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Office of Civilian Radioactive Waste Management

CHARACTERISTICS OF SPENT FUEL, HIGH-LEVEL WASTE, AND OTHER RADIOACTIVE WASTES WHICH MAY REQUIRE LONG-TERM ISOLATION

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U.S. Department of Energy
Office of Civilian Radioactive Waste Management
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APPENDIX 2B

USER'S GUIDE TO THE LWR ASSEMBLIES DATA BASE

CONTENTS

1.0 Introduction

This User's Guide for the LWR Assemblies data base system is part of the Characteristics Data Base being developed under the Waste Systems Data Development Program sponsored by the U. S. Department of Energy Office of Civilian Radioactive Waste Management. The objective of the LWR Assemblies data base is to provide access at the personal computer level to information about fuel assemblies used in light-water reactors. The information available is physical descriptions of intact fuel assemblies and radiological descriptions of spent fuel disassembly hardware.

The LWR Assemblies data base is a user-oriented menu driven system. Each menu is instructive about its use. Section 5 of this guide provides a sample session with the data base to assist the user.

2.0 Data and Data Sources

Physical description data were obtained directly from the following LWR assembly manufacturers: Babcock and Wilcox, Combustion Engineering, Exxon Advanced Nuclear Fuel, and Westinghouse. Information on other assemblies was obtained from reports in the open literature and, to some extent, information on reload fuels from other vendors. Efforts to obtain additional information on these fuel assemblies is ongoing.

Radiological data were obtained from the computer code ORIGEN2, as described in Methodology for Radiological Characterization, section 2.7.3 of the Characteristics of Potential Repository Wastes Report. The data are provided for the assemblies in two types of reactors, pressurized-water and boiling-water reactors. Data for each type of reactor are provided at two representative burnups: for PWR's, a standard burnup of 33,000 megawatt-days per metric ton of initial heavy metal (MWd/MTIHM) and a high burnup of 60,000 MWd/MTIHM; for BWR's, a standard burnup of 27,500 MWd/MTIHM and a high burnup of 50,000 MWd/MTIHM. The data were calculated for six different materials of construction in four different neutron exposure zones (as detailed in section 2.7.3).

3.0 Requirements

The LWR Assemblies data base is designed for use on IBM personal computers or compatibles. It was developed using dBASE III Plus, a product of Ashton-Tate. The data base system is translated into an executable file using Clipper and Plink86, products of Nantucket Corporation. Because of this translation, dBASE III Plus is not required in the use of the data base system. The data base system runs independently. Only some version of personal computer DOS is necessary to run the data base.

The LWR Assemblies data base requires 4 megabytes of storage and thus is designed to run on Bernoulli Box drives (trademark of iOmega Corporation) or fixed drives. If a math coprocessor chip is installed, the LWR Assemblies data base will utilize it for faster calculations.

Owing to the width and length of the radiological description reports for SFD hardware, these reports are available only on a 132-column printer. Most narrow carriage printers have a condensed print option that can be used for these reports. All other reports are available on the screen and optionally on the printer.

4.0 Reporting Capabilities

Six types of reports are provided by the LWR Assemblies data base.

The Physical Description reports provide detailed information about the physical characteristics of an assembly type as well as a table of SFD hardware, descriptions of the fuel rods and production data; the Elemental Composition reports, which describe materials used in the construction of SFD hardware and provide the composition used to calculate the radiological characteristics data for the remaining four types of reports. Four different types of Radiological Description reports are provided: (1) For all SFD hardware in an entire assembly by isotope in units of curies, watts or grams (only the radioactive isotopes are reported). This report is also available for SFD hardware in any one particular neutron exposure zone. This may be further refined to any one part in any one zone. (2) The photon spectra (number of photons versus energy) for all SFD hardware. This report may also be refined to one zone and one or all parts in that zone. (3) For a material in any one neutron exposure zone by isotope in curies, watts, or grams. (4) The photon spectra for a material in any one neutron exposure zone.

5.0 Operating Instructions

Installation: Instructions for installation of the data base are provided with the LWR Assemblies data base. If the data base you receive is on Bernoulli cartridge, the designated drive will be C:, D:, or E:, dependent on your computer's configuration. If you install the data base on a fixed drive, the designated drive will be C:. If you receive the demonstration diskette, the drive will be A: or B: and the default directory will be the root. In the example startup below, the designated drive is assumed to be D: and the default directory LWRASSEM. If your configuration varies from this chosen example, substitute the correct drive and directory.

Startup: Start up your computer as usual. The LWR Assemblies data base must be run from the default directory. In other words, if the data base was installed on (copied to) a Bernoulli cartridge and that cartridge is inserted in drive D: of your Bernoulli drive, the default directory must be "D: LWRASSEM". (LWRASSEM is the name provided for the subdirectory when shipped. If you elect to change the subdirectory name, you must now use that new name in place of LWRASSEM.)

To ensure that this is the default directory, issue the following commands, pressing the enter key after each command:

```
D:

cd LWRASSEM          (do not issue this for the
                      demonstration diskette)
```

You should receive the response:

```
D: LWRASSEM>
```

If you do not receive this response, type in:

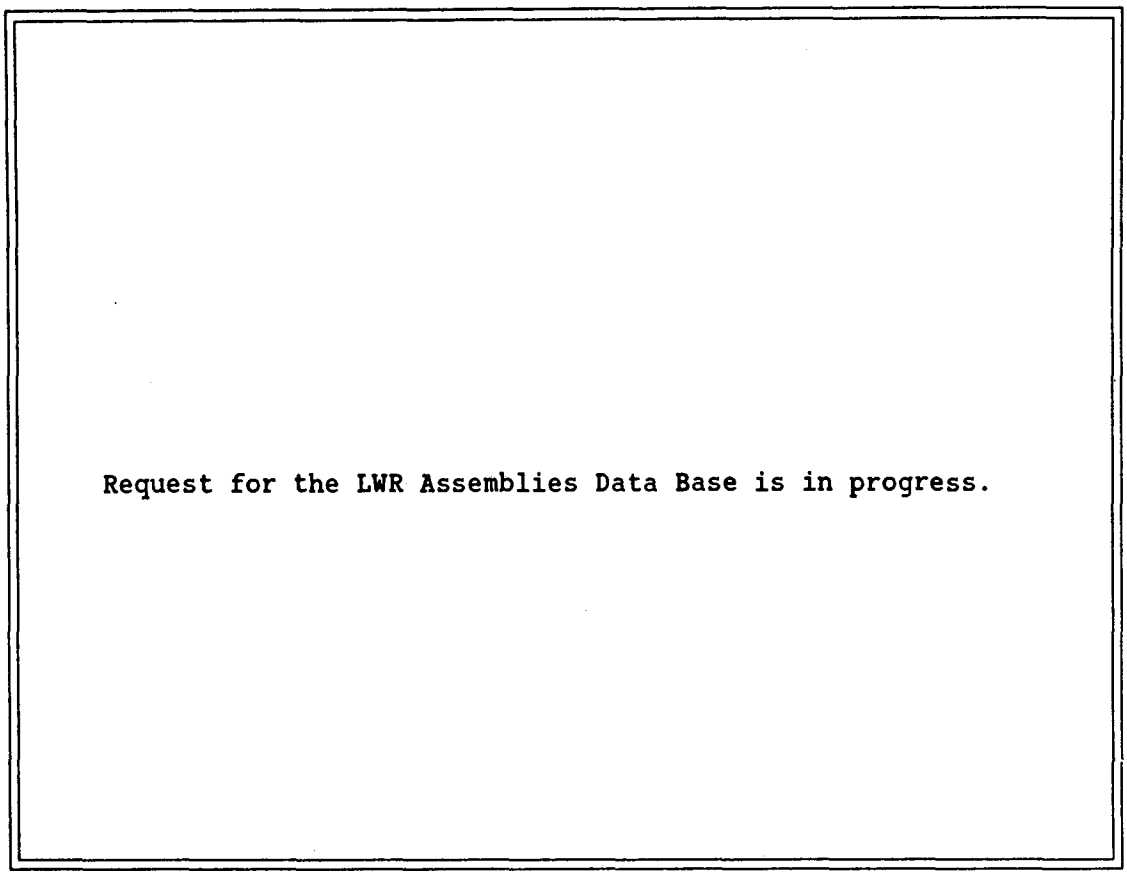
```
prompt $p$g
```

and press the enter key. If you still do not receive this response, verify the drive designation and subdirectory. (For the demonstration diskette, the command "cd LWRASSEM" is not necessary.) If you still have problems, review the installation procedure.

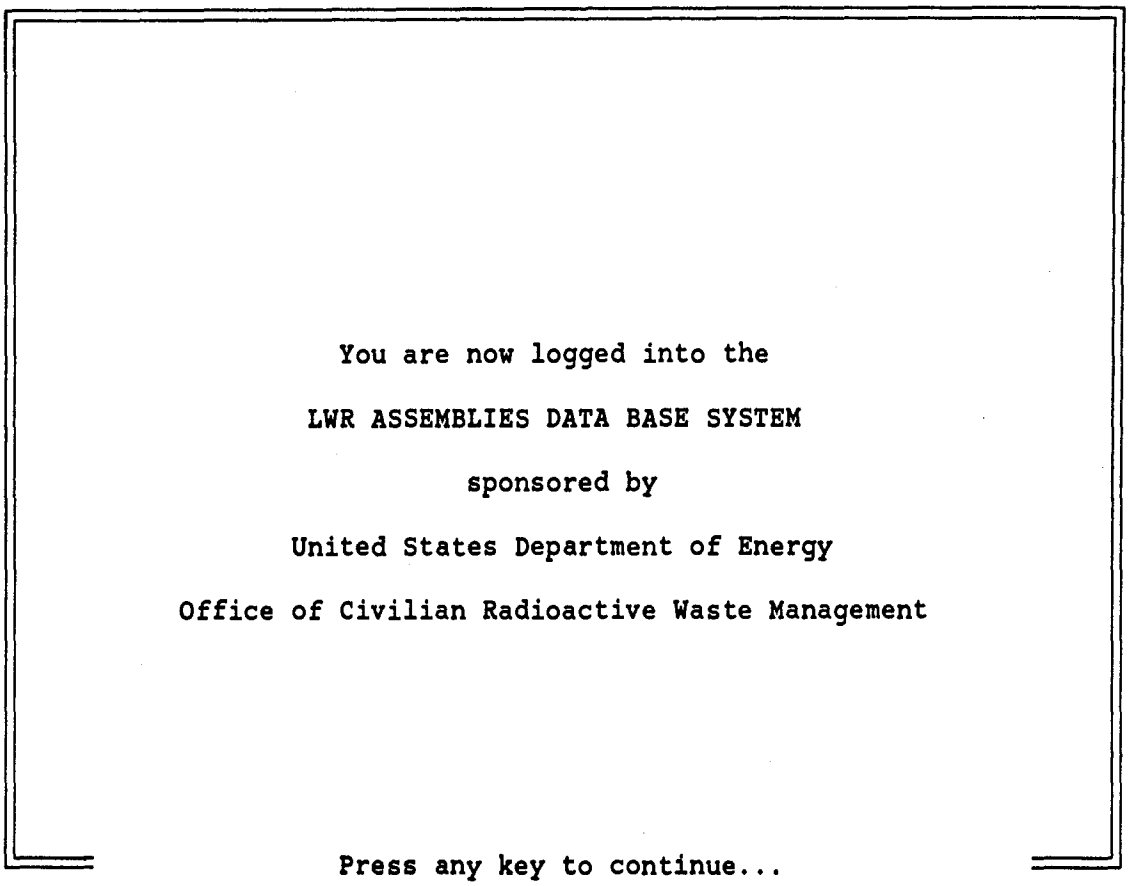
Sample Session: To initiate use of the data base, type:

LWRASSEM and press the enter key.

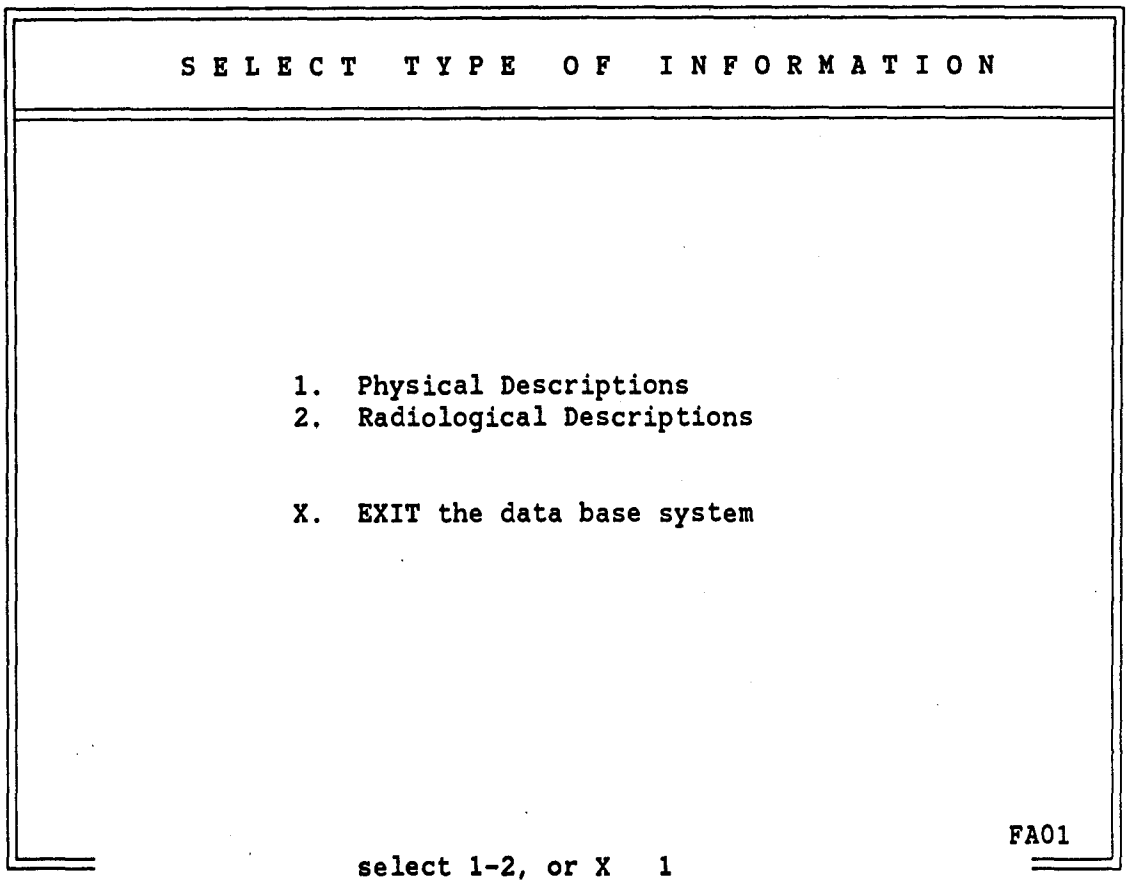
The remaining pages detail a sample session with the LWR Assemblies data base.



This message will appear on your screen while the LWR Assemblies data base is being loaded into memory, an operation that will take a few moments to complete.



When this introductory screen appears on your terminal, the LWR Assemblies data base system is loaded and running. To begin using the data base, press any key.



Description:

The LWR Assemblies PC Data Base provides reports in two categories: Physical Descriptions and Radiological Descriptions.

The Physical Description Reports describe the physical characteristics of Light Water Reactor(LWR) Assembly Types. Included is a description of the intact fuel assembly, the fuel rods, and the spent fuel disassembly hardware. Also available is a report describing the elemental composition of certain materials used in construction of light water reactor assemblies.

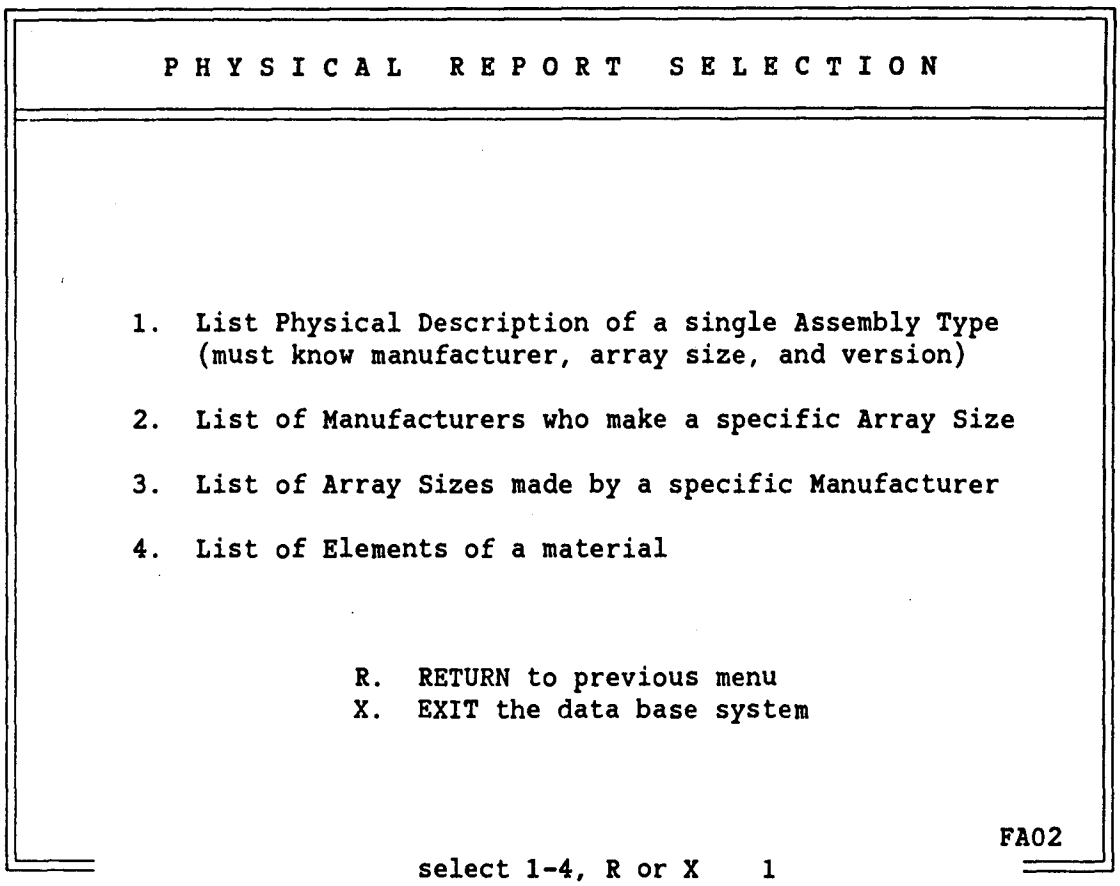
The Radiological Description Reports describe the radiological characteristics of the intact assemblies, the spent fuel disassembly hardware, and materials exposed to different levels of neutron activation in a power reactor.

Instruction:

Enter 1 to select the Physical Description Reports. Be sure to press the enter key after each selection.

Similarly, enter 2 to select the Radiological Description Reports.

In this example, 1 was selected for Physical Description Reports.



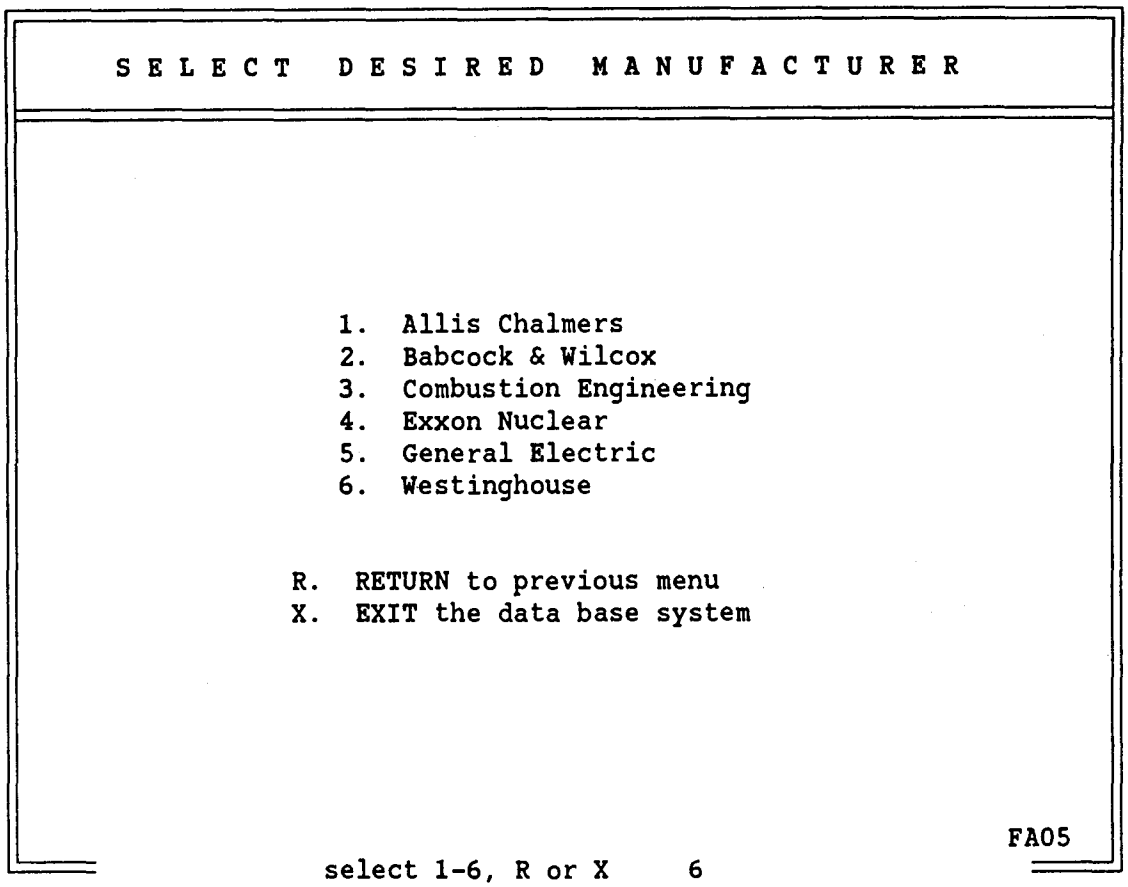
Description:

This screen offers selection of a Physical Description Report. Options 1 through 3 are different paths to the same report. Selecting either options 1 or 3 will result in a list of assembly manufacturers to choose from, where option 2 will give a list of all array sizes.

Instruction:

Select 1, 2, 3, or 4, R or X and press the enter key.

In this example, option 1 is chosen.



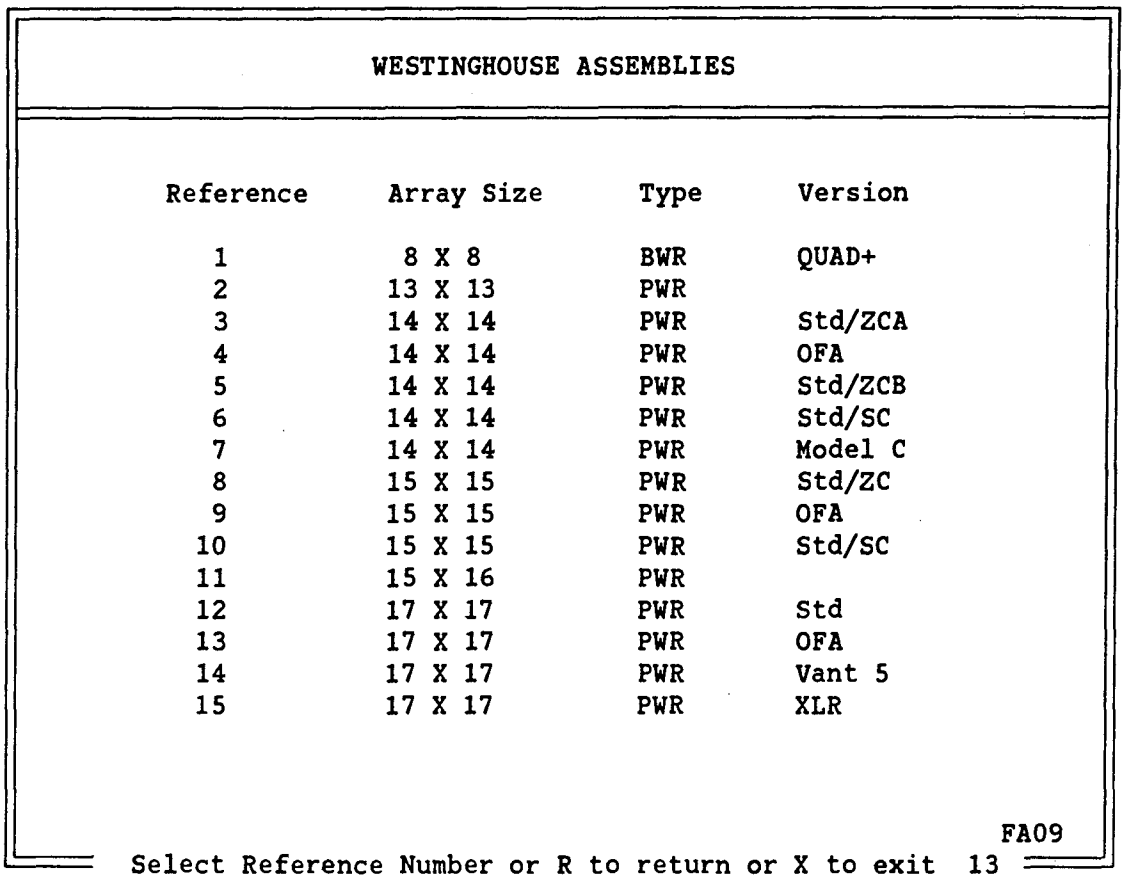
Description:

This screen instructs you to select the manufacturer of the Assembly Type for which you want a Physical Description Report.

Instruction:

Enter a 1 through 6 to indicate which manufacturer you are interested in. To return to the last screen (FA02), select R. An X will return you to DOS. Press the enter key after making your selection.

In this example, option 6 is chosen to view Westinghouse assembly types.



WESTINGHOUSE ASSEMBLIES

Reference	Array Size	Type	Version
1	8 X 8	BWR	QUAD+
2	13 X 13	PWR	
3	14 X 14	PWR	Std/ZCA
4	14 X 14	PWR	OFA
5	14 X 14	PWR	Std/ZCB
6	14 X 14	PWR	Std/SC
7	14 X 14	PWR	Model C
8	15 X 15	PWR	Std/ZC
9	15 X 15	PWR	OFA
10	15 X 15	PWR	Std/SC
11	15 X 16	PWR	
12	17 X 17	PWR	Std
13	17 X 17	PWR	OFA
14	17 X 17	PWR	Vant 5
15	17 X 17	PWR	XLR

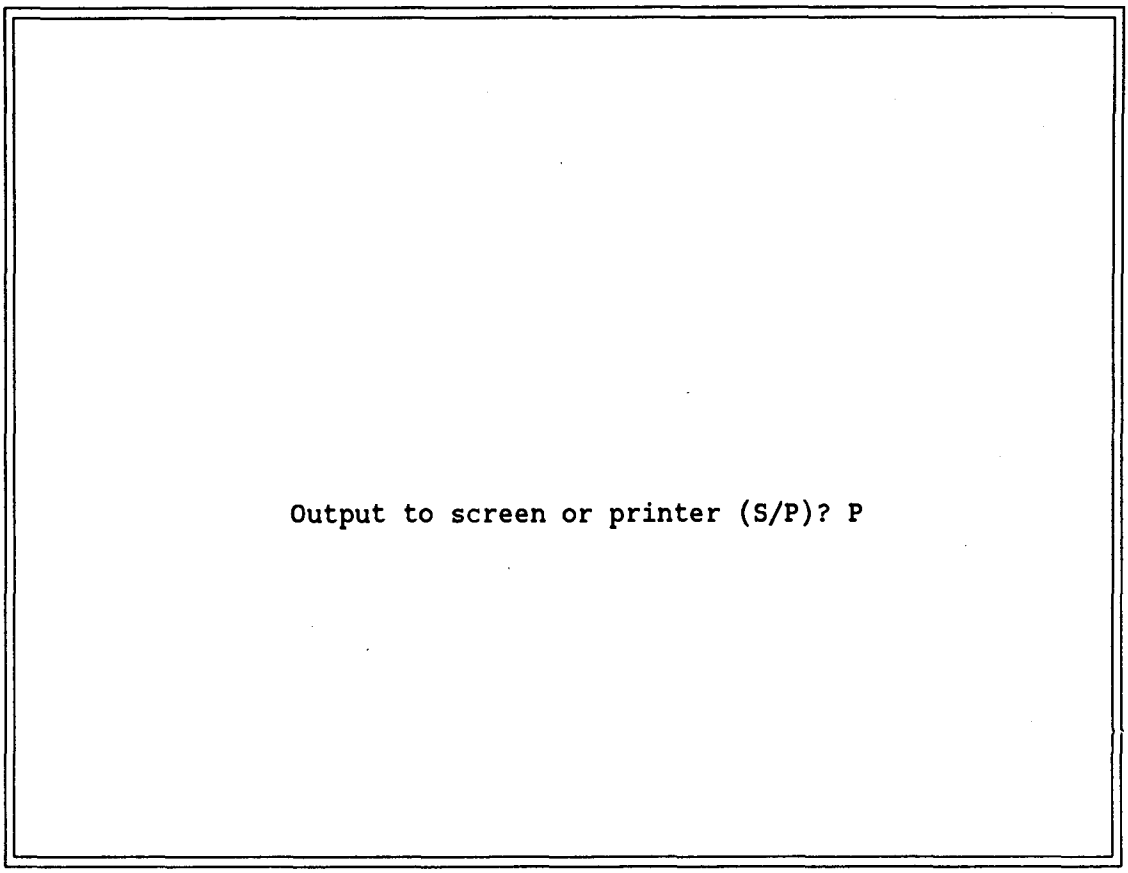
Description:

This screen identifies the specific Assembly Types manufactured by Westinghouse and instructs you to choose the one for which you want a Physical Description Report.

Instruction:

Select the assembly type you are interested in by it's reference number on the left. Again R will return you to the last screen and X will exit the data base.

In this example, 13 is chosen to view a physical description report for a Westinghouse 17 X 17 PWR optimized Fuel Assembly.



Description:

This screen instructs you to specify if you want a hard copy sent to the printer (P) or simply wish to view the data on the screen (S). If you select P for printer, your printer should be online.

Instruction:

Select S or P and press the enter key. If you select S, the report will pause at the end of each screen until you press any key to indicate that you want to continue. Each pause is accompanied by instructions to press any key to continue.

In this example, the printer option was chosen. The next 4 pages are a Physical Description report for a Westinghouse 17 X 17 OFA.

PHYSICAL DESCRIPTION REPORT PAGE: 1

Westinghouse 17 X 17 OFA PWR
OVERALL ASSEMBLY CHARACTERISTICS

Initial Year of Manufacture	1983
Final Year of Manufacture	SINP
Total Number Fabricated to Date	1417
Assembly Width (inches)	8.434
Assembly Length (inches)	159.76
with Control Rod Inserted	167.22
including Holddown Device, etc	161.57
Rod Pitch (inches)	0.496
Total Assembly Weight (lbs)	1373.0
Weight of Heavy Metal (lbs)	939.00
Metric Tons Initial Heavy Metal (metric tons)	0.42600
Enrichment Range (% U235)	1.6-3.8
Average Design Burnup (MWd/MTIHM)	38,000
Maximum Design Burnup (MWd/MTIHM)	
Linear Heat Rating (KW/Foot)	5.44
Difficulty Index for Cutting	0-3
Difficulty Index for Mechanical Disassembly in Air	3
Difficulty Index for Underwater Disassembly	3
Difficulty Index for Underwater Rod Replacement	3

(Difficulty index: 0-not required, 1-simple, ..., 6-impossible)

Comments:

Westinghouse 17 X 17 OFA PWR
FUEL ASSEMBLY HARDWARE PARTS AND MATERIALS

Part Name	Parts/ Assembly	Weight(kg)/ Assembly	Zone	Material Name	Material Fraction
SPACER-LOWER	1	0.9250	IN CORE	Inconel-718	1.00000
SPACER-INCORE	5	7.0220	IN CORE	Zircaloy-4	1.00000
GUIDE TUBES	24	9.5300	IN CORE	Zircaloy-4	1.00000
SPACER-PLENUM	1	0.8850	GAS PLENUM	Inconel-718	1.00000
TOP NOZZLE	1	6.8900	TOP	St. Steel 304	1.00000
BOTTOM NOZZLE	1	5.8970	BOTTOM	St. Steel 304	1.00000
HOLDDOWN SPRING	4	0.9600	TOP	Inconel-718	1.00000
B. GRID SLEEVE	1	0.0910	IN CORE	St. Steel 304	1.00000
GRID SLEEVE	1	0.0910	GAS PLENUM	St. Steel 304	1.00000

Drawing Numbers Associated With Assembly:

1465F89

Westinghouse 17 X 17 OFA PWR
FUEL ROD DESCRIPTION TABLE

Type of Rod	Fuel Rod
Fuel Rod Positions per Assembly	289
Typical Number of Fueled Rods per Assembly	264
Rod Diameter (inches)	0.360
Rod Length (inches)	151.560-151.635
Active Length (inches)	144.00
Weight per Rod (lbs)	4.940
Clad Material	Zircaloy-4
Clad Thickness (inches)	0.0225
Clad Final Conditioning	HT,SRA
Fuel-Clad Gap (inches)	0.0031
Fill Gas Used	He
Initial Gas Pressure (psig)	275-350
Nitrogen Content of Fill Gas (percent)	4.0

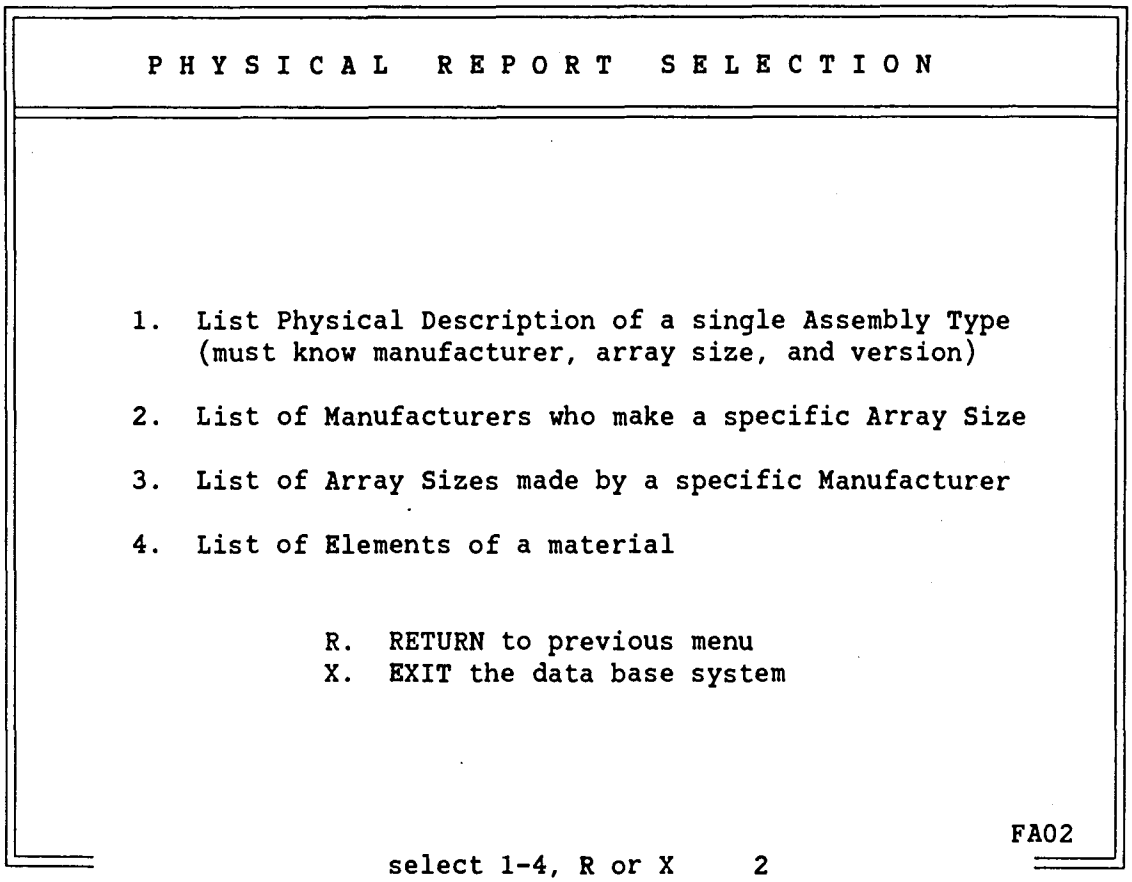
PHYSICAL DESCRIPTION REPORT Page: 4

Westinghouse 17 X 17 OFA PWR
FUEL ROD DESCRIPTION TABLE CONTINUED

Fuel Pellet Material	Uranium Oxide
Fuel Pellet Shape	Dished, Chamfered
Fuel Pellet Diameter (inches)	0.3088
Fuel Pellet Length (inches)	0.507
Fuel Pellet Weight per Rod (lbs)	4.01
Open Porosity (percent)	0-3%
Grain Size (microns)	8-20
Fuel Density (% theoretical)	95
O/U Ratio	
Smear Density(gr/cm3)	9.99
Spacer Pellet Material	N/A
Space Pellet Length (inches)	N/A
Plenum Spring Material	St. Steel 302
Plenum Spring Weight per Assembly (lbs)	0.020-0.030
Plenum Length (inches)	6.900
Plenum Volume (cubic inches)	1.05-1.35

Comments:

At the end of this report, you will be returned to the Physical Report Selection screen.



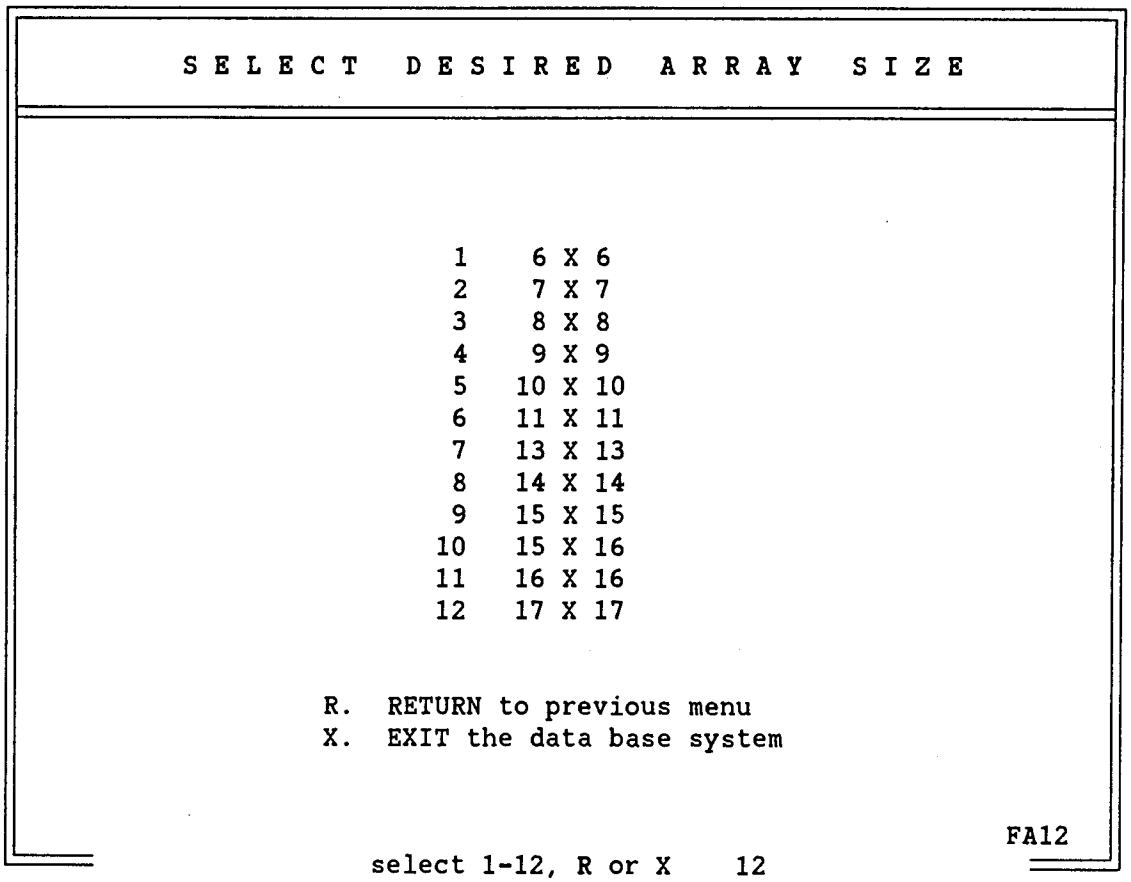
Description:

When the Physical Description Report is completed, you are returned to this screen. You may now select any of the four options, or to return or exit.

Instruction:

Select 1 through 4 or R or X and press the enter key.

In this example, option 2 is selected to receive a list of array sizes.



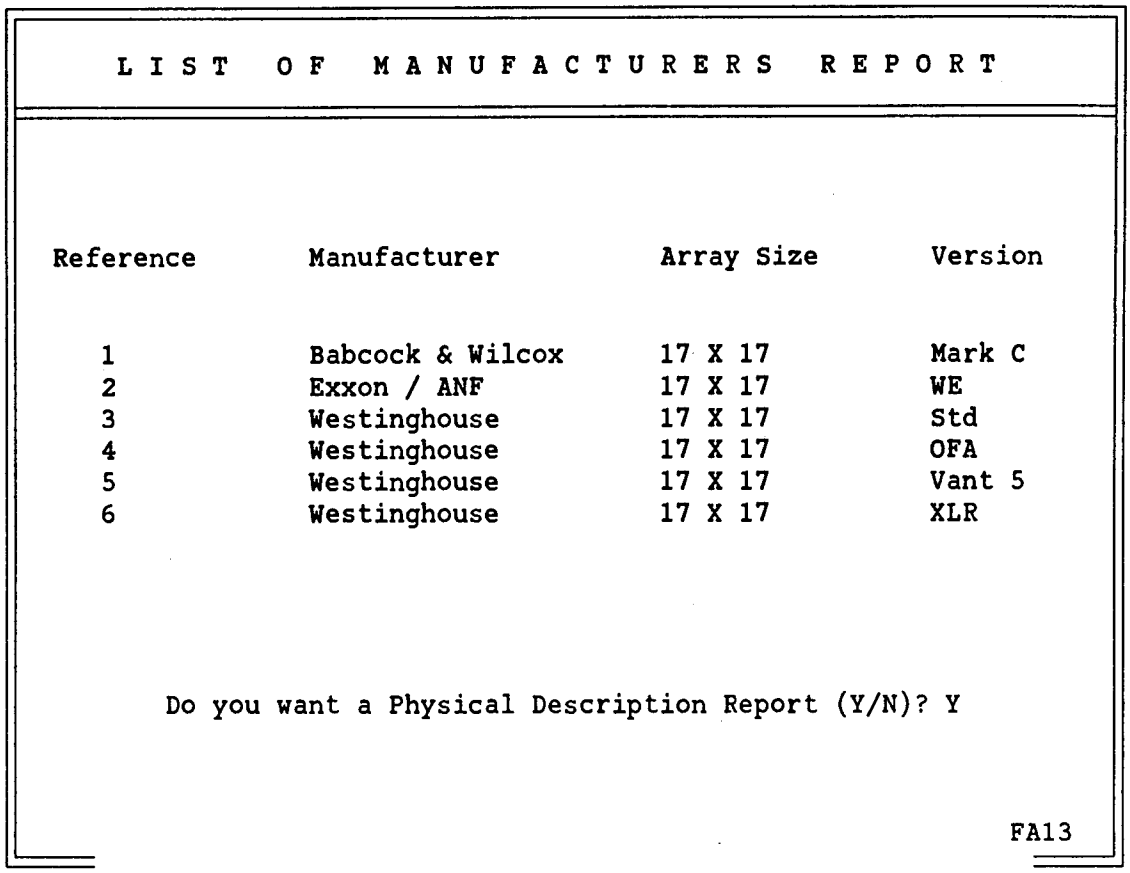
Description:

This screen identifies the array sizes of LWR Fuel Assemblies that have been, are being, or will be manufactured. By selecting a specific array size, you will receive a list of manufacturers which produce that array size and the versions of it that they make.

