Qualification category:	QUAL/TREND	Uncertainty:	1.14 DEG F
Comments:	COMPOSITE DATA		
TSAT-PRIMARY	TEMPERATURE	REACTOR COOLANT	TIMSER
Description:	Reactor Coolant Saturation Temperature - Calcul. from Composite Pri. Press. PRESS.-PRI. Timser4		
Qualification category:	QUALIFIED	Uncertainty:	4.8 DEG F
Comments:	COMPUTED PARAMETER		

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
TSAT-SG-A	TEMPERATURE	STEAM GENERATOR A	TIMSER
Description:	Saturation Temperature Calculated from Secondary Pressure (SP-6A-PT1-R), Steam Gen. A Timser4		
Qualification category:	QUALIFIED	Uncertainty:	5.5 DEG F
Comments:	COMPUTED PARAMETER		
TSAT-SG-B	TEMPERATURE	STEAM GENERATOR B	TIMSER
Description:	Saturation Temperature Calculated from Secondary Pressure (SP-6B-PT1-R), Steam Gen. B Timser4		
Qualification category:	QUALIFIED	Uncertainty:	5.5 DEG F
Comments:	COMPUTED PARAMETER		
WDL-PT-1202-R	PRESSURE	PRESSURIZER	TIMSER
Description:	Reactor Coolant Drain Tank (RCDT) Pressure Timser3		
Qualification category:	QUALIFIED	Uncertainty:	3.9 PSI
Comments:	QUALIFIED UP TO 932 MINUTES - FAILED THEREAFTER		
WDL-R-1311-M	RADIATION	DISCHARGE	TIMSER
Description:	Plant Effluent Radiation Monitor, Unit 2 Timser2		
Qualification category:	TREND	Uncertainty:	TIME +-5 MIN
Comments:			

TABLE B-1 SUMMARY OF ICBC TIME SERIES FUNCTIONS

Function Identification	Function Type	Function System	ICBC Area
WDL-TE-1200-P	TEMPERATURE	PRESSURIZER	TIMSER
Description: Reactor Coolant Drain Tank (RCDT) Temperature Timser2			
Qualification category: QUALIFIED		Uncertainty: 1.7 DEG F	
Comments:			
WGD-R-1480-G-M	RADIATION - GAS	WASTE GAS	TIMSER
Description: Waste Gas Discharge Duct Radiation Monitor - Gas Timser2			
Qualification category: TREND		Uncertainty: TIME +-2 MIN	
Comments:			

APPENDIX C

INSTRUCTIONS TO REBUILD USER INDEX FILE

APPENDIX C

CONTENTS

FIGURES

APPENDIX C - PROCEDURE TO REBUILD USER DATA AREA

ICBC Version 3.1 contains provision for users to enter their own time series functions. These data are stored in block files within the \ICBC subdirectory of the PC system; associated with this block file are a data and an index file (UDATA.BLK, UDATA.DAT and UDATA.IDX). The user should periodically back these files up on some disk media to insure that his information will not be lost.

A SAGE utility, named REBUILD, has been provided in the \ICBC area and can be used (1) to restore a damaged index file to operation or (2) to remove unused space within the UDATA.BLK file caused by deletion of user functions.

The utility is accessed by entering the ICBC subdirectory (cd\icbc) and typing the command 'rebuild' followed by a carriage return (Enter). A form shown in Figure C-1 is produced on which the user enters 'Data' as the name of the relation to rebuild and 'ICBC.DFL' as the current definition file (if compacting a data file, case 2 above, 'ICBC.DFL' is also required as the old definition file). Processing messages are displayed at the bottom of the form during the rebuild operation; should errors occur, SAGE error message notation will be displayed.