Instruction:

Enter 1 through 12 for a specific array size, R to return to previous screen (FA02) or X to exit and return to DOS. Press the enter key following your selection.

In this example 12 is selected and the 17 X 17 sized assembly types will be shown next.



L I S T O F M A N U F A C T U R E R S R E P O R T

Reference	Manufacturer	Array Size	Version
1	Babcock & Wilcox	17 X 17	Mark C
2	Exxon / ANF	17 X 17	WE
3	Westinghouse	17 X 17	Std
4	Westinghouse	17 X 17	OFA
5	Westinghouse	17 X 17	Vant 5
6	Westinghouse	17 X 17	XLR

Do you want a Physical Description Report (Y/N)? Y

FA13

Description:

This screen lists the manufacturers that make a 17 X 17 array and the specific versions they make.

Instruction:

Enter Y to view a Physical Description Report. Enter N to return to the Physical Report Selection screen.

In this example, a Y is entered.

```
L I S T   O F   M A N U F A C T U R E R S   R E P O R T


Reference       Manufacturer            Array Size      Version

    1           Babcock & Wilcox        17 X 17         Mark C
    2           Exxon / ANF             17 X 17         WE
    3           Westinghouse            17 X 17         Std
    4           Westinghouse            17 X 17         OFA
    5           Westinghouse            17 X 17         Vant 5
    6           Westinghouse            17 X 17         XLR


      Do you want a Physical Description Report (Y/N)? Y

                                                        FA13
              Select Reference Number   4
```

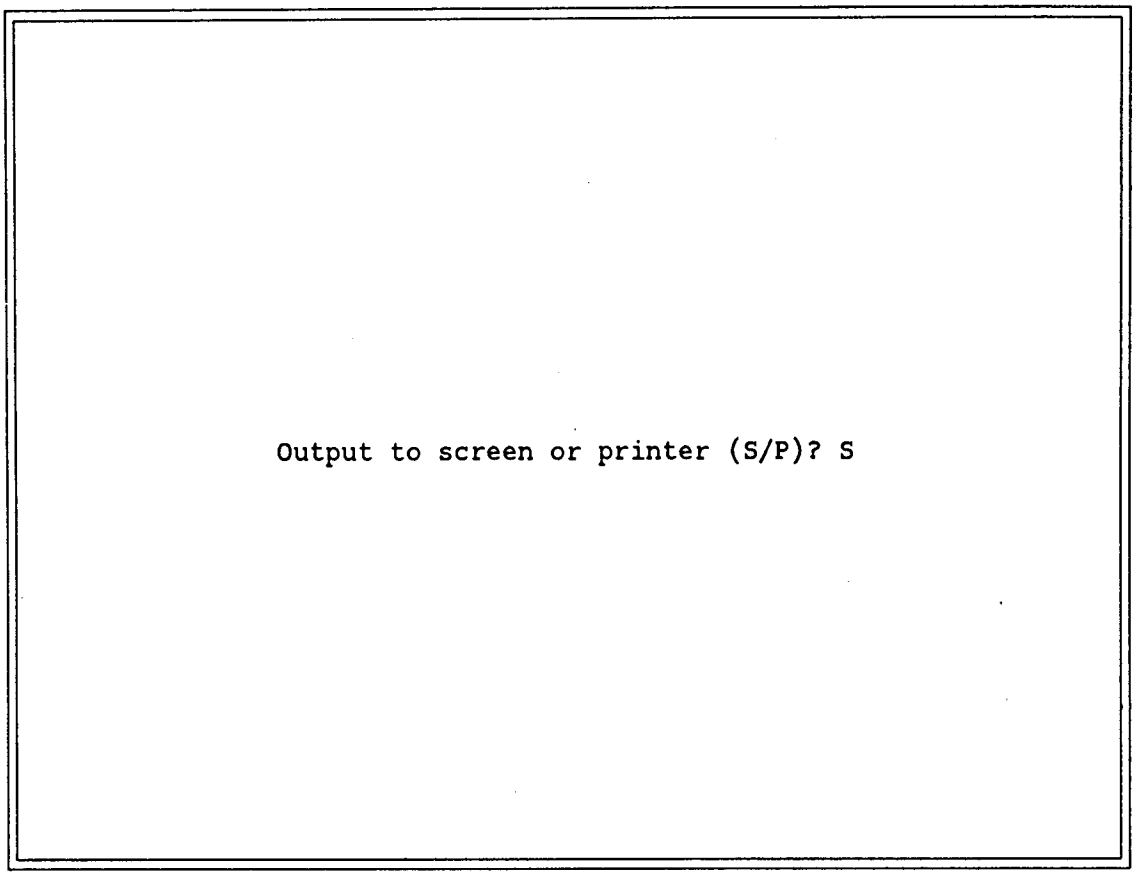
Description:

Having chosen to receive a Physical Description report, you are asked to select the assembly type for which you want a report.

Instruction:

Select the desired assembly type by reference number. Press the enter key after making your selection.

In this example, 4 is selected for a Westinghouse 17 X 17 OFA report.



Description:

Now that a Physical Description Report has been requested, you have the option of getting a hard copy of the report on your printer or viewing the report on the screen.

Instruction:

Select S or P and press the enter key.

In this example, the screen was chosen for the report. Because of the length of this report, it will take several screens to cover it all. If the printer were requested (as was done in an earlier example), there would be four pages of printer output. At the end of each screen, the report pauses until you indicate that you wish to continue by pressing any key.

PHYSICAL DESCRIPTION REPORT PAGE: 1

Westinghouse 17 X 17 OFA PWR
OVERALL ASSEMBLY CHARACTERISTICS

Initial Year of Manufacture..... 1983

Final Year of Manufacture..... SINP

Total Number Fabricated to Date..... 1417

Assembly Width (inches)..... 8.434

Assembly Length (inches)..... 159.76
with Control Rod Inserted..... 167.22
including Holddown Device, etc..... 161.57

Rod Pitch (inches)..... 0.496

Press any key to continue viewing Physical Description Report

Instructions:

Press any key to continue to next screen of the report. If you want to print this particular screen, or any subsequent screen, using the [shift] print screen located on your keyboard.

PHYSICAL DESCRIPTION REPORT

Westinghouse 17 X 17 OFA PWR

Total Assembly Weight (lbs)	1373.0
Weight of Heavy Metal (lbs)	939.00
Metric Tons Initial Heavy Metal (metric tons)	0.42600
Enrichment Range (% U235)	1.6-3.8
Average Design Burnup (MWd/MTIHM)	38,000
Maximum Design Burnup (MWd/MTIHM)	
Linear Heat Rating (KW/Foot)	5.44

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT PAGE: 1
(continued)

Westinghouse 17 X 17 OFA

Difficulty Index for Cutting..... 0-3

Difficulty Index for Mechanical Disassembly in Air..... 3

Difficulty Index for Underwater Disassembly..... 3

Difficulty Index for Underwater Rod Replacement..... 3
(Difficulty index: 0-not required, 1-simple, ..., 6-impossible)

Comments:

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT PAGE: 2

Westinghouse 17 X 17 OFA
FUEL ASSEMBLY HARDWARE PARTS AND MATERIALS

Part Name	Parts/ Assembly	Weight(kg)/ Assembly	Zone	Material Name	Material Fraction
SPACER-LOWER	1	0.9250	IN CORE	Inconel-718	1.00000
SPACER-INCORE	5	7.0220	IN CORE	Zircaloy-4	1.00000
GUIDE TUBES	24	9.5300	IN CORE	Zircaloy-4	1.00000
SPACER-PLENUM	1	0.8850	GAS PLENUM	Inconel-718	1.00000
TOP NOZZLE	1	6.8900	TOP	St. Steel 304	1.00000
BOTTOM NOZZLE	1	5.8970	BOTTOM	St. Steel 304	1.00000

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT

Westinghouse 17 X 17 OFA PWR

HOLDDOWN SPRING	4	0.9600	TOP	Inconel-718	1.00000
B. GRID SLEEVE	1	0.0910	IN CORE	St. Steel 304	1.00000
GRID SLEEVE	1	0.0910	GAS PLENUM	St. Steel 304	1.00000

Drawing Numbers Associated With Assembly:

1465F89

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT PAGE: 3

Westinghouse 17 X 17 OFA PWR
FUEL ROD DESCRIPTION TABLE

Type of Rod	Fuel Rod
Fuel Rod Positions per Assembly	289
Typical Number of Fueled Rods per Assembly	264
Rod Diameter (inches)	0.360
Rod Length (inches)	151.560-151.635
Active Length (inches)	144.00
Weight per Rod (lbs)	4.940
Clad Material	Zircaloy-4
Clad Thickness (inches)	0.0225
Clad Final Conditioning	HT,SRA

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT

Westinghouse 17 X 17 OFA PWR

Fuel-Clad Gap (inches)	0.0031
Fill Gas Used	He
Initial Gas Pressure (psig)	275-350
Nitrogen Content of Fill Gas (percent)	4.0

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT Page: 4

Westinghouse 17 X 17 OFA PWR
FUEL ROD DESCRIPTION TABLE CONTINUED

Fuel Pellet Material	Uranium Oxide
Fuel Pellet Shape	Dished, Chamfered
Fuel Pellet Diameter (inches)	0.3088
Fuel Pellet Length (inches)	0.507
Fuel Pellet Weight per Rod (lbs)	4.01
Open Porosity (percent)	0-3%
Grain Size (microns)	8-20
Fuel Density (% theoretical)	95
O/U Ratio	
Smear Density(gr/cm3)	9.99

Press any key to continue viewing Physical Description Report

PHYSICAL DESCRIPTION REPORT PAGE: 4 (continued)

Westinghouse 17 X 17 OFA PWR

Spacer Pellet Material..... N/A

Space Pellet Length (inches)..... N/A

Plenum Spring Material..... St. Steel 302

Plenum Spring Weight per Assembly (lbs)..... 0.020-0.030

Plenum Length (inches)..... 6.900

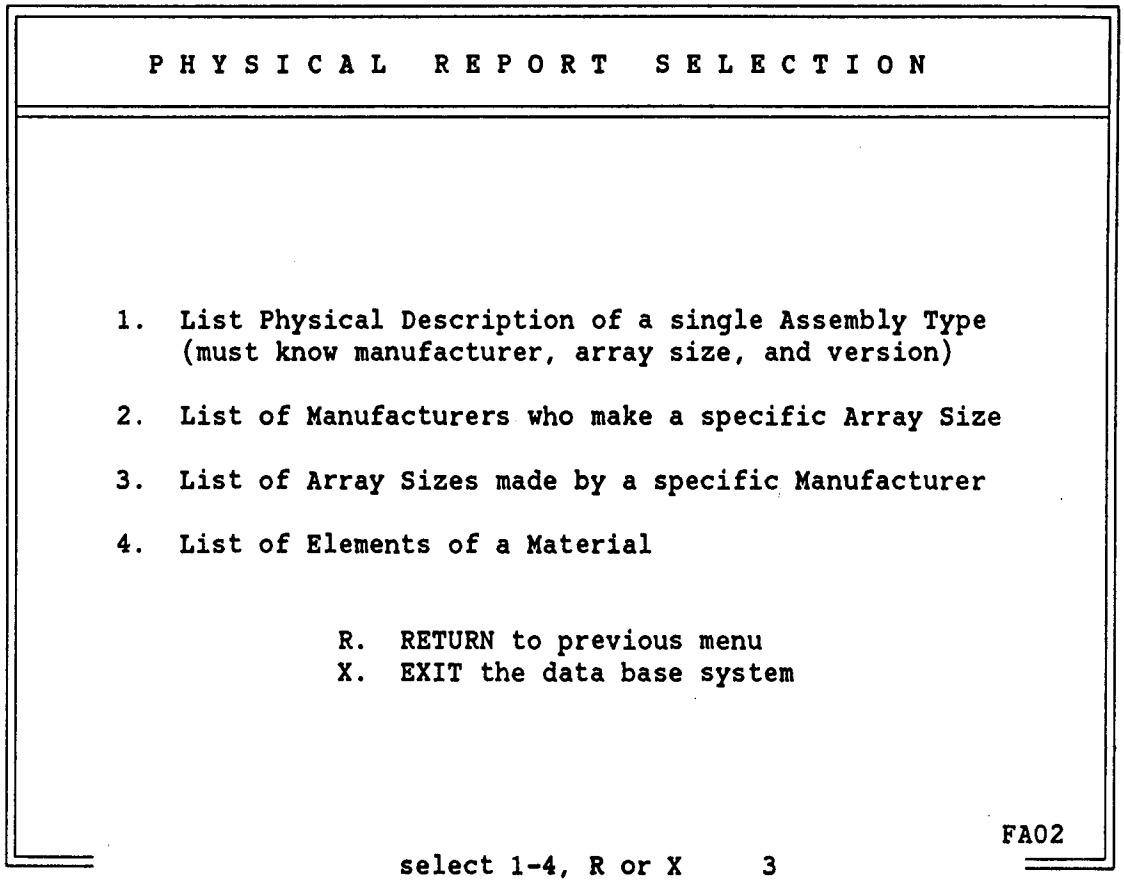
Plenum Volume (cubic inches)..... 1.05-1.35

Comments:

Report complete. Press any key to return to menu.

Instructions:

The Physical Description Report for a Westinghouse 17 X 17 OFA PWR is now complete. Pressing any key will return you to the Physical Report Selection screen (FA02).



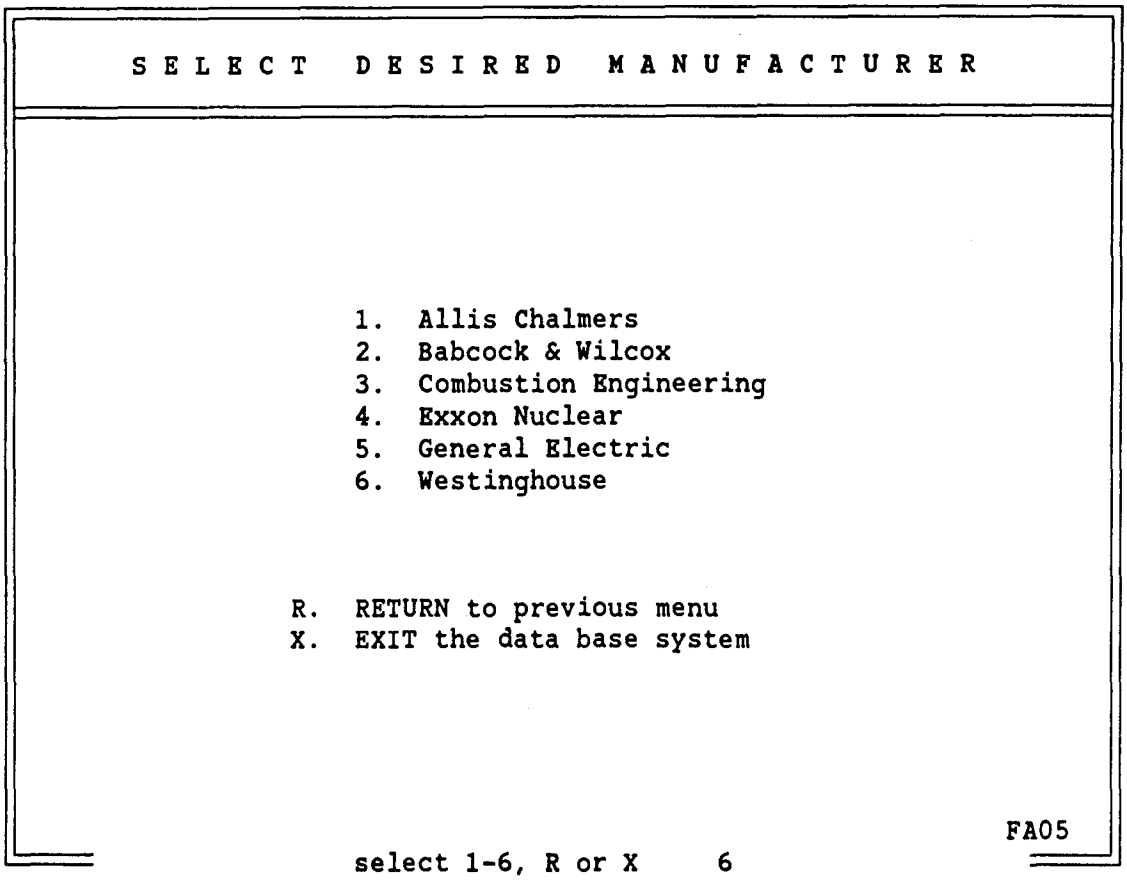
Description:

This screen offers selection of a Physical Description Report. Options 1, 2, and 3 offer different paths to the same report. Options 1 and 3 are very similar, option 1 assumes you want a report; option 3 will ask you if you want a report or not.

Instruction:

Select 1 through 4 or R to return to select type of information screen, or X to exit to DOS.

In this example, option 3 is selected.



Description:

This screen instructs you to select the manufacturer for which you wish to view a list of assembly types.

Enter 6 to obtain a list of all assembly types manufactured by Westinghouse

Instruction:

Enter a 1 through 6 to view a list of all the assembly types manufactured by a particular vendor. R returns you to the Physical Description Report Selection screen (FA02) and X exits the data base to return to DOS level.

In this example, option 6 is selected to obtain a list of Westinghouse assembly types.

WESTINGHOUSE ASSEMBLIES

Reference	Array Size	Type	Version
1	8 X 8	BWR	QUAD+
2	13 X 13	PWR	
3	14 X 14	PWR	Std/ZCA
4	14 X 14	PWR	OFA
5	14 X 14	PWR	Std/ZCB
6	14 X 14	PWR	Std/SC
7	14 X 14	PWR	Model C
8	15 X 15	PWR	Std/ZC
9	15 X 15	PWR	OFA
10	15 X 15	PWR	Std/Sc
11	15 X 16	PWR	
12	17 X 17	PWR	Std
13	17 X 17	PWR	OFA
14	17 X 17	PWR	Vant 5
15	17 X 17	PWR	XLR

Do you want a Physical Description Report (Y/N)? N

FA09

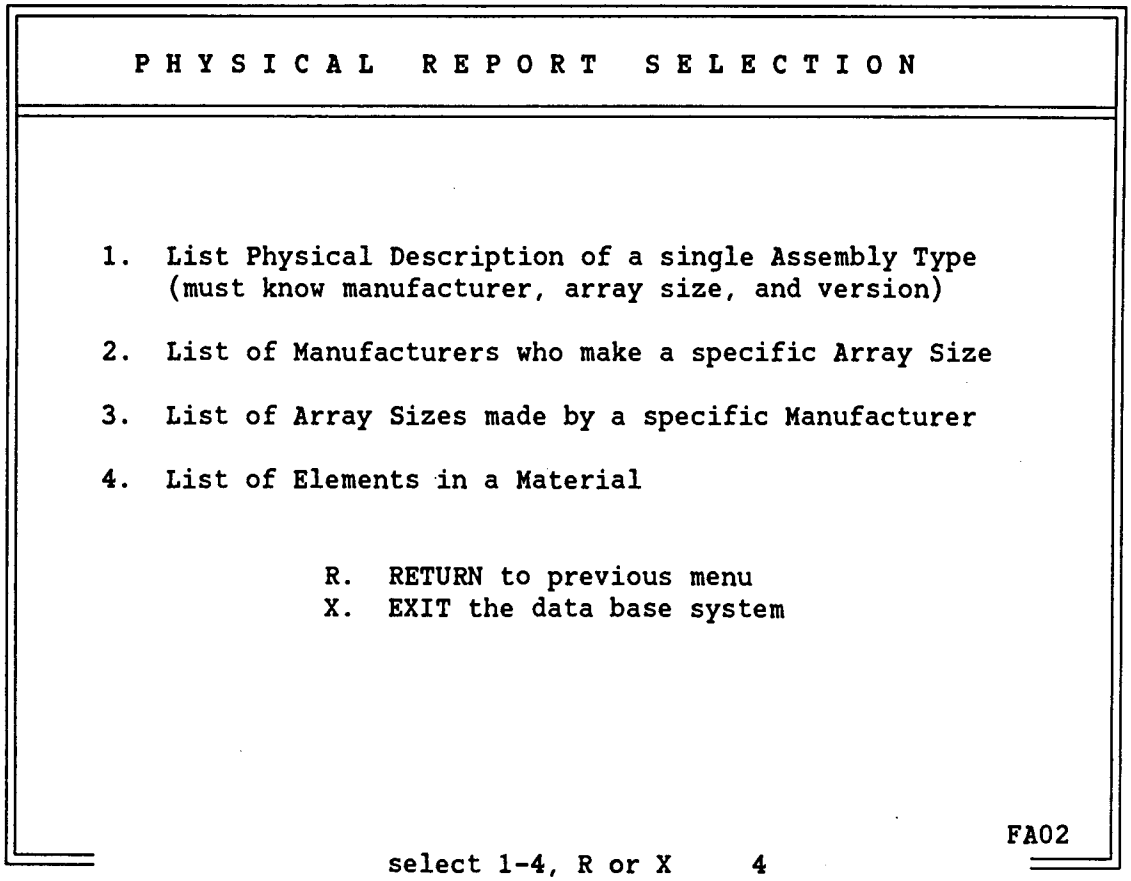
Description:

This screen lists the assembly types manufactured by Westinghouse. At the bottom of the screen you are asked if you want a Physical Description report for one of the above assembly types.

Instructions:

Enter Y to receive a report or N to not receive one. If you select Y to report, you will be asked which assembly type you want a report for and if you want to use the screen or the printer. After receiving the report you will return to the Physcial Report Selection Menu.

In this example, N is entered to indicate that a Physical Description report is not wanted.



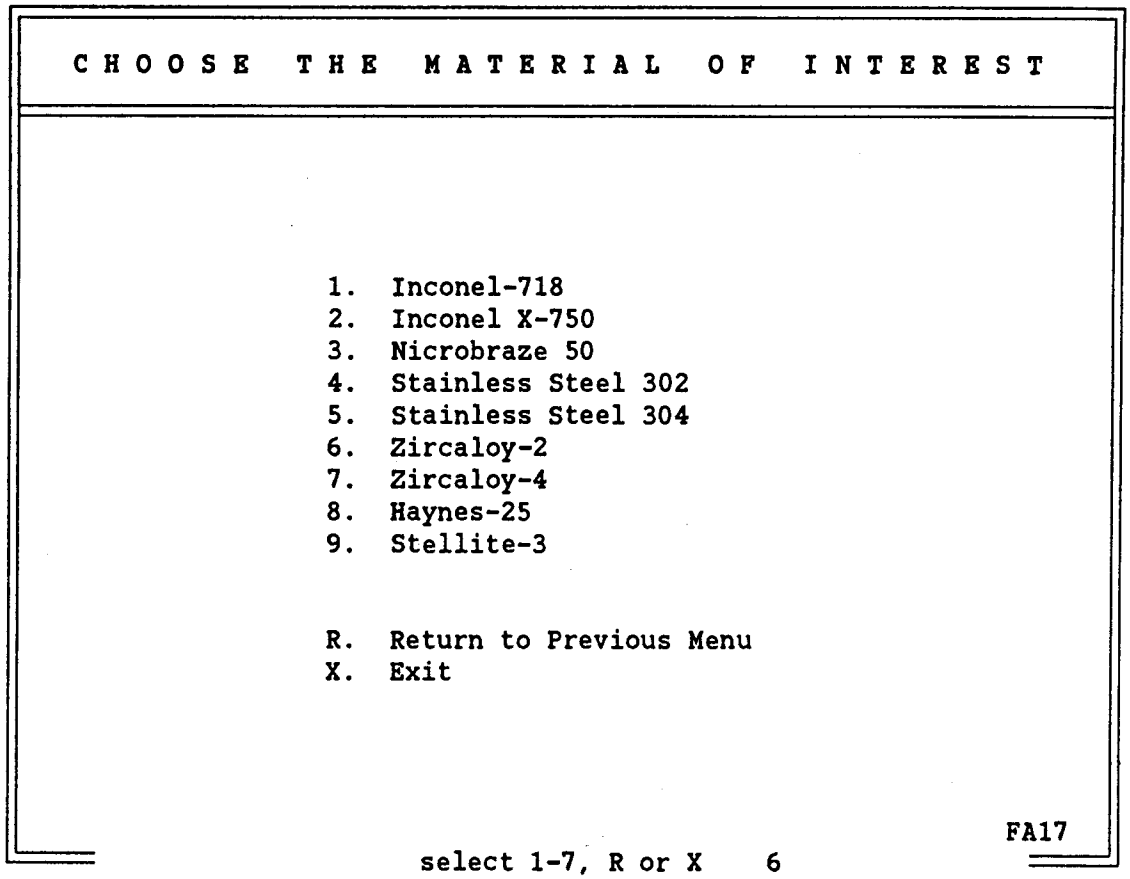
Description:

This screen offers a physical description report by options 1 through 3 or an Elemental Composition Report by option 4. The elemental composition report is available for several materials used in the construction of LWR Assemblies. Each report list the elements which a material is composed of and each elements concentration in the material.

Instruction:

Select 1 through 4 for report options, R to return or X to exit the data base. Press the enter key after your selection.

In this example, option 4 is chosen to receive an elemental composition report.



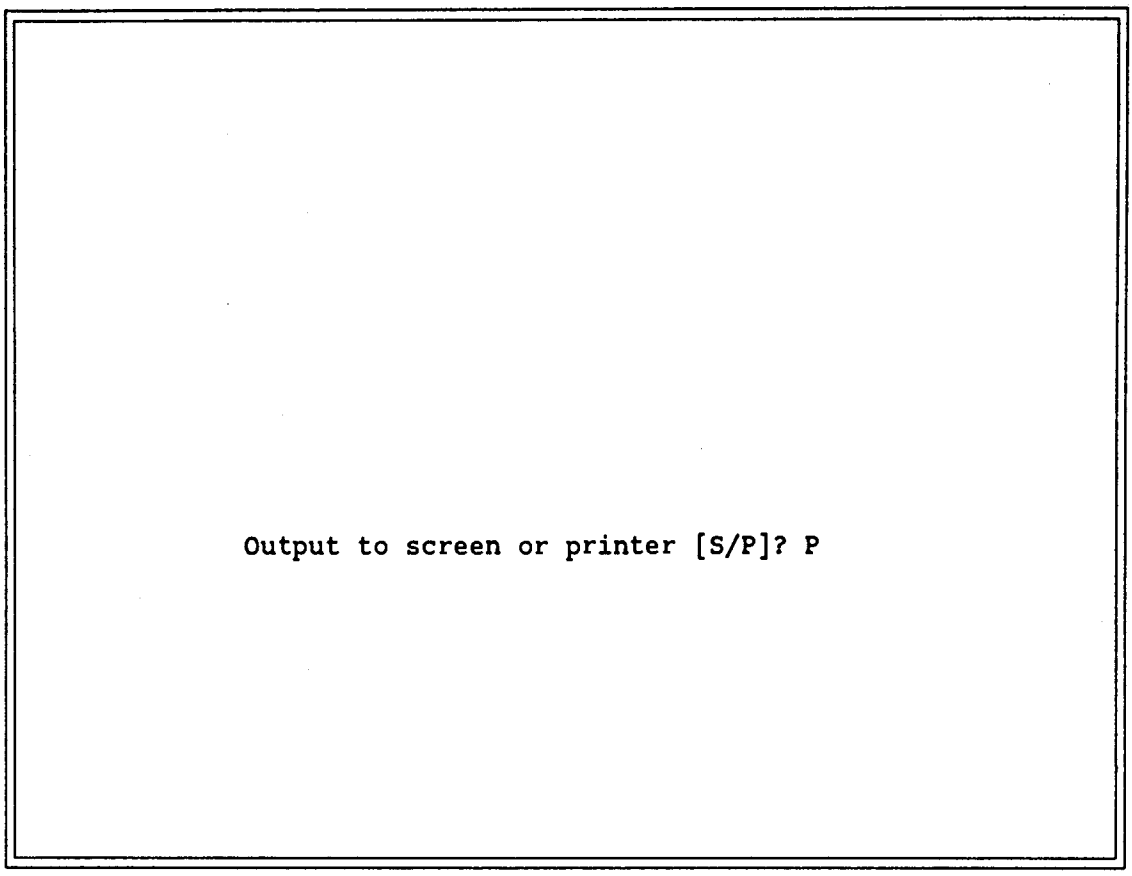
Description:

This screen lists the materials for which an elemental composition report is available.

Instruction:

Select the material you are interested in by the number to it's left or select R to return or X to exit to DOS.

In this example, option 6 was selected to receive an elemental composition report for the material, Zircaloy-2.



Description:

This screen instructs you to specify if you want a hard copy sent to the printer or simply wish to view the report on your screen. If you select printer, you should have your printer online. If you select S and the report runs across more than one screen, it will pause at the bottom of each screen until you press any key to indicate you are ready to continue.

Instructions:

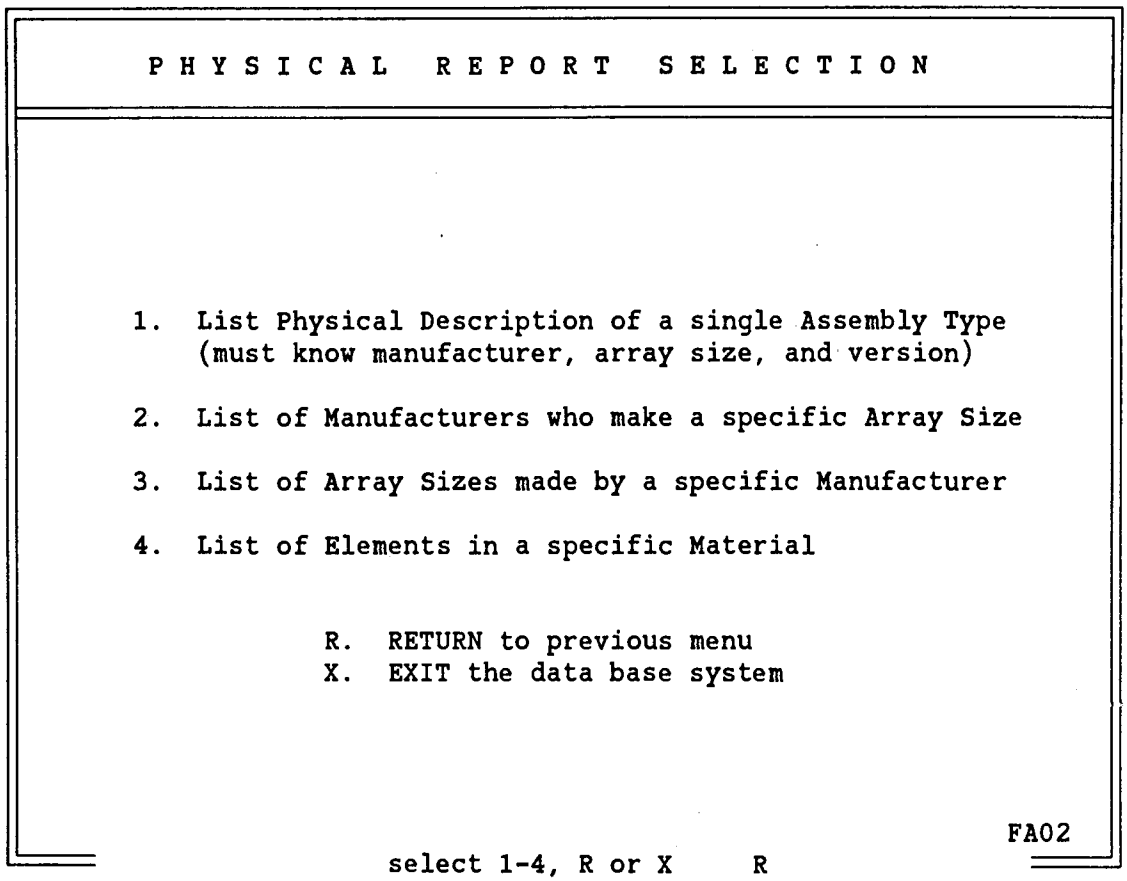
Select S for screen, or after making sure that your printer is online, select P for printer. Press the enter key after making your selection.

In this example, the printer option was chosen. The following page is a elemental composition report for Zircaloy-2.

Elements Contained
in
Zircaloy-2

Element	Concentration
Hydrogen	13.00 PPM
Boron	0.33 PPM
Carbon	120.00 PPM
Nitrogen	80.00 PPM
Oxygen	950.00 PPM
Aluminum	24.00 PPM
Sulfur	35.00 PPM
Titanium	20.00 PPM
Vanadium	20.00 PPM
Chromium	1000.00 PPM
Manganese	20.00 PPM
Iron	1500.00 PPM
Cobalt	10.00 PPM
Nickel	500.00 PPM
Copper	20.00 PPM
Zirconium	98.00 %
Niobium	120.00 PPM
Cadmium	0.25 PPM
Tin	1.60 %
Hafnium	78.00 PPM
Tungsten	20.00 PPM
Uranium	0.20 PPM

Once the report is complete, you will be returned to the Physical Report Selection Menu.



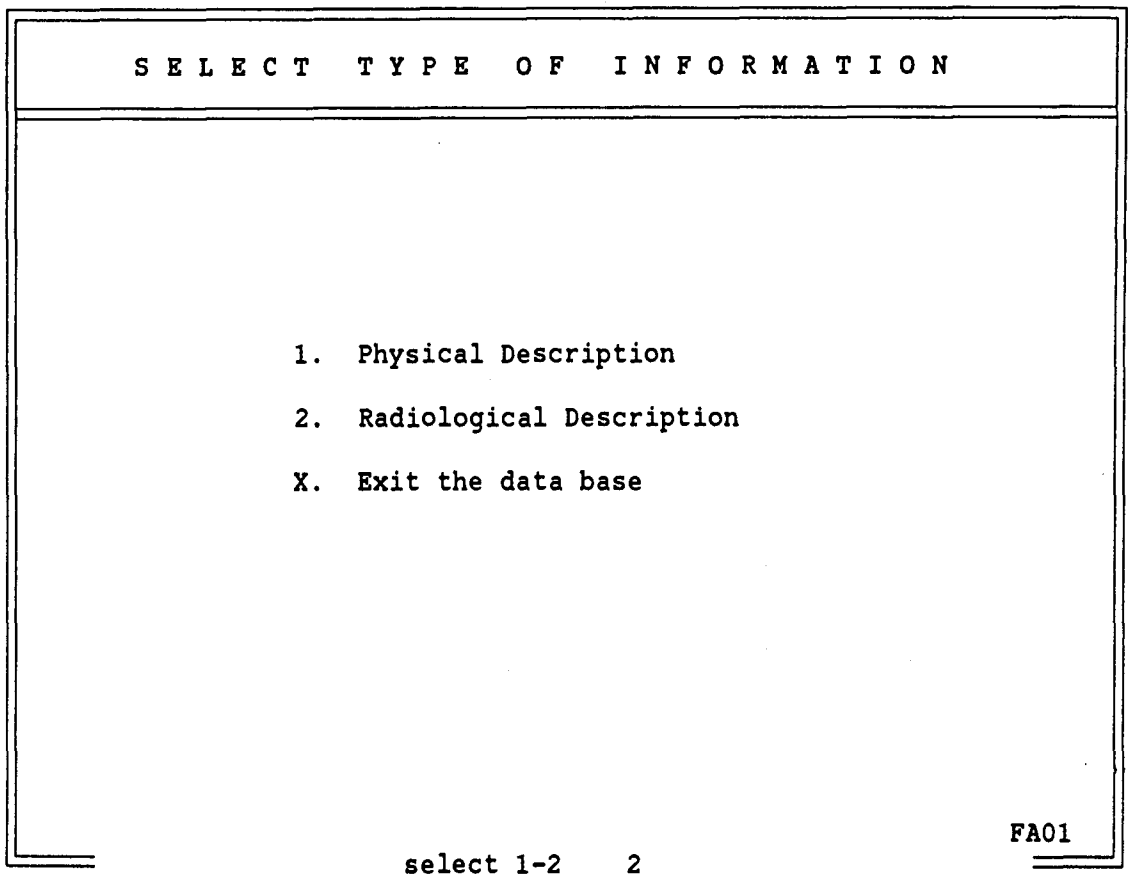
Description:

This screen offers physical description reports. To access the radiological description reports the user must return to the Select Type of Information menu and choose Radiological Descriptions.

Instruction:

Enter 1 through 4 for the type of Physical Description report desired. Enter R to return to the Select Type of Information menu or X to return to DOS.

In this example, R is selected to return to the Select Type of Information menu.



Description:

This screen allows you to branch into one of the two categories of reports offered by the LWR Assemblies Data Base, Physical Description Reports or Radiological Description Reports.

Instruction:

Enter 1 to select Physical Description reports or 2 to select Radiological Description reports. To exit the data base, select X. Press the enter key after making your selection.

In this example, 2 is selected to look at available radiological reports.

```
R A D I O L O G I C A L   R E P O R T   S E L E C T I O N


   1.  Radiological Description of the Spent Fuel Disassembly
       Hardware for a Specific Assembly Type

   2.  Radiological Description of the Components Within a
       Specific Zone for a Specific Assembly Type

   3.  Radiological Description of a Specific Material in
       a Specified Zone

            R.  RETURN to previous menu
            X.  EXIT the data base system


                                                        FA04
                  select 1-3, R or X     1
```

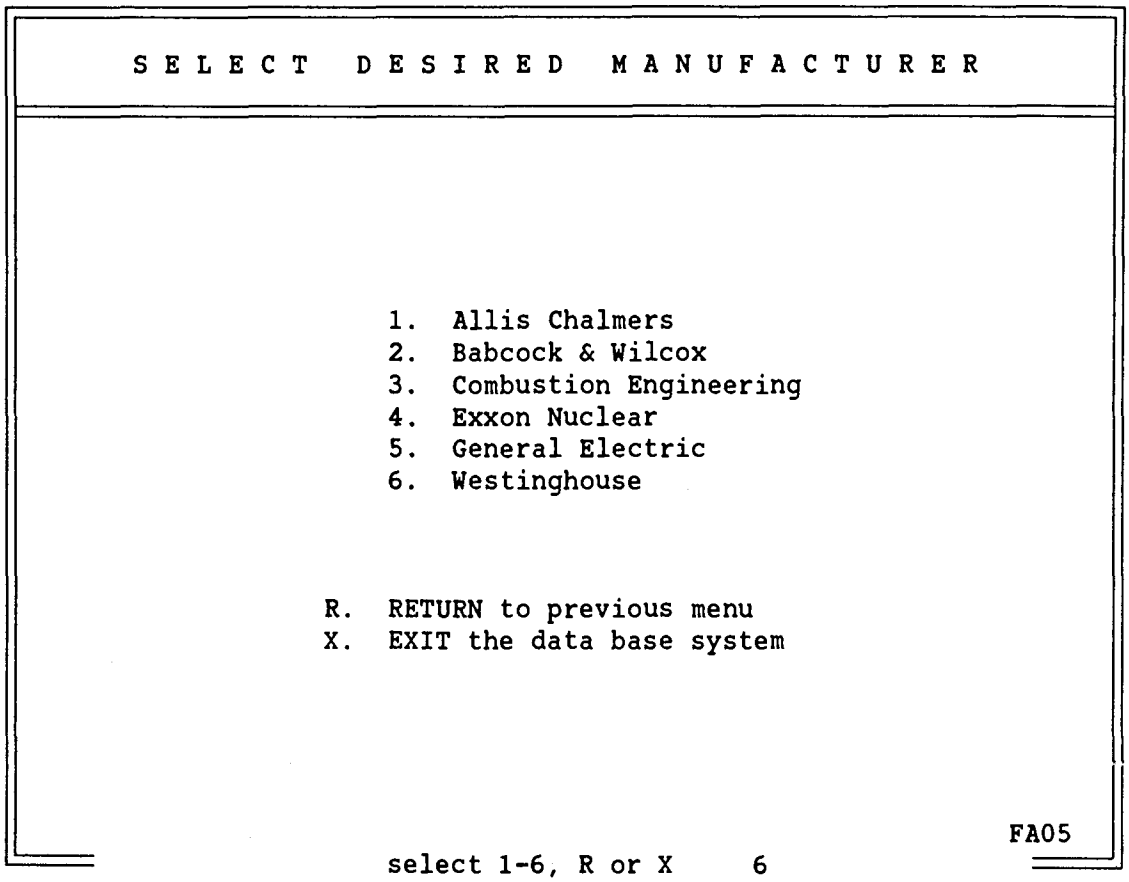
Description:

This screen instructs you to select the type of Radiological Description Report you wish to view. Option 1 will allow you to view a report describing the radiological characteristics for all the Spent Fuel Disassembly hardware in one particular assembly type. Option 2 will allow you to choose the same report for a portion of the hardware. Option 3 is a path to a report on radiological characteristics of a specific material in one specific zone.

Instruction:

Select 1, 2 or 3 for a report, R to return or X to exit to DOS.

In this example, option 1 was selected.



Description:

This screen instructs you to select the manufacturer of the particular assembly for which you want a complete Radiological Description Report.

Instruction:

Select the manufacturer of the assembly type you are interested in by number 1 through 6 or R to return to the Radiological Report Selection menu, or X to exit to DOS.

In this example, 6 is selected for Westinghouse assemblies.