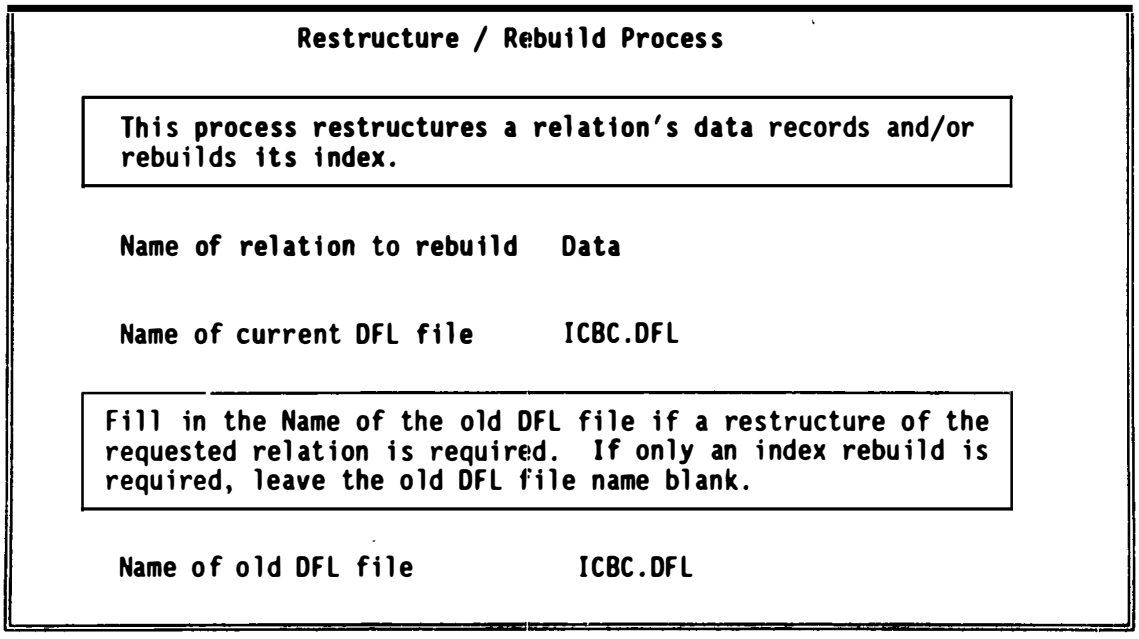


Figure C-1. REBUILD Definition Form

Any ICBC data file or index may be processed using REBUILD, however, since the user is unable to change data in any file other than UDATA, it is preferred that errors in other files which may occur be corrected by recopying them from the Version 3.1 diskettes to area \ICBC.

APPENDIX D

IMPROVED DECIMATION OF REACTIMETER DATA CHANNELS

APPENDIX D

CONTENTS

TABLES

FIGURES

APPENDIX D - IMPROVED DECIMATION OF REACTIMETER DATA CHANNELS

A typical reactimeter channel contains in excess of 20,000 samples for the first 1,000 minutes of the TMI-2 accident. The data base becomes inefficient both in speed of performance and required disk storage space for channels in excess of about 2,500 samples. The objective in decimating the TMI-2 data is to provide less than 2,500 samples that represent the original data with regard to magnitude, event timing, frequency content, and measurement range. Simple methods such as keeping every tenth point, although simple and easy to implement, reduces the frequency content by the same magnitude. A method utilizing the first derivative, absolute magnitude changes, and relative minima and maxima of the data was developed to accomplish data decimation while meeting the stated criteria. The computer code which accomplished the decimation in effect simulated hand selection of the data to be retained.

Table 1 provides a summary of the decimated data. Only 14 of the measurements required decimation. The decimation ratio ranged from approximately 3:1 up to approximately 17:1. The number of samples retained for a specific measurement and time period is highly dependent on the character of the data. For example a comparison of the original to decimated data for the measured steam pressure of steam generator A (SP-6A-PT1-R) for three 100 minute time periods is shown in figures D-1 through D-6. These figures show that the character of the data is retained with regard to frequency content (except for noise), magnitudes (variations are within data uncertainty) and event timing. No known essential features have been deleted from the data.

TABLE O-1
TMI-2 REACTIMETER DATA CHANNEL DECIMATION

Identification	Description	Range (sec)	Nr Samples Original	Nr Samples Decimated
PRESS.-PRIMARY	Reactor Coolant Composite Pressure	-10 - 1000	7229	1411
RC-1-LT1-L-R	Pressurizer Level	-10 - 1000	20115	2347
RC-5A-TE2-R	Cold Leg Temperature - Loop 1A Inlet: Wide Range	-10 - 1000	20116	1948
RC-5B-TE2-R	Cold Leg Temperature - Pump 1B Inlet: Wide Range	-10 - 1000	20116	1829
SG-A-LEVEL	Steam Generator A - Composite Level	-10 - 1000	20195	1864
SG-B-LEVEL	Steam Generator B - Composite Level	-10 - 1000	20115	1704
SP-10A-PT1-R	Turbine Header Pressure - Loop A	-10 - 132	20115	1216
SP-6A-PT1-R	Steam Generator A - Steam Pressure	-10 - 933	18745	1583
SP-6A-PT1-ABS	Steam Generator A - Absolute Pressure	-10 - 933	18745	2164
SP-6B-PT1-R	Steam Generator B - Steam Pressure	-10 - 933	18745	2197
SP-6B-PT1-ABS	Steam Generator B - Absolute Pressure	-10 - 933	18745	2405
TE-HL-A	Reactor Coolant Composite Temperature - Loop A	-10 - 938	9099	1618
TE-HL-B	Reactor Coolant Composite Temperature - Loop B	-10 - 979	3495	1336
WDL-PT-1202-R	Reactor Coolant Drain Tank (RCDT) Pressure	-10 - 933	18765	1974

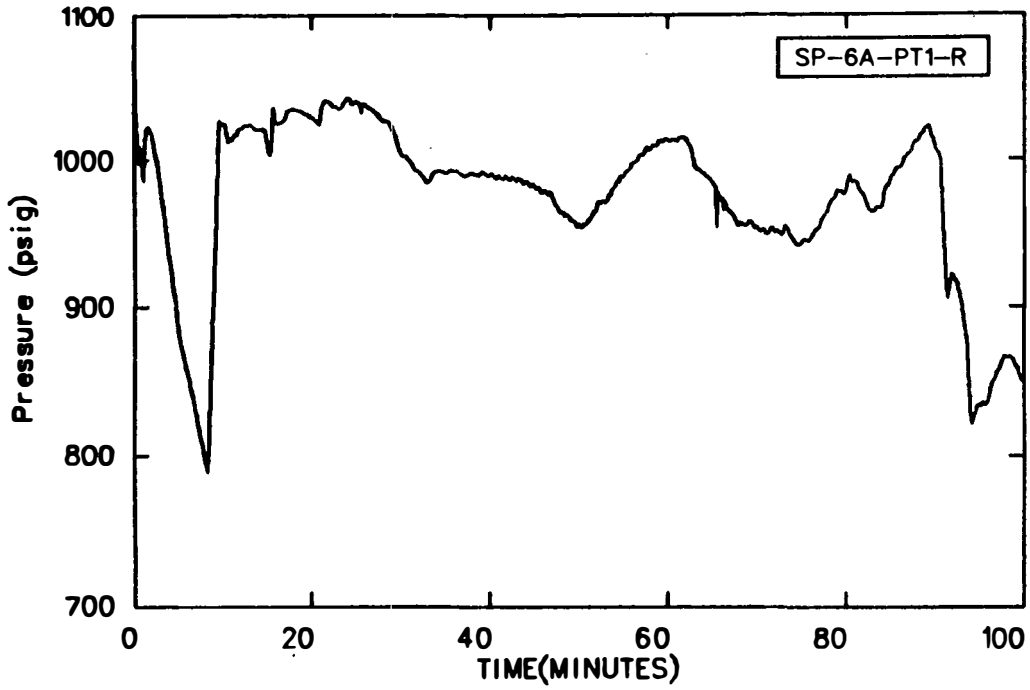


Figure D-1. Steam Generator A Pressure 0 to 100 Minutes (SP-6A-PT1-R)