W E S T I N G H O U S E A S S E M B L I E S

Reference	Array Size	Type	Version
1	8 X 8	BWR	QUAD+
2	13 X 13	PWR	
3	14 X 14	PWR	Std/ZCA
4	14 X 14	PWR	OFA
5	14 X 14	PWR	Std/ZCB
6	14 X 14	PWR	Std/SC
7	14 X 14	PWR	Model C
8	15 X 15	PWR	Std/ZC
9	15 X 15	PWR	OFA
10	15 X 15	PWR	Std/SC
11	15 X 16	PWR	
12	17 X 17	PWR	Std
13	17 X 17	PWR	OFA
14	17 X 17	PWR	Vant 5
15	17 X 17	PWR	XLR

FA09

Select Reference Number or R to return or X to exit 13

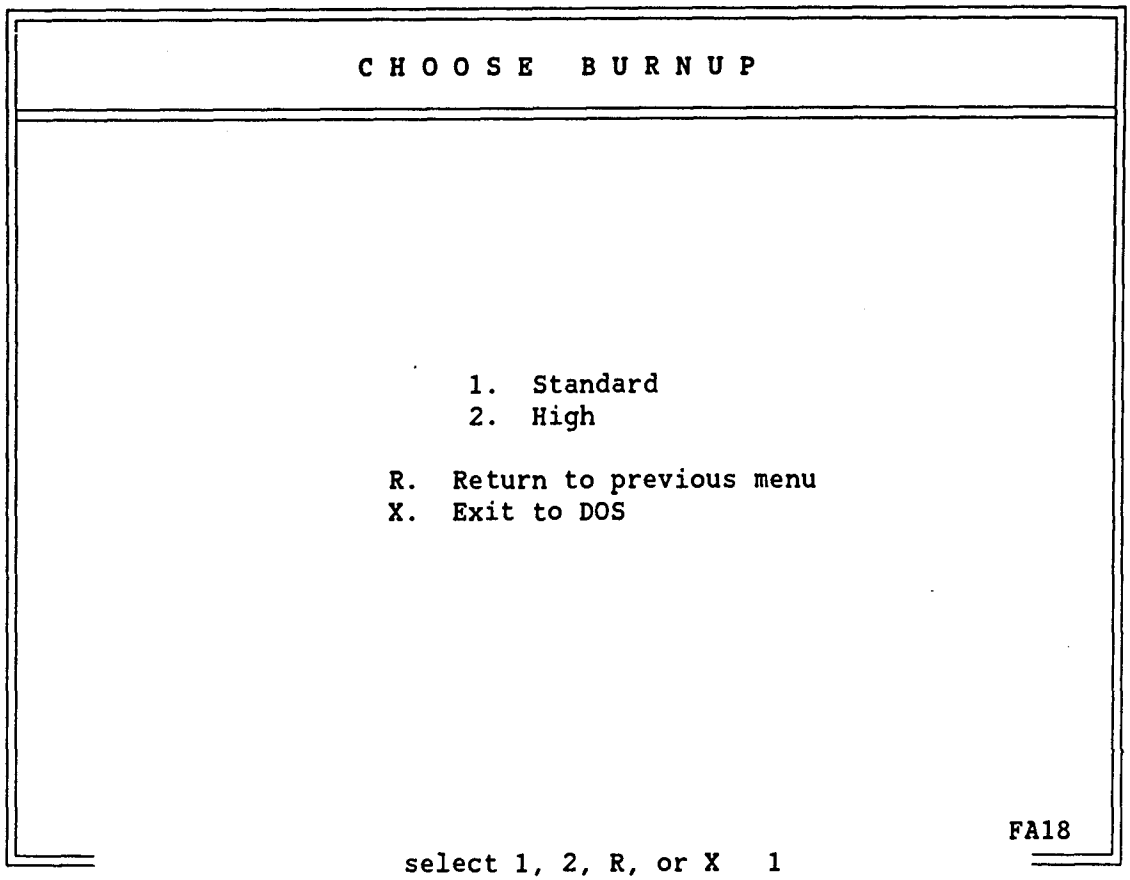
Description:

This screen instructs you to select the specific array size and version of the assembly type for which you wish to receive a Radiological Description Report.

Instructions:

Select the desired assembly type by the reference number (1 to 15) or R to return to previous screen (FA05) or X to return to DOS. Press the enter key after you make your selection.

In this example, 13 is selected for a Westinghouse 17 X 17 Optimized Fuel Assembly.



Description:

This screen instructs you to choose the burnup level you want for the Radioloigcal Description Report of the Spent Fuel Disassembly Hardware. If the assembly type you have chosen for the radiological report is designed for PWRs, standard burnup is 33,000 MWd/MTIHM and high burnup is 60,000 MWd/MTIHM. For a BWR, standard burnup is 27,500 MWd/MTIHM and high burnup is 50,000 MWd/MTIHM.

Instructions:

Choose the burnup which best approximates the burnup you are interested in by selecting a 1 or a 2. R will return you to the assembly type selection menu or X will exit to DOS. Press the enter key after making your selection.

In this example, 1 is selected for a standard burnup of 33,000 MWd/MTIHM.

```
                    T I M E   F R A M E   S E L E C T I O N


        1.   0            9.    50          17.     2,000
        2.   1           10.   100          18.     5,000
        3.   2           11.   200          19.    10,000
        4.   5           12.   300          20.    20,000
        5.  10           13.   350          21.    50,000
        6.  15           14.   500          22.   100,000
        7.  20           15. 1,000          23.   500,000
        8.  30           16. 1,050          24. 1,000,000


                    R.  RETURN to previous menu
                    X.  EXIT the data base system

                     (all numbers are in years)


                                                          FA19
                    select 1-24, R, or X    13
```

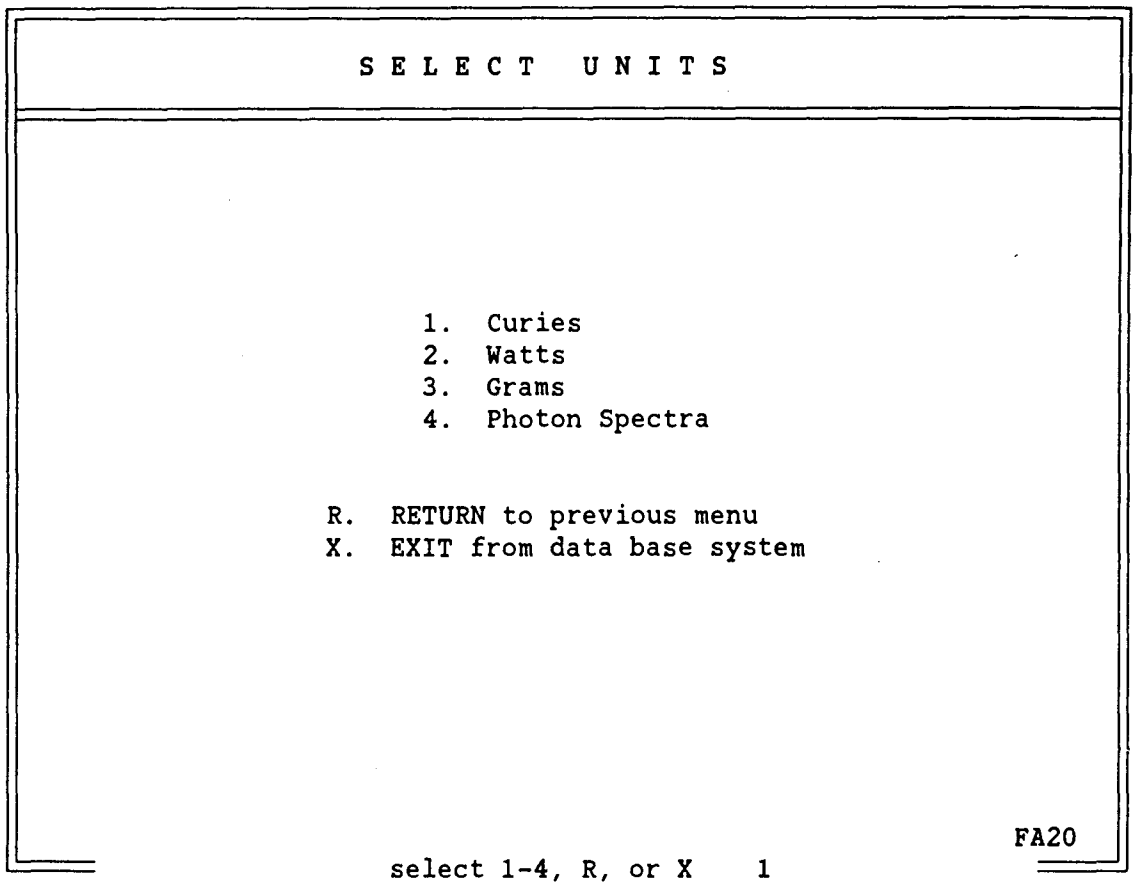
Description:

This screen instructs you to specify the time frame you want for the Radiological Description Report. All times are in years after discharge.

Instructions:

Enter 1 to receive radiological characteristics calculated at discharge, 2 for calculations a year after discharge and so forth up to 24 for one million years of decay. R will return to the burnup selection menu and X will exit to DOS.

In this example, 13 is chosen to use a decay time of 350 years after discharge from the reactor.



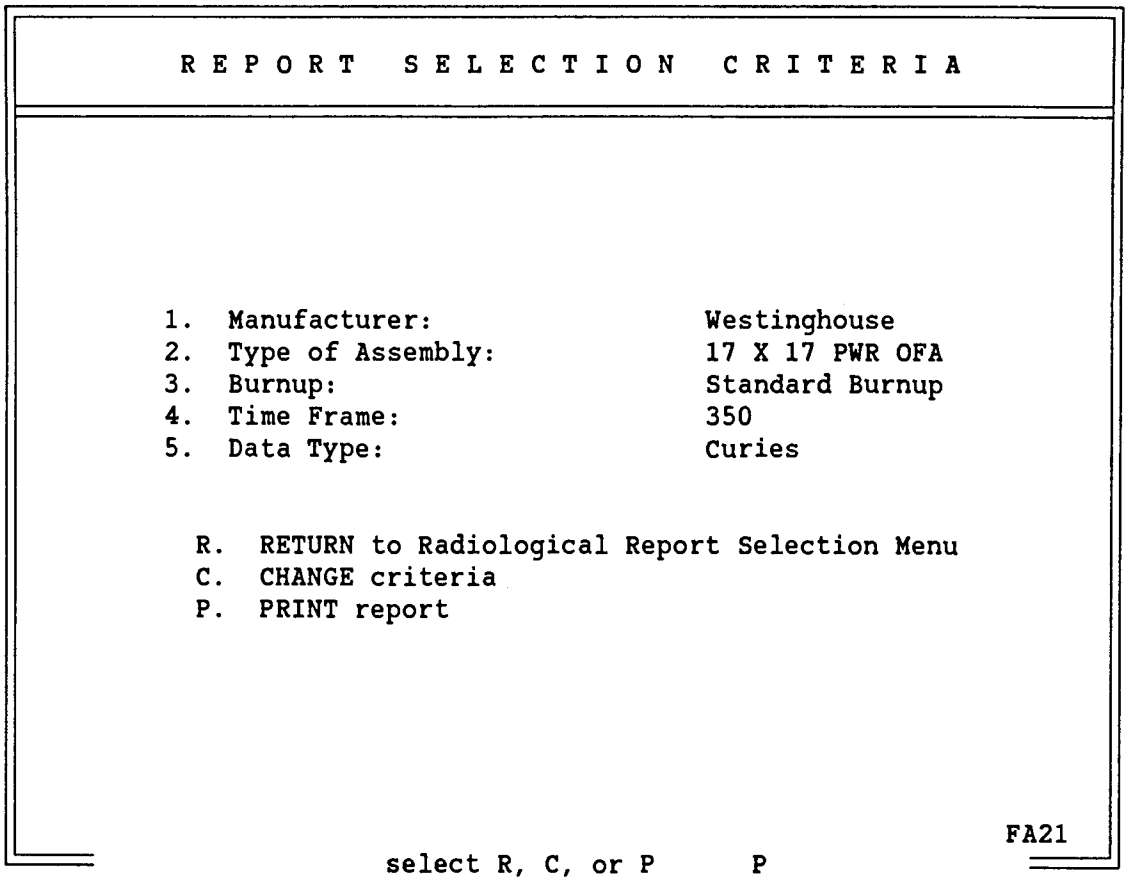
Description:

This screen instructs you to select the type of units you want the Radiological Description Report to contain. Curies, watts, and grams are reported by isotope and photon spectra are reported by energy.

Instructions:

Enter 1 through 4 to select the desired units, R to return or X to exit. Press the enter key after making your selection.

In this example, 1 was entered for curies.



Description:

This screen reiterates the choices. This screen appears both after all choices have been made and after each report.

Instructions:

Enter R to return to the Radiological Description Report Selection screen. Enter C to change one of the criteria. You will be prompted to select the number of the item you wish to change. You can change more than one criteria by repeating this operation.

Enter P to print the specified report. Due to the width and length of the radiological description report in curies, watts and grams, it is not available except as a printed report. Therefore to print this report, you must have an online 132 column printer. (Most narrow carriage printers have a condensed print option which can be used for this report. Consult your printer manual for more information.)

In this example, P is chosed to Print the report.

Spent Fuel Disassembly Hardware
for a
Westinghouse 17 X 17 OFA

Top Zone Standard Burnup 350 years after discharge Units are Curies

Component Name	Inconel-718	St.Steel 304	Isotope Total
HOLDDOWN SPRING	(0.9600 kg)		
C 14	1.098E-03		1.098E-03
Ni 59	1.532E-02		1.532E-02
Ni 63	1.346E-01		1.346E-01
Zr 93	6.487E-09		6.487E-09
Nb 93m	6.162E-09		6.162E-09
Nb 94	1.734E-03		1.734E-03
Mo 93	1.908E-05		1.908E-05
Tc 99	9.482E-07		9.482E-07
	1.527E-01		
TOP NOZZLE	(6.8900 kg)		
Be 10		2.407E-10	2.407E-10
C 14		7.882E-03	7.882E-03
Ni 59		1.886E-02	1.886E-02
Ni 63		1.657E-01	1.657E-01
Zr 93		8.020E-11	8.020E-11
Nb 93m		7.620E-11	7.620E-11
Nb 94		2.242E-05	2.242E-05
		1.924E-01	

Spent Fuel Disassembly Hardware Page: 2
for a
Westinghouse 17 X 17 OFA

Top Zone Standard Burnup 350 years after discharge Units are Curies

Total zone weight: 7.850000 kg. Total zone volume: 0.0009763 cu m.

Top Zone Totals by isotope:

Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
Be 10	2.407E-10	3.066E-11	2.465E-07		
C 14	8.980E-03	1.144E-03	9.198E+00	80.00	1.150E-01
Ni 59	3.418E-02	4.354E-03	3.501E+01	220.00	1.591E-01
Ni 63	3.003E-01	3.825E-02	3.076E+02	7000.00	4.394E-02
Zr 93	6.567E-09	8.366E-10	6.726E-06		
Nb 93m	6.238E-09	7.946E-10	6.389E-06		
Nb 94	1.756E-03	2.237E-04	1.799E+00	0.20	8.993E+00
Mo 93	1.908E-05	2.431E-06	1.954E-02		
Tc 99	9.482E-07	1.208E-07	9.712E-04		

Top Zone Totals by material:

Inconel-718	St.Steel 304
1.527E-01	1.924E-01

Top Zone Totals by material in kilograms:

Inconel-718	St.Steel 304
0.9600	6.8900

Spent Fuel Disassembly Hardware
for a
Westinghouse 17 X 17 OFA

Gas Plenum Zone Standard Burnup 350 years after discharge Units are Curies

Component Name	Inconel-718	Isotope Total
SPACER-PLENUM	(0.8850 kg)	
C 14	1.006E-02	1.006E-02
Ni 59	1.379E-01	1.379E-01
Ni 63	1.215E+00	1.215E+00
Zr 93	4.055E-08	4.055E-08
Nb 93m	3.852E-08	3.852E-08
Nb 94	1.419E-02	1.419E-02
Mo 93	1.194E-04	1.194E-04
Tc 99	5.889E-06	5.889E-06
	1.377E+00	

Spent Fuel Disassembly Hardware Page: 4
for a
Westinghouse 17 X 17 OFA

Gas Plenum Zone Standard Burnup 350 years after discharge Units are Curies

Total zone weight: 0.796500 kg. Total zone volume: 0.0000973 cu m.

Gas Plenum Zone Totals by isotope:

Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
C 14	1.006E-02	1.263E-02	1.034E+02	80.00	1.293E+00
Ni 59	1.379E-01	1.731E-01	1.418E+03	220.00	6.445E+00
Ni 63	1.215E+00	1.525E+00	1.249E+04	7000.00	1.785E+00
Zr 93	4.055E-08	5.091E-08	4.170E-04		
Nb 93m	3.852E-08	4.836E-08	3.961E-04		
Nb 94	1.419E-02	1.782E-02	1.459E+02	0.20	7.295E+02
Mo 93	1.194E-04	1.499E-04	1.228E+00		
Tc 99	5.889E-06	7.394E-06	6.055E-02		

Gas Plenum Zone Totals by material:

Inconel-718

1.377E+00

Gas Plenum Zone Totals by material in kilograms:

Inconel-718

0.7965

Spent Fuel Disassembly Hardware Page: 5
for a
Westinghouse 17 X 17 OFA

In Core Zone Standard Burnup 350 years after discharge Units are Curies

Component Name	Zircaloy-4	Inconel-718	St.Steel 304	Isotope Total
B. GRID SLEEVE	(0.0910 kg)			
Be 10			2.892E-10	2.892E-10
C 14			2.195E-03	2.195E-03
Cl 36			8.280E-10	8.280E-10
Ni 59			4.259E-03	4.259E-03
Ni 63			4.159E-02	4.159E-02
Zr 93			9.473E-11	9.473E-11
Nb 93m			8.996E-11	8.996E-11
Nb 94			1.590E-05	1.590E-05
			4.806E-02	
SPACER-LOWER	(0.9250 kg)			
Be 10		1.470E-09		1.470E-09
C 14		2.231E-02		2.231E-02
Ni 59		2.523E-01		2.523E-01
Ni 63		2.465E+00		2.465E+00
Zr 93		5.604E-07		5.604E-07
Nb 93m		5.323E-07		5.323E-07
Nb 94		8.969E-02		8.969E-02
Mo 93		1.670E-03		1.670E-03
Tc 99		7.469E-05		7.469E-05
		2.832E+00		
GUIDE TUBES	(9.5300 kg)			
C 14	1.415E-02			1.415E-02
Ni 59	9.997E-05			9.997E-05
Ni 63	1.013E-03			1.013E-03
Zr 93	5.299E-03			5.299E-03
Nb 93m	5.034E-03			5.034E-03
Nb 94	1.997E-03			1.997E-03
Sn121m	1.879E-04			1.879E-04
	2.778E-02			
SPACER-INCORE	(7.0220 kg)			
C 14	1.043E-02			1.043E-02
Ni 59	7.366E-05			7.366E-05
Ni 63	7.464E-04			7.464E-04
Zr 93	3.904E-03			3.904E-03
Nb 93m	3.709E-03			3.709E-03
Nb 94	1.472E-03			1.472E-03
Sn121m	1.385E-04			1.385E-04
	2.047E-02			

Spent Fuel Disassembly Hardware Page: 6
for a
Westinghouse 17 X 17 OFA

In Core Zone Standard Burnup 350 years after discharge Units are Curies

Total zone weight: 17.568000 kg. Total zone volume: 0.0026475 cu m.

In Core Zone Totals by isotope:

Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
Be 10	1.759E-09	1.001E-10	6.644E-07		
C 14	4.908E-02	2.794E-03	1.854E+01	80.00	2.317E-01
Cl 36	8.280E-10	4.713E-11	3.128E-07		
Ni 59	2.568E-01	1.462E-02	9.700E+01	220.00	4.409E-01
Ni 63	2.509E+00	1.428E-01	9.477E+02	7000.00	1.354E-01
Zr 93	9.204E-03	5.239E-04	3.477E+00		
Nb 93m	8.744E-03	4.977E-04	3.303E+00		
Nb 94	9.318E-02	5.304E-03	3.520E+01	0.20	1.760E+02
Mo 93	1.670E-03	9.506E-05	6.308E-01		
Tc 99	7.469E-05	4.251E-06	2.821E-02		
Sn121m	3.264E-04	1.858E-05	1.233E-01		

In Core Zone Totals by material:

Zircaloy-4	Inconel-718	St.Steel 304
4.825E-02	2.832E+00	4.806E-02

In Core Zone Totals by material in kilograms:

Zircaloy-4	Inconel-718	St.Steel 304
16.5520	0.9250	0.0910

Spent Fuel Disassembly Hardware
for a
Westinghouse 17 X 17 OFA

Bottom Zone Standard Burnup 350 years after discharge Units are Curies

Component Name	St.Steel 304	Isotope Total
BOTTOM NOZZLE	(5.8970 kg)	
Be 10	1.180E-09	1.180E-09
C 14	3.861E-02	3.861E-02
Ni 59	9.164E-02	9.164E-02
Ni 63	8.085E-01	8.085E-01
Zr 93	3.926E-10	3.926E-10
Nb 93m	3.730E-10	3.730E-10
Nb 94	1.164E-04	1.164E-04
	9.388E-01	

Spent Fuel Disassembly Hardware Page: 8
for a
Westinghouse 17 X 17 OFA

Bottom Zone Standard Burnup 350 years after discharge Units are Curies

Total zone weight: 5.897000 kg. Total zone volume: 0.0007353 cu m.

Bottom Zone Totals by isotope:

Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
Be 10	1.180E-09	2.001E-10	1.605E-06		
C 14	3.861E-02	6.547E-03	5.251E+01	80.00	6.564E-01
Ni 59	9.164E-02	1.554E-02	1.246E+02	220.00	5.665E-01
Ni 63	8.085E-01	1.371E-01	1.100E+03	7000.00	1.571E-01
Zr 93	3.926E-10	6.658E-11	5.339E-07		
Nb 93m	3.730E-10	6.325E-11	5.073E-07		
Nb 94	1.164E-04	1.974E-05	1.583E-01	0.20	7.915E-01

Bottom Zone Totals by material:

St.Steel 304
9.388E-01

Bottom Zone Totals by material in kilograms:

St.Steel 304
5.8970

Spent Fuel Disassembly Hardware
for a
Westinghouse 17 X 17 OFA

All Zones Standard Burnup 350 years after discharge Units are Curies

Total zones weight: 32.111500 kg. Total zones volume: 0.0044563 cu m.

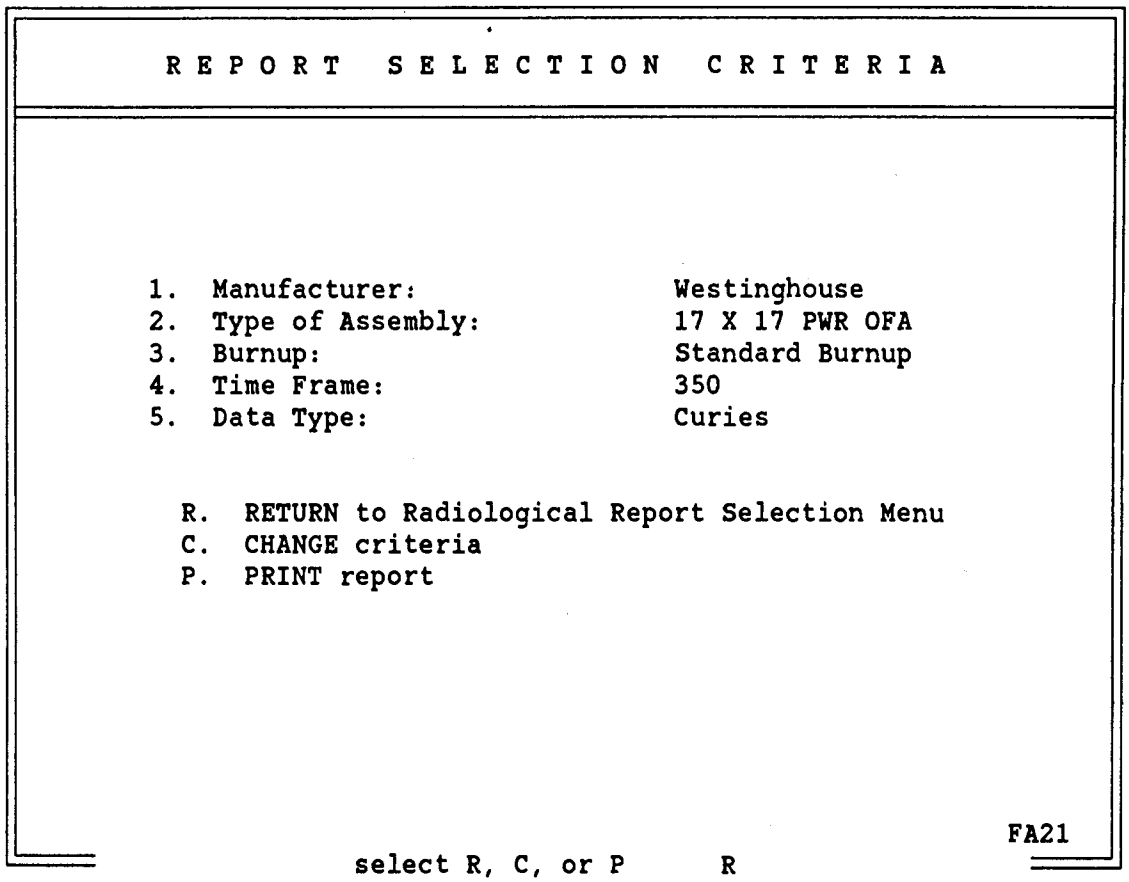
Totals by isotope for all zones:

Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
Be 10	3.180E-09	9.903E-11	7.136E-07		
C 14	1.067E-01	3.323E-03	2.394E+01	80.00	2.993E-01
Cl 36	8.280E-10	2.579E-11	1.858E-07		
Ni 59	5.205E-01	1.621E-02	1.168E+02	220.00	5.309E-01
Ni 63	4.832E+00	1.505E-01	1.084E+03	7000.00	1.549E-01
Zr 93	9.204E-03	2.866E-04	2.065E+00		
Nb 93m	8.744E-03	2.723E-04	1.962E+00		
Nb 94	1.092E-01	3.401E-03	2.450E+01	0.20	1.225E+02
Mo 93	1.808E-03	5.630E-05	4.057E-01		
Tc 99	8.153E-05	2.539E-06	1.830E-02		
Sn121m	3.264E-04	1.016E-05	7.324E-02		

Assembly totals by material:

Zircaloy-4	Inconel-718	St.Steel 304
4.825E-02	4.362E+00	1.179E+00

Assembly grand total in Curies	Curies/kg	Curies/cu m
5.589E+00	1.741E-01	1.254E+03



Description:

Now that the report is complete, you are returned to this menu. If you wish to change one or more criteria and rerun the report, you may do so using the change and print options. Otherwise, you can return to the Radiological Report Selection Menu (FA04).

Instruction:

Enter R to return to the Radiological Report Selection screen. Enter C to change a single criteria. You will be asked to select the item you wish to change. Enter P to print the report again. Press the enter key after making your selection.

In this example, R is chosen to return.

```
R A D I O L O G I C A L   R E P O R T   S E L E C T I O N


1.  Radiological Description of the Spent Fuel Disassembly
    Hardware for a Specific Assembly Type

2.  Radiological Description of the Components within a
    Specific Zone for a Specific Assembly Type

3.  Radiological Description of a Specific Material in
    a Specified Zone

              R.  RETURN to previous menu
              X.  EXIT the data base system


                                                        FA04
              select  1-3, R, or X   2
```

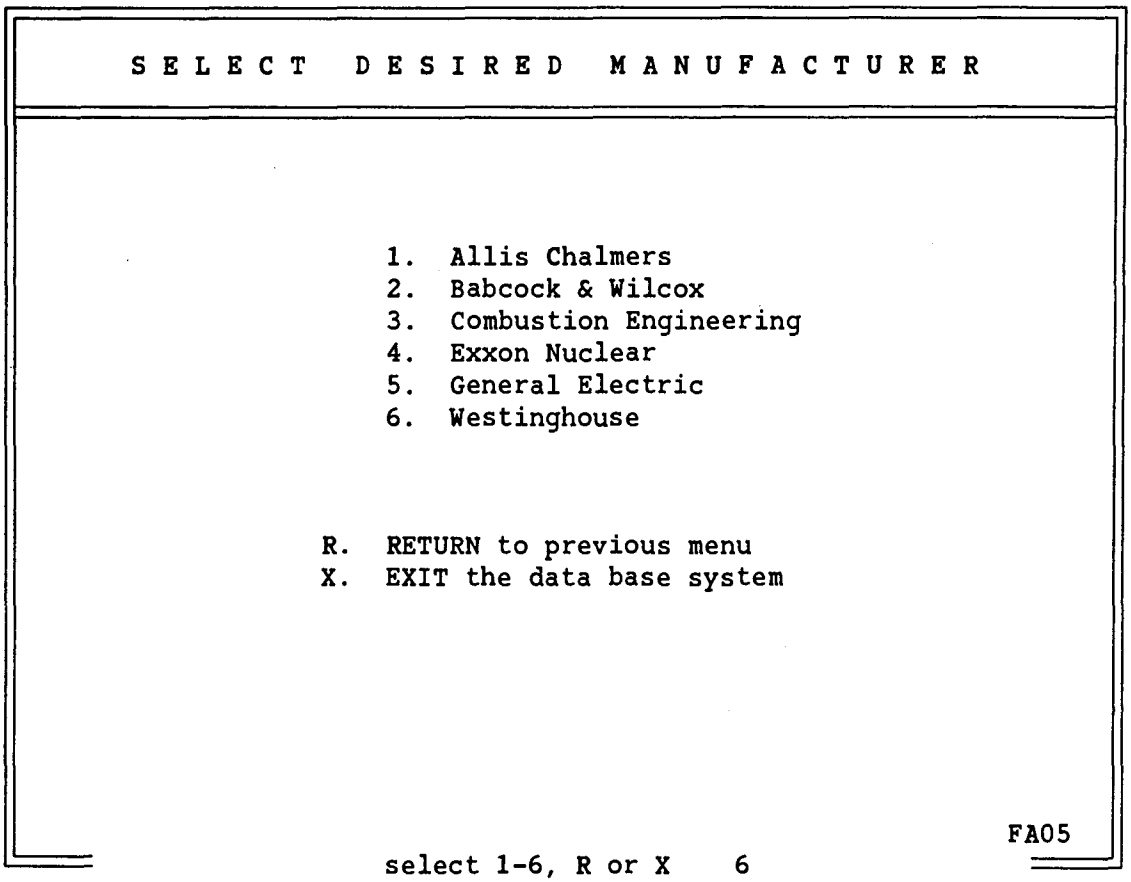
Description:

This screen instructs you to select the type of Radiological Description Report you wish to view.

Instruction:

Enter 1 for a radiological description report for an entire assembly type, 2 for a report on a specific zone of the reactor that the assembly resides in or 3 for a report on a particular material of construction. R will return you to the Type of Information menu (FA01) and X will exit to DOS.

In this example, option 2 is selected.



Description:

This screen instructs you to select the manufacturer of the particular assembly for which you want a zone-specific Radiological Description Report.

Instruction:

Select a vendor by entering 1 through 6 or R to return or X to exit to DOS. Press the enter key after making your selection.

In this example, Westinghouse is chosen by selecting 6.

W E S T I N G H O U S E A S S E M B L I E S

Reference	Array Size	Type	Version
1	8 X 8	BWR	QUAD+
2	13 X 13	PWR	
3	14 X 14	PWR	Std/ZCA
4	14 X 14	PWR	OFA
5	14 X 14	PWR	Std/ZCB
6	14 X 14	PWR	Std/SC
7	14 X 14	PWR	Model C
8	15 X 15	PWR	Std/ZC
9	15 X 15	PWR	OFA
10	15 X 15	PWR	Std/Sc
11	15 X 16	PWR	
12	17 X 17	PWR	Std
13	17 X 17	PWR	OFA
14	17 X 17	PWR	Vant 5
15	17 X 17	PWR	XLR

FA09

Select Reference Number or R to return or S to exit 13

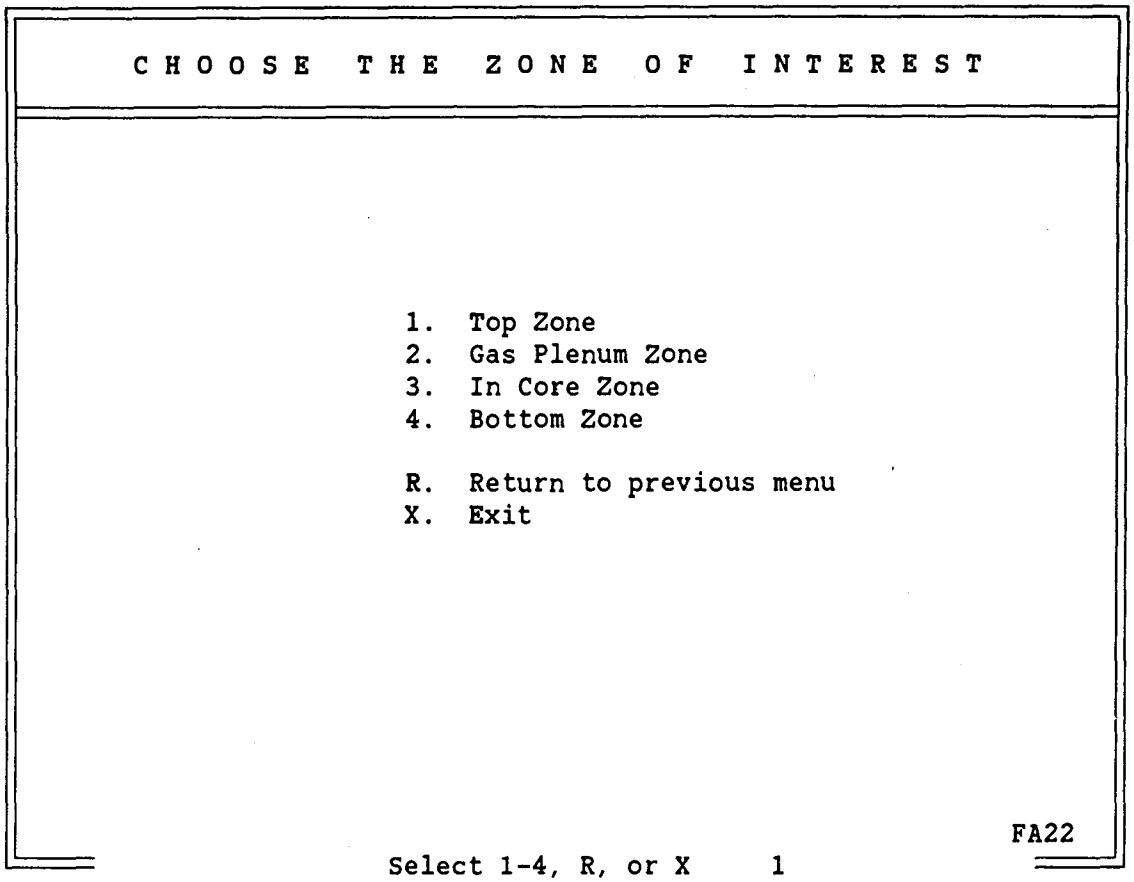
Description:

This screen instructs you to select the specific array size and version of the assembly type for which you wish to receive a Radiological Description Report.

Instructions:

Select the desired assembly type by the reference number (1 to 15) or R to return to previous screen (FA05) or X to return to DOS. Press the enter key after you make your selection.

In this example, 13 is selected for a Westinghouse 17 x 17 Optimized Fuel Assembly.



Description:

This screen instructs you to choose the particular zone for which you want a Radiological Description Report of the Spent Fuel Disassembly Hardware in that zone. It will be followed by a list of hardware in the zone you select.

Instruction:

Enter 1 for the top zone, 2 for the gas plenum zone, 3 for the in core zone and 4 for the bottom zone. R will return you to the previous menu (assembly types of Westinghouse manufacture) and X will return you to DOS.

In this example, 1 is selected for the Top Zone.

SPENT FUEL DISASSEMBLY HARDWARE COMPONENTS
for a Westinghouse 17 X 17 PWR OFA Assembly
located in the Top Zone

Reference	Part Name
1	TOP NOZZLE
2	HOLDDOWN SPRING
A	ALL Components

FA24

Enter Reference No., or A for all, R to return, or X to exit: A

Description:

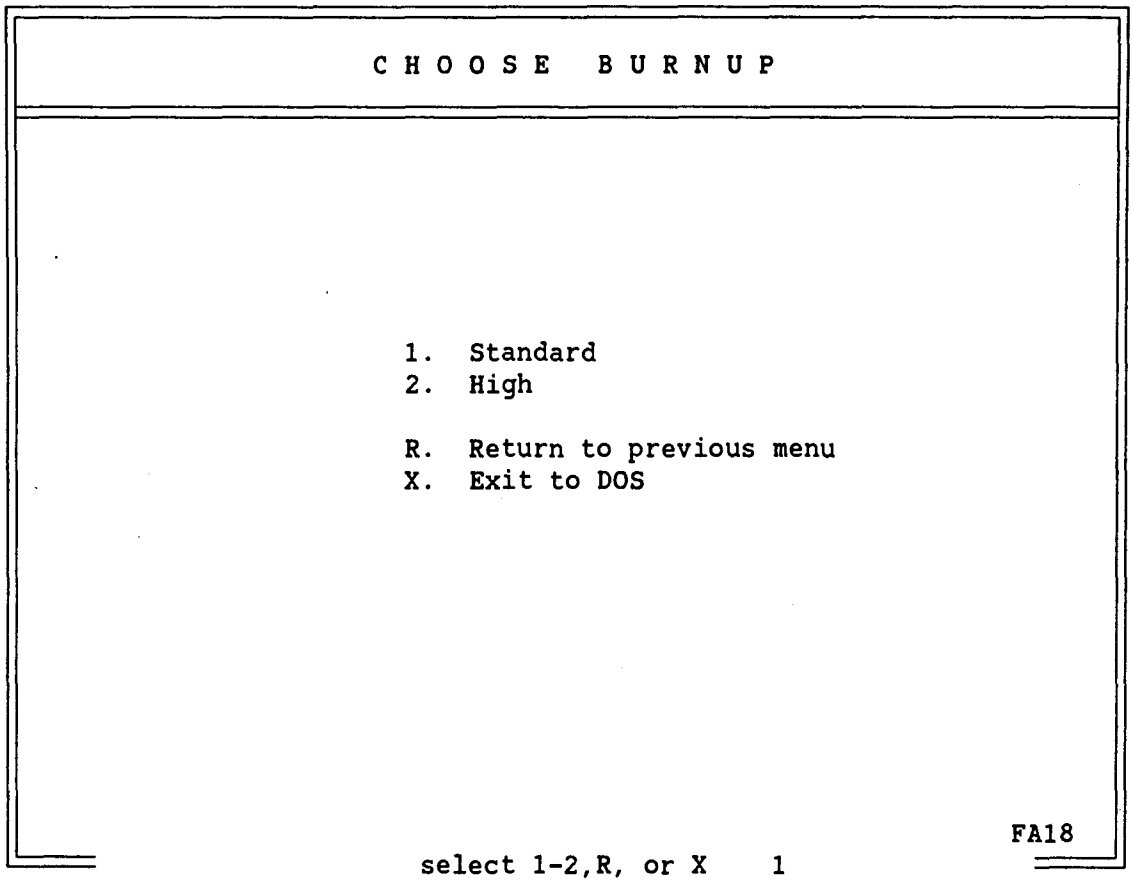
You have received a list of all the Spent Fuel Disassembly Hardware in the Top Zone of a Westinghouse 17 X 17 PWR OFA Assembly.

You can receive a Radiological Description Report for any single part or for all parts in the zone.

Instruction:

If you select a single part, do so by entering a single reference number. If you are interested in all the parts in this reactor zone, enter A for all. R returns you to the previous menu (Choose Zone of Interest) and X will exit to DOS.

In this example, A is selected for all SFD hardware of a Westinghouse 17 X 17 OFA in the Top Zone.



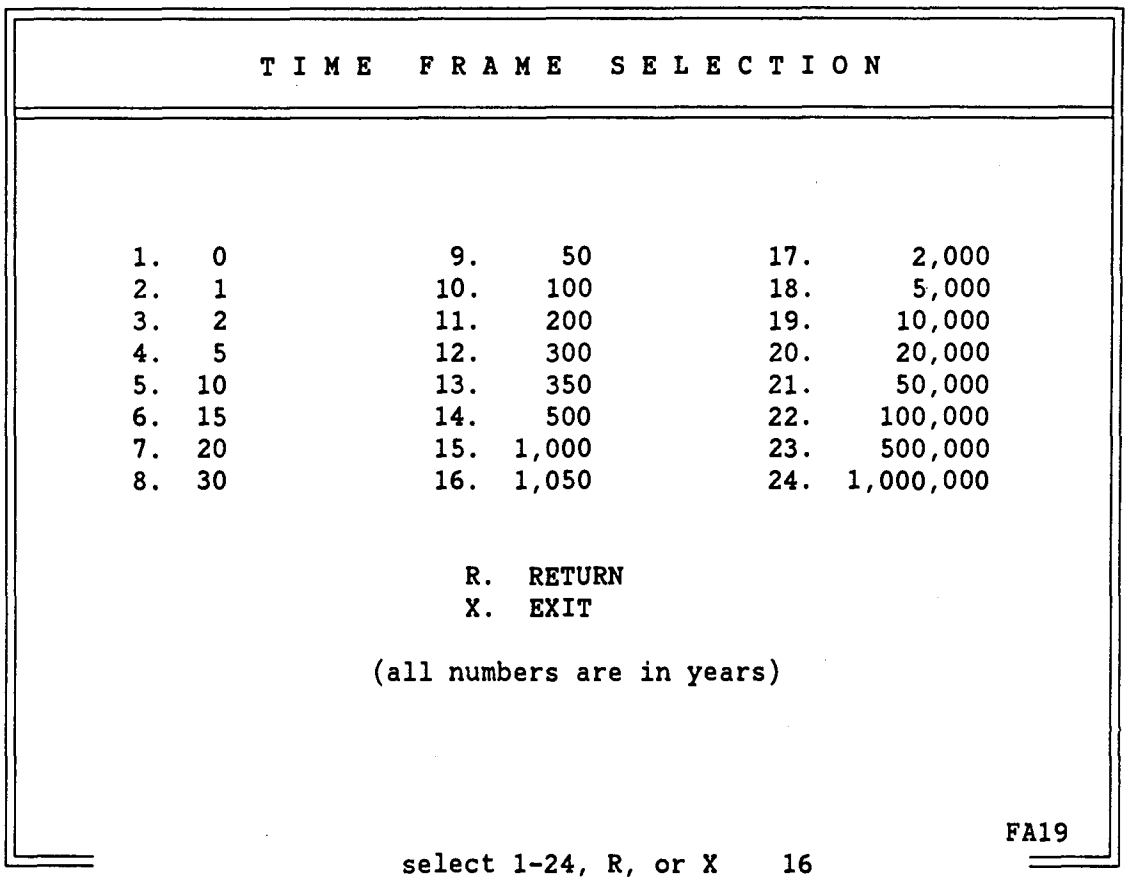
Description:

This screen instructs you to choose the burnup level you want used for the Radiological Description Report.