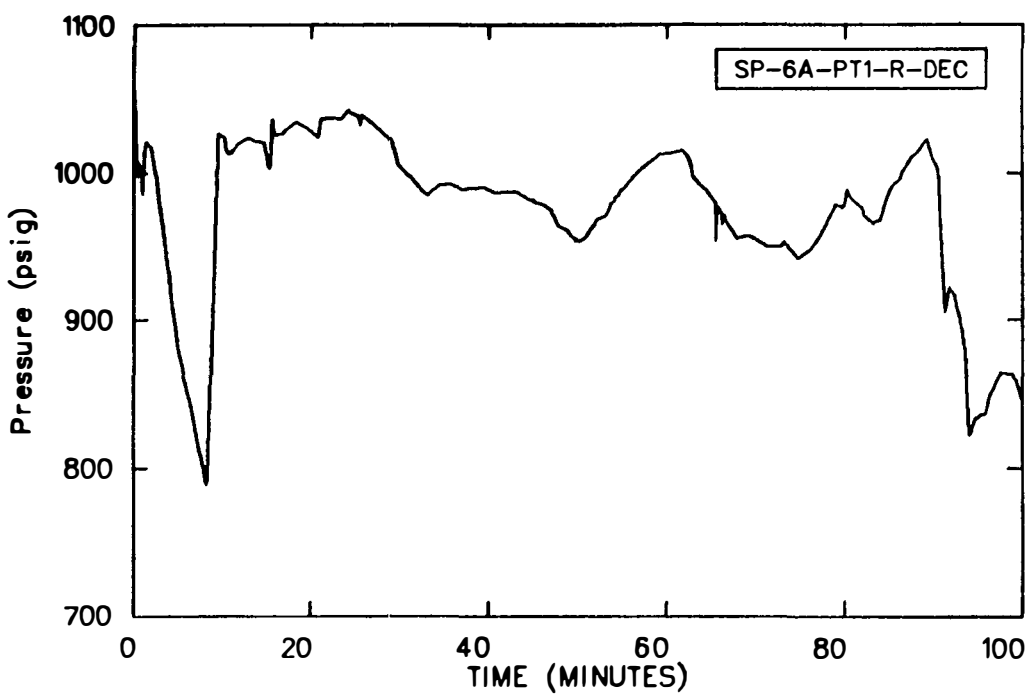


Figure D-2. Decimated Steam Generator Pressure 0 to 100 minutes

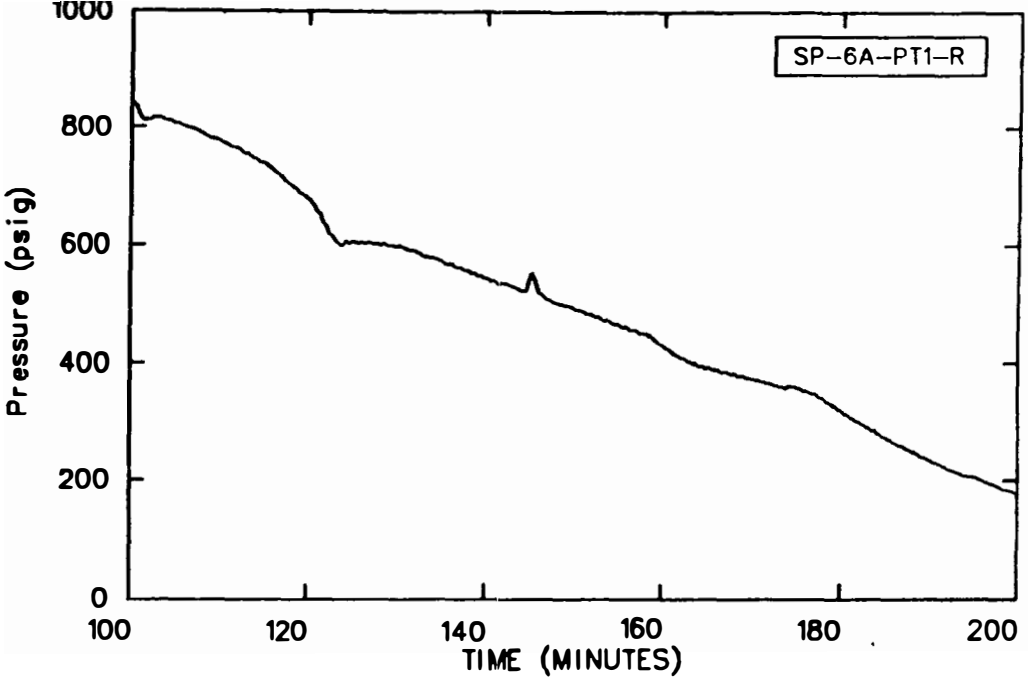


Figure D-3. Steam Generator A Pressure 100 to 200 Minutes (SP-6A-PT1-R)

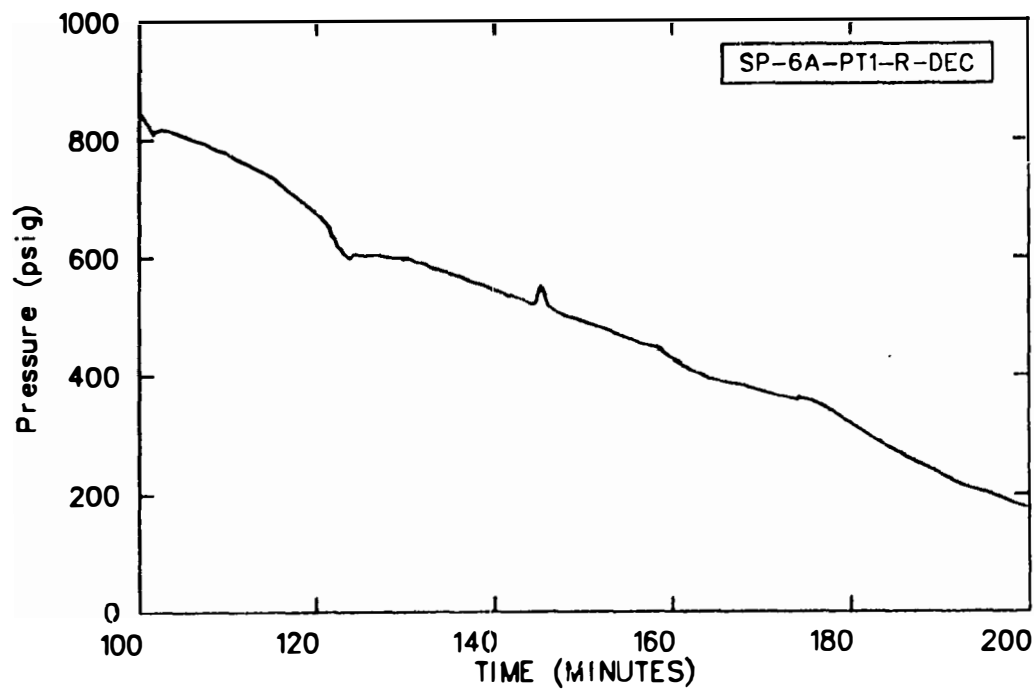


Figure D-4. Decimated Steam Generator Pressure 100 to 200 Minutes

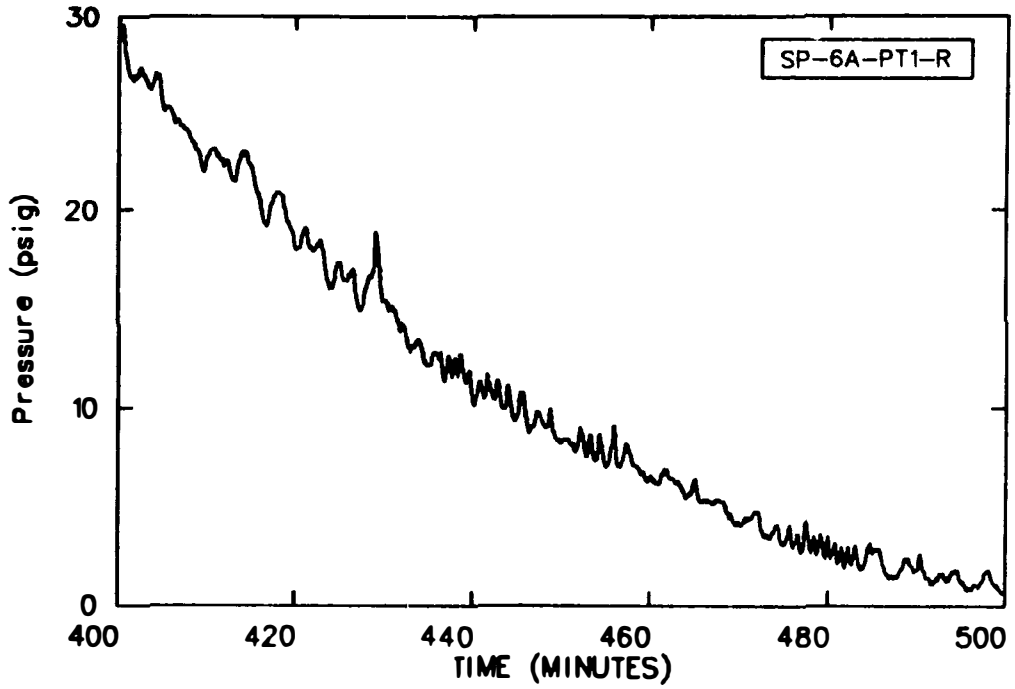


Figure D-5. Steam Generator A Pressure 400 to 500 Minutes (SP-6A-PT1-R)