Instruction:

Select 1 for Standard Burnup, 2 for High Burnup, R to Return to the list of components or X to exit to DOS. Press the enter key after making your selection.

In this example, 1 is chosen for Standard burnup. Because a Westinghouse 17 X 17 OFA is for Pressurized Water Reactors, Standard in this case means 33,000 megawatt day per MTIHM.



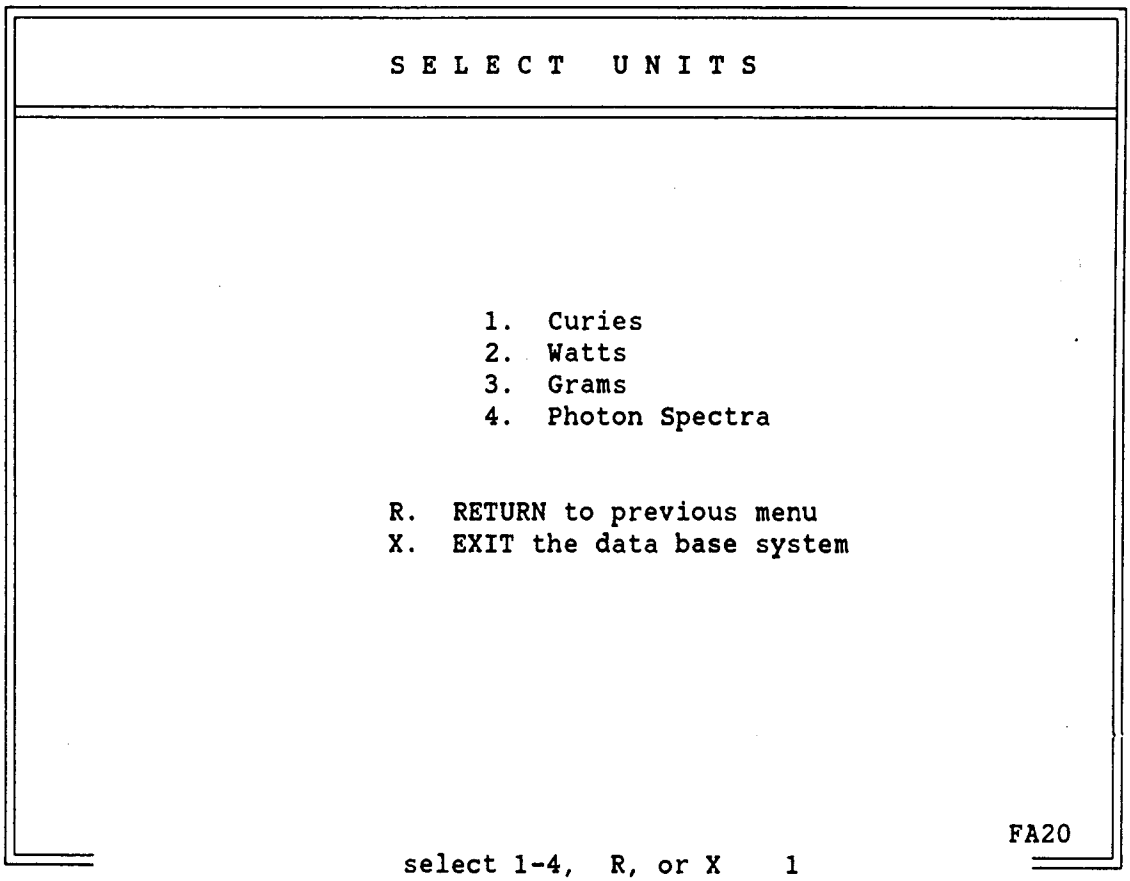
Description:

This screen instructs you to select the time frame you want for the Radiological Description Report. All times are in years after discharge.

Instructions:

Enter 1 for at discharge, 2 for one year after discharge, 3 for 2 years after discharge, 4 for 5 years after discharge and so on. To return to the burnup selection menu, choose R. X will exit to DOS. Press the enter key after making your selection.

In this example, 16 is selected for 1050 years after discharge.



Description:

This screen instructs you to select the type of units you want the Radiological Description Report to contain. Curies, watts, and grams are reported by isotope and photon spectra are reported by energy.

Instruction:

Choose the unit by number or R to return to time frame selection or X to exit the data base. Press enter after making your selection.

In this example, curies are selected as the unit.

```
                    R E P O R T   S E L E C T I O N   C R I T E R I A


        1.  Manufacturer:              Westinghouse
        2.  Type of Assembly:          17 X 17 PWR OFA
        3.  Zone:                      Top Zone
        4.  Part(s):                   All
        5.  Burnup:                    Standard Burnup
        6.  Time frame:                1050
        7.  Data Type:                 Curies

          R.  RETURN to Radiological Report Selection menu
          C.  CHANGE criteria
          P.  PRINT report

                                                                  FA25
                        select R, C, or P       P
```

Description:

Again, your selections are displayed and you may change any criteria you wish.

Instruction:

Enter C to change an item; you will be prompted to enter the item number (1 to 7) which you wish to change. R will return to the Radiological Report Selection menu. If you enter P to print the report, you must have an online 132-column printer.

In this example, P is chosen to print the report.

Spent Fuel Disassembly Hardware Page: 1
for a
Westinghouse 17 X 17 OFA

Top Zone Standard Burnup 1050 years after discharge Units are Curies

Component Name	Inconel-718	St. Steel 304	Isotope Total
HOLDDOWN SPRING	(0.9600 kg)		
C 14	1.009E-03		1.009E-03
Ni 59	1.523E-02		1.523E-02
Ni 63	6.897E-04		6.897E-04
Zr 93	6.485E-09		6.485E-09
Nb 93m	6.160E-09		6.160E-09
Nb 94	1.693E-03		1.693E-03
Mo 93	1.660E-05		1.660E-05
Tc 99	9.460E-07		9.460E-07
	1.864E-02		
TOP NOZZLE	(6.8900 kg)		
Be 10		2.406E-10	2.406E-10
C 14		7.241E-03	7.241E-03
Ni 59		1.875E-02	1.875E-02
Ni 63		8.488E-04	8.488E-04
Zr 93		8.013E-11	8.013E-11
Nb 93m		7.613E-11	7.613E-11
Nb 94		2.190E-05	2.190E-05
		2.686E-02	

Spent Fuel Disassembly Hardware Page: 2
for a
Westinghouse 17 X 17 OFA

Top Zone Standard Burnup 1050 years after discharge Units are Curies

Total zone weight: 7.850000 kg. Total zone volume: 0.0009763 cu m.

Top Zone Totals by isotope:

Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
Be 10	2.406E-10	3.065E-11	2.464E-07		
C 14	8.250E-03	1.051E-03	8.450E+00	80.00	1.056E-01
Ni 59	3.398E-02	4.329E-03	3.480E+01	220.00	1.582E-01
Ni 63	1.538E-03	1.959E-04	1.575E+00	7000.00	2.250E-04
Zr 93	6.565E-09	8.363E-10	6.724E-06		
Nb 93m	6.236E-09	7.944E-10	6.387E-06		
Nb 94	1.715E-03	2.185E-04	1.757E+00	0.20	8.783E+00
Mo 93	1.660E-05	2.115E-06	1.700E-02		
Tc 99	9.460E-07	1.205E-07	9.689E-04		

Top Zone Totals by material:

Inconel-718	St. Steel 304
1.864E-02	2.686E-02

Top Zone Totals by material in kilograms:

Inconel-718	St. Steel 304
0.9600	6.8900

```
                    R E P O R T   S E L E C T I O N   C R I T E R I A


        1.  Manufacturer:              Westinghouse
        2.  Type of Assembly:          17 X 17 PWR OFA
        3.  Zone:                      Top Zone
        4.  Part(s):                   All
        5.  Burnup:                    Standard Burnup
        6.  Time Frame:                1050
        7.  Data Type:                 Curies

            R.  RETURN to Radiological Report Selection Menu
            C.  CHANGE criteria
            P.  PRINT report now

                                                                    FA25
                        select R, C, or P     C
```

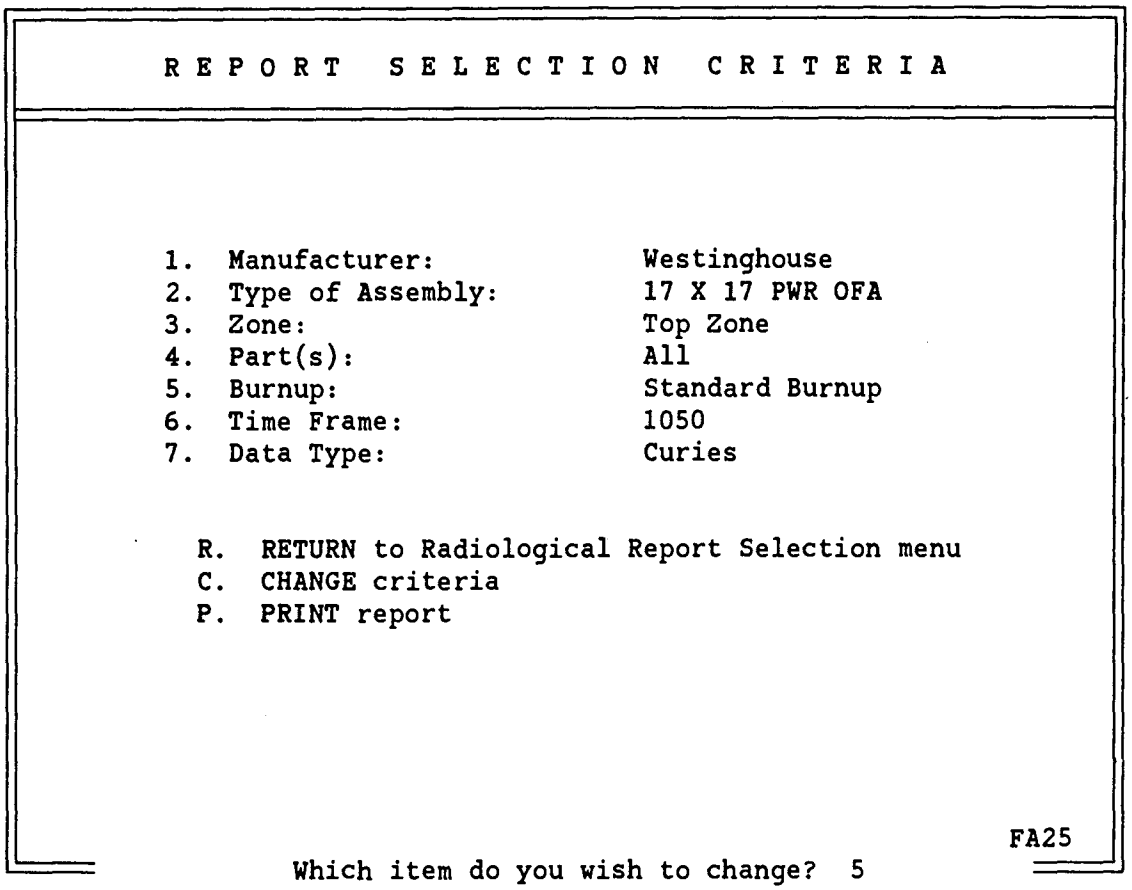
Description:

After the report is printed, you are returned to this menu. Again, you have the option to change a selection, print a report, or return to the Radiological Report Selection Menu.

Instruction:

Enter C, P, or R for your selection and press the enter key.

In this example, C is chosen to change criteria.



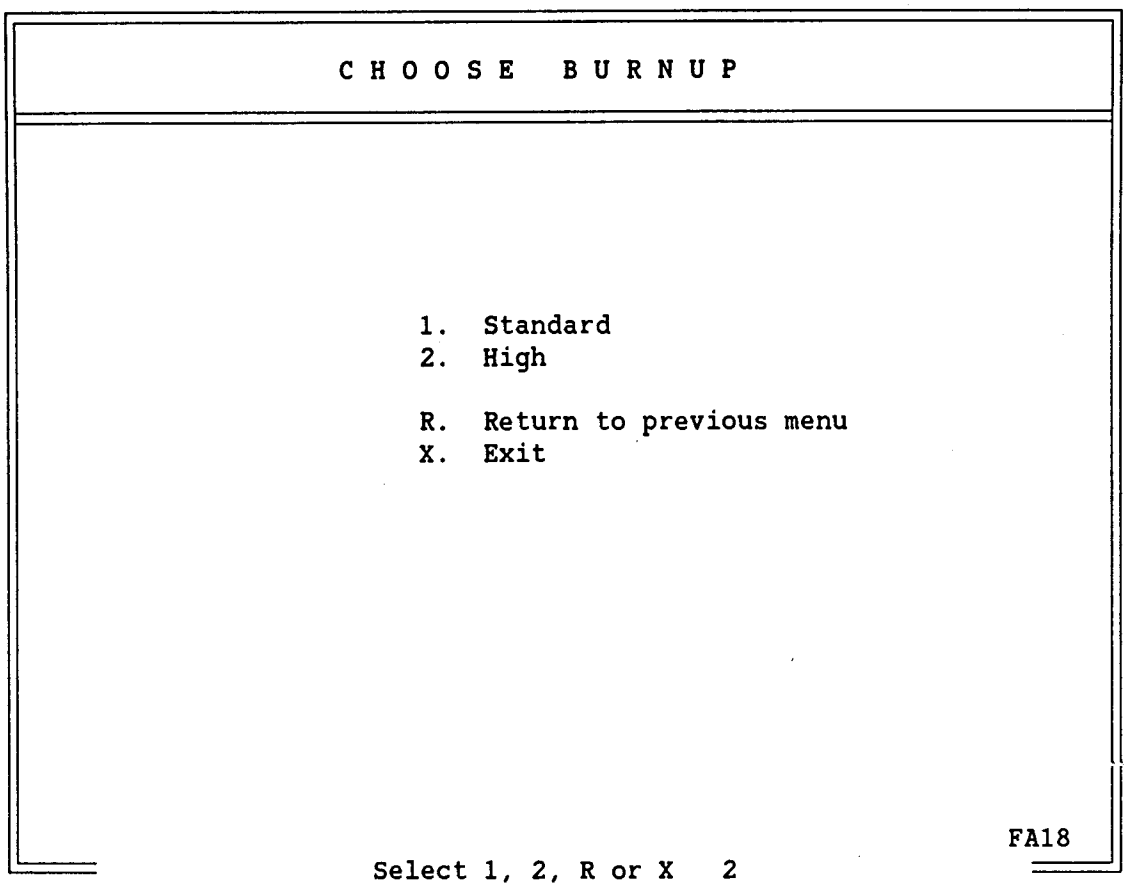
Description:

After C is chosen to change criteria, the prompt at the bottom of the screen is given to select the item to change.

Instruction:

To change manufacturer enter a 1. If you elect to change manufacturer, you will automatically be asked to select a new assembly type from the list of that manufacturer's assembly types. You will also be required to select new parts since the hardware will vary from one assembly type to another. To change other criteria enter that item number.

In this example, 5 is chosen to change burnup.



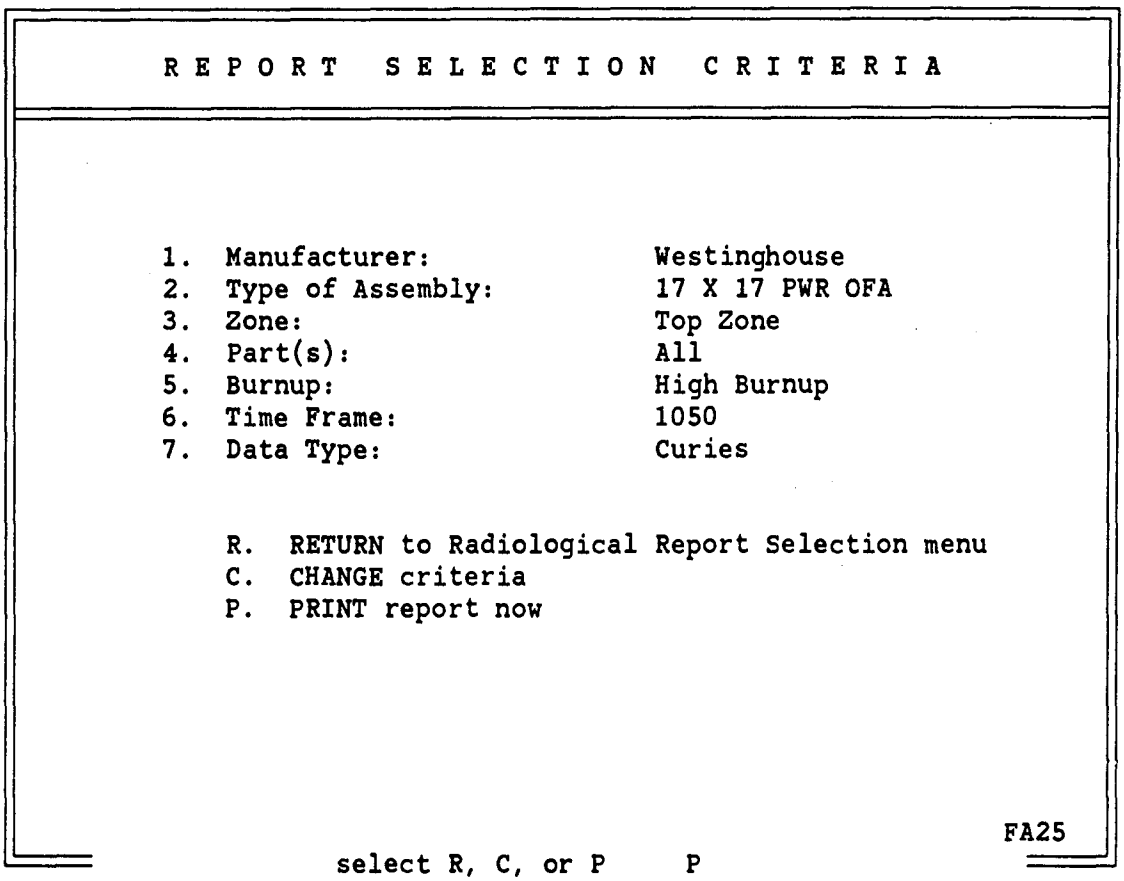
Description:

This screen offers a choice of two representative burnups. In this case, an assembly type designed for use in PWRs is selected so standard burnup reflects 33,000 MWd/MTIHM and high 60,000 MWd/MTIHM.

Instruction:

Select 1 or 2 for burnup, R to return to the Report Selection Criteria menu or X to exit to DOS. Press the enter key after your selection is made.

In this example, 2 is chosen for a high burnup.



Description:

Note that the value for the burnup has been changed from Standard to High.

Instruction:

Enter C to change other criteria, R to return to Radiological Report Selection menu or P to print the report. To print this report requires an online 132-column printer.

In this example, P is selected to print the report.

Spent Fuel Disassembly Hardware
for a
Westinghouse 17 X 17 OFA

Top Zone | High Burnup | 1050 years after discharge | Units are Curies

Component Name	Inconel-718	St. Steel 304	Isotope Total
HOLDDOWN SPRING	(0.9600 kg)		
C 14	1.835E-03		1.835E-03
Ni 59	2.378E-02		2.378E-02
Ni 63	1.227E-03		1.227E-03
Zr 93	5.812E-08		5.812E-08
Nb 93m	5.522E-08		5.522E-08
Nb 94	3.612E-03		3.612E-03
Mo 93	3.412E-05		3.412E-05
Tc 99	2.109E-06		2.109E-06
	3.048E-02		
TOP NOZZLE	(6.8900 kg)		
Be 10		5.149E-10	5.149E-10
C 14		1.317E-02	1.317E-02
Ni 59		2.928E-02	2.928E-02
Ni 63		1.510E-03	1.510E-03
Zr 93		7.434E-10	7.434E-10
Nb 93m		7.062E-10	7.062E-10
Nb 94		4.671E-05	4.671E-05
		4.401E-02	

Spent Fuel Disassembly Hardware
for a
Westinghouse 17 X 17 OFA

Top Zone High Burnup 1050 years after discharge Units are Curies

Total zone weight: 7.850000 kg. Total zone volume: 0.0009763 cu m.

Top Zone Totals by isotope:

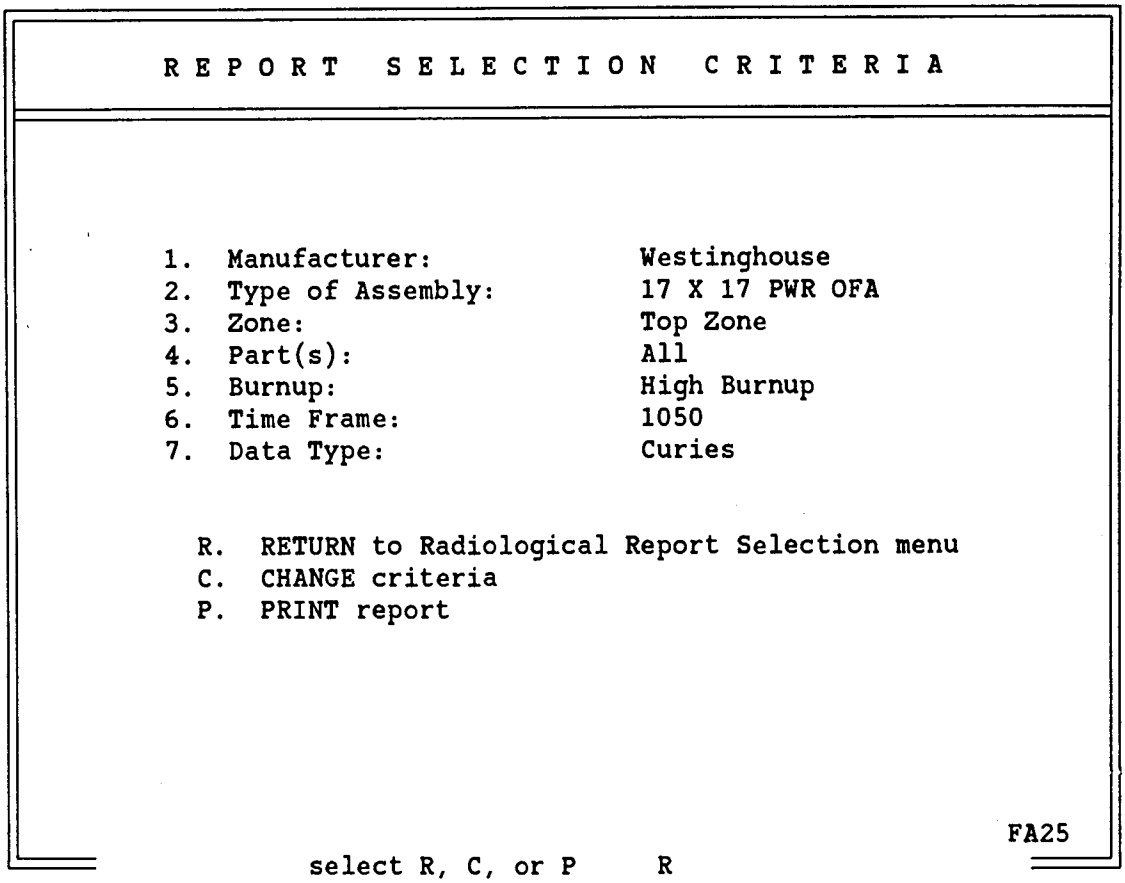
Isotope	Curies	Curies/kg	Curies/cu m	Class C Limit	Ratio
Be 10	5.149E-10	6.559E-11	5.274E-07		
C 14	1.500E-02	1.911E-03	1.536E+01	80.00	1.920E-01
Ni 59	5.306E-02	6.759E-03	5.435E+01	220.00	2.470E-01
Ni 63	2,737E-03	3.487E-04	2.803E+00	7000.00	4.005E-04
Zr 93	5.886E-08	7.498E-09	6.029E-05		
Nb 93m	5.593E-08	7.125E-09	5.729E-05		
Nb 94	3.659E-03	4.661E-04	3.748E+00	0.20	1.874E+01
Mo 93	3.412E-05	4.346E-06	3.495E-02		
Tc 99	2.109E-06	2.687E-07	2.160E-03		

Top Zone Totals by material:

Inconel-718	St. Steel 304
3.048E-02	4.401E-02

Top Zone Totals by material in kilograms:

Inconel-718	St. Steel 304
0.9600	6.8900



Description:

When the report is complete, you return to this screen.

Instruction:

Enter C to change criteria, R to return to Radiological Report Selection menu or P to print the report.

In this example, R is chosen to return.

```
R A D I O L O G I C A L   R E P O R T   S E L E C T I O N

1. Radiological Description of the Spent Fuel Disassembly
   Hardware for a Specific Assembly Type

2. Radiological Description of the Components Within a
   Specific Zone for a Specific Assembly Type

3. Radiological Description of a Specific Material in
   a Specific Zone

        R.  RETURN to previous menu
        X.  EXIT the data base system

                                                    FA04
        select 1-3, R, or X    3
```

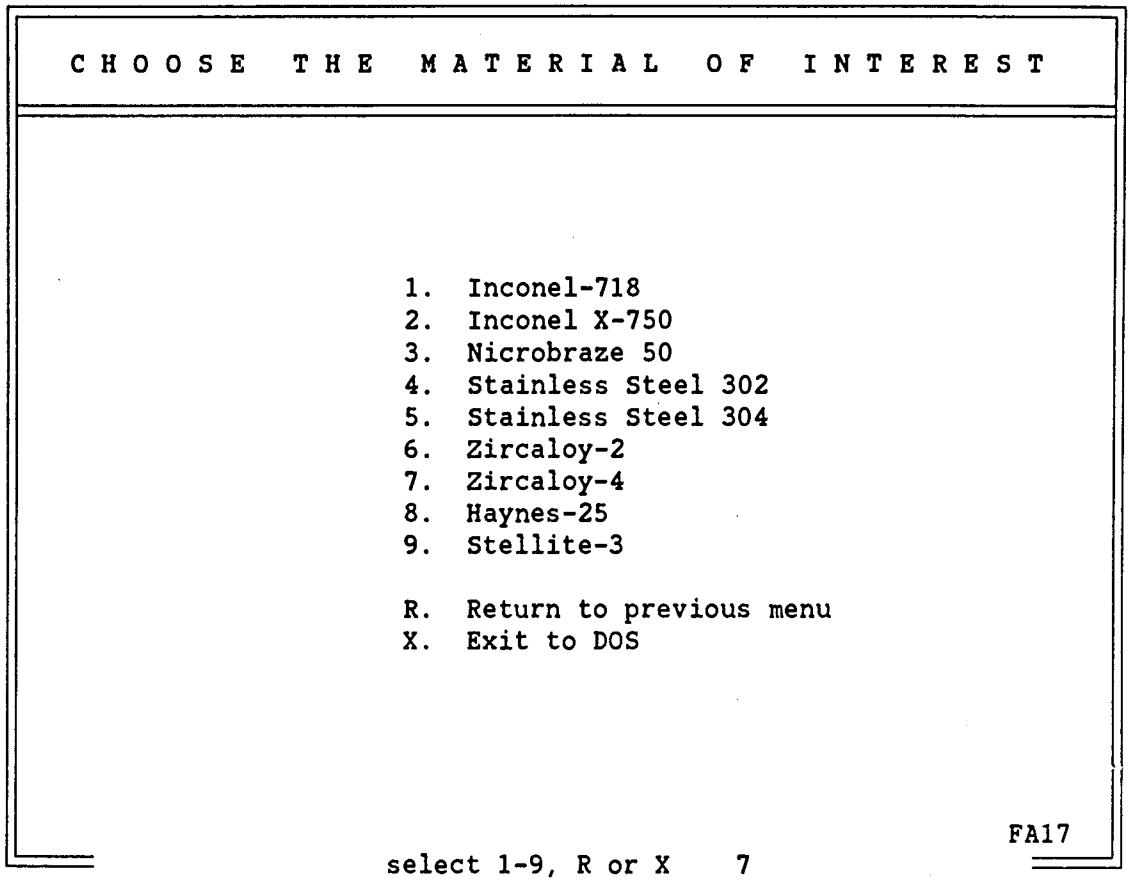
Description:

This screen offers radiological description reports for all or some of the SFD hardware associated with an assembly type or a report for a particular material of construction.

Instruction:

Enter 1, 2, or 3 to select the report option you want or R to return to information type selection menu or X to exit. Press the enter key after making your selection.

In this example, 3 is selected for a radiological description report of a specific material.



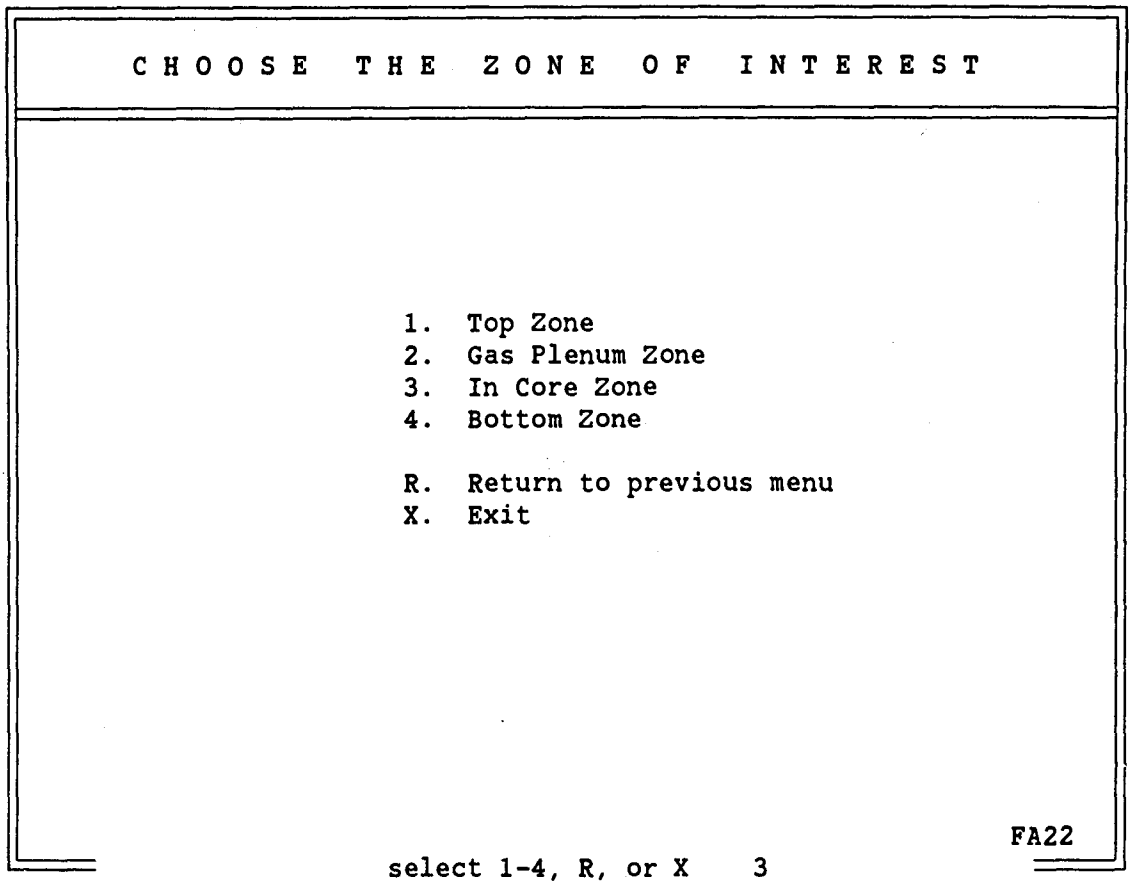
Description:

This menu offers a choice of materials used to construct LWR assembly hardware.

Instruction:

Select the material you are interested in and press the enter key, or select R to return to previous menu or X to exit.

In this example, a report on Zircaloy-4 is requested by selecting 7.



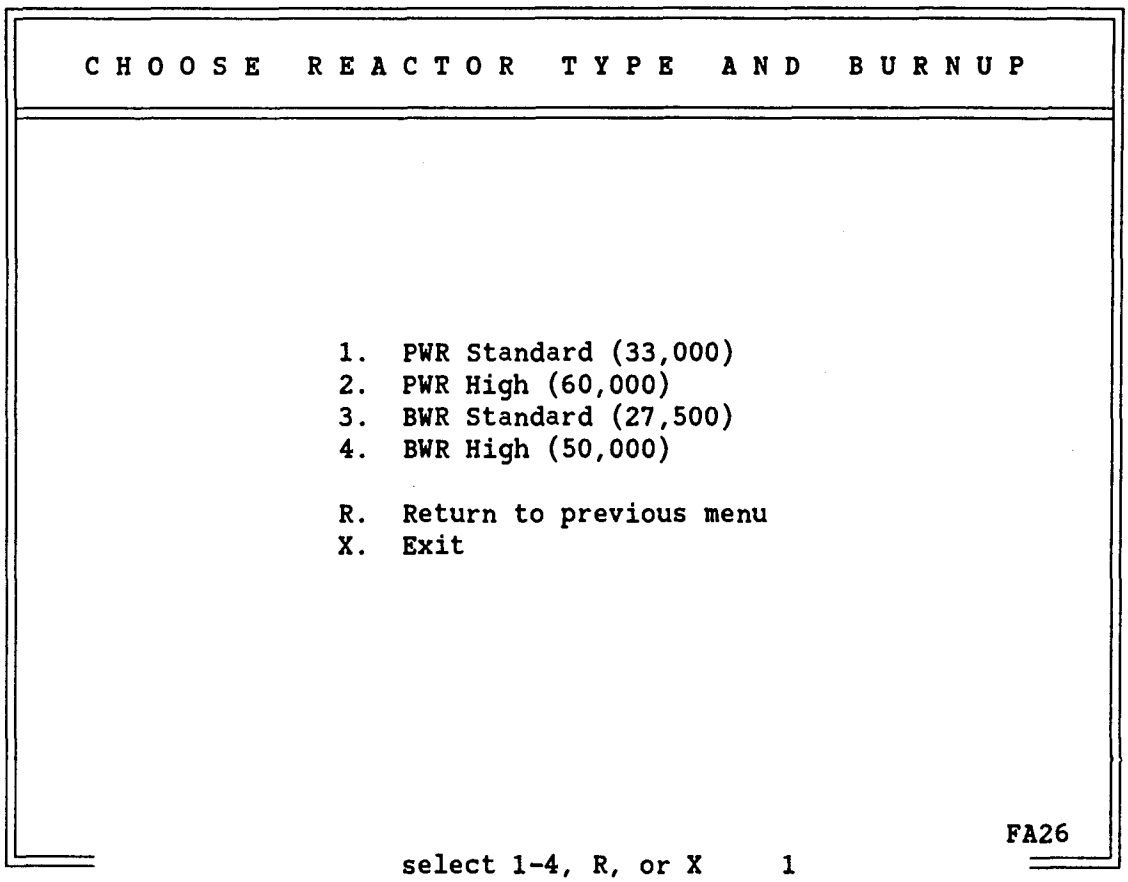
Description:

The radiological report for the material will be based on a particular exposure dependent upon what zone the material would reside in. Choose one of the 4 neutron exposure zones.

Instruction:

Select 1 through 4 for a zone or R to return to material selection screen or X to exit.

In this example, 3 is selected for the In Core Zone.



Description:

This screen instructs you to choose the reactor type and burnup that you wish to have the Material Radiological Description Report run for. Here you see, the 4 burnup cases that exist.

Instruction:

Choose the burnup and reactor type you are interested in and press the enter key. You may select R to return to the zone selection menu or X to exit to DOS.

In this example, 1 is selected for a standard burnup in a PWR.

```
                    T I M E   F R A M E   S E L E C T I O N

        1.    0            9.     50           17.      2,000
        2.    1           10.    100           18.      5,000
        3.    2           11.    200           19.     10,000
        4.    5           12.    300           20.     20,000
        5.   10           13.    350           21.     50,000
        6.   15           14.    500           22.    100,000
        7.   20           15.  1,000           23.    500,000
        8.   30           16.  1,050           24.  1,000,000

                    R.  RETURN to previous menu
                    X.  EXIT the data base system

                    (all numbers are in years)

                                                              FA19
                    select 1-24, R, or X    9
```

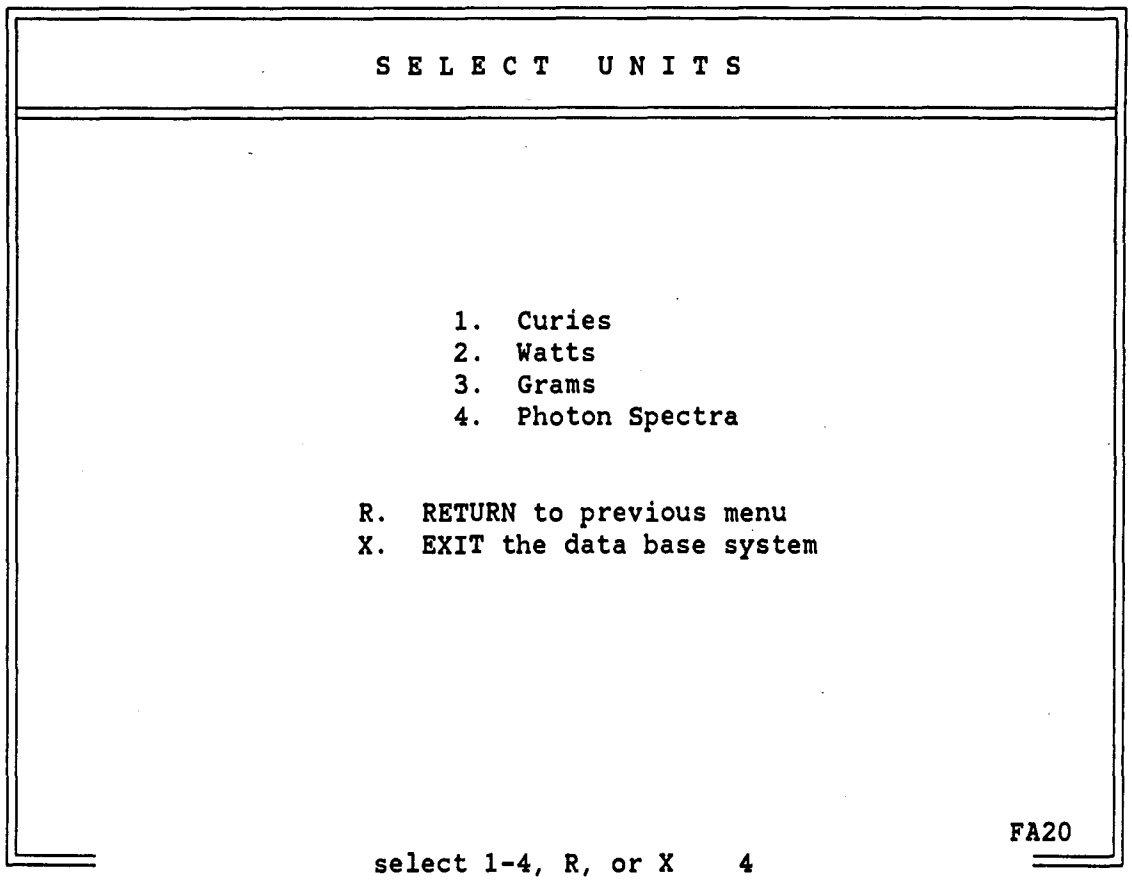
Description:

This screen instructs you to select the time frame you want for the Radiological Description Report. All times are expressed in years after discharge.

Instruction:

Enter the number, 1 to 24, designating the desired time frame. R will return to Burnup and Reactor Type Selection or X will exit to DOS. Press the enter key after making a selection.

In this example, 9 is selected for a time of 50 years after discharge from the reactor.



Description:

This screen instructs you to select the type of units you want the Radiological Description Report to contain. Curies, watts, and grams are reported by isotope and photon spectra are reported by energy.

Instruction:

Select desired unit by choosing 1 through 4 or R to return to time frame selection menu or X to exit to DOS.

In this example, 4 is selected to choose photon spectra.

```
R E P O R T   S E L E C T I O N   C R I T E R I A

1.  Material:                 Zircaloy-4
2.  Zone:                     In Core Zone
3.  Reactor Type & Burnup:    PWR Standard (33,000)
4.  Time Frame:               50
5.  Data Type:                PHOTON

    R.  RETURN to Radiological Report Selection Menu
    C.  CHANGE criteria
    P.  PRINT report

                                                    FA28
          select R, C, or P     P
```

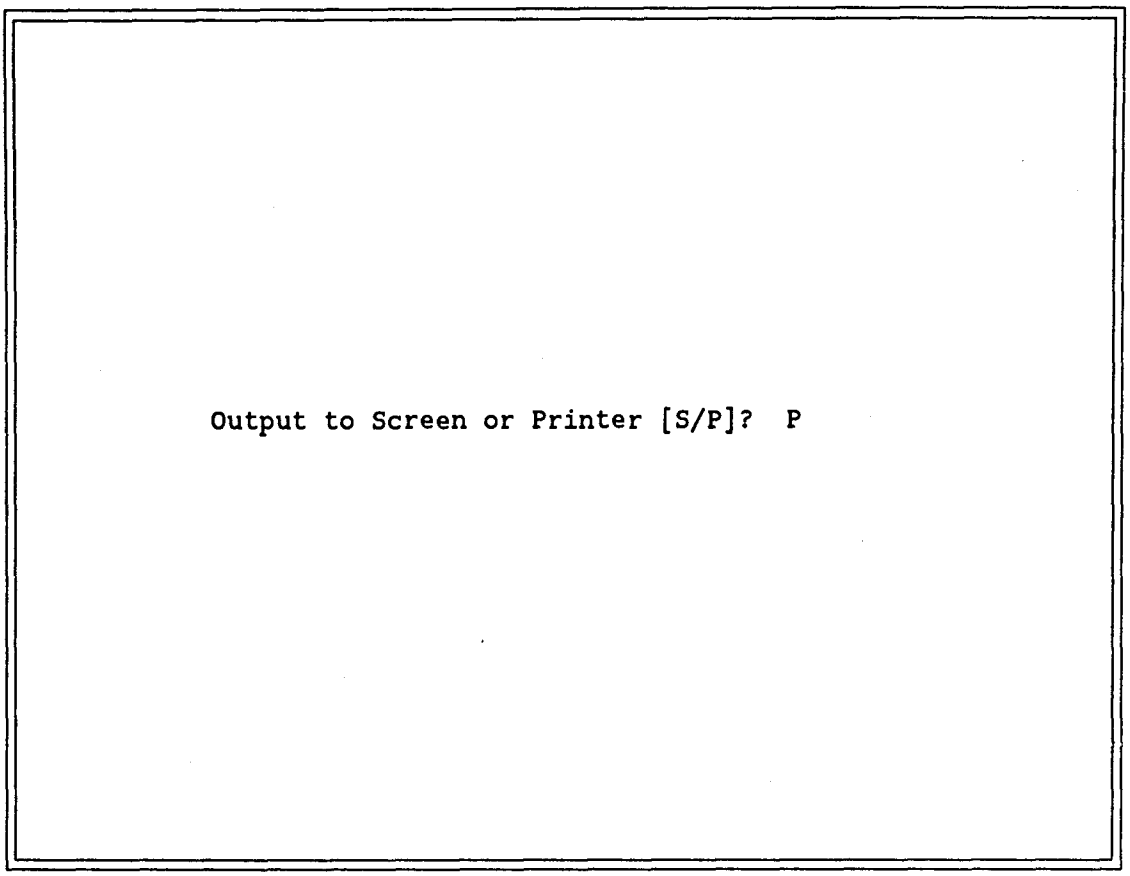
Description:

This menu displays all the selections you have made for a report. You can now print the report or change one of the selections or abandon the entire operation by returning to the Radiological Report Selection menu.

Instruction:

Enter C to change a selection. You will be prompted to choose the item you wish to change. Enter R to return or P to print the report. You will be asked if you want the report on the screen or the printer.

In this example, P is chosen to get the report.



Description:

The radiological report can be viewed on the screen or the printer. If you choose the screen, the report will pause each time the screen fills up. You must press any key to continue to the next screen. You will be prompted to do this. If you elect to print the report, you should have an online printer.

In this example, P is selected to send the report to the printer.

Photon Spectra
for
Zircaloy-4

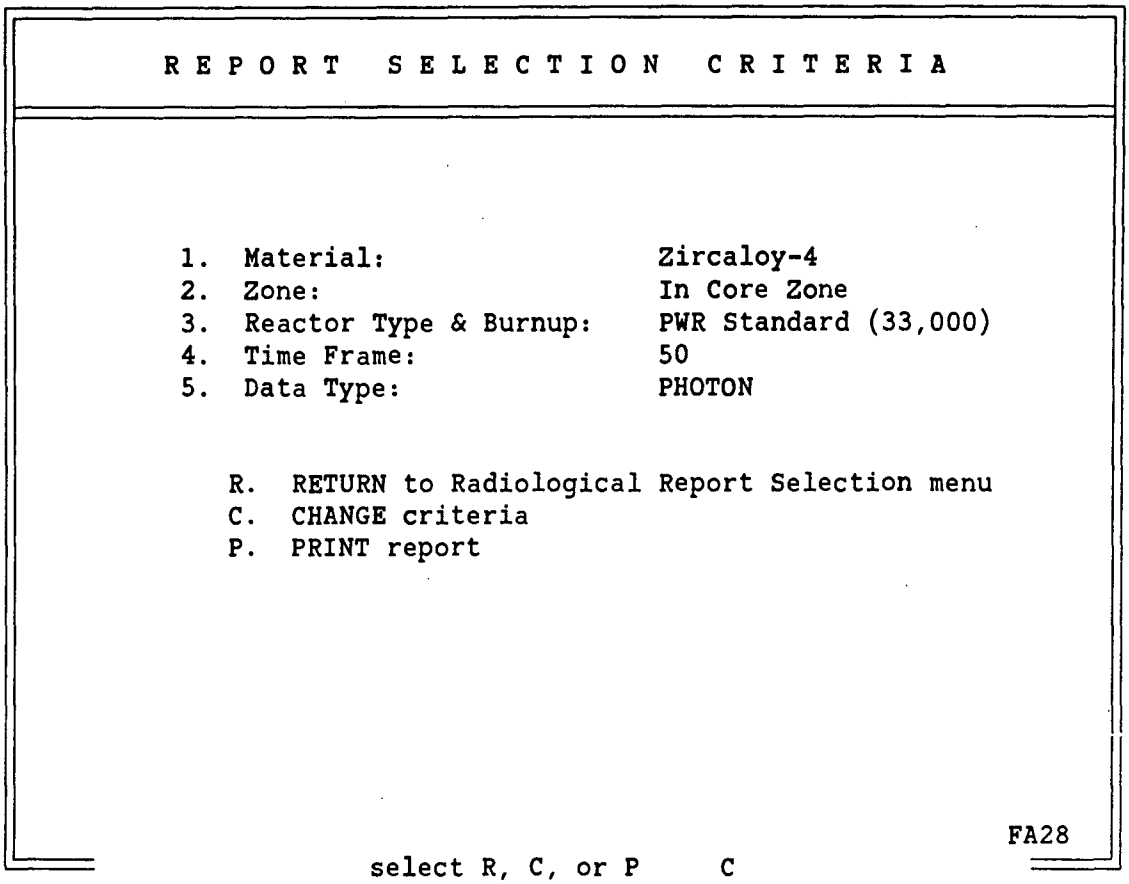
Reactor type: PWR
In Core Zone

Burnup: Standard (33,000)
50 year(s) after discharge

Mean Energy (MeV)	Photons/sec
0.0100	8.710E+06
0.0250	1.425E+06
0.0375	6.073E+05
0.0575	4.910E+05
0.0850	1.858E+05
0.1250	7.712E+04
0.2250	8.702E+04
0.3750	3.253E+05
0.5750	4.103E+05
0.8500	1.450E+07
1.2500	1.070E+08
1.7500	9.380E+00
2.2500	5.672E+02
2.7500	1.755E+00
3.5000	2.536E-14

(Values are per kg of material)

At the end of the report, you return to the Report Selection Criteria menu.



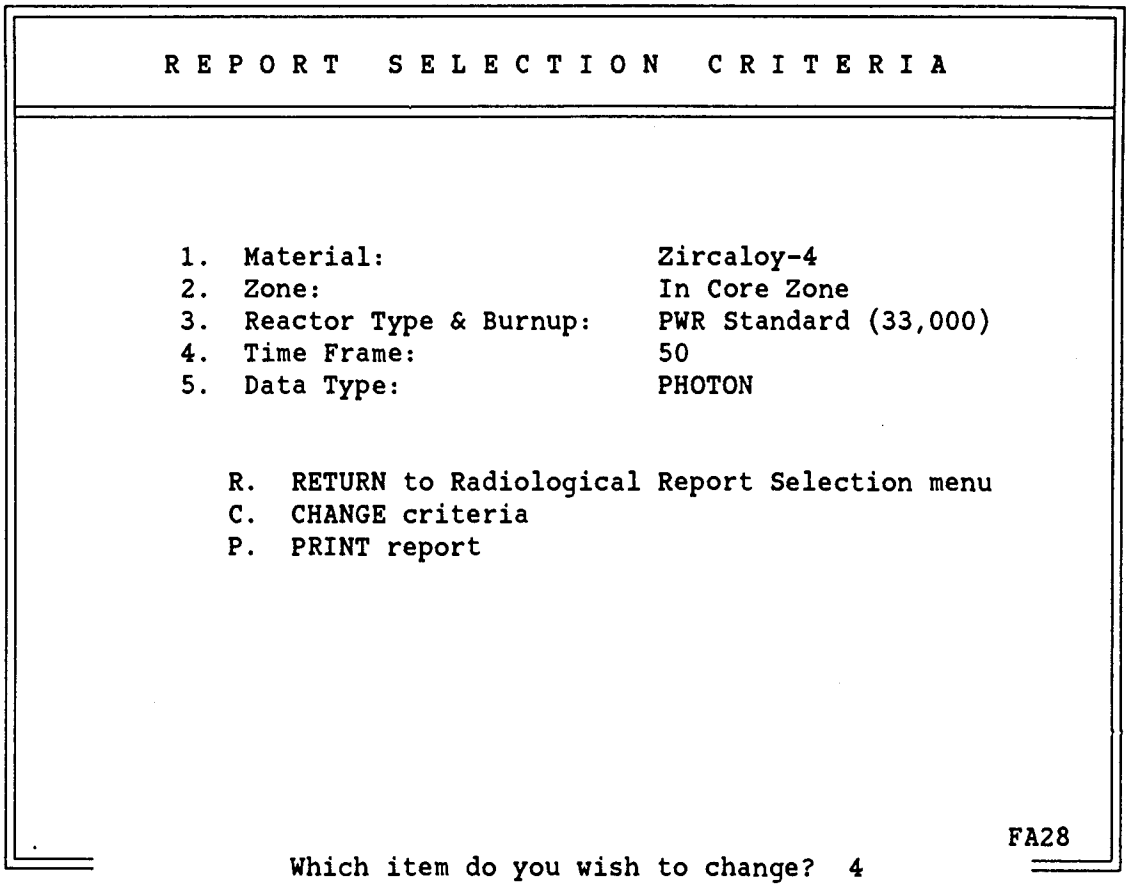
Description:

Upon completion of the report, this screen is displayed. Again, the user may change criteria, print the report or return to the Radiological Report Selection menu.

Instruction:

Enter C to change criteria, R to return or X to Exit to DOS.

In this example, C is entered to change criteria.



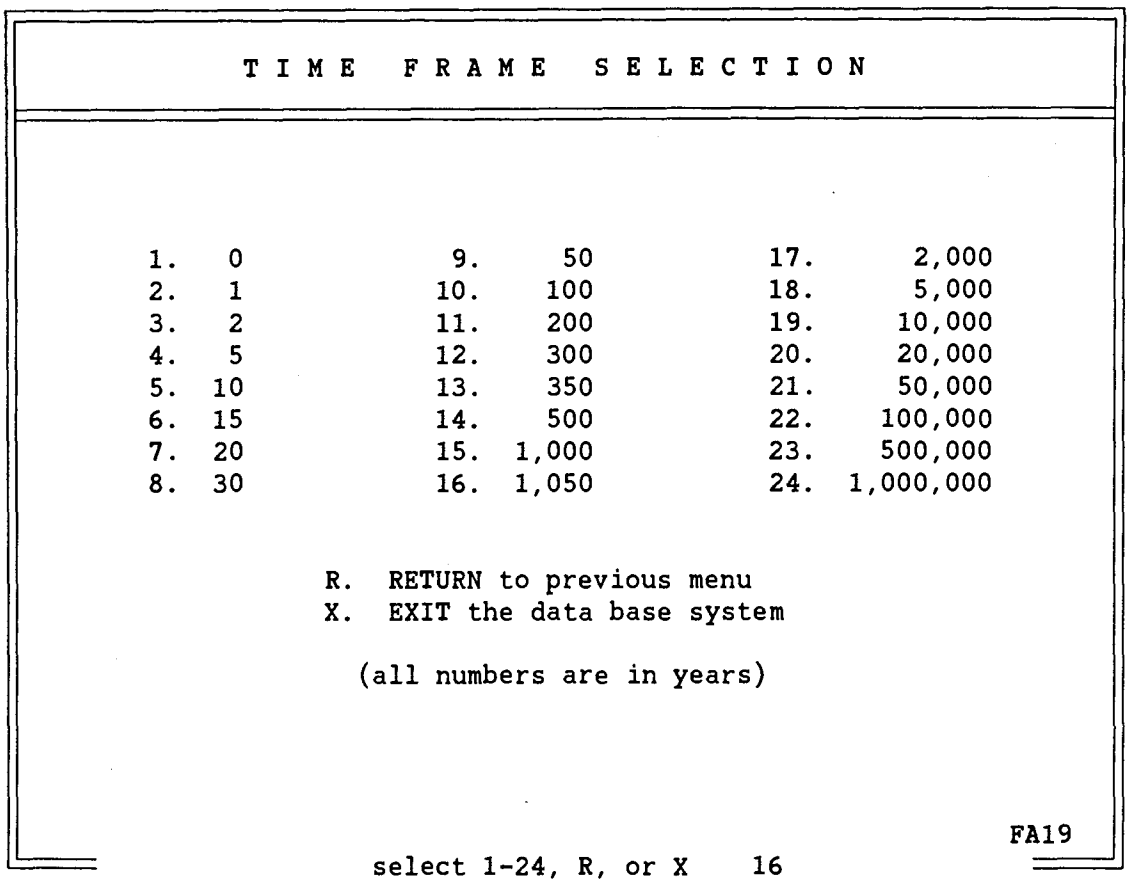
Description:

Having selected a change in criteria, you must select the item to change by number.

Instruction:

Enter the number, 1 through 5, of the selection you wish to change and press the enter key.

In this example, item 5 is entered to indicate a change in time frame.



Description:

This screen instructs you to select the time frame you want for the Radiological Description Report. All times are expressed in years after discharge.

Instruction:

Enter 1 through 24 for the desired time frame. Enter R to return to the Report Selection Criteria menu without changing the currently selected time frame. Enter X to exit to DOS. Press the enter key after your selection is made.

In this example, the time frame is changed to 1,050 years after discharge by selecting 16.

```
                    R E P O R T   S E L E C T I O N   C R I T E R I A


     1.  Material:                    Zircaloy-4
     2.  Zone:                        In Core Zone
     3.  Reactor Type & Burnup:       PWR Standard (33,000)
     4.  Time Frame:                  1050
     5.  Data Type:                   PHOTON

        R.  RETURN to Radiological Report Selection Menu
        C.  CHANGE criteria
        P.  PRINT report

                                                                    FA28
                        Select R, C, or P    P
```

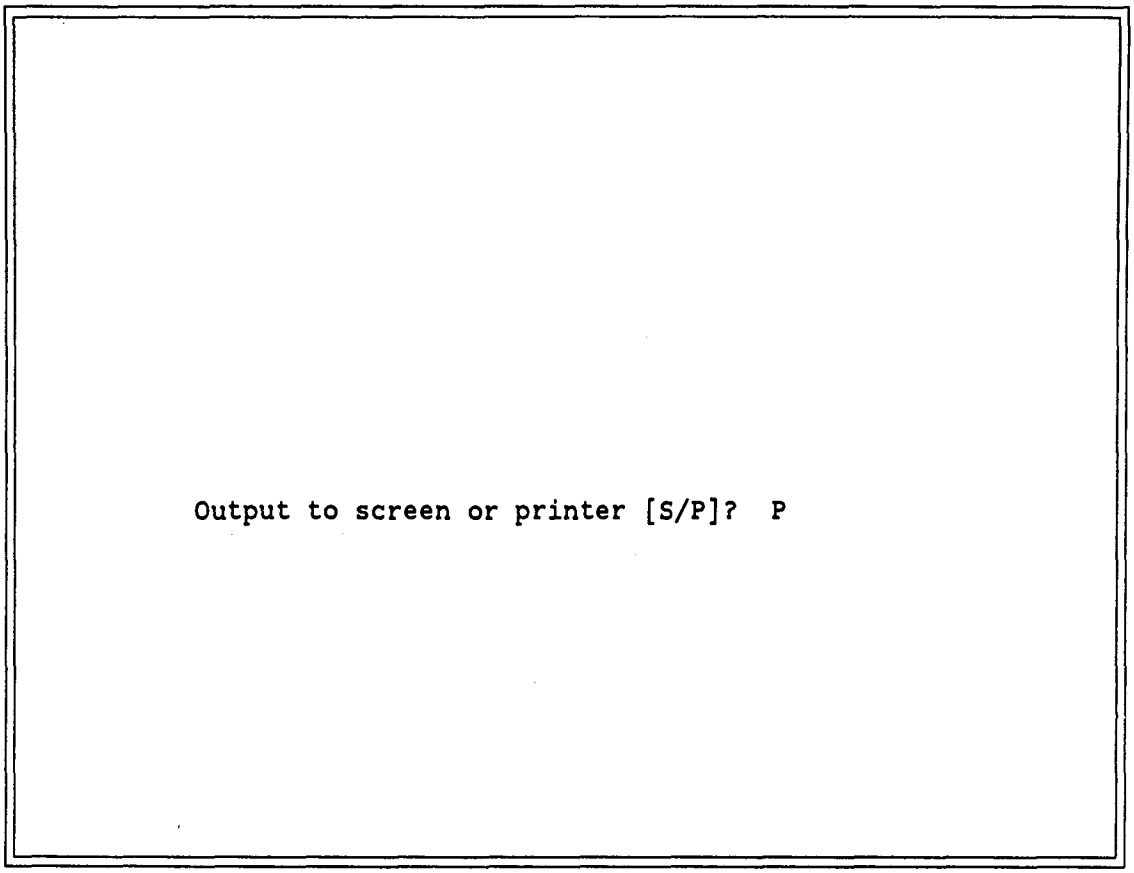
Description:

Note the change in time frame from 50 to 1,050 years after discharge. The report can be printed now, or another change can be made, or you may return to the Radiological Report Selection menu.

Instruction:

Enter C to change criteria, P to print the report or R to return.

In this example, P is chosen to get a report.



Description:

Selection of a printed report or viewing the report on the screen is offered here.

Instruction:

Enter S to view the report on the screen or P to print the report. The printer should be online before selecting the print option.

In this example, P is selected for a hard copy of the report.

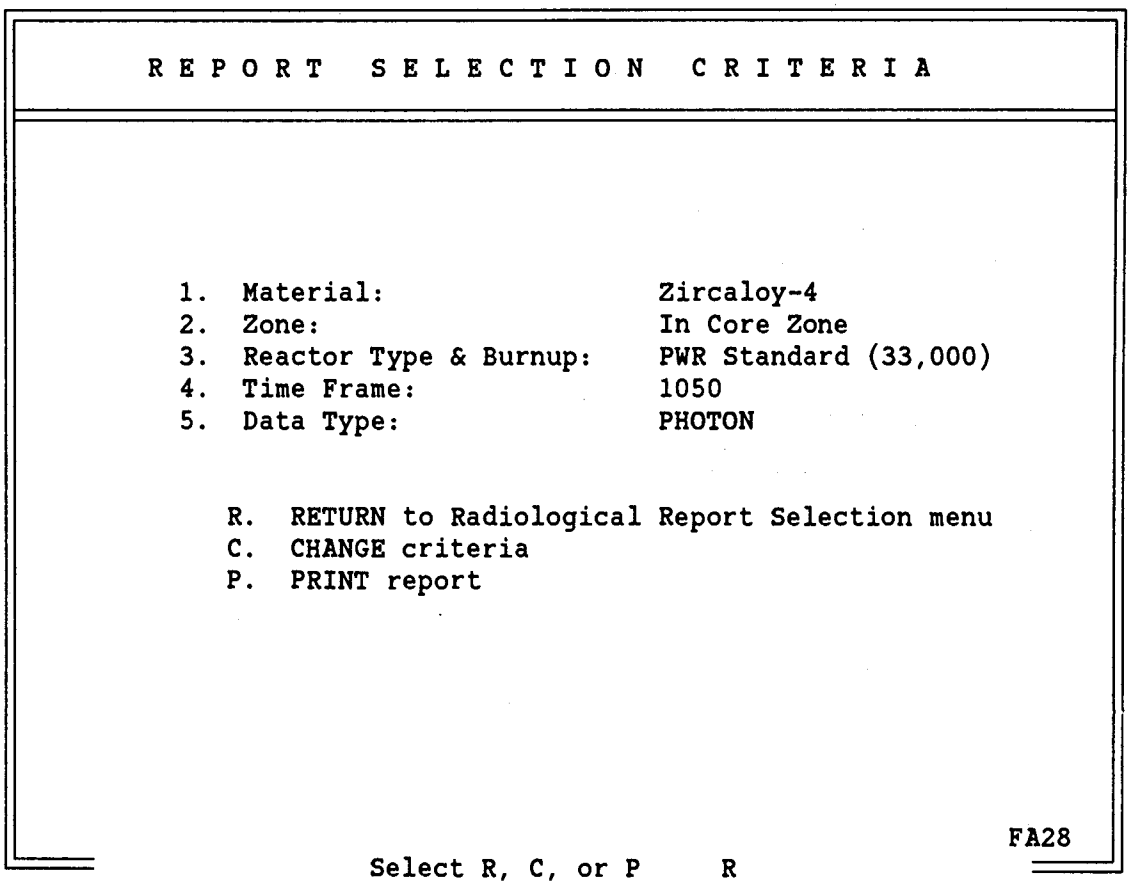
Photon Spectra for Zircaloy-4

Reactor Type: PWR
In Core Zone

Burnup: Standard (33,000)
1050 year(s) after discharge

Mean Energy (MeV)	Photons/sec
0.0100	5.639E+06
0.0250	2.924E+05
0.0375	1.519E+05
0.0575	1.496E+05
0.0850	5.101E+04
0.1250	2.053E+04
0.2250	1.228E+04
0.3750	1.519E+05
0.5750	1.496E+05
0.8500	5.101E+04
1.2500	2.053E+04
1.7500	9.718E-08
2.2500	1.228E+04
2.7500	1.224E-20
3.5000	1.178E-21

(Values are per kg of material)



Description:

This screen is displayed when the report is complete. You may now change criteria, return to the Radiological Report Selection menu, or print a report.

Instruction:

Enter C to change criteria, R to return or P to get a report.

In this example, R is selected to return to the Radiological Report Selection Menu.

```
R A D I O L O G I C A L   R E P O R T   S E L E C T I O N

1.  Radiological Description of the Spent Fuel Disassembly
    Hardware for a Specific Assembly Type

2.  Radiological Description of the Components Within a
    Specific Zone for a Specific Assembly Type

3.  Radiological Description of a Specific Material in
    a Specified Zone

        R.  RETURN to previous menu
        X.  EXIT the data base system

                                                        FA04
            select 1-4, R or X    X
```

Description:

This screen allows access to any one of the radiological reports. You may also return to the Select Type of Information screen so that you can access the physical description reports. In addition, the exit option will return to DOS.

Instruction:

Enter 1 through 3 for the desired radiological report selection, R to return to the select type of information screen or X to exit DOS.

In this example, X is selected to exit the data base and return to DOS. This ends the sample menu session of the LWR Assemblies data base system.

Glossary

Bernoulli Cartridge - The removable storage media which holds the LWR Radiological data base.

Bernoulli Drive - The mechanical device which reads Bernoulli cartridges. Yours will have either one or two cartridge slots.

Boot - Start your computer by turning on the power or press the <Ctrl><Alt><Del> key combination simultaneously.

DOS - Disk Operating System. The basic operating software which controls the functioning of your computer. DOS may also be called PC-DOS or MS-DOS which are registered trademarks of IBM and Microsoft, respectively.

DOS Prompt - The characters which DOS displays on your screen to indicate that it is ready for you to enter a command. The actual characters displayed will vary depending on the configuration of your computer. Examples: A>, C>, C:\>.

DOS search PATH - The PATH command in DOS allows you to specify a list of subdirectories be searched for programs if the program which you attempt to run is not present in your current directory.

Formatted Floppy - A formatted diskette is one which has been prepared for use, using the FORMAT command of DOS. See your DOS documentation for instructions on how to format a floppy.

Conventions

In this document, when you are expected to type in text which is underlined. Special keys on the keyboard are represented by the key label surrounded by angle brackets. For example, the enter key is shown as <Enter>, the escape key is shown as <Esc>, etc. Text and special keys on the same line are all underlined (for example the DOS directory command would be shown as dir<Enter>).

Printing a Snapshot of the Screen

If a printer has been attached to the system, hardcopy of what appears on the screen can be made by holding down <Shift> and pressing <PrtSc>. The page will not be ejected automatically. If you do not know how to eject the paper in your printer, consult your printer's owners manual.

APPENDIX 2C

USER'S GUIDE TO THE LWR RADIOLOGICAL DATA BASE

TABLE OF CONTENTS

1.0 INTRODUCTION

The LWR Radiological Database contains a large amount of data about the radiological properties of LWR spent fuel. The database actually consists of these 3 parts.

1. The Main LWR Radiological Database System that includes the radioactivity (curies), mass (grams), and heat output (watts) of LWR spent fuel. This part was the first one developed and has by far the greatest amount of data. It is distributed on 25 floppy diskettes or 1 10 Mb Bernoulli cartridge.
2. The Spent Fuel Photon and Neutron Database System that includes photon spectra and neutron source data for LWR spent fuel. It is distributed on 2 floppy diskettes or 1 10 Mb Bernoulli cartridge.
3. The Totals and Calculated Integral Heat Release database that contains total curies, grams, and watts figures, as well as calculated integrated heat release values. This database is distributed on 1 floppy diskette.

These 3 systems are grouped together because they all contain data about LWR spent fuel. The have all been developed at ORNL and are very similar in design and operation. The 3 parts can be distributed together or separately, to fit your needs.

This user's guide contains information about the contents, installation, and operation of all 3 database systems. Sections 2 through 6 describe the Main LWR Radiological Database System. Sections 7 through 10 describe the Spent Fuel Photon and Neutron Database. Section 11 covers the Totals and Calculated Integral Heat Release database.

The sections for each database system have been written to be a complete guide for that system. In some cases, there are parts repeated in all three major parts of this user's guides, in order that the three parts would contain complete information. If you are interested in only 1 part of the LWR Radiological Database System, you will only need to read the sections that pertain to that database.

PART 1 -- LWR RADIOLOGICAL DATA BASE SYSTEM

2.0 INTRODUCTION

This User's Guide is for the LWR Radiological Data Base System of the Waste Characterization Data Base. It is Appendix 2C of the report - Characteristics of Potential Repository Wastes. The LWR Radiological Data Base contains data describing the radioactivity (curies), mass (grams), and heat output (watts) for light water reactors. Data for thirteen different burnups for pressurized water reactors (PWRs) and 9 different burnups for boiling water reactors (BWRs) have been generated using the ORIGEN2 computer code and stored in the data base for retrieval by the user.

2.1 SYSTEM CAPABILITIES

The LWR Radiological Data Base System is a user-friendly, interactive menu-driven computer program. It can provide screen, printer, and disk file output of all available on-line data. Its unique non-hierarchical design allows you to change any of your selections whenever you wish without the need to recycle through a series of menus. Your current selections appear on the screen at all times, allowing easy review should you ever forget what information you had requested.

2.2 OPERATING ENVIRONMENT

The LWR Radiological Data Base System is written in dBASE III and distributed in compiled form, using Nantucket's Clipper compiler. You do not have to own a copy of Ashton-Tate's dBASE III to run the system. It will operate on any MS-DOS based personal computer (such as IBM PCs and compatibles) with at least 512kb of memory, and an Iomega 10mb removable cartridge drive (Bernoulli Box). The system is distributed on one 10mb Bernoulli cartridge.

2.3 HARDWARE REQUIREMENTS

To run the LWR Radiological Data Base, you must have the following computer hardware.

Hardware	Demand
IBM compatible PC	Required
Bernoulli Drive or Fixed Disk	Required (Bernoulli recommended)
512kb of memory	Required
Printer	Recommended

3.0 DESCRIPTION OF DATA AVAILABLE

The LWR Radiological Data Base System provides you access to a large amount of data on the decay characteristics of both PWR and BWR reactors. Described in this section are the data available, and a list of selection options.

3.1 LIST OF AVAILABLE OPTIONS

In order to define what data you wish to retrieve there are four basic selections which must be made before any data can be retrieved. These are: reactor type and burnup, measure desired, decay period, and cutoff accuracy. The options for reactor type and burnup are:

PWRs:	5,000	10,000	15,000	20,000	25,000
	30,000	33,000	35,000	40,000	45,000
	50,000	55,000	60,000		
BWRs:	5,000	10,000	15,000	20,000	25,000
	27,500	30,000	35,000	40,000	

Measure desired refers to the physical property in which the user is interested. This can be the mass, radioactivity, or the thermal output. The options for the measure
desired are:

Measure Desired: Grams, Curies, and Watts.

The options for decay time are in years. There are 38 time periods available. These are:

Data Available:	1	2	3	4	5
	6	7	8	9	10
	16	18	20	25	30
	40	50	60	70	80
	90	100	200	300	400
	500	1000	2000	3000	5000
	10000	30000	40000	50000	100000
	200000	500000	1000000		

Lastly, you may select to see all isotopes generated by ORIGEN2 matching your request or you may choose to include only those isotopes greater than one of four cutoff limits. The limits are:

Accuracy Limits Available:	Contributing greater than 1% of the total.
	Contributing greater than 0.1% of the total.
	Contributing greater than 0.01% of the total.
	Contributing greater than 0.001% of the total.
	All Isotopes.

You can also choose the following output destinations of the data: screen, printer, or disk file. A useful method of system operation is to leave the output directed to the screen (its initial setting) until you are satisfied that you have found the data you were looking for, and then switch the output direction to the printer to generate hard-copy.

You may also find it useful to direct your output to a disk file so that you can use the data file as input to another program or a word processor. If you choose to send data to a disk file, you will be prompted for the name of the file to which the data will be written. If the file already exists, the system will ask if you want to append data to the existing file, or overwrite the old file with the new data.

3.2 PROGRAM OPERATION FLOWCHART

Figure 1 on the next page is a flowchart of all possible selections which you can make in the LWR Radiological Data Base System. As the diagram shows, after you must first make your initial selections, you will come to the "Enter Your Selection" box on the chart. From this point, you can generate the desired output (using option R), change any single selection criterion currently chosen (options A, B, C or D), sequence back through questions A thru D (option S), change whether the output is directed to the screen, printer, or disk file (option E), or exit the program (option X). These options provide a quick and easy mechanism for retrieving similar, but slightly different data from the database. All choices which you have previously made are displayed on the screen for your reference.

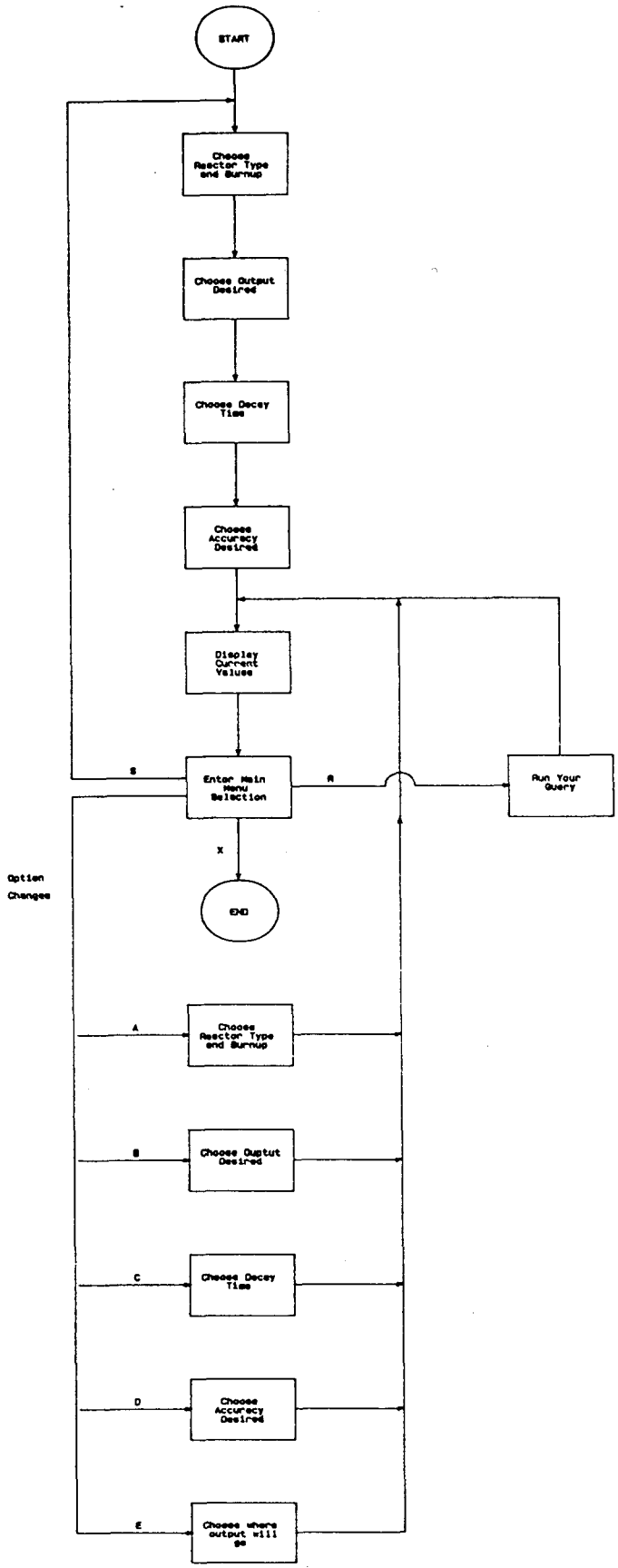


Figure 1. Program Operation Flowchart

4.0 SAMPLES OF DATA AVAILABLE

This section contains three sample reports generated by the LWR Radiological Database system. The reports have the same format, but contain different data selections.

The following reports are included:

Figure	Reactor Type & Burnup	Output Desired	Decay (Years)	Accuracy
2	PWR 15,000	Watts	5	All Isotopes
3	BWR 27,500	Grams	10	> 0.1 %
4	BWR 10,000	Curies	5000	> 1 %

The options which determined what data was included on each report are printed on the top of the report.

Spent Fuel Repository Characteristics Data Base
Developed by: Oak Ridge National Laboratory, Oak Ridge, TN.

Type of Reactor: PWR 15,000 Elapsed Decay: 5 years
All isotopes representing: All isotopes

Isotope	Watts	Percentage of Total
H 3	4.49E-03	0.001 %
MN 54	4.48E-02	0.006 %
FE 55	2.42E-02	0.003 %
CO 60	2.95E+01	3.939 %
NI 63	1.15E-01	0.015 %
ZN 65	1.58E-03	0.000 %
KR 85	5.36E+00	0.716 %
SR 90	3.96E+01	5.287 %
Y 90	1.89E+02	25.234 %
NB 94	5.62E-03	0.001 %
RU106	4.08E-01	0.054 %
RH106	6.58E+01	8.785 %
AG110M	7.15E-02	0.010 %
CD113M	2.44E-02	0.003 %
SN119M	1.04E-02	0.001 %
SB125	6.48E+00	0.865 %
TE125M	4.25E-01	0.057 %
CS134	6.69E+01	8.932 %
CS137	4.70E+01	6.275 %
BA137M	1.58E+02	21.095 %
CE144	6.33E+00	0.845 %
PR144	7.01E+01	9.359 %
PR144M	3.92E-02	0.005 %
PM147	1.08E+01	1.442 %
SM151	2.94E-02	0.004 %
EU152	3.01E-02	0.004 %
EU154	1.24E+01	1.656 %
EU155	6.25E-01	0.083 %
PA234M	1.59E-03	0.000 %
U234	4.29E-02	0.006 %
U235	1.02E-03	0.000 %
U236	4.32E-03	0.001 %
U237	1.68E-03	0.000 %
U238	8.17E-03	0.001 %
NP237	3.10E-03	0.000 %
NP239	2.15E-03	0.000 %
PU236	9.93E-04	0.000 %
PU238	1.08E+01	1.442 %
PU239	7.86E+00	1.049 %
PU240	7.10E+00	0.948 %

Figure 2. Example Report 1.

PU241	1.12E+00	0.150 %
PU242	6.73E-03	0.001 %
AM241	1.19E+01	1.589 %
AM242	1.70E-03	0.000 %
AM243	2.86E-02	0.004 %
CM242	1.35E-01	0.018 %
CM243	2.60E-02	0.003 %
CM244	1.02E+00	0.136 %
Subtotal Watts =	7.49E+02	100.000 %
Total all isotopes =	7.49E+02	

Figure 2. (continued) Example Report 1.

Spent Fuel Repository Characteristics Data Base
Developed by: Oak Ridge National Laboratory, Oak Ridge, TN.

Type of Reactor: BWR 27,500 Elapsed Decay: 10 years
All isotopes representing: > 0.100 % of Total

Isotope	Grams	Percentage of Total
O 16	1.35E+05	7.714 %
CR 52	7.79E+03	0.445 %
FE 56	2.84E+04	1.623 %
NI 58	4.61E+03	0.263 %
NI 60	1.83E+03	0.105 %
ZR 90	2.80E+05	16.000 %
ZR 91	6.19E+04	3.537 %
ZR 92	9.59E+04	5.480 %
ZR 94	9.95E+04	5.686 %
ZR 96	1.69E+04	0.966 %
SN118	2.18E+03	0.125 %
SN120	2.96E+03	0.169 %
XE136	1.88E+03	0.107 %
U235	7.53E+03	0.430 %
U236	3.32E+03	0.190 %
U238	9.52E+05	54.400 %
PU239	4.83E+03	0.276 %
PU240	2.10E+03	0.120 %
Subtotal Grams =	1.71E+06	97.636 %
Total all isotopes =	1.75E+06	

Figure 3. Example Report 2.

Spent Fuel Repository Characteristics Data Base
Developed by: Oak Ridge National Laboratory, Oak Ridge, TN.

Type of Reactor: BWR 10,000 Elapsed Decay: 5000 years
All isotopes representing: > 1.000 % of Total

Isotope	Curies	Percentage of Total
TC 99	4.25E+00	1.455 %
PU239	1.89E+02	64.726 %
PU240	9.13E+01	31.267 %
Subtotal Curies =	2.85E+02	97.449 %
Total all isotopes =	2.92E+02	

Figure 4. Example Report 3.

5.0 INSTALLATION AND USE OF SOFTWARE

This section provides step by step information on how to install and start the LWR Radiological Database system. To use the LWR Radiological Database System you must have either a Bernoulli Cartridge Drive or a fixed disk. If you have a Bernoulli drive see section 5.1. If you do not have a Bernoulli drive but have a fixed disk, see section 5.2.

5.1 INSTALLATION AND STARTUP FOR SYSTEMS WHICH HAVE A BERNOULLI DRIVE

Follow the instructions in this section if you have a Bernoulli drive on your computer and have received the LWR Radiological Database System on a Bernoulli cartridge.

5.1.1 TRANSFER OF THE LWR RADIOLOGICAL DATABASE

There are no file transfer requirements if you use a Bernoulli drive. Proceed to section 5.1.2.

5.1.2 MAKING YOUR COMMAND.COM ACCESSIBLE

The LWR Radiological Data Base System needs access to DOS from within the program. In order to do this the file COMMAND.COM, which is included on your DOS diskette, must be located where it would normally be when you boot your computer. Choose the case below which is appropriate for your hardware configuration.

1. If you boot from a floppy drive, leave the DOS diskette in the floppy when you run the LWR Radiological system.
2. If you boot from a hard disk, this file will always be accessible.
3. If you boot from a single cartridge Bernoulli drive and have to change cartridges to run the system, do the following:
   A. Insert your DOS diskette (make sure the version number is consistent with the one on your boot Bernoulli).
   B. Assuming that your Bernoulli drive is labeled drive C: and that the LWR Radiological Bernoulli cartridge is in this drive, type in the following command:

      COPY A:COMMAND.COM C:*.*<Enter>

      You will see a message indicating that one file has been copied if the command was entered properly.
4. If you boot from a dual cartridge Bernoulli drive, leave the boot cartidge in the first drive and use the second drive for your LWR Radiological

cartridge.

5.1.3 MODIFYING YOUR CONFIG.SYS FILE

You must have another file located in the same place as your COMMAND.COM (discussed in the previous section) which tells your computer to allow enough open files to run the LWR Radiological Database System. This file is named CONFIG.SYS. You may already have such a file. If you already have this file, use the TYPE command to see if the file contains two lines like the ones below:

FILES = 20

BUFFERS = 24

As long as these lines are present, and the numerical values are as high as those shown (or higher) the system is configured properly.

If the CONFIG.SYS file exists, but these lines are missing or the values are too low you may use a text editor, such as DOS's EDLIN to modify the file. See your DOS documention for instructions on using EDLIN.

If no such file as CONFIG.SYS exists, you may create one by entering the commands following. This example assumes that the CONFIG.SYS file being created is on drive A:.

COPY CON: A:\CONFIG.SYS<Enter>

FILES = 20<Enter>

BUFFERS = 24<Enter>

<F6><Enter>

This will create a CONFIG.SYS file. You should create this file on the diskette, fixed disk, or Bernoulli cartridge from which you boot. If you had to change the CONFIG.SYS file you must now force DOS to read it. This can be done by pressing the following keys: <Ctrl><Alt><Del> all together. Once this file has been set up you do not need to change it again.

5.1.4 STARTUP FROM A BERNOULLI DRIVE

Your installation is now complete, and you are now ready to start the system. Boot your computer and insert the LWR Radiological Database Bernoulli cartridge into the drive and flip down the lock lever. Now if, for example, your Bernoulli drive you are using is drive D:, enter these commands:

D:<Enter>

LWR-RAD<Enter>

The introductory screen should appear in a few seconds and you can start selecting what data you would like to see. Proceed to Chapter 6, OPERATING

INSTRUCTIONS, for detailed information on how to use the system.

5.2 INSTALLATION AND STARTUP FOR SYSTEMS WITHOUT A BERNOULLI DRIVE

Follow the instructions in this section if you do not have a Bernoulli drive on your computer and have received the LWR Radiological Data Base System on floppy disks.

5.2.1 TRANSFER OF THE LWR RADIOLOGICAL DATABASE

You must transfer your LWR Radiological Database programs to your fixed disk. You may also transfer your LWR data to fixed disk as well. Transfer of the LWR data makes the operation of your system much faster, but requires approximately seven megabytes of storage. Proceed as follows.

1. Decide first whether you wish to transfer the programs only or both the programs and data.
2. Insert the floppy labled "LWR Radiological Installation Diskette" in drive A:.
3. If you plan to transfer only the programs, type in following (substituting the appropriate drive letter for your fixed disk in place of C:):

   A:TRANSFER PROGRAMS C:

   If you plan to transfer both the programs and data, type in the following (substituting the appropriate drive letter for your fixed disk in place of C:):

   A:TRANSFER ALL C:
4. Follow the instructions in the transfer program for inserting the appropriate diskettes in your floppy drive to be copied to your fixed disk.

5.2.2 MAKING YOUR COMMAND.COM ACCESSIBLE

The LWR Radiological Data Base System needs access to DOS from within the program. This should always be possible when booting from a fixed disk. Proceed to section 5.2.3.

5.2.3 MODIFYING YOUR CONFIG.SYS FILE

You must have another file located in the root directory of your fixed disk which tells your computer to allow enough open files to run the LWR Radiological Database System. This file is named CONFIG.SYS. You may already have such a file. If you already have this file, use the TYPE command to see if the file contains two lines like the ones below:

```
FILES = 20
BUFFERS = 24
```

As long as these lines are present, and the numerical values are as high as those shown (or higher) the system is configured properly.

If the CONFIG.SYS file exists, but these lines are missing or the values are too low you may use a text editor, such as DOS's EDLIN to modify the file. See your DOS documention for instructions on using EDLIN.

If no such file as CONFIG.SYS exists, you may create one by entering the commands following. This example assumes that the CONFIG.SYS file being created is on drive C:.

```
COPY CON: C:\CONFIG.SYS<Enter>
FILES = 20<Enter>
BUFFERS = 24<Enter>
<F6><Enter>
```

This will create a CONFIG.SYS file on your fixed disk.

If you had to change the CONFIG.SYS file you must now force DOS to read it. This can be done by pressing the following keys: <Ctrl><Alt><Del> all together. Once this file has been set up you do not need to change it again.

5.2.4 STARTUP FROM A FIXED DISK

Your installation is now complete, and you are now ready to start the system. Boot your computer and enter the following command:

```
LWR-RAD<Enter>
```

The introductory screen should appear in a few seconds and you can start selecting what data you would like to see. Proceed to Chapter 6, OPERATING INSTRUCTIONS, for detailed information on how to use the system.

6.0 OPERATING INSTRUCTIONS

This section describes the operation of the LWR Radiological Database system. First, an overview of the system design is presented in section 5.1. Next, section 5.2 describes a step-by-step scenario of using the program, with sample screen outlines showing exactly what will appear on your screen.

6.1 OVERVIEW

The LWR Radiological Database system has a flexible full-screen menu that allows you to specify the information you wish to retrieve. You must supply these parameters:

1. Reactor Type and Burnup.
2. Output Desired.
3. Decay Time.
4. Accuracy.
5. Where the Output will go.

You can change any individual selection at any time. These selections are identified on the screen by a letter and description of the selection. For example, suppose you had selected the following:

A. REACTOR TYPE:	PWR 20,000 MWD/metric ton
B. OUTPUT DESIRED:	Curies
C. DECAY TIME:	4 Years
D. ACCURACY:	All Isotopes
E. OUTPUT WILL GO TO:	Screen

You can change any of the five parameters in any order to retrieve different data. If you wanted to see information for a different decay time, you could select a different DECAY TIME value. To do this, you would select option C and change to the desired decay time. If you wanted to see the heat generation after examining the radioactivity, you could select Watts for OUTPUT DESIRED. You would select option B to change this parameter. There is no need to first change option A before changing option B. This flexibility makes it easy to quickly specify exactly what data you wish to see.

6.2 SAMPLE OPERATING SCENARIO

This section takes you through a sample session with the LWR Radiological Database system, showing exactly what you will see on the screen as you operate the program.

6.2.1 INITIAL AUTOMATIC OPTION SEQUENCE

Start the system as described in Section 4.4. The introductory screen that will be displayed when you first start the program is shown in Figure 5.

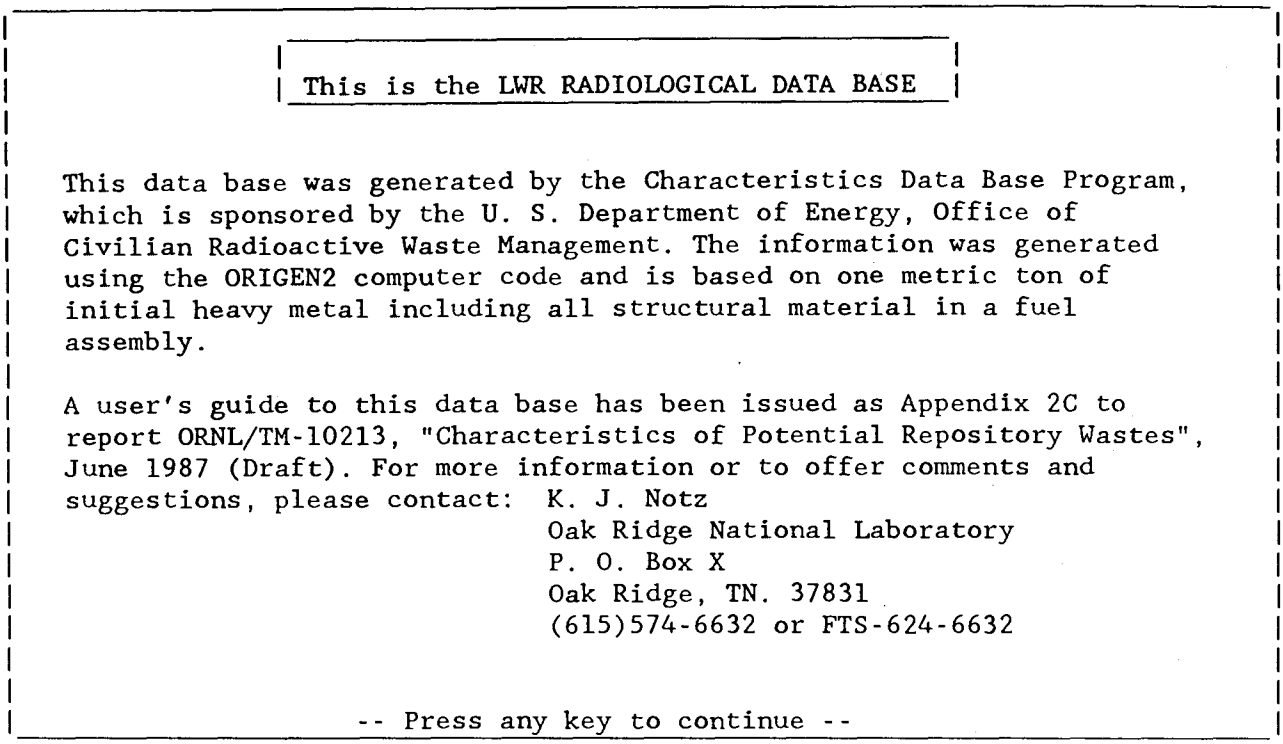


Figure 5. LWR Radiological Data Base Introductory Screen

This screen provides a brief introduction to the data base, lists the sponsor, and provides the name and address of the contact at Oak Ridge National Laboratory for additional copies of the data base or further information. After perusing the introductory screen, press a key and the main menu is displayed.

The main menu can be thought of as four sections. In the double lines on the left the system options are listed, to the right of the first five options is the current values area, below the current values is the help area, and the bottom of the screen below the double lined box is where options are changed. Since this is the first time the screen is displayed, no selections have been made. The program will sequence through the items A-D, asking you to select options for data retrieval.

When selecting a value for a option, the choices will be listed on the bottom half of the screen. Once you have made a selection, it will be displayed in the current values portion of the screen. The help area provides additional details about the selection which you are making.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	
B. Output Desired:	
C. Decay Time:	
D. Accuracy Desired:	
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Enter the number associated with one of the reactor/burnups below. Burnup is in MWD per metric ton.
Enter Your Selection:	

(A.) Select Type of Reactor and Burnup:

1. PWR 5,000	7. PWR 33,000	13. PWR 60,000	19. BWR 27,500
2. PWR 10,000	8. PWR 35,000	14. BWR 5,000	20. BWR 30,000
3. PWR 15,000	9. PWR 40,000	15. BWR 10,000	21. BWR 35,000
4. PWR 20,000	10. PWR 45,000	16. BWR 15,000	22. BWR 40,000
5. PWR 25,000	11. PWR 50,000	17. BWR 20,000	
6. PWR 30,000	12. PWR 55,000	18. BWR 25,000	

Which Selection is desired (1-22): 0

Figure 6. Initial Reactor Type and Burnup Selection

The first parameter to be selected is REACTOR TYPE AND BURNUP. You can select any of the 22 listed reactor type / burnup combinations by typing in the appropriate digits and then pressing the <Enter> key.

In this case, the user has selected option 19, the standard burnup (27,500 MWD/metric ton) boiling water reactor. This selection now appears in the current values area of the screen and the LWR Radiological Data Base System proceed to the OUTPUT DESIRED option.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	
C. Decay Time:	
D. Accuracy Desired:	
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Enter the number associated with the measure (unit) you wish to see. All measures are on a per metric ton of initial heavy metal basis.
Enter Your Selection:	

(B.) Select Output Desired:
1. Grams
2. Curies
3. Watts

Which Output is desired (1-3): 0

Figure 7. Initial Output Desired Selection

As indicated in the help area, all measures are on a per metric ton of initial heavy metal basis. To select curies for output desired, type 2<Enter>. This will cause curies to be displayed in the current values area across from the output desired label. Continuing the initial sequence, option C is for the DECAY TIME.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Curies
C. Decay Time:	
D. Accuracy Desired:	
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Enter the number associated with the number of years decay of spent fuel you wish to examine.
Enter Your Selection:	

(C.) Select number of years of Decay, which is desired (1-38): 0

1. 1	8. 8	15. 30	22. 100	29. 3000	36. 200000	
2. 2	9. 9	16. 40	23. 200	30. 5000	37. 500000	
3. 3	10. 10	17. 50	24. 300	31. 10000	38. 1000000	
4. 4	11. 16	18. 60	25. 400	32. 30000		
5. 5	12. 18	19. 70	26. 500	33. 40000		
6. 6	13. 20	20. 80	27. 1000	34. 50000		
7. 7	14. 25	21. 90	28. 2000	35. 100000		

Figure 8. Initial Decay Time Selection

There are 38 options for decay time as listed above. To select 50 years you would choose number 17 by typing 17<Enter>. The initial selections for options A thru C are now set. The last initial selection to be made is for the ACCURACY DESIRED.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Curies
C. Decay Time:	50 years
D. Accuracy Desired:	
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Enter the number associated with the % contribution to the total radioactivity which an isotope must contribute to be reported.
Enter Your Selection:	

(D.) Select Accuracy Level:
1. > 1.000 % of Total
2. > 0.100 % of Total
3. > 0.010 % of Total
4. > 0.001 % of Total
5. All isotopes

Which Level of Accuracy is desired (1-5): 0

Figure 9. Initial Accuracy Desired Selection

To create the LWR Radiological Data Base, numerous runs of the ORIGEN2 radioactive decay code were made. The output is now in this data base. Often, a case includes isotopes which made a very small contribution to the overall unit being reported. The accuracy desired option allows you to narrow down what you see to only the isotopes which make significant contributions if you wish. In this case, we choose to include only isotopes whose contribution is greater than or equal to at least 1% of the total curies predicted by ORIGEN2 for all isotopes. This is choice number 1. You would type 1<Enter> to select it.
Now, all initial option selections have been made. These options all appear in the current values area of the screen.

6.2.2 MAIN MENU OPTIONS

The flashing cursor which is on the screen is now by the "Enter Your Selection" prompt in the system options area. You now choose what you want to do next from the options in this area. You can change the current value of any option, run your query, or exit the data base.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Curies
C. Decay Time:	50 years
D. Accuracy Desired:	> 1.000 % of Total
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Select from the options shown in the left hand column by pressing the letter key for that option.
Enter Your Selection: R	

Figure 10. Completed Options Screen

The LWR Radiological Data Base System guesses that you now wish to run the report which you have defined, and so, puts an "R" in the selection spot. You may now run the report by pressing <Enter> or perform any other option by typing the letter associated with it and pressing <Enter>. If we decided to run the report by pressing <Enter> the output would appear on the screen as in Figure 11 on the next page.

Filename: sf.out

Spent Fuel Repository Characteristics Data Base
Developed by: Oak Ridge National Laboratory, Oak Ridge, TN.

Type of Reactor: BWR 27,500 Elapsed Decay: 50 years
All isotopes representing: > 1.000 % of Total

Isotope	Curies	Percentage of Total
SR 90	1.81E+04	17.238 %
Y 90	1.81E+04	17.238 %
CS137	2.70E+04	25.714 %
BA137M	2.55E+04	24.286 %
PU238	1.30E+03	1.238 %
PU241	1.01E+04	9.619 %
AM241	3.35E+03	3.190 %
Subtotal Curies =	1.03E+05	98.524 %
Total all isotopes =	1.05E+05	

Command: **End of File** KEYS: <>^v PgUp PgDn Home End ?=Help X=eXit

Figure 11. First Sample Screen Output.

The report requested is displayed on the screen. In this case, the entire report fits on one screen. There are additional options available to control the display of longer reports. These are invoked using the keys indicated on the command line on the bottom of the screen. You can use the up and down arrow keys to scroll the data one line at a time. You can use the PgUp and PgDn keys to jump up and down through the report several lines at a time. You can use the Home and End keys to go directly to the top and bottom of the report, respectively. Other commands are available while browsing the report, but you will probably not need these for the LWR Radiological Data Base System. Enter an **X** (without <Enter>) to eXit the report display and return to the main menu.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Curies
C. Decay Time:	50 years
D. Accuracy Desired:	> 1.000 % of Total
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Select from the options shown in the left hand column by pressing the letter key for that option.
Enter Your Selection: R	

Figure 12. Completed Options Screen

The system returns to the main menu. Again, you can choose any of the options listed inside the screen box. To now examine the thermal output (watts) for the same reactor type and burnup, the same decay time, and the same accuracy, you can change the OUTPUT DESIRED directly by typing **B<Enter>**.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Curies
C. Decay Time:	50 years
D. Accuracy Desired:	> 1.000 % of Total
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Enter the number associated with the measure (unit) you wish to see. All measures are on a per metric ton of initial heavy metal basis.
Enter Your Selection: B	

(B.) Select Output Desired:
1. Grams
2. Curies
3. Watts

Which Output is desired (1-3): 0

Figure 13. Revision of Output Desired

Now, select watts by pressing 3<Enter> in response to the Output Desired prompt and the current value of watts will appear as shown below.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Watts
C. Decay Time:	50 years
D. Accuracy Desired:	> 1.000 % of Total
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Select from the options shown in the left hand column by pressing the letter key for that option.
Enter Your Selection: R	

Figure 14. Revised Options Screen

To run this report, press the <Enter> key (R is already displayed for you), and the data requested will be displayed on the screen as shown in Figure 15.

Filename: sf.out
Spent Fuel Repository Characteristics Data Base
Developed by: Oak Ridge National Laboratory, Oak Ridge, TN.

Type of Reactor: BWR 27,500 Elapsed Decay: 50 years
All isotopes representing: > 1.000 % of Total

Isotope	Watts	Percentage of Total
SR 90	2.11E+01	4.795 %
Y 90	1.01E+02	22.955 %
CS137	2.98E+01	6.773 %
BA137M	1.00E+02	22.727 %
PU238	4.31E+01	9.795 %
PU239	9.25E+00	2.102 %
PU240	1.49E+01	3.386 %
AM241	1.11E+02	25.227 %
CM244	6.70E+00	1.523 %
Subtotal Watts =	4.37E+02	99.284 %
Total all isotopes =	4.40E+02	

Command: **End of File** KEYS: <>^v PgUp PgDn Home End ?=Help X=eXit

Figure 15. Watts for Revised Selection.

Press an X to return to the Main Menu.

Each individual value option (A thru E) can be revised in the same way in which the OUTPUT DESIRED was just revised.

Option E (OUTPUT WILL GO TO) is not displayed in the initial sequence of questions. Instead, it is automatically set to the screen. To change it you can type E<Enter>. You can choose either Screen, Print, or Disk File. Directing output to the screen is useful for a quick preview of certain information. Directing output to the printer will provide hard copy reports. The disk file option can be used to capture a report that can then later be taken to another computer and printed, if your computer does not have a printer attached. This option can also be used to capture some data in a text file that you could later use as input to another program. Once you select the disk file option, the system will prompt you for the name of the file to which you want to send the data. If the file already exists, you will be asked if you want to overwrite the existing file, or append additional data.

The Sequence is chosen by typing S<Enter>. This option is a shortcut for redefining the current values for all options without selecting each

individually.

6.2.3 EXITING THE LWR RADIOLOGICAL DATA BASE SYSTEM

Lastly, when you are finished using the LWR Radiological Data Base System you can exit the system by typing X<Enter>. The confirmation request shown in Figure 16 is displayed.

LWR SPENT FUEL DATA BASE

Choose an Option Below:	Current Values of Options:
A. Type of Reactor & Burnup:	BWR 27,500
B. Output Desired:	Watts
C. Decay Time:	50 years
D. Accuracy Desired:	> 1.000 % of Total
E. Output will go to:	Screen
S. Sequence thru options A-D.	Help Area (description of what to do now):
R. Run your query.	
X. eXit data base to DOS.	Select from the options shown in the left hand column by pressing the letter key for that option.
Enter Your Selection: X	

EXIT SYSTEM SELECTED !

Do you wish to end this session (Y/N)? N

Figure 16. Exit Confirmation Screen

To confirm that you wish to quit, type Y<Enter>, otherwise type <Enter> to return to the Main Menu.

PART 2 -- SPENT FUEL PHOTON AND NEUTRON DATABASE SYSTEM

7.0 INTRODUCTION

The next part of this User's Guide to the LWR Radiological Database covers the Spent Fuel Photon and Neutron(SFPN) Database System. Sections 7 through 10 describe the SFPN system, what data is available, and how to install and operate the system.

7.1 OVERVIEW

The SFPN Database system contains photon spectra and neutron source data for spent light-water reactor fuel assemblies which supplements the Heat, Mass, and Activity data that was covered in the first part of this guide. The SFPN Database system is distributed on 2 floppy diskettes or on a 10 Mb Bernoulli cartridge. You can request this data base alone or along with the other parts of the LWR Radiological Data Base system.

The data was generated by the ORIGEN2 computer code at the Oak Ridge National Laboratory (ORNL) and has been put into this SFPN Personal Computer (PC) Database system to facilitate retrieval. The SFPN Database system is a user-friendly, menu-driven system that provides both screen and printer output. It is very similar in operation to the other parts of the LWR Radiological Database.

7.2 OPERATING ENVIRONMENT

The SFPN Database System is written in dBASE III and distributed in compiled form, using Nantucket's Clipper compiler. You do not have to own a copy of Ashton-Tate's dBASE III to run the system. It will operate on any MS-DOS based personal computer (such as IBM PCs and compatibles) with at least 384kb of memory, and two flexible (floppy) disk drives or one floppy disk drive and one fixed disk. It is distributed on 2 floppy disks, but the system can be transferred to a fixed disk drive for improved system performance and convenience.

8.0 DESCRIPTION OF DATA AVAILABLE

8.1 LIST OF OPTIONS

The SFPN Database system provides data on the photon emission rate and neutron source from (alpha,n) reaction and spontaneous fission. The values are based on one metric ton of initial heavy metal(MTIHM). Data for PWR and BWR reactors at numerous burnups and decay times after discharge from the reactor are included. The data were generated by the ORIGEN2 computer code at the Oak Ridge National Laboratory (ORNL), based on PWR and BWR models described by Croff, et.al., in "Revised Uranium-Plutonium Cycle PWR and BWR Models for the ORIGEN Computer Code", ORNL/TM-6051 (Sept. 1978).

In order to define what data you wish to retrieve there are 3 basic selections which must be made before any data can be retrieved. These are:

Reactor type and burnup

Decay times

Report type

The options for Reactor type and burnup are:

PWRs:	5,000	10,000	15,000	20,000	25,000
	30,000	33,000	35,000	40,000	45,000
	50,000	55,000	60,000		
BWRs:	5,000	10,000	15,000	20,000	25,000
	27,500	30,000	35,000	40,000	

For each reactor and burnup, data is available for 41 decay times. These decay times have been grouped into the following sets:

1, 2, 3, 4, 5 years
6, 7, 8, 9, 10 years
15, 16, 18, 20, 25, 30 years
40, 50, 60, 70, 80, 90 years
100, 200, 300, 350, 400, 500 years
1000, 1050, 2000, 3000, 5000 years
10K, 30K, 40K, 50K years
100K, 200K, 500K, 1000K years

For the above reactors and decay times, two basic reports are available:

Photon Spectra per MTIHM vs. Decay Time
Neutron Emission Rate per MTIHM vs. Decay Time

You can define what data will be included in a report by selecting one reactor and burnup, one of the sets of decay times, and one of the report types. Additional data can then be retrieved by changing one or more of the three

selections.

You can also choose whether you want the data to go to the screen or to the printer. It is often useful to preview the data on the screen, then send it to the printer if you need a hard copy.

Defining and obtaining reports is covered in detail in Section 10, Operating Instructions.

8.2 SAMPLE REPORTS

This section contains 2 sample reports generated by the SFPN Database system. The first one shows photon spectra data, and the second report shows neutron source data. These reports show some, but not all, of the data available. They are included here to give a brief look at the kinds of reports available.

Each report covers a specific reactor and burnup and one set of decay times. Similar reports can be obtained from the system for different combinations of reactors, burnups and decay times.

The following reports are included:

Figure 17 -- Photon spectra per MTIHM vs. decay time

Figure 18 -- Neutron generation rate per MTIHM vs. decay time

PHOTON SPECTRA PER MTIHM VS. DECAY TIME

REACTOR: PWR 33,000 UNITS: Photons/sec

EMEAN	40YR	50YR	60YR	70YR	80YR	90YR
1.000E-02	9.122E+14	7.274E+14	5.823E+14	4.680E+14	3.777E+14	3.063E+14
2.500E-02	1.808E+14	1.432E+14	1.137E+14	9.036E+13	7.202E+13	5.754E+13
3.750E-02	2.127E+14	1.668E+14	1.314E+14	1.037E+14	8.196E+13	6.485E+13
5.750E-02	2.124E+14	1.797E+14	1.535E+14	1.324E+14	1.154E+14	1.017E+14
8.500E-02	9.740E+13	7.663E+13	6.045E+13	4.775E+13	3.776E+13	2.989E+13
1.250E-01	6.854E+13	5.184E+13	3.995E+13	3.114E+13	2.443E+13	1.925E+13
2.250E-01	8.175E+13	6.401E+13	5.029E+13	3.960E+13	3.122E+13	2.464E+13
3.750E-01	3.431E+13	2.697E+13	2.124E+13	1.674E+13	1.320E+13	1.041E+13
5.750E-01	1.499E+15	1.189E+15	9.436E+14	7.487E+14	5.942E+14	4.716E+14
8.500E-01	1.293E+13	7.694E+12	4.960E+12	3.427E+12	2.496E+12	1.886E+12
1.250E+00	1.299E+13	5.877E+12	2.963E+12	1.666E+12	1.034E+12	6.963E+11
1.750E+00	3.842E+11	2.194E+11	1.356E+11	9.027E+10	6.372E+10	4.691E+10
2.250E+00	4.392E+07	2.528E+07	1.709E+07	1.255E+07	9.585E+06	7.491E+06
2.750E+00	3.182E+08	2.876E+08	2.603E+08	2.358E+08	2.137E+08	1.938E+08
3.500E+00	6.441E+06	4.563E+06	3.280E+06	2.404E+06	1.806E+06	1.397E+06
5.000E+00	2.751E+06	1.947E+06	1.399E+06	1.024E+06	7.681E+05	5.932E+05
7.000E+00	3.167E+05	2.240E+05	1.607E+05	1.175E+05	8.797E+04	6.781E+04
9.500E+00	3.635E+04	2.569E+04	1.842E+04	1.346E+04	1.007E+04	7.757E+03
TOTAL	3.325E+15	2.640E+15	2.104E+15	1.683E+15	1.351E+15	1.089E+15

Figure 17. Photon Spectra per MTIHM vs. Decay Time

NEUTRON GENERATION RATE-SUMMARY TOTALS-PER MTIHM VS. DECAY TIME

REACTOR: BWR 25,000 UNITS: Neutrons/sec

TOTALS	100YR	200YR	300YR	350YR	400YR	500YR
(Alpha,N)	4.173E+06	3.376E+06	2.834E+06	2.622E+06	2.437E+06	2.127E+06
Spontaneous Fission	5.107E+06	2.616E+06	2.508E+06	2.487E+06	2.469E+06	2.439E+06
Overall	9.280E+06	5.992E+06	5.342E+06	5.109E+06	4.906E+06	4.567E+06

Figure 18. Neutron generation rate per fuel assembly vs. decay time

9.0 INSTALLATION AND USE OF SOFTWARE

This section describes how to install and run the Spent Fuel Photon and Neutron (SFPN) Database system on your machine. You must have an IBM PC or an IBM PC compatible machine (MS-DOS version 2.00 or higher operating system).
All users will need to set up a CONFIG.SYS file in order to run the system. This operation is described in the next section, 9.1. The remaining installation procedures will vary according to your system configuration.
If you have received the SFPN Database System on a Bernoulli cartridge as part of the complete LWR Radiological Database, follow the installation procedure in section 9.2. If your personal computer has only floppy disk drives then follow the procedures described in section 9.3 below. If your machine has a fixed disk, and you want to transfer the SFPN Database system to the fixed disk for faster and more convenient operation, go to section 9.4.

9.1 SETTING UP YOUR CONFIG.SYS FILE

To run the system, the CONFIG.SYS file must be present on the disk you use to start (boot) your computer. For floppy drive based systems, this will be a floppy diskette. For fixed disk systems, this will be the fixed disk, usually drive C:. It may be a Bernoulli cartridge.
The CONFIG.SYS file should have the following lines:

files=20

buffers=24

If the numbers are larger, that's fine, you can skip the remainder of this section. But if you do not have a CONFIG.SYS file, or if the numbers are smaller they should be increased to run the SFPN Database system. If you have a favorite text editor, you may use it to create this file or add these lines to your existing file. If you do not have a text editor you can create the file by entering the following from your keyboard:

COPY CON: CONFIG.SYS <Enter>

FILES=20 <Enter>

BUFFERS=24 <Enter>

<F6><Enter>

If you have had to alter your CONFIG.SYS file or create a new one, you must reboot to activate the file. This can be done by pressing the following keys: **<Ctrl><Alt><Del>** all together. Once your config.sys has been set up you do not

need to change it again.

9.2 OPERATION FROM A BERNOULLI CARTRIDGE

If you have received the SFPN Database system on a Bernoulli cartridge, you probably will not have to do anything to install the system, since it is already installed on the Bernoulli cartridge. There is, however, one exception to this rule. If you boot your system from a Bernoulli cartridge, you will need to insure that the DOS file, COMMAND.COM, is transferred to your LWR Radiological Bernoulli cartridge. To do this, insert your DOS floppy in drive A: and your LWR Bernoulli cartridge in your Bernoulli drive. Assuming that your Bernoulli drive identifier is drive C:, you would enter this command:

COPY A:COMMAND.COM C:*.*<Enter>

If your Bernoulli drive is identified by another letter, such as D, substitute that letter for C in the above command.

You will see a message saying that 1 file has been copied.

9.2.1 Starting the SFPN Database System from a Bernoulli cartridge

To run the SFPN Database system, place you LWR Radiological Bernoulli cartridge in the Bernoulli drive. Make the root directory of the Bernoulli drive the default directory by typing the command:

CD\<Enter>

Then enter this command:

SFPN<Enter>

You will see the introductory screen in a few seconds. Proceed to the section 10, OPERATING INSTRUCTIONS, for complete instructions on system operation.

9.3 OPERATION WITH TWO FLOPPY DRIVES

You have received two diskettes. One is the SFPN Database Program diskette, and the other is the SFPN Database Data diskette. Before you begin to use the system, you should make a copy of these two diskettes and put them away for safekeeping. Never use your original diskettes for routine operation.

9.3.1 Making Backup Copies of Your Distribution Diskettes

To copy your SFPN Database diskettes, first start up (boot) your computer with your own DOS diskette. Enter the data and time if requested to do so. When you receive the operating system prompt "A>", type in the command shown below:

A>DISKCOPY A: B: <Enter>

Now take your DOS diskette out of drive A and place the SFPN Database Program diskette in drive A. Place a blank diskette in drive B. This diskette does not

have to be formatted before use. When both diskettes are in place, press the <Enter> key. Your PC should now copy the SFPN Database programs to the new diskette in drive B. When the copying is complete, remove the diskettes from the disk drives. The new diskette will be called the "SFPN Database PROGRAMS working diskette". The PC will ask if you wish to copy another diskette. Respond by typing "Y" and <Enter>. Place the SFPN Database Data diskette in drive A and another blank diskette in drive B. When both diskettes are in place, press the <Enter> key. When the copy is complete remove the diskettes. This new diskette will be called the "SFPN Database DATA working diskette". You may now respond to the computer's query as to copying another diskette with a "N" and <Enter>. Label the copies appropriately and put the original diskettes away.

9.3.2 Copying DOS File to the Programs Working Diskette

You will need to copy one file, COMMAND.COM, from your DOS diskette to the SFPN Database programs working diskette. To copy this file to the programs working diskette place the DOS diskette in drive A and the SFPN Database Programs working diskette in drive B. Enter these two commands:

A>COPY A:COMMAND.COM B: <Enter>

You should get a message after the command that the file was successfully copied.

9.3.3 Starting the SFPN Database System from a Floppy Diskette

To run the SFPN Database system, place your programs working diskette in drive A, and your data working disk in drive B. Now type in:

A>SFPN <Enter>

This will bring up the SFPN Database system. Proceed to chapter 10, OPERATING INSTRUCTIONS, for information on how to use the system.

9.4 OPERATION WITH A FIXED DISK

You have received two diskettes. One is the SFPN Database Program diskette, and the other is the SFPN Database Data diskette. Before you begin to use the system, you must transfer the contents of these two diskettes to your fixed disk, then put the original diskettes away for safekeeping.

9.4.1 Copying the SFPN Database System to your Fixed Disk

To transfer your SFPN Database diskettes to your fixed disk, first start up (boot) your computer from your fixed disk. Enter the date and time if requested to do so. You will receive the operating system prompt ("C>" if your fixed disk

is disk C, another letter if your fixed disk is another drive). Insert your SFPN Database Program diskette in drive A.

Change your default drive to drive A by typing in the following command:

C>A: <Enter>

The system prompt will now be: A>. You will now execute a batch file that will make a subdirectory for your SFPN Database programs and data named SFPND. First you must know what the identifying drive letter for your fixed disk is (usually "C"). If for example, your fixed disk is drive C, then enter the command:

A>INSTALL C: <Enter>

If your fixed disk drive is another letter, such as D, substitute that letter for C in the above command.

This will create the subdirectory and copy the programs to the fixed disk. When the programs have all been copied, you will be asked to insert the SFPN Database Data diskette. Do so and press <Enter>. The data files will now be copied to the fixed disk. When this operation is complete, you may put away your distribution diskettes for backup use only.

9.4.2 Starting the SFPN Database System from a Fixed Disk

To run the SFPN Database system, enter the command:

C>SFPN <Enter>

from your root directory. This will bring up the SFPN Database system. The next section, OPERATING INSTRUCTIONS, describes how to use the system.

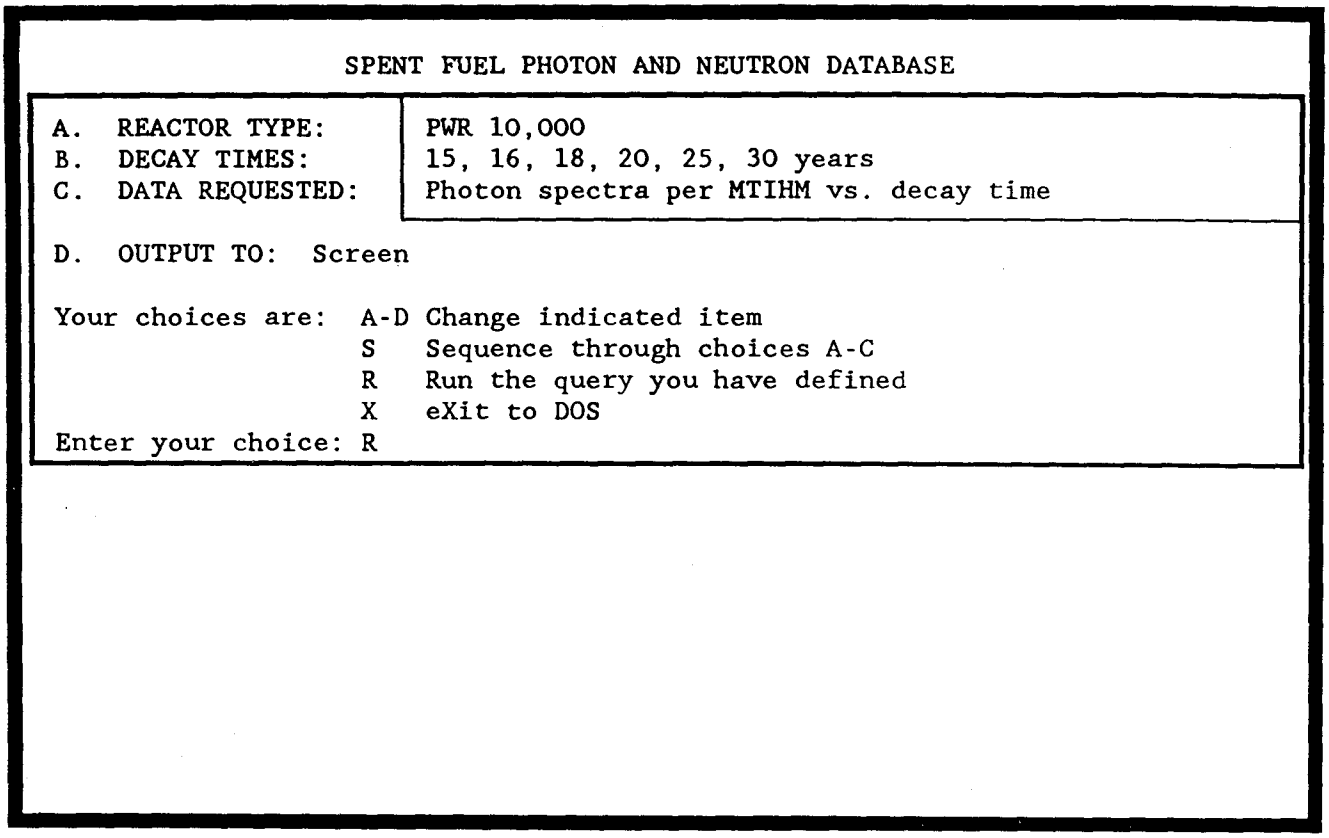


Figure 19. Sample Menu Screen

10.0 OPERATING INSTRUCTIONS

This section describes how to operate the SFPN Database system. First, the menu options that define what data is included in a report are explained. Then the system operation is explained, showing how to obtain the desired reports on either the screen or the printer.

10.1 DEFINING A REPORT

The menu options allow you to define and run reports that cover the specific data of interest. In order to define a report, you must select a value for these 4 parameters:

A. REACTOR TYPE

B. DECAY TIMES

C. DATA REQUESTED

D. OUTPUT TO

These are the first four items on the sample menu in Figure 19. Each of these items is explained in more detail in the following paragraphs.

REACTOR TYPE -- Data is available for two different kinds of light water reactors: BWR and PWR. For each type of reactor, several different burnups are available. The program will list all the available choices.

DECAY TIMES -- Data is available for forty-one decay times. For convenience, the times have been grouped into 8 sets of decay times, so that a report will show data for a range of years, rather than just one.

DATA REQUESTED -- Two basic types of reports are available:

1. Photon spectra per MTIHM vs. decay time
2. Neutron generation rate per MTIHM vs. decay time

OUTPUT TO -- This item defines where the report will be sent. Two choices are available: Screen or Printer.

10.2 SYSTEM OPERATION

The flexible menu system of the SFPN Database system allows you to easily specify values for the above 4 parameters. As they are selected, the values are displayed on the screen, so that you will always be aware of what values you have chosen. Note how the values are displayed in the inside box of Figure 20. You can indicate which item you wish to change by entering the appropriate letter, A-D. Once you have entered one of these letters, the system will display the choices for that option in the bottom of the screen. You can select one of the choices by entering the appropriate number. Figure 20 shows the

```
                    SPENT FUEL PHOTON AND NEUTRON DATABASE

 A.  REACTOR TYPE:       PWR 10,000
 B.  DECAY TIMES:        15, 16, 18, 20, 25, 30 years
 C.  DATA REQUESTED:     Photon spectra per MTIHM vs. decay time

 D.  OUTPUT TO:  Screen

 Your choices are:  A-D Change indicated item
                    S   Sequence through choices A-C
                    R   Run the query you have defined
                    X   eXit to DOS
 Enter your choice: A

(A.) Select a Reactor and Burnup:
  1.  PWR  5,000      8.  PWR 35,000      14.  BWR  5,000      21.  BWR 35,000
  2.  PWR 10,000      9.  PWR 40,000      15.  BWR 10,000      22.  BWR 40,000
  3.  PWR 15,000     10.  PWR 45,000      16.  BWR 15,000
  4.  PWR 20,000     11.  PWR 50,000      17.  BWR 20,000
  5.  PWR 25,000     12.  PWR 55,000      18.  BWR 25,000
  6.  PWR 30,000     13.  PWR 60,000      19.  BWR 27,500
  7.  PWR 33,000                          20.  BWR 30,000

Enter your selection (1-22): 7
```

Figure 20. Sample menu screen with REACTOR TYPE selections

screen as it would look if you were selecting a REACTOR TYPE. You must enter a number between 1 and 22 to select one of the listed choices for reactor and burnup. In Figure 20, the user has selected choice 7, for PWR 33,000. After the user strikes the Enter key, selecting the value for reactor and burnup, the new choice will be written near the top of the screen, opposite REACTOR TYPE, in the position now occupied by PWR 10,000.

Once all the parameters have been defined, you can run the report by entering R. If the output destination is Screen, the report will be displayed on the screen. If the output destination is Printer, the report will be sent to the printer. You can then alter any or all of the report parameters by entering the appropriate letter A-D. For example, suppose you had selected the following, as shown in Figure 20:

A.	REACTOR TYPE:	PWR 10,000
B.	DECAY TIMES:	1, 2, 3, 4, 5 years
C.	DATA REQUESTED:	Photon spectra per fuel assembly vs. decay time
D.	OUTPUT TO:	Screen

If you needed to see data for the same decay times but for a different reactor and/or burnup, you could enter an A, to change reactor, then select a new reactor and burnup from the list of choices. Or, if you wanted to see data for the same reactor and burnup but for additional decay times, you could enter a B, to change the decay times, then select a new set of decay times from the choices presented. If you wanted to review neutron data instead of photon data, you could enter a C, then select the neutron report. Entering a D will change the output destination to Printer. A useful method of operation is to leave the output directed to the screen (its initial setting) so that you can preview the report on the screen. When you need a printed copy of the report, switch the output direction to the printer. Then you can switch it back to the screen for additional data retrieval.

Once you had made a change in the parameters, you could enter an R to run the new report.

Figure 21 shows a sample report as it would be displayed on the screen. You can browse through the report using the arrow keys and PgUp(page up) and PgDn(page down) keys. You can also look for a particular text string with the Find command. The commands are listed on the right half of the command line (the bottom screen line). For further information, you can enter "?" to obtain the help screen.

Filename: photons.txt

PHOTON SPECTRA PER MTIHM VS. DECAY TIME

REACTOR: PWR 10,000 UNITS: Photons/sec

EMEAN	15YR	16YR	18YR	20YR	25YR	30YR
1.000E-02	5.784E+14	5.639E+14	5.365E+14	5.110E+14	4.531E+14	4.025E+14
2.500E-02	1.211E+14	1.175E+14	1.110E+14	1.053E+14	9.279E+13	8.219E+13
3.750E-02	1.322E+14	1.286E+14	1.219E+14	1.158E+14	1.021E+14	9.035E+13
5.750E-02	1.147E+14	1.121E+14	1.073E+14	1.028E+14	9.244E+13	8.330E+13
8.500E-02	6.591E+13	6.412E+13	6.079E+13	5.770E+13	5.083E+13	4.493E+13
1.250E-01	4.604E+13	4.461E+13	4.198E+13	3.957E+13	3.434E+13	2.999E+13
2.250E-01	5.488E+13	5.346E+13	5.079E+13	4.831E+13	4.268E+13	3.778E+13
3.750E-01	2.466E+13	2.375E+13	2.220E+13	2.090E+13	1.826E+13	1.612E+13
5.750E-01	8.377E+14	8.168E+14	7.775E+14	7.411E+14	6.590E+14	5.867E+14
8.500E-01	1.198E+13	1.050E+13	8.425E+12	7.077E+12	5.133E+12	4.017E+12
1.250E+00	3.305E+13	2.930E+13	2.308E+13	1.827E+13	1.036E+13	6.065E+12
1.750E+00	2.489E+11	2.343E+11	2.086E+11	1.865E+11	1.430E+11	1.119E+11
2.250E+00	7.502E+08	4.037E+08	1.612E+08	9.450E+07	4.638E+07	2.700E+07
2.750E+00	6.410E+07	4.482E+07	3.004E+07	2.609E+07	2.387E+07	2.275E+07
3.500E+00	5.154E+06	2.647E+06	7.509E+05	2.705E+05	1.096E+05	1.012E+05
5.000E+00	4.800E+04	4.753E+04	4.664E+04	4.581E+04	4.399E+04	4.246E+04
7.000E+00	5.447E+03	5.391E+03	5.285E+03	5.187E+03	4.972E+03	4.792E+03

Command: KEYS:PgUp PgDn HOME END ?=Help X=eXit

Figure 21. Sample report sent to the screen.

Figures 17 and 18 show sample reports that were sent to the printer.

To exit the system, enter an X. The system will give you a final prompt:

Do you wish to end this session (Y/N)?

Enter a Y if you wish to exit, and the system will return to DOS.

PART 3 -- TOTALS AND CALCULATED INTEGRAL HEAT RELEASE DATABASE SYSTEM

11.0 INTRODUCTION

This third and final part of the User's Guide to the LWR Radiological Database System covers the Totals and Calculated Integral Heat Release Database System. This database system is small and very easy to install and operate, so only 1 section is devoted to this part.

11.1 OVERVIEW

The Totals and Calculated Integral Heat Release Database System provides data on the total radioactivity (curies) and heat output (watts) from LWR spent fuel as a function of time after discharge from the reactor. It also includes calculated integral heat release for spent fuel over varying lengths of time. The radioactivity and heat output data were generated by the ORIGEN2 computer code at the Oak Ridge National Laboratory (ORNL). The calculations are based on one metric ton of initial heavy metal(MTIHM). The integral heat data was then calculated from the ORIGEN generated data. The approximate integral of the curve of heat as a function of time was calculated using the trapezoidal rule. That is, the points were connected by straight lines, and the area of the trapezoid was calculated.

The Totals and Calculated Integral Heat Release Database System is distributed on 1 floppy diskette, or it can be included on a 10 Mb Bernoulli cartridge with other databases distributed in support of the report "Characteristics of Potential Repository Wastes", DOE/RW-.

11.2 OPERATING ENVIRONMENT

The Totals and Calculated Integral Heat Release Database System is written in dBaseIII and compiled with Nantucket's Clipper compiler. It is distributed in compiled form, so you do not have to own dBaseIII to run the system. It will operate on any MS-DOS based personal computer with at least 384 kb of memory. It can be run from a floppy disk drive, a fixed disk, or a Bernoulli cartridge.

11.3 DESCRIPTION OF DATA AVAILABLE

The Totals and Calculated Integral Heat Release Database System contains data for 22 different reactors and burnup combinations. These are listed below.

PWRs:	5,000	10,000	15,000	20,000	25,000
	30,000	33,000	35,000	40,000	45,000
	50,000	55,000	60,000		

BWRs:	5,000	10,000	15,000	20,000	25,000
	27,500	30,000	35,000	40,000	

For each reactor and burnup, data is available for these 38 decay times.

1	2	3	4	5
6	7	8	9	10
16	18	20	25	30
40	50	60	70	80
90	100	200	300	400
500	1000	2000	3000	5000
10000	30000	40000	50000	100000
200000	500000	1000000		

There are 4 different queries available. These are listed below.

1. Total curies and watts for a specific reactor and burnup for all decay times.
2. Total curies and watts for all burnups for a specific decay time.
3. Total curies and watts for a specific reactor and burnup and a specific decay time.
4. Calculated integral heat for a reactor and burnup over a specified time interval.

The system is very easy to use. You select one of the 4 available queries, and the system will prompt you for the additional selections necessary, such as which burnup and/or which decay time. You can also choose whether you want the data to go to the screen or to the printer. It is often useful to preview the data on the screen, then send it to the printer if you need a hard copy. System operation is explained in detail in section 11.5.

11.4 INSTALLATION AND SYSTEM STARTUP

This section will cover all the necessary installation and startup procedures. You can run the Totals and Calculated Integral Heat Release Database System from a floppy disk, a fixed disk, or a Bernoulli cartridge. Although the system will run from a floppy disk, we recommend that you transfer it to a fixed disk or Bernoulli cartridge, if one is available, so that the system will run much more quickly.

All users will need to set up a CONFIG.SYS file in order to run the system. If you haven't already done this, you can follow the directions in section 9.1. The remaining installation procedures will vary according to your system configuration. If you have received the Totals and Calculated Integral Heat Release Database System on a Bernoulli cartridge as part of the complete LWR Radiological Database, follow the installation procedure in section 11.4.1. If your personal computer has only floppy disk drives then follow the procedures

described in section 11.4.2. If your machine has a fixed disk, and you want to transfer the system to the fixed disk for faster and more convenient operation, go to section 11.4.3.

11.4.1 Operation from a Bernoulli Cartridge

If you have received the Totals and Calculated Integral Heat Release Database system on a Bernoulli cartridge, you probably will not have to do anything to install the system, since it is already installed on the Bernoulli cartridge. There is, however, one exception to this rule. If you boot your system from a Bernoulli cartridge, you will need to insure that the DOS file, COMMAND.COM, is transferred to your LWR Radiological Bernoulli cartridge. To do this, insert your DOS floppy in drive A: and your LWR Bernoulli cartridge in your Bernoulli drive. Assuming that your Bernoulli drive identifier is drive C:, you would enter this command:

COPY A:COMMAND.COM C:*.*<Enter>

Substitute the letter of your Bernoulli drive for C in the above command.

You will see a message saying that 1 file has been copied.

To run the Totals and Calculated Integral Heat Release Database System, place you LWR Radiological Bernoulli cartridge in the Bernoulli drive. Make the root directory of the Bernoulli drive the default directory by typing the command:

CD\<Enter>

Then enter this command:

TOTALS<Enter>

You will see the introductory screen in a few seconds. Proceed to the section 11.5, OPERATING INSTRUCTIONS, for complete instructions on system operation.

11.4.2 Operation With Two Floppy Drives

Before you begin to use the system, you should make a copy of your distribution diskette and put it away for safekeeping. Never use your original diskette for routine operation.

11.4.2.1 Making Backup Copies of Your Distribution Diskettes

To copy your Totals and Calculated Integral Heat Release Database System diskette, first start up (boot) your computer with your own DOS diskette. Enter the data and time if requested to do so. When you receive the operating system prompt "A>", type in the command shown below:

A>DISKCOPY A: B: <Enter>

Now take your DOS diskette out of drive A and place the Totals and Calculated

Integral Heat Release Database System diskette in drive A. Place a blank diskette in drive B. This diskette does not have to be formatted before use. When both diskettes are in place, press the <Enter> key. Your PC should now copy the distribution diskette to the new diskette in drive B. When the copying is complete, remove the diskettes from the disk drives. The new diskette will be called the "Totals and Calculated Integral Heat Release Database System" diskette. The PC will ask if you wish to copy another diskette. Respond by typing "N" and <Enter>.

11.4.2.2 Starting the Database System from a Floppy Diskette

To run the Totals and Calculated Integral Heat Release Database System, start your computer as you usually do.

If you do not have a fixed disk (only 2 floppy disk drives), place your DOS diskette in drive A, and your Totals and Calculated Integral Heat Release Database System diskette in drive B. Make drive B the default drive by typing the command:

B:<Enter>

Next start the system by typing in the command:

TOTALS<Enter>

You should see the introductory screen in a few seconds.

If you start your computer from a Fixed Disk, but want to run the Totals and Calculated Integral Heat Release Database System from the floppy disk drive, place your copy of the Totals and Calculated Integral Heat Release Database System diskette in drive A. Make drive A the default drive by typing in the command:

A:<Enter>

Next start the system by typing in the command:

TOTALS<Enter>

You should see the introductory screen in a few seconds. Proceed to section 11.5, Operating Instructions.

11.4.3 Operation with a Fixed Disk

Before you begin to use the system, you must transfer the contents of the distribution diskette to your fixed disk, then put the original diskette away for safekeeping.

11.4.3.1 Copying the Database System to your Fixed Disk

To transfer your Totals and Calculated Integral Heat Release Database System

diskette to your fixed disk, first start up (boot) your computer from your fixed disk. Enter the date and time if requested to do so. You will receive the operating system prompt ("C>" if your fixed disk is disk C, another letter if your fixed disk is another drive). Insert your Totals and Calculated Integral Heat Release Database System diskette in drive A.

Change your default drive to drive A by typing in the following command:

C>A: <Enter>

The system prompt will now be: A>. You will now execute a batch file that will make a subdirectory for the database system called TCIG. First you must know what the identifying drive letter for your fixed disk is (usually "C"). If for example, your fixed disk is drive C, then enter the command:

A>INSTALL C: <Enter>

If your fixed disk drive is another letter, such as D, substitute that letter for C in the above command.

This will create the subdirectory and copy the programs and data to the fixed disk. When this operation is complete, you may put away your distribution diskettes for backup use only.

11.4.3.2 Starting the Database System from a Fixed Disk

To run the Database system, enter the command:

C>TOTALS <Enter>

from your root directory. This will bring up the introductory screen. The next section, OPERATING INSTRUCTIONS, describes how to use the system.

11.5 OPERATING INSTRUCTIONS

This section describes how to operate the Totals and Calculated Integral Heat Release Database System. The operation is very simple and easy to learn. It is very similar to the other parts of the LWR Radiological System.

The main menu screen is shown in Figure 22. You can see that there are 5 items, A through E listed on the left hand side of the screen. Your selections for these items define what data will be retrieved from the database, and where it will be displayed (screen or printer). The options for these 5 items are listed below.

A. QUERY

1. Total curies and watts for a specific reactor and burnup for all decay times.
2. Total curies and watts for all burnups for a specific decay time.
3. Total curies and watts for a specific reactor and burnup and a

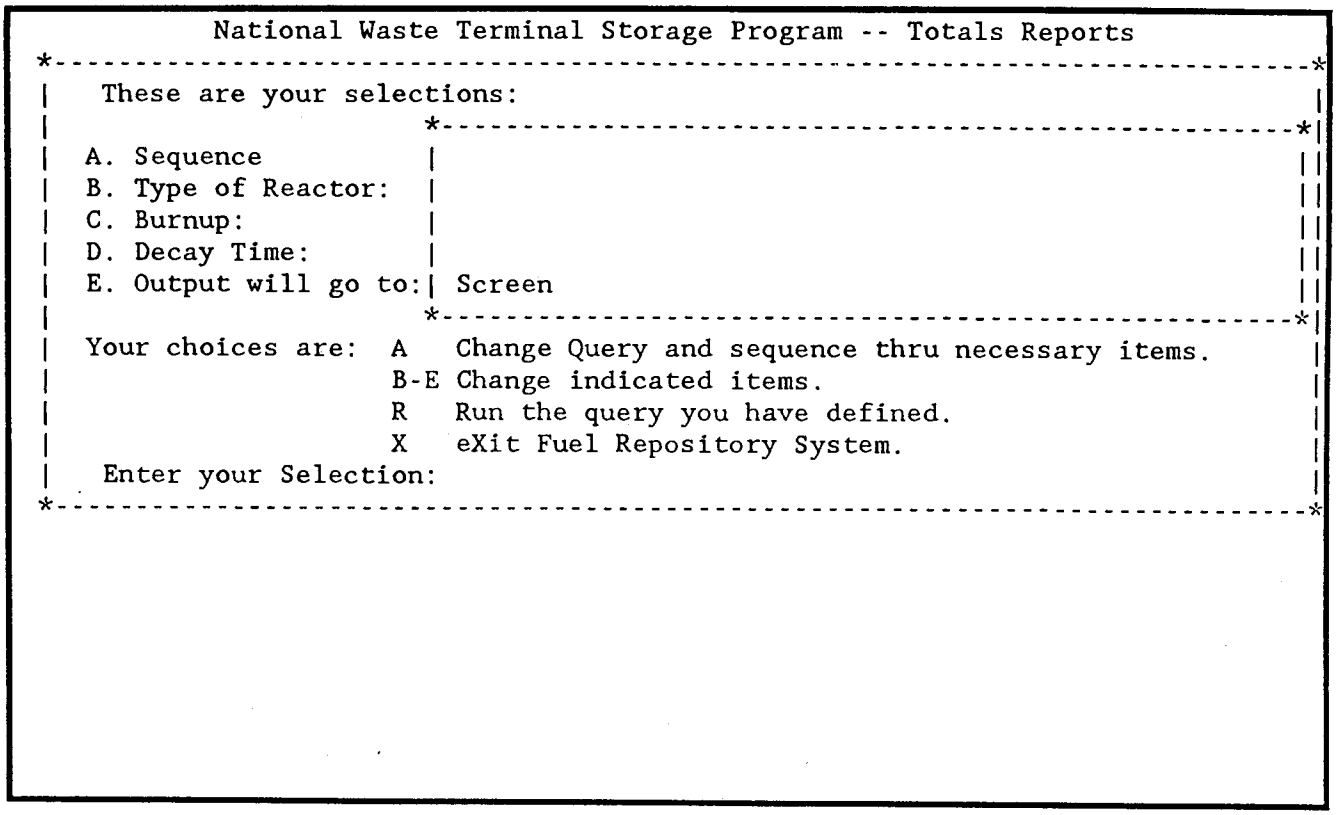


Figure 22. Main Menu for Totals and Calculated Integral Heat Database System

specific decay time.
4. Calculated integral heat for a reactor and burnup over a specified time interval.

B. REACTOR

1. BWR
2. PWR
3. BWR AND PWR

C. BURNUP

PWRs:	5,000	10,000	15,000	20,000	25,000
	30,000	33,000	35,000	40,000	45,000
	50,000	55,000	60,000		
BWRs:	5,000	10,000	15,000	20,000	25,000
	27,500	30,000	35,000	40,000	

D. DECAY TIME (years)

1	2	3	4	5
6	7	8	9	10
16	18	20	25	30
40	50	60	70	80
90	100	200	300	400
500	1000	2000	3000	5000
10000	30000	40000	50000	100000
200000	500000	1000000		

E. OUTPUT DEVICE

1. Screen
2. Printer

In order to tell the system what data you want to review, you must first specify what query you want, which is option A of the menu. When you first begin operation, the system will automatically prompt your for the query.
Once you have chosen one of the above choices, the system will prompt you for any additional parameters required. For example, if you had chosen option 1, Total curies and watts for a specific reactor and burnup for all decay times, the system would then ask you what reactor type and burnup you wanted to see. It would not ask you for a decay time, since the query specifies all decay times. Once you have completely specified a particular query, you can choose any of the options listed on lines 11 through 14 of the screen. Entering "R" will run the query. The data will go to the currently selected output device. Entering "A" will allow you to change the query, and you will once again be prompted for all relevant parameters. Options B,C, and D allow you to change the parameters of a query to obtain more information. Suppose you had selected

query 1, Total curies and watts for a specific reactor and burnup for all decay times, and had specified a reactor and burnup of PWR 33,000. Once you had seen that data, you might want to see the same data but this time for a burnup of 30,000. You could then choose option "C" to change the burnup. Once you enter a "C", the system will prompt you with a list of choices for burnup, from which you could choose 30,000.

Option E allows you to change the output device from Screen to Printer and vice versa. Option X is used to exit the system, when you have retrieved all the data that you are want to see at that time.

APPENDIX 2D

USER'S GUIDE TO THE LWR QUANTITIES DATA BASE

TABLE OF CONTENTS

1.0 INTRODUCTION

This User's Guide describes the Light Water Reactor Quantities database system(Quantities Database). The Quantities Database contains a large amount of data on fuel assemblies discharged from reactors (historical data) and projections of fuel assemblies to be used in future years (projected data). The principle objective of the Quantities Database is to provide a fast, easy way for you to obtain information on fuel assemblies tabulated in a way that is useful to you. The system is a user-oriented, interactive, menu-driven program that is easy to install and operate. It can provide screen, printer, and disk file output of all available data. Many options are available for tabulating the data. You can view summary data grouped by categories of interest such as by utility, reactor, storage pool, etc. You can also choose to view only data from a particular entity, such as a specified reactor, utility, storage pool, etc.

The historical data has been obtained from the Energy Information Administration(EIA). It includes numbers of assemblies discharged each year, along with average burnup and average weight, and the number of defective assemblies discharged. The projected data is taken from work done by Pacific Northwest Laboratories (PNL) and published in 'Reactor-Specific Spent Fuel Discharge Projections: 1985 to 2020', by Heeb, et. al. Two of PNL's cases are included: the No New Orders case and the Upper Reference case, both assuming extended fuel burnup. The projected data includes the number of fuel assemblies to be discharged each year and their expected average weight. A complete discussion of the data available is given in section 2.

This User's Guide provides an introduction and overview to the Quantities Database. It includes a description of the data available (Section 2), some sample reports (Section 3), complete installation instructions (Section 4) and operating instructions (Section 5). It is recommended that you read Section 2 carefully to understand what data is in the Quantities Database, and how it is organized. You can read through the remainder of this guide briefly to understand the basics of the system, and then install and use it on your computer. You will quickly learn how to use the system by experimenting with the different options.

1.1 OPERATING ENVIRONMENT

The Quantities Database has been developed in dBASE III Plus, and compiled using Nantucket's Clipper compiler. It is distributed in compiled form, so that you do not need to own a copy of dBASE III Plus to run the system. It will operate on any MS-DOS based personal computer (such as IBM PCs and compatibles) with at least 384 Kb of memory and a fixed disk or Bernoulli removable cartridge drive system. It is distributed on either floppy diskettes or Bernoulli cartridges. You can then install the system on your hard disk from the floppy diskettes. Four floppy diskettes are needed to distribute the system. The are labeled:

Quantities Database Programs
Quantities Database Data 1
Quantities Database Data 2
Quantities Database Data 3
Quantities Database Data 4

2.0 DESCRIPTION OF DATA AVAILABLE

The Quantities Database contains a large amount of information about all the fuel assemblies used by LWR reactors in the Unites States. This data is divided into historical data about used fuel assemblies, and projected data, which is predictions of the assemblies to be used in future years. The historical data is, of course, much more detailed, since actual usage information from the reactors is available. Figure 2.1 outlines the historical data available, and Figure 2.2 outlines the projected data available. This section will explain exactly what data is contained in the Quantities Database, the origin of the data, and also why the data is organized in this way.

For both historical and projected data, you can obtain either General or Specific type reports. The General reports contain data of a summary nature. They show all fuel assemblies, broken down into groups such as by utility, or by reactor. For additional detail you can choose to see the data broken down year by year. The Specific reports cover data for only one specific entity such as one particular utility, or one particular storage pool. When you choose to see a Specific report, the system will prompt you to choose the item of interest from a list of utilities, or storage pools, etc. This lets you narrow the scope of data to see only the particular area of interest. The Specific reports for historical data also offer additional subtotal options so that you can break the data down into a finer level of detail.

Dividing the data into these two report types offers the ability to review the

QUANTITIES DATABASE

HISTORICAL DATA

All reports include:

NUMBER OF ASSEMBLIES
NUMBER OF DEFECTIVE ASSEMBLIES
AVERAGE BURNUP
AVERAGE WEIGHT

GENERAL REPORTS	SPECIFIC REPORTS
Data for all discharged assemblies grouped by: UTILITY REACTOR STORAGE POOL ASSEMBLY TYPE REACTOR TYPE (BWR,PWR)	Data for discharged assemblies for 1 SPECIFIC: UTILITY REACTOR STORAGE POOL ASSEMBLY TYPE REACTOR TYPE (BWR,PWR)
Can be broken down by: DISCHARGE YEAR	Can be subtotaled by: STORAGE POOL ASSEMBLY TYPE
	Can be broken down by: DISCHARGE YEAR DISCHARGE YEAR AND BURNUP BIN

FIGURE 2.1 Overview of Historical data

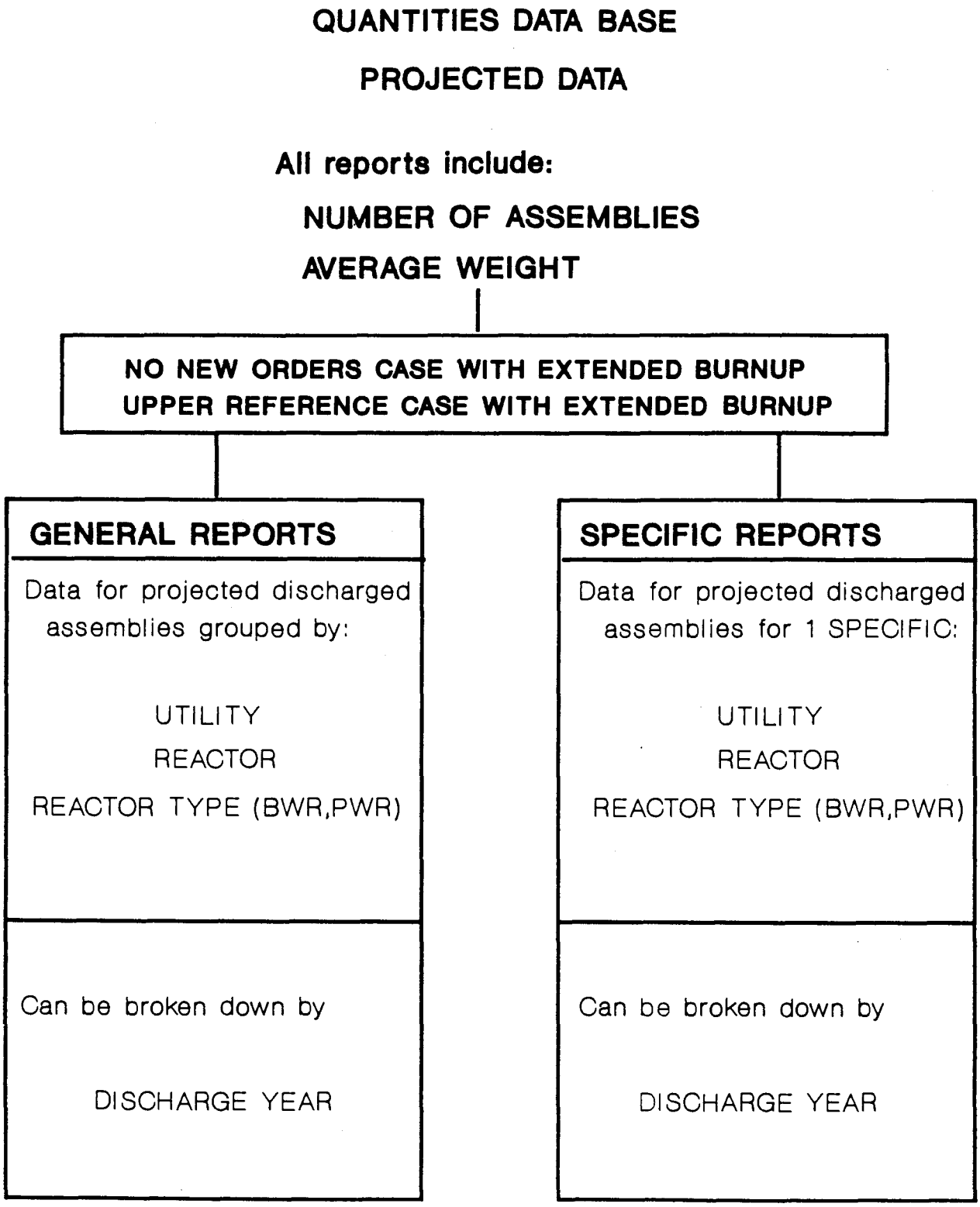


FIGURE 2.2 Overview of Projected data

data in different levels of detail. The General reports are intended to give broadly summarized data about the distribution of assemblies among utilities, or reactors, etc., by years. When a report covers thousands of assemblies, a fine level of detail would be inappropriate, particularly for a PC based system. The Specific reports, on the other hand, let you see a detailed level of data for one particular utility, or reactor type, etc. When the data is limited to one entity, then it is likely that users would like to see as much detail as possible about the burnup distribution, assembly types, etc.

2.1 HISTORICAL DATA

The historical data in the Quantities Database is taken from the EIA's data collected from the utilities via the RW-859 form. The EIA organizes this data into a transaction file containing data about the reactors, storage pools, and discharged assemblies. Most of the historical data in the Quantities Database comes from this transaction file. Additional EIA data on the numbers of defective fuel assemblies tabulated from the RW-859 forms is also included.

Identification of the assembly types by manufacturer, array size, and version (according to the fuel assembly types described in the LWR Assemblies Data Base) has been accomplished by several means. Primarily, drawing numbers, array sizes, dates and places of use, and weights from the EIA transaction files were used to identify the assembly type. Also, shipping records submitted by fuel vendors in conjunction with their descriptions of the fuel assemblies have identified the assembly types used at various times by various reactors. As much information as possible has been included here. For some of the used fuel assemblies, it was not possible to completely identify the assembly type. Frequently, some of the assembly features were known, such as the array size, or just the manufacturer without the array size or version. In those cases, the assemblies were assigned a "generic type" based on what was known, such as "14 X 14", where the array size was known but not the manufacturer, or "General Electric unspecified", where the manufacturer was known and the array size was not.

All the historical data reports contain the following basic information:

Number of assemblies discharged
Number of defective assemblies discharged
Average burnup of assemblies (megawatt days per ton)
Average weight (metric tons of heavy metal) of assemblies

2.1.1 Historical General Reports

The general reports for historical data show the basic data for all assemblies or tabulated by:

Utility
Reactor
Storage Pool
Assembly Type (Manufacturer, rod array size, and version)
Reactor Type (BWR, PWR)

You can also choose to see the data broken down by discharge year.

A sample historical general report is shown in Figure 3.1. That report shows assembly data grouped by utility and further broken down by discharge year. The actual report is many pages; figure 3.1 shows only the first page.

2.1.2 Historical Specific Reports

The specific reports for historical data show the basic data for assemblies of one particular entity. You can specify one specific

Utility
Reactor
Storage Pool
Assembly Type (Manufacturer, rod array size, and version)
Reactor Type (BWR, PWR)

Once you have specified which of the above categories in which you are interested, the program will prompt you for the name of the particular item. For example, if you had chosen a specific utility report, the system would ask you which utility you want to see. You can either type the utility name, or enter a '?' to see a list of utility names from which you can choose the one you want.

The specific reports can also be subtotaled (where appropriate) by storage pool or assembly type.

In addition, you can also choose to have the data broken down by:

Discharge year
Discharge year and burnup bin

These categories need some further explanation. The burnup bin breakdown shows you the burnup distribution in ranges of 5000 megawatt days per ton. The assemblies discharged in a given year are grouped in the different bins, or ranges, according to their burnup values. This gives a more detailed look at the actual burnups of the assemblies, rather than an average of all the assemblies discharged in a given year.

Figure 3.2 shows a sample historical data specific report. The sample report

shows the discharged assemblies from one specific utility, Alabama Power and Light, broken down by discharge year and burnup bin.

2.2 PROJECTED DATA

The projected data in the Quantities Database is taken from projections of fuel assembly usage by PNL, published as 'Reactor-Specific Spent Fuel Discharge Projections: 1985 to 2020', by Heeb, et. al. The PNL work covers many different cases. Two of these cases have been included in the Quantities Database: the No New Orders Case and the Upper Reference case. Both of these cases have been calculated assuming extended fuel burnup. For more information on these projections, please see the PNL report cited above.

The projections on assembly usage take into account the licensing dates of the reactors. Projections of assembly usage are made only for those years in which it is predicted a reactor will be in operation. For reactors under construction, the predicted startup date is used to project when fuel assemblies will begin to be discharged.

The projected data is far more limited than the historical data, since these are only approximate predictions. In particular, there is no projected data concerning the numbers of defective fuel assemblies, the burnup of assemblies, storage pools, or assembly types.

All the projected data reports contain the following basic information:

Number of assemblies discharged
Average weight (metric tons of heavy metal) of assemblies

2.2.1 Projected General Reports

The general reports for projected data show the basic data for all assemblies or tabulated by:

Utility
Reactor
Reactor Type (BWR, PWR)

You can also choose to see the data broken down by discharge year.

A sample projected general report is shown in Figure 3.3. That report shows assembly data grouped by reactor and further broken down by discharge year. The actual report is many pages; figure 3.3 shows only the first page.

2.2.2 Projected Specific Reports

The specific reports for historical data show the basic data for assemblies of one particular entity. You can specify one specific

Utility
Reactor
Reactor Type (BWR, PWR)

Once you have specified which of the above categories in which you are interested, the program will prompt you for the name of the particular item. For example, if you had chosen a specific utility report, the system would ask you which utility you want to see. You can either type the utility name, or enter a '?' to see a list of utility names from which you can choose the one you want.

Figure 3.4 shows a projected specific report, that covers the projected data for a particular reactor, Calvert Cliffs 1, broken down by discharge year. This report covers only 1 page.

3.0 SAMPLE REPORTS

This section contains some sample reports generated by the Quantities Database system. The reports included show some, but not all, of the data available. They are included here to give a brief look at the kinds of reports available. Similar general reports can be obtained for the different categories. Similar specific reports can be obtained from the system for the different utilities, reactors, storage pools, assembly types, and reactor types. Some of these reports, particularly the general reports, actually require several pages, but only the first page is included here to give you the general idea of how the output will appear.

The following reports are included:

Figure 3.1 Historical assembly data grouped by utility and broken down by discharge year(page one only).

Figure 3.2 Historical assembly data for one specific utility, Alabama Power Company, broken down by discharge year and burnup bin.

Figure 3.3 Projected assembly data grouped by reactor and discharge year(page one only).

Figure 3.4 Projected assembly data for one specific reactor, Calvert Cliffs 1, broken down by discharge year.

LWR QUANTITIES DATABASE
Historical Data
Discharged Assemblies by Utility

UTILITY	DISCHARGE YEAR	NUMBER ASSEMBLIES	DEFECTIVE ASSEMBLIES	AVG BURNUP (MWd/MTIHM)	AVG WEIGHT (MTIHM)
Alabama Power Co.	1979	46	1	17453	0.459
	1980	53		27244	0.460
	1981	28		28980	0.460
	1982	52		16946	0.458
	1983	130	15	26715	0.459
	1984	78	3	27867	0.458
	1985	150		28125	0.459
*** SUB TOTALS		537	19	25707	0.459
Arkansas Power & Light	1977	50		16533	0.464
	1978	61		26040	0.462
	1979	65		30134	0.463
	1981	98	22	21943	0.450
	1982	130	7	27526	0.437
	1983	64		28948	0.415
	1984	68		31659	0.464
	1985	68		32516	0.427
*** SUB TOTALS		604	29	27018	0.446
Baltimore G&E	1977	32		17973	0.392
	1978	195		22415	0.379
	1979	136		27194	0.383
	1980	71		30644	0.387
	1981	85		32159	0.386
	1982	154		30842	0.388
	1983	99		31875	0.379
	1984	101		31878	0.374
	1985	129		36482	0.387
*** SUB TOTALS		1002		29326	0.383
Boston Edison Co.	1973	20	16	5997	0.194
	1976	132	128	11308	0.193
	1977	428	1	16480	0.193
	1980	92		20506	0.184
	1981	232		20192	0.184
	1983	224		21459	0.184

Figure 3.1 Historical assembly data grouped by Utility and broken down by Discharge Year(page one only)

LWR QUANTITIES DATABASE
Historical Data
Data Broken Down By: Discharge Year and Burnup Bin
Discharged Assemblies for Utility: Alabama Power Co.

DISCHARGE YEAR	BURNUP BIN	NUMBER ASSEMBLIES	AVG BURNUP (MWd/MTIHM)	AVG WEIGHT (MTIHM)
1979	15000-20000	46	17453	0.459
1980	20000-25000	2	22412	0.460
1980	25000-30000	51	27434	0.460
1981	15000-20000	1	18237	0.460
1981	25000-30000	27	29378	0.460
1982	15000-20000	52	16946	0.458
1983	5000-10000	12	7655	0.458
1983	15000-20000	2	17327	0.458
1983	20000-25000	2	23325	0.459
1983	25000-30000	95	27509	0.459
1983	35000-40000	19	36123	0.460
1985	20000-25000	1	24132	0.460
1985	25000-30000	30	27023	0.459
1985	30000-35000	41	33435	0.458
*** TOTALS		381	25244	0.459

Figure 3.2 Historical assembly data for one specific utility, Alabama Power Company, broken down by Discharge Year and Burnup Bin

LWR QUANTITIES DATABASE
Projected Data: Upper Reference Case with Extended Burnup
Projected Assemblies by Reactor through 2020

REACTOR	DISCHARGE YEAR	NUMBER ASSEMBLIES	AVG WEIGHT (MTIHM)
FARLEY 1	1986	59	0.460
	1988	60	0.461
	1989	58	0.461
	1991	69	0.461
	1992	61	0.461
	1994	60	0.461
	1995	61	0.461
	1997	58	0.461
	1998	56	0.461
	2000	62	0.461
	2001	54	0.461
	2003	65	0.461
	2004	58	0.461
	2006	63	0.461
	2007	61	0.461
	2009	60	0.461
	2010	61	0.461
	2012	58	0.461
	2013	60	0.461
	2015	48	0.461
	2016	52	0.461
	2017	157	0.461
*** SUB TOTALS		1401	0.461
FARLEY 2	1986	63	0.459
	1987	53	0.462
	1989	61	0.462
	1990	58	0.461
	1992	63	0.461
	1993	57	0.461
	1995	63	0.461
	1996	51	0.461
	1998	58	0.461
	1999	54	0.461
	2001	58	0.461
	2002	48	0.461

Figure 3.3 Projected assembly data grouped by reactor and Discharge Year(page one only)

LWR QUANTITIES DATABASE
Projected Data: Upper Reference Case with Extended Burnup
Data Broken Down By: Discharge Year
Projected Assemblies for Reactor: CALVERT CLF 1

DISCHARGE YEAR	NUMBER ASSEMBLIES	AVG WEIGHT (MTIHM)
1986	71	0.382
1988	78	0.372
1990	78	0.389
1992	82	0.378
1994	77	0.376
1996	68	0.376
1998	74	0.376
2000	78	0.376
2002	65	0.376
2004	76	0.376
2006	81	0.376
2008	62	0.376
2010	81	0.376
2012	75	0.376
2014	61	0.376
2015	216	0.378
*** TOTALS	1323	0.377

Figure 3.4 Projected assembly data for one specific reactor, Calvert Cliffs 1, broken down by Discharge Year

4.0 SOFTWARE INSTALLATION AND STARTUP

This section provides step by step information on how to install and start the Quantities Database system. The first part, 4.1, describes how to set up a CONFIG.SYS file to ensure proper operation of the Quantities Database. The next part, 4.2, describes how to install the Quantities Database onto a fixed disk from the distribution floppy diskettes. The third section has installation instructions for those who have received the Quantities Database on a Bernoulli cartridge.

If you want to install the Quantities Database onto your fixed disk, you will need to read 4.1 and 4.2, and can skip section 4.3. If you have received the Quantities Database on a Bernoulli cartridge, and want to run the system from there, you need to read section 4.1, and then go to section 4.3 to read about installation and system startup on a Bernoulli cartridge.

4.1 SETTING UP A CONFIG.SYS FILE

A file named CONFIG.SYS must be present on the disk you use to start your computer. It must have the following lines:

FILES = 20

BUFFERS = 24

If the numbers are larger, that's fine, but if they are smaller they should be set to the above numbers. This file must be in the root directory of the disk you use to start your computer.

You can use a text editor to create this file or add these lines to an existing CONFIG.SYS file you may already have. Or, you can create the file by following these steps:

1. Enter the command:

   COPY CON: CONFIG.SYS <Enter>

2. Enter these lines: (each line is followed by the <ENTER> key)

   FILES = 20<Enter>

   BUFFERS = 24<Enter>

   <Ctrl>Z<Enter>

You will then need to activate the file by restarting the computer. This can be done by pressing the following keys: <Ctrl><Alt><Del> all together. Once your CONFIG.SYS file has been set up you do not need to change it again.

4.2 INSTALLATION AND STARTUP ON A FIXED DISK PC

To install the Quantities Database on your fixed disk, first start up your computer as you usually do. Then place the Quantities Database Programs diskette in drive A and enter this command:

A:<Enter>

The next step is to enter the install command followed by the letter of your fixed disk. This is usually C, but sometimes is D or E. If your fixed disk is C, enter the command:

INSTALL C:<Enter>

Substitute the correct letter of your fixed disk for C.

This will execute a batch file that will create a subdirectory QDB and copy the programs to the fixed disk. Also, a batch file, QTY.BAT, will be placed in the root directory. That file will be used to begin operation of the system. After the programs have all been copied, you will be asked to insert the Quantities Database Data 1 diskette. Do so and press **<Enter>**. The data files will be copied to the fixed disk. Then you will be asked to insert the Quantities Database Data 2 diskette. Do so and press **<Enter>**. This procedure will be repeated for the Quantities Database Data 3 and Data 4 diskettes. When all the diskettes have been copied onto the fixed disk, the installation is complete and you may put away your master distribution diskettes for safekeeping.

4.2.1 System Startup on a Fixed Disk

To start up the Quantities Database system, first make the root directory of the fixed disk the default directory. To do this, enter the following command:

CD \<Enter>

Then enter this command:

QTY<Enter>

This will begin the Quantities DataBase system. Please read section 5 for operating instructions.

4.3 INSTALLATION AND STARTUP ON A BERNOULLI CARTRIDGE

If you have received the Quantites Database system on a Bernoulli cartridge, you will usually not need any installation procedures. There is, however, one exception. If you start your computer from a Bernoulli cartridge, you will need to copy 1 DOS file, COMMAND.COM, to the Quantities Database system Bernoulli cartridge. You can do this by placing your DOS diskette in drive A, and entering the following command (assuming that your Bernoulli drive is drive C):

COPY A:COMMAND.COM C:<Enter>

If your Bernoulli drive is another letter (such as D), then substitute that letter plus a colon for C: in the above command.

4.3.1 System Startup from a Bernoulli Cartridge

To start up the Quantities Database system, first make the root directory of the Bernoulli cartridge drive the default drive. Then make the root directory of that drive the default directory. To do this, enter this command:

CD \<Enter>

Then enter this command:

QTY<Enter>

This will begin the Quantities DataBase system. Please read section 5 for operating instructions.

5.0 OPERATING INSTRUCTIONS

This section describes the operation of the Quantities Database system. First, an overview of the system design is presented in section 5.1. Next, section 5.2 describes a step-by-step scenario of using the program, with sample screen outlines showing exactly what will appear on your computer screen.

5.1 OVERVIEW

The Quantities Database contains a great deal of information that can be retrieved in reports as described in section 2. The flexible full-screen menu has been designed to let you easily specify what data you want to see, and how you would like the data tabulated. In general you first define what reports you want by making a selection for each of these four parameters:

A. **Historical or Projected:** Whether you want historical or projected data.

B. **Data Requested:** The available general and specific reports. There are different reports for historical and projected data.

C. **Data broken down by:** The options for grouping, or subtotaling the data. The options available are a function of what was chosen for A and B.

D. **Output To:** The destination for the data: screen, printer, or disk file.

As you make your selections for these parameters, the values you have chosen will be displayed in the main menu box at the top of the screen, so that you

will constantly know what has been selected.

Once you have initially specified these four parameters you can then enter 'R' to run the report, and the data will go to the specified output destination. It is often useful to send output to the screen first to check that it is the report you want, and then send it to the printer if you need hard copy output. The disk file option is useful if you want to transfer the data into another program, such as a word processing program (to include the data in a document), or to use the data in a scientific program to perform some analysis or calculations.

You can change any of the four parameters, A-D, at any time. For example, suppose you had selected the following:

A.	**Historical or Projected:**	Historical
B.	**Data Requested:**	Assemblies by utility
C.	**Data broken down by:**	Discharge year
D.	**Output to:**	Screen

If you wanted to change the output destination to Printer, you would enter a 'D' to change that parameter, and then the system would display all available options for output destination. You would choose Printer from that list.

Or, if you wanted to change the Data Requested to get a specific report for one particular utility, then you would enter a 'B', then select the report from the list of reports displayed. Then, since you had just selected a specific report, the system would prompt you for which utility you wanted to see.

This ability to change one parameter at a time allows you to more quickly specify different reports. But it can lead to situations where some of the parameters specified are not appropriate. For example, suppose you had selected the following:

A.	**Historical or Projected:**	Historical
B.	**Data Requested:**	Assemblies by assembly type
C.	**Data broken down by:**	Discharge year
D.	**Output to:**	Screen

If you change the A parameter to Projected, the Data Requested is no longer appropriate because there is no projected data for assembly types. The system would prompt you to make a new selection for Data Requested by displaying a list of choices appropriate for projected data.

You do not need to be concerned about which selections are appropriate as you

change other items, because the system will automatically detect any inappropriate selections and prompt you to make new selections that will produce a valid report.

5.2 SAMPLE OPERATING SCENARIO

This section takes you through a sample session with the Quantities Database system, showing exactly what you will see on the screen as you operate the program. This is just a brief walk-through to introduce you to the operation of the Quantities Database. Much more data in various combinations is available than what is shown here. You are encouraged to try experimenting with the system yourself to see how it can best serve your needs.

LWR QUANTITIES DATABASE

Welcome to the OCRWM/ORNL
LWR Quantities PC Database System -- September 1987

This database was assembled by the Waste Characterization task group at Oak Ridge National Laboratory under the sponsorship of the Department of Energy Office of Civilian Radioactive Waste Management as part of the Waste Systems Data and Development Program.

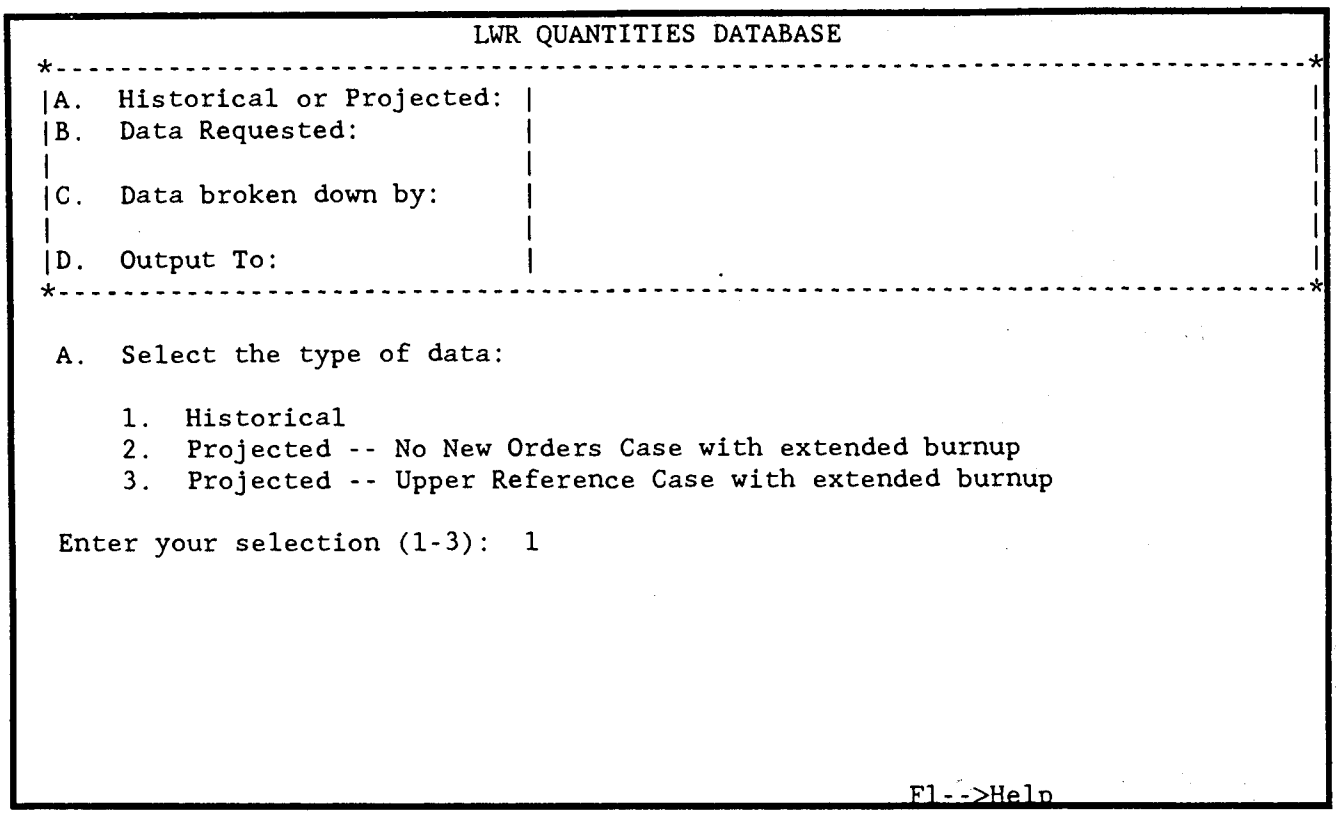
The database contains information on fuel assemblies discharged from reactors and also projections of fuel assemblies to be used in future years. The historical data comes primarily from the Energy Information Administration, and the projected data comes from Pacific Northwest Laboratory.

A user's guide to this database has been issued as Appendix 2D to report DOE/RW-XXXX, "Characteristics of Potential Repository Wastes", September 1987. For more information or to offer comments and suggestions, please contact Karl J. Notz, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN. 27831 (615)574-6632 or FTS 624-6632.

Strike any key to continue . . .

This is the introductory screen that you will see when the program first begins. This screen gives some information about the database and a contact person at the Oak Ridge National Laboratory.

You can strike any key to move on to the next screen, the main menu.



This next screen shows the selection menu box displayed in the top part of the screen. This shows the four parameters(A-D) necessary to define a report in the left side of the box. The right side will show the currently selected options. It is now blank, since the system has just been started.

The lower right hand corner contains a message saying "F1-->Help". At any time during system operation, you can press the F1 function key to get some help information.

The system will prompt you for the four parameters, starting with A. Notice the bottom half of the screen. The choices for option **A, Historical or Projected**, are listed underneath the menu box. In our sample scenario, the user enters a 1, to select historical data.

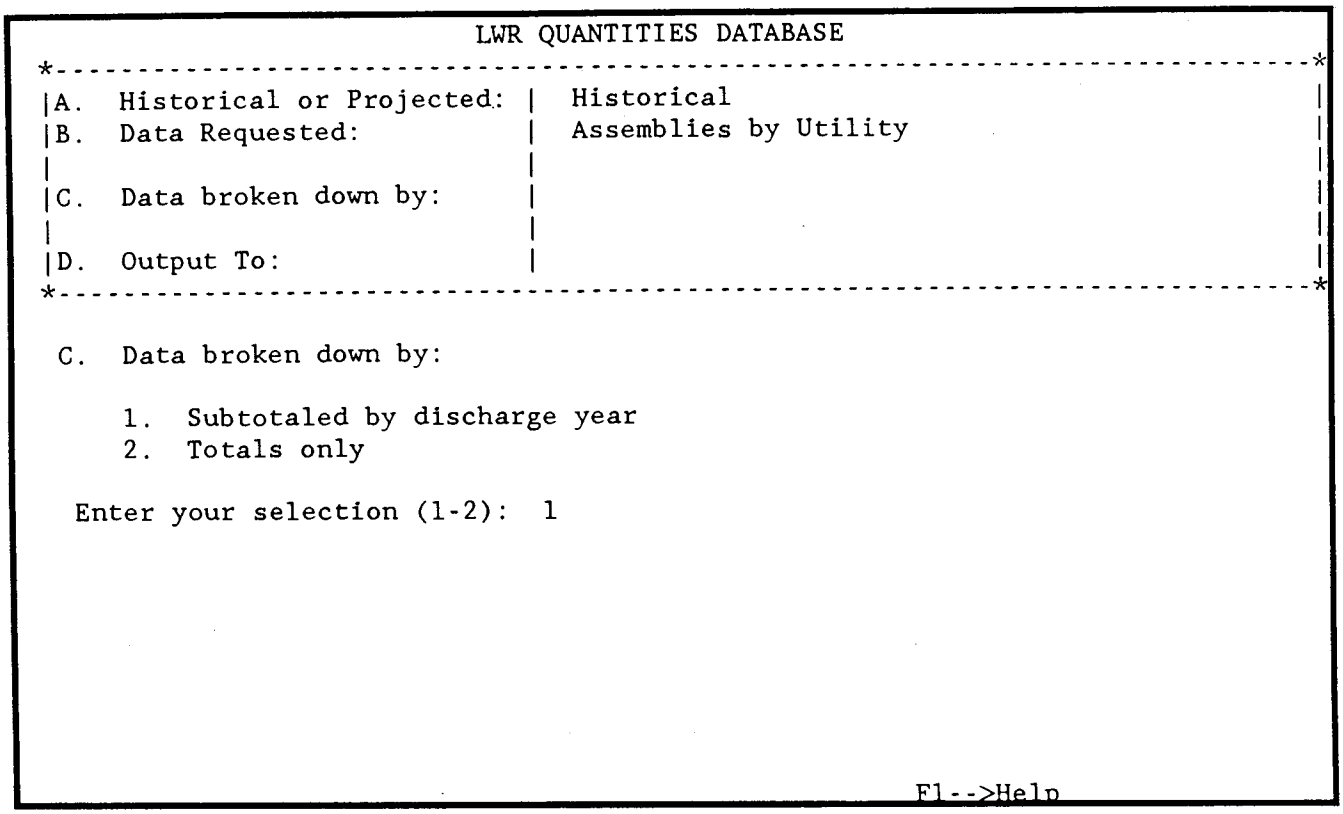
```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |                                           |
|                             |                                           |
|C.  Data broken down by:     |                                           |
|                             |                                           |
|D.  Output To:               |                                           |
*-------------------------------------------------------------------------*

 B.  Data Requested:

  1.  All assemblies
  2.  Assemblies by Utility                      7.  Assemblies for 1 Utility
  3.  Assemblies by Reactor                      8.  Assemblies for 1 Reactor
  4.  Assemblies by Storage Pool                 9.  Assemblies for 1 Storage Pool
  5.  Assemblies by Assembly Type               10.  Assemblies for 1 Assembly Type
  6.  Assemblies by Reactor Type(BWR and PWR)   11.  Assemblies for 1 Reactor Type

 Enter your selection (1-11):  2


                                                          F1-->Help
```

Note that the value selected for parameter A, **Historical**, is displayed in the top right of the main menu box.

The next option is **B, Data Requested**. You will see a list of the possible reports. The choices available depend on what has already been chosen for options A. The choices would be different if you had chosen projected data for the A option. An example of the possible reports for projected data will be shown later.

You can see that the reports have been divided into General reports, in the left had column (1-6), and Specific reports in the right hand column (7-11). The General reports cover all the assemblies, grouped in the various ways listed. The Specific reports cover only assemblies for one particular entity.

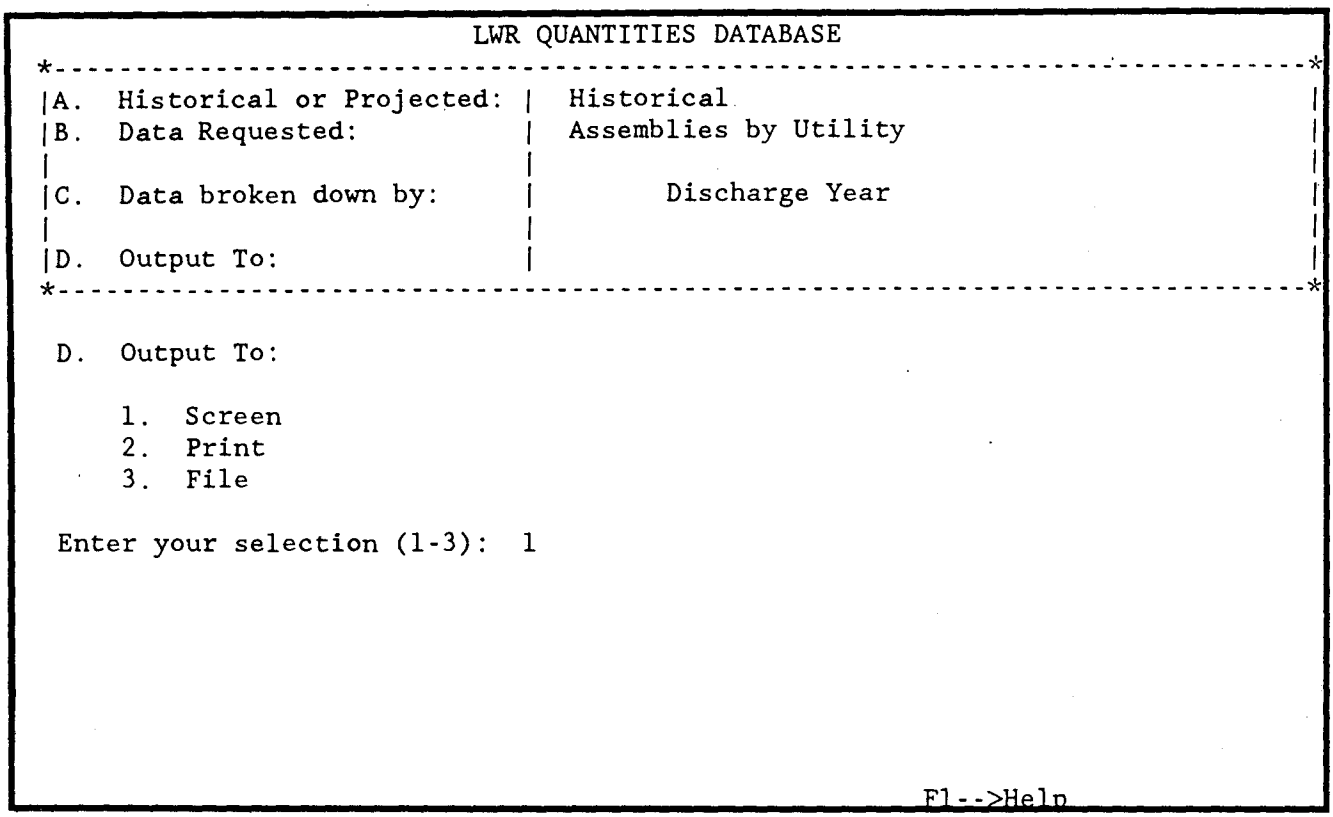
The user enters a 2, to choose a General report, assemblies grouped by utility.



The next option is **C, Data broken down by**. You will see a list of the possible subtotal options, for the chosen Data Requested. The choices available depend on what has already been chosen for options A and B. The choices would be different if you had chosen a specific report for option B, or had chosen projected data for the A option.

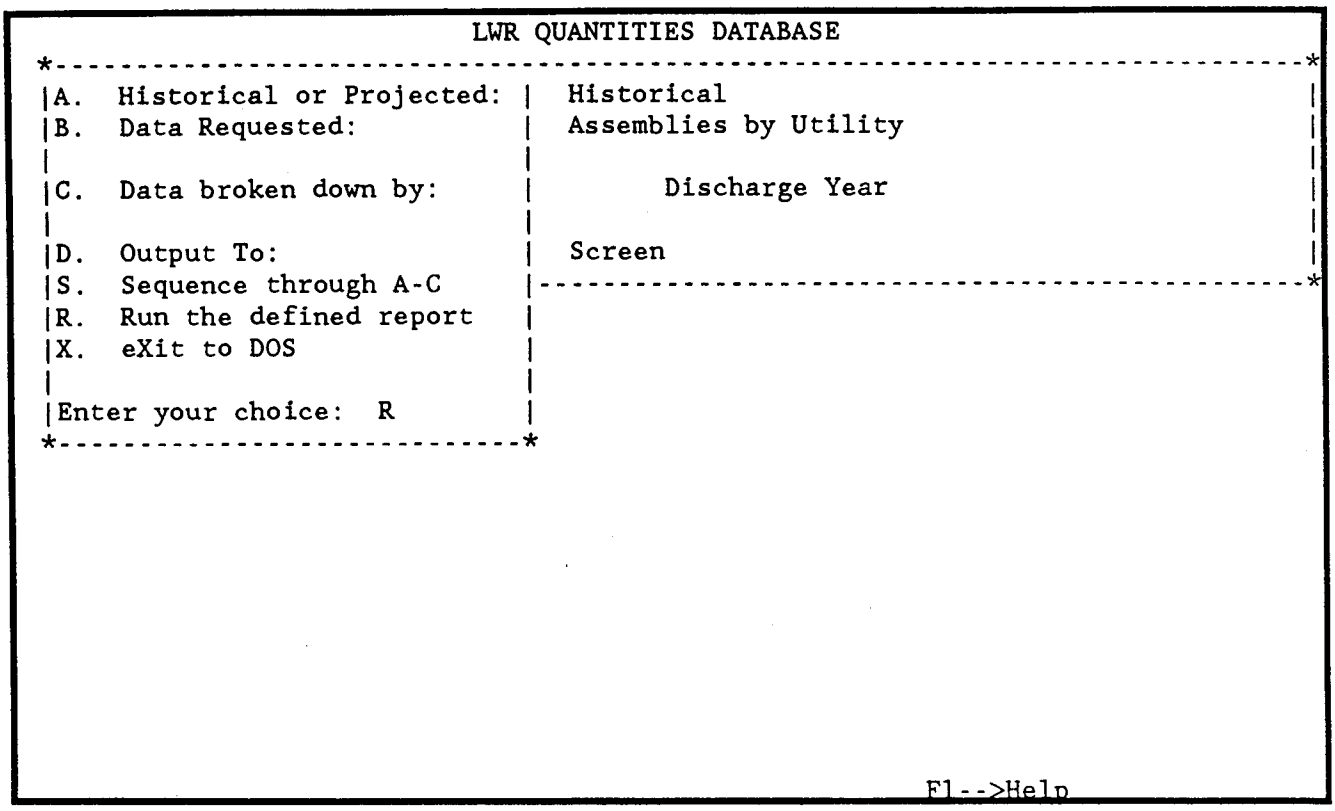
You can see that in this case there are 2 possible subtotal options, subtotal by year, or no subtotals, just total numbers only.

The user enters a 1, to see the data broken down by discharge year.



The fourth and final parameter is the D, Output To. You can see that the choices are Screen, Print, and File. Sending output to the screen is useful for a quick check on some numbers, or to preview some data before sending it to a printer. The Print option provides hard copy output. The disk file option is useful to incorporate the data into another document using a word processing program, or to use the data for further calculations in another program.

The user enters 1, to send output to the screen.



Now all the four parameters (A-D) have been specified, and the main menu is displayed. You can see the currently selected options in the right half of the main menu box. At this point, you could choose any of the letter options listed on the left. Options A-D would let you change one of the parameters. Option R runs the report as already defined. Option S sequences through the different options A-C. It is an easy way to specify a completely new report. Option X is used to exit the system.

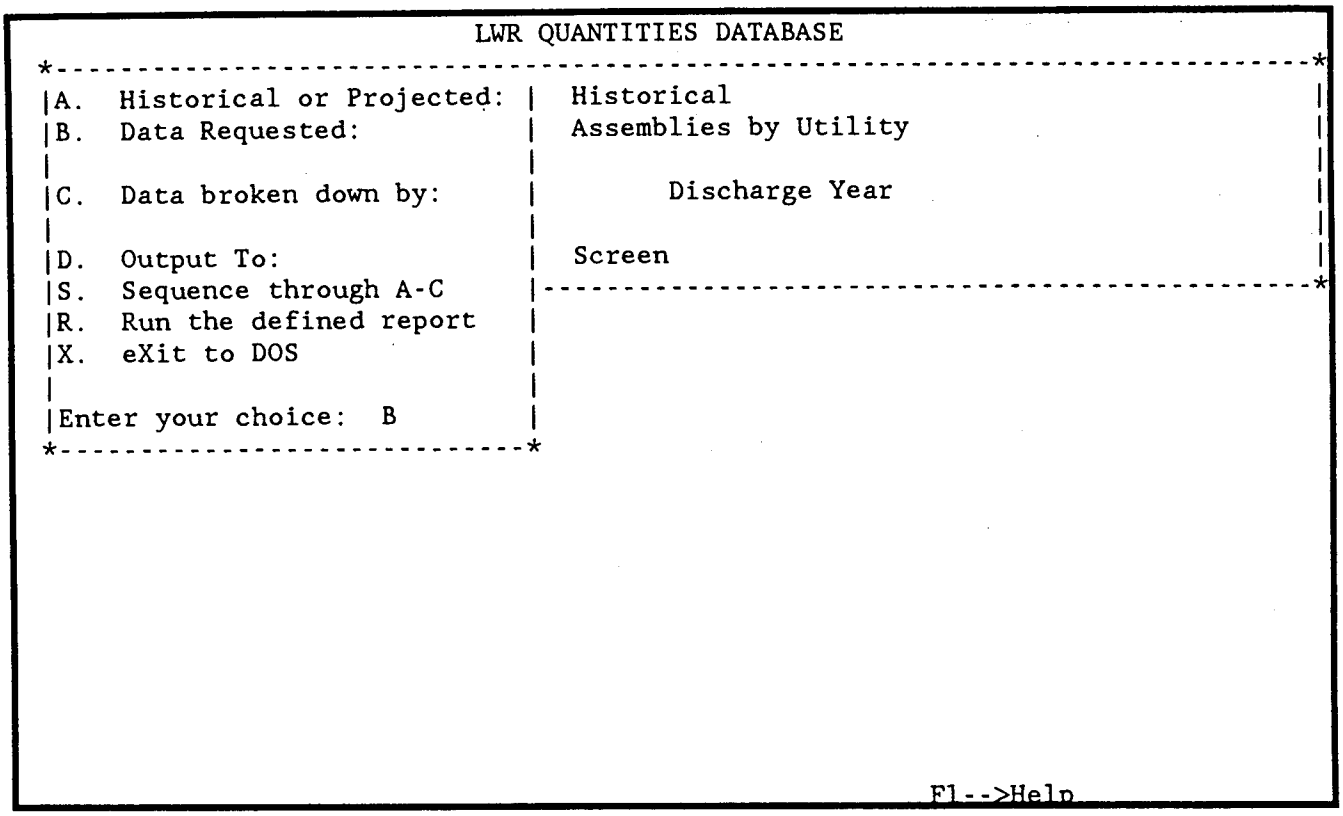
In this sample scenario, the user enters R, to run the report he has defined: Historical data, all assemblies grouped by utility, and broken down by discharge year. The output will go to the currently selected destination, the screen.

LWR QUANTITIES DATABASE
Historical Data
Discharged Assemblies by Utility

UTILITY	DISCHARGE YEAR	NUMBER ASSEMBLIES	DEFECTIVE ASSEMBLIES	AVG BURNUP (MWd/MTIHM)	AVG WEIGHT (MTIHM)
Alabama Power Co.	1979	46	1	17453	0.459
	1980	53		27244	0.460
	1981	28		28980	0.460
	1982	52		16946	0.458
	1983	130	15	26715	0.459
	1984	78	3	27867	0.458
	1985	150		28125	0.459
*** SUB TOTALS		537	19	25707	0.459
Arkansas Power & Light	1977	50		16533	0.464
	1978	61		26040	0.462
	1979	65		30134	0.463
	1981	98	22	21943	0.450
	1982	130	7	27526	0.437
	1983	64		28948	0.415
	1984	68		31659	0.464

Command: KEYS: PgUp PgDn HOME END ?=Help X=eXit

The requested report is displayed on the screen. Usually, the report will not fit on one screen. You can browse through the data, scrolling forwards and backwards. The bottom line is a command line. You can enter commands to browse through the report. The most common keys are listed on the right hand side of the command line. PgDn and PgUp keys are used to skip to the next or previous screenful of data. The down and up arrow keys move you down and up 1 line of text. For more information on these commands, you can enter a ? to see all the options available. To exit this browse mode after reviewing the data as much as you like, enter an X.



You have been returned from viewing the report to the main menu. At this point, you could choose any of the letter options listed on the left. You could change the **Output To** parameter if you wanted to send the report to another output destination, such as the printer. Or you could change parameters A-C, to define a different report, to view different data, or data tabulated in a different way. In this case, the user wants to specify a different report, so he enters **B**, to select a new value for **Data Requested**.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |  Assemblies by Utility                    |
|                             |                                           |
|C.  Data broken down by:     |       Discharge Year                      |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

 B.  Data Requested:

  1.  All assemblies
  2.  Assemblies by Utility                      7.  Assemblies for 1 Utility
  3.  Assemblies by Reactor                      8.  Assemblies for 1 Reactor
  4.  Assemblies by Storage Pool                 9.  Assemblies for 1 Storage Pool
  5.  Assemblies by Assembly Type               10.  Assemblies for 1 Assembly Type
  6.  Assemblies by Reactor Type(BWR and PWR)   11.  Assemblies for 1 Reactor Type

 Enter your selection (1-11):  8


                                                          F1-->Help
```

The options for Data Requested are listed in the bottom half of the screen. The General reports are listed in the left hand column (1-6) and the Specific reports are listed in the right hand column (7-11).

The user wants to see some detailed information about assemblies from a particular reactor, so he enters 8, to select the Specfic report, assemblies for one reactor.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |  Assemblies by Utility                    |
|                             |                                           |
|C.  Data broken down by:     |        Discharge Year                     |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

B.  Data Requested:  Assemblies for 1 Reactor

    Reactor Name:  C_____________________

You can either:
    Enter the entire reactor name
    Enter only the first character to see a list of reactors that
        start with that letter
    Enter a ? to see a list of all reactors




                                                          F1-->Help
```

Since a specific report was chosen, the user needs to specify for which particular reactor he would like to see the data. In the bottom part of the screen, the program is prompting the user to indicate which reactor he would like to see. You have 3 choices of how to enter the reactor name. You can type the entire name, you can type just the first letter, or you can type a ?. If you type the first letter, you will then see a list of reactor names that start with that letter, and you can choose from that list. The next page shows an example of this. If you type a ?, you will see a complete list of all reactors for which the system has data, and you can choose from that list.

The user enters a C, because he wants to see data for Calvert Cliffs 1, and entering a C is easier than typing the entire name.

```
                          LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |  Assemblies by Utility                    |
|                             |                                           |
|C.  Data broken down by:     |        Discharge Year                     |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

B.  Data Requested:  Assemblies for 1 Reactor

1.  Callaway 1                          8.  Cook 1
2.  Calvert Cliffs 1                    9.  Cook 2
3.  Calvert Cliffs 2                   10.  Cooper Station
4.  Catawba 1                          11.  Crystal River 3
5.  Catawba 2
6.  Clinton
7.  Comanche Park 1
8.  Comanche Park 2



Enter your selection (1-11):  2                          F1-->Help
```

All the reactor names that begin with a C are listed. In this case, there are eleven reactors. You can enter the number of the reactor of interest. If there had been too many to include on one screen display, you would see a message saying you could select a number from those listed, or hit the <ENTER> key to see more choices.

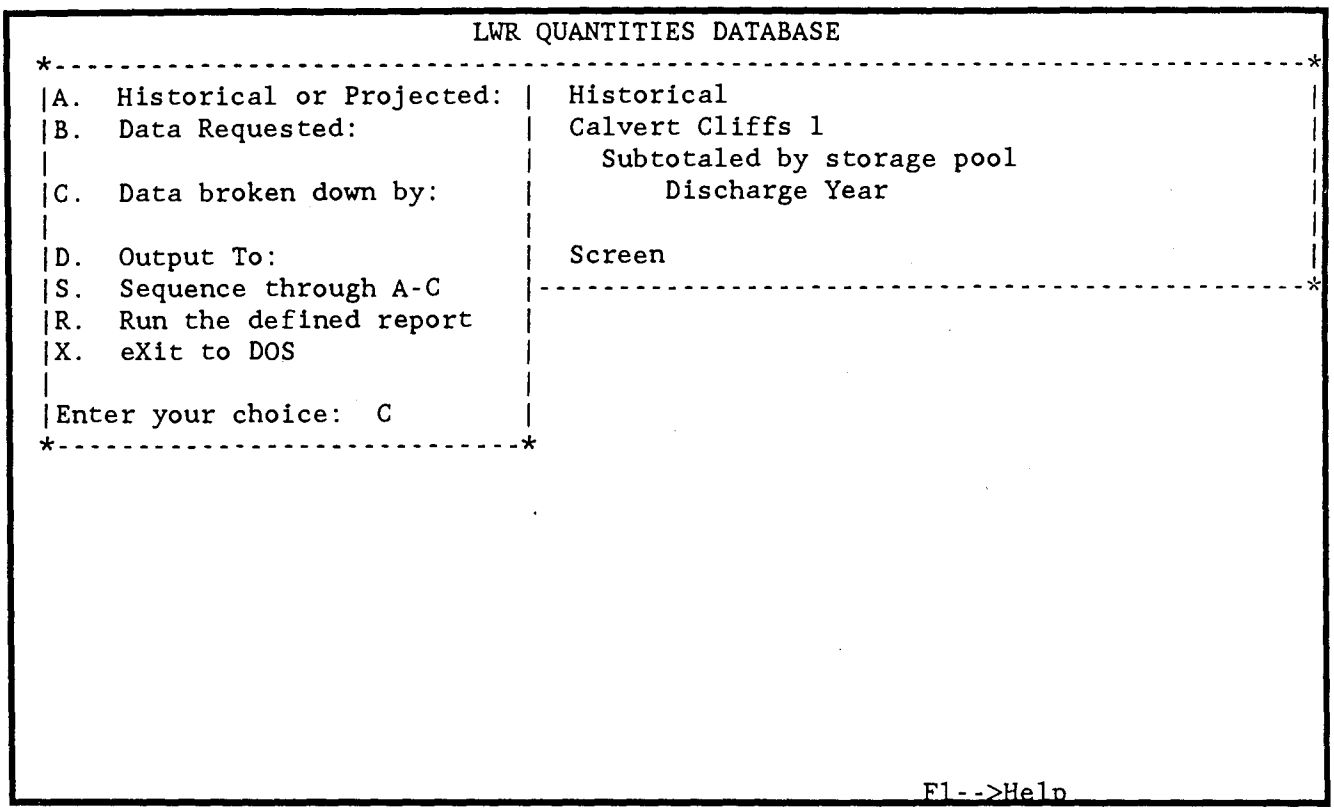
The user enters a 2, to select the reactor Calvert Cliffs 1.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |  Calvert Cliffs 1                         |
|                             |                                           |
|C.  Data broken down by:     |       Discharge Year                      |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

B.  Data Requested:  Assemblies for 1 Reactor
For a report on 1 specific reactor, you may choose to see the data subtotaled by
these additional categories.

    1.  Subtotaled by storage pool
    2.  Subtotaled by assembly type
    3.  Totals only

Enter your selection (1-3):  1

                                                          F1-->Help
```

For a Specific report for historical data, you have some additional subtotaling options. These are listed in the bottom half of the screen. You can choose to subtotal the data by storage pool or assembly type, or you can choose to not group the figures, and include totals only.

These options are included to provide a more detailed look at the Quantities data. The subtotal by assembly type allows you to see how many different assembly types were used by a particular reactor, or utility, etc. The subtotal by storage pool allows you to see in which different storage pools the spent fuel assemblies have been stored.

The user enters a 1, to have the data subtotaled by storage pool.



Note that the new choice for **Data Requested** is in the right half of the main menu box. At this point, the user has defined a new report: Historical data for the reactor Calvert Cliffs 1, subtotaled by storage pool, and broken down by discharge year.

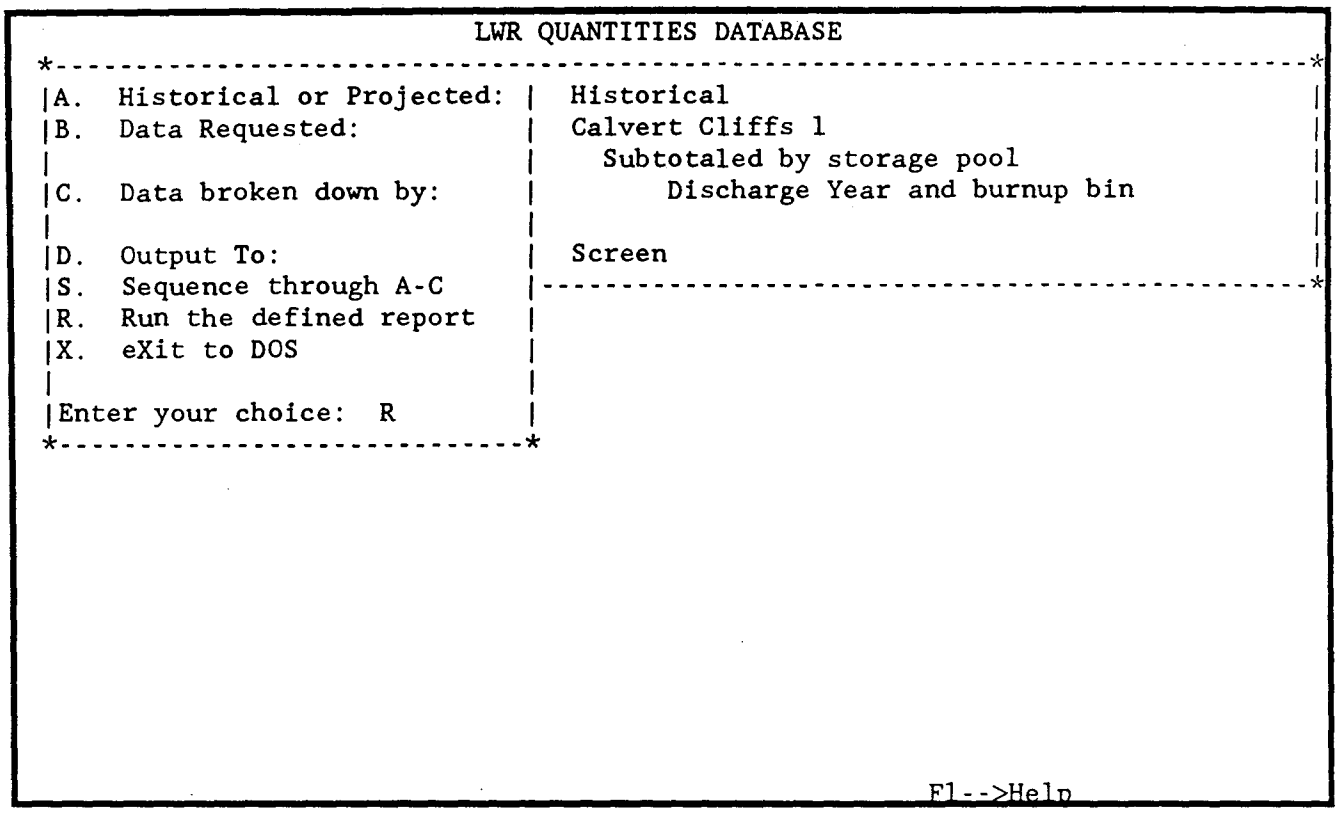
You could use any of the letter options in the main menu box: A-D to change that report paramter, R to run the report, S to sequence through the options to define a new report, or X to exit the program.

The user wants to change the values for **Data broken down by**, so he enters a C.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |  Calvert Cliffs 1                         |
|                             |    Subtotaled by storage pool             |
|C.  Data broken down by:     |        Discharge Year                     |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

 C.  Data broken down by:

     1.  Subtotaled by discharge year
     2.  Subtotaled by discharge year and burnup bin
     3.  Totals only

   Enter your selection (1-3):  2




                                                          F1-->Help
```

The list of choices is displayed. There are 3 possible choices, subtotaled by discharge year, subtotaled by discharge year and burnup bin, and totals only. The second one is only available for the specific reports. Subtotaled by burnup bin and discharge year means that the data is grouped into ranges of burnups (in megawatt days/per MTIHM) for each discharge year. When a general report has been chosen for the **Data Requested** option, then only choices 1 and 3 are available. This is because the specific reports cover only a narrow area of discharged assemblies, and it may be useful to see the burnup bin distribution, while the scope of the general reports is so large, that to include burnup bin distrubtion would make the report extremely long.

The user enters a 2, to see the data broken down by discharge year and burnup bin.



Note that the new selection for **Data broken down by** is in the right half of the main menu box. At this point, the user has defined a new report: Historical data for the reactor Calvert Cliffs 1, subtotaled by storage pool, and broken down by discharge year and burnup bin.

You could use any of the letter options in the main menu box: A-D to change that report paramter, R to run the report, S to sequence through the options to define a new report, or X to exit the program.

The report as defined is what the user wants to see, so he enters a R, to run the report.

Filename: qty.rpt

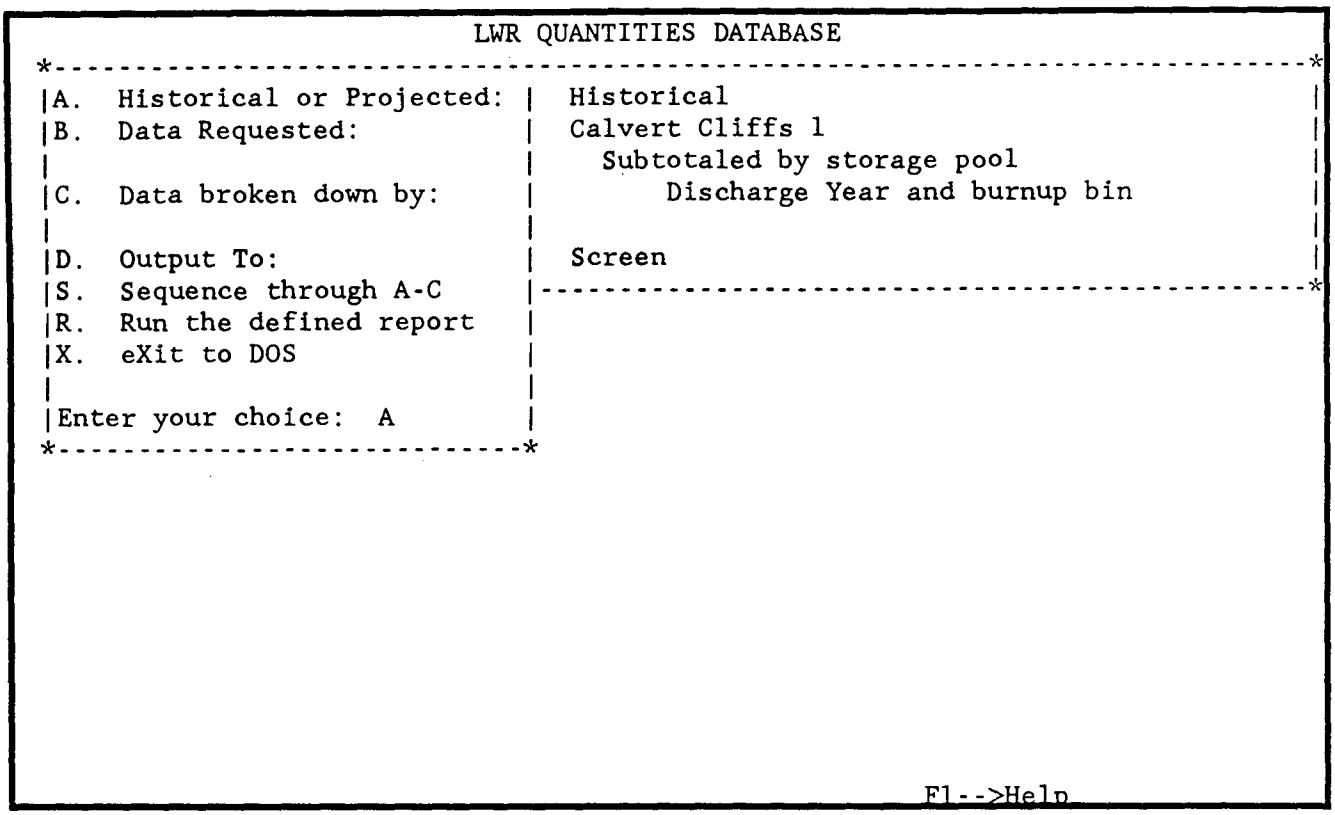
LWR QUANTITIES DATABASE
Historical Data
Data Broken Down By: Storage Pool, Discharge Year and Burnup Bin
Discharged Assemblies for Reactor: Calvert Cliffs 1

DISCHARGE YEAR	BURNUP BIN	NUMBER ASSMB	DEFEC. ASSMB	AVG BURNUP	AVG WEIGHT
Pool: Calvert Cliffs 1					
1977	15000-20000	32		17973	0.392
1978	20000-25000	8		22308	0.395
1978	25000-30000	104		26578	0.368
1979	25000-30000	72		27450	0.395
1980	30000-35000	69		30454	0.388
1980	40000-45000	1		42970	0.359
1982	25000-30000	24		26650	0.389
1982	30000-35000	52		33362	0.388

Command: KEYS: PgUp PgDn HOME END ?=Help X=eXit

The requested report is displayed on the screen. Usually, the report will be longer than will fit on one screen. You can browse through the report, scrolling forwards and backwards. The bottom line is a command line. You can enter commands to browse through the report. The most common keys are listed on the right hand side of the command line. PgDn and PgUp keys are used to skip to the next or previous screenful of data. The down and up arrow keys move you down and up 1 line of text. For more information on these commands, you can enter a ? to see all the options available.

To exit this browse mode after reviewing the data as much as you like, enter an X.



After veiwing the data on the screen, you are returned to the main menu. Once again, you can choose from all the letter options on the left hand side of the main menu box.

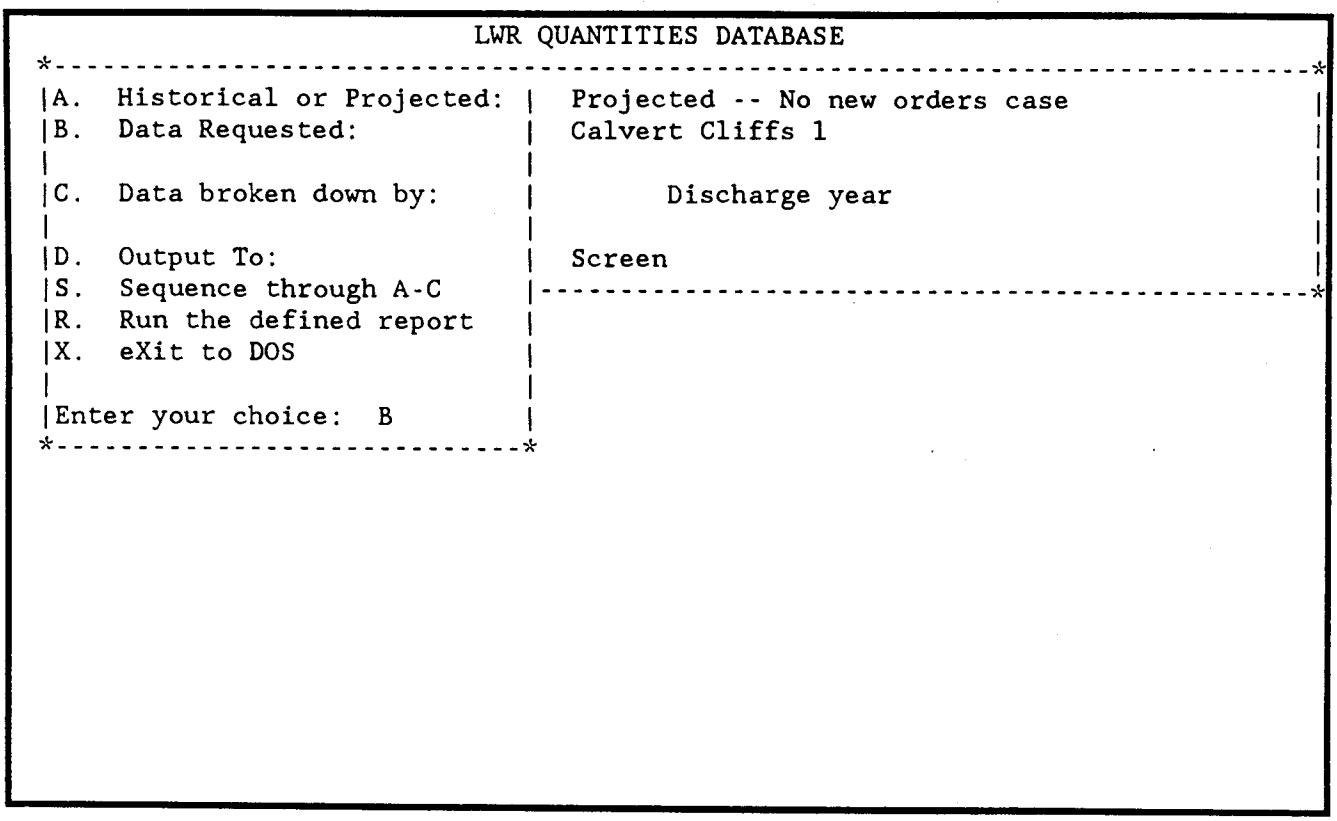
In this case, the user now wants to see some projected data, rather than historical data, so he enters **A** to change the **Historical or Projected** option.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Historical                               |
|B.  Data Requested:          |  Calvert Cliffs 1                         |
|                             |    Subtotaled by storage pool             |
|C.  Data broken down by:     |        Discharge Year and burnup bin      |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

 A.  Select the type of data:

      1.  Historical
      2.  Projected -- No New Orders Case with extended burnup
      3.  Projected -- Upper Reference Case with extended burnup

 Enter your selection (1-3):  2

                                                          F1-->Help
```

The selections for **Historical or Projected** are displayed. The user enters 2, to see projected data in the No New Orders Case with extended burnup.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Projected -- No new orders case          |
|B.  Data Requested:          |  Calvert Cliffs 1                         |
|                             |                                           |
|C.  Data broken down by:     |  *** Must be redefined for projected data |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

 C.  Data broken down by:

     1.  Subtotaled by discharge year
     2.  Totals only

  Enter your selection (1-2):  1




                                                          F1-->Help
```

Notice that the new value for **Historical or Projected** is displayed in the first line of the menu box. Also, there is a message opposite the **Data broken down by** option, saying that this option must be redefined for projected data. Previously, the **Data broken down by** option had been discharge year and burnup bin. However, there is no information about burnups for projected data, so that option is not available, once the A option was changed to projected. The program detects this inconsistency, and automatically asks the user to redefine the **Data broken down by** option. The possible choices are listed in the bottom part of the screen, and the user can then select a subtotal option that is available for projected data. The user enters 1, to subtotal the data by discharge year.



The newly selected value for **Data broken down by** is displayed in the right side of the main menu box. Once again, all the main menu options are available. In this case, the user wants to change the **Data Requested**, so he enters B.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Projected -- No new orders case          |
|B.  Data Requested:          |  Calvert Cliffs 1                         |
|                             |                                           |
|C.  Data broken down by:     |       Discharge year                      |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
*-------------------------------------------------------------------------*

 B.  Data Requested:

  1.  All assemblies
  2.  Assemblies by Utility                        5.  Assemblies for 1 Utility
  3.  Assemblies by Reactor                        6.  Assemblies for 1 Reactor
  4.  Assemblies by Reactor Type(BWR and PWR)      7.  Assemblies for 1 Reactor Type

 Enter your selection (1-7):  3


                                                          F1-->Help
```

The selections for **Data Requested** are listed. There are not as many selections as there were shown previously, because at this time, projected data has been chosen for option A. The projected data does not include grouping by assembly type or storage pool.

The user enters a 3, to select assemblies grouped by reactor.

```
                        LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------*
|A.  Historical or Projected: |  Projected -- No new orders case          |
|B.  Data Requested:          |  Assemblies by reactor                    |
|                             |                                           |
|C.  Data broken down by:     |        Discharge year                     |
|                             |                                           |
|D.  Output To:               |  Screen                                   |
|S.  Sequence through A-C     |-------------------------------------------*
|R.  Run the defined report   |
|X.  eXit to DOS              |
|                             |
|Enter your choice:  R        |
*-----------------------------*

                                                          F1-->Help
```

The new value for **Data Requested** is displayed on the right side of the main menu box. At this time, all the main menu options are available.

The user has defined the report he would like to see. He enters R, to run that report.

LWR QUANTITIES DATABASE
Projected Data: No New Orders Case with Extended Burnup
Projected Assemblies by Reactor through 2020

REACTOR	DISCHARGE YEAR	NUMBER ASSEMBLIES	AVG WEIGHT (MTIHM)
FARLEY 1	1986	59	0.460
	1988	60	0.461
	1989	58	0.461
	1991	69	0.461
	1992	61	0.461
	1994	60	0.461
	1995	61	0.461
	1997	58	0.461
	1998	56	0.461
	2000	62	0.461
	2001	54	0.461
	2003	65	0.461
	2004	58	0.461
	2006	63	0.461
	2007	61	0.461
	2009	60	0.461

Command: KEYS: PgUp PgDn HOME END ?=Help X=eXit

The requested report is displayed on the screen. Usually, the report will be longer than will fit on one screen. You can browse through the report, scrolling forwards and backwards. The bottom line is a command line. You can enter commands to browse through the report. The most common keys are listed on the right hand side of the command line. PgDn and PgUp keys are used to skip to the next or previous screenful of data. The down and up arrow keys move you down and up 1 line of text. For more information on these commands, you can enter a ? to see all the options available.

To exit this browse mode after reviewing the data as much as you like, enter an **X**.

```
                              LWR QUANTITIES DATABASE
*-------------------------------------------------------------------------------*
|A.  Historical or Projected: |  Projected -- No new orders case                |
|B.  Data Requested:          |  Assemblies by reactor                          |
|                             |                                                 |
|C.  Data broken down by:     |        Discharge year                           |
|                             |                                                 |
|D.  Output To:               |  Screen                                         |
|S.  Sequence through A-C     |-------------------------------------------------*
|R.  Run the defined report   |
|X.  eXit to DOS              |
|                             |
|Enter your choice:  X        |
*-----------------------------*

                          Exit Quantities Database (Y/N)?  Y