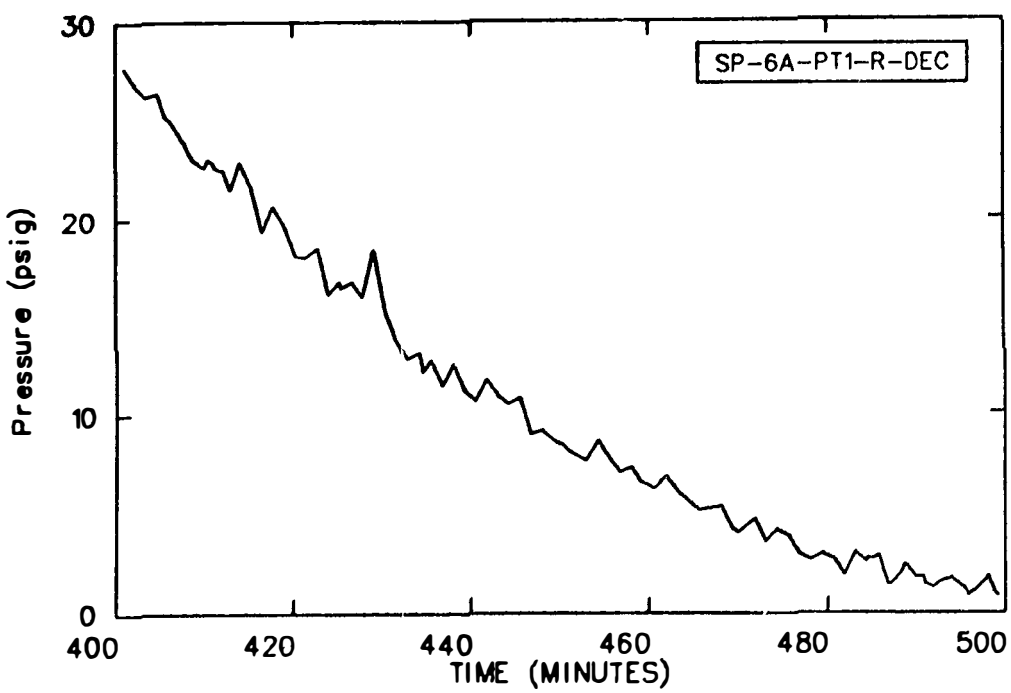


Figure D-6. Decimated Steam Generator Pressure 400 to 500 Minutes

APPENDIX E

CONTENTS OF ICBC DISKETTES

APPENDIX E

CONTENTS

CONTENTS OF ICBC LOW DENSITY DISKETTES

Diskette 1:

INSTALL	BAT	INSTALLX	BAT	ICBC	BAT	BURNUP	DAT
DBUSER	DAT	GPSUM	DAT	GROUPS	DAT	NOTES	DAT
TSDAT	DAT	TIMSER	DAT	BURNUP	IDX	DBUSER	IDX
GROUPS	IDX	NOTES	IDX	TIMSER	IDX	TSDAT	IDX
M2	EXE	REBUILD	EXE	ICBC	DFL		

Diskette 2:

COND	DAT	COND	IDX	ICBCPD	LOD	ICBCW02	LOD
ICBCW03	LOD	ICBCW05	LOD	ICBCW07	LOD	ICBCW08	LOD
ICBCW11	LOD	ICBCW12	LOD	ICBCW13	LOD	ICBCW14	LOD

Diskette 3:

APPEND	DAT	PKFAC	DAT	APPEND	IDX	PKFAC	IDX
ICBC	LOD						

Diskette 4:

DISKITS	LOD	ICBCPM	LOD	MANIPTS	LOD

Diskette 5:

TIMSER	BLK	HALOKBDI	COM	MARK	COM	RELEASE	COM
ICBCW04	LOD	HALOMSMI	LOC	REBUILD	DFL		

Diskette 6:

TSDAT	BLK	HALOMSMI	COM	HALOSDTI	COM	HALORLM	EXE
THALO	EXE	EDITI	LOD	HPPLOT	LOD	HALOIBME	DEV
HALO106	FNT	HALOEPSN	PRN				

Diskette 7:

HP7550	EXE	ICBCP	LOD	ICBCW	LOD	ICBCW09	LOD
ICBCW10	LOD	ICBCW15	LOD	ICBCW16	LOD		

Diskette 8:

TIMSER3	BLK	TIMSER3	DAT	TIMSER3	IDX

Diskette 9:

TIMSER4	BLK	TIMSER4	DAT	HP7475	EXE	TIMSER4	IDX

Diskette 10:

TIMSER2	BLK	TIMSER2	DAT	TIMSER2	IDX

CONTENTS OF ICBC HIGH DENSITY DISKETTES

Diskette 1:

INSTALL	BAT	INSTALLX	BAT	ICBC	BAT	ICBC	DFL
M2	EXE	DISKITS	LOD	EDITI	LOD	HPPLOT	LOD
ICBC	LOD	ICBCP	LOD	ICBCPD	LOD	ICBCPM	LOD
ICBCW	LOD	ICBCW02	LOD	ICBCW03	LOD	ICBCW04	LOD
ICBCW05	LOD	ICBCW07	LOD	ICBCW08	LOD	ICBCW09	LOD
ICBCW10	LOD	ICBCW11	LOD	ICBCW12	LOD	ICBCW13	LOD
ICBCW14	LOD	ICBCW15	LOD	ICBCW16	LOD	MANIPTS	LOD

Diskette 2:

TIMSER3	BLK	TIMSER4	BLK	APPEND	DAT	BURNUP	DAT
COND	DAT	DBUSER	DAT	GPSUM	DAT	GROUPS	DAT
HPI	DAT	NOTES	DAT	PKFAC	DAT	TIMSER	DAT
TIMSER2	DAT	TIMSER3	DAT	TIMSER4	DAT	TSDAT	DAT
REBUILD	DFL	HP7475	EXE	HP7550	EXE	REBUILD	EXE
APPEND	IDX	BURNUP	IDX	COND	IDX	DBUSER	IDX
GROUPS	IDX	NOTES	IDX	PKFAC	IDX	TIMSER	IDX
TIMSER2	IDX	TIMSER3	IDX	TIMSER4	IDX	TSDAT	IDX

Diskette 3:

TIMSER	BLK	TIMSER2	BLK	TSDAT	BLK	HALOKBDI	COM
HALOMSMI	COM	HALOSDTI	COM	MARK	COM	RELEASE	COM
HALOIBM	DEV	HALOIBME	DEV	HALOIBMG	DEV	HALOPLHP	EXE
HALORLM	EXE	HALO106	FNT	HALOKBDI	LOC	HALOMSMI	LOC
HALOSDTI	LOC	HALOEPSN	PRN	HALOLJTP	PRN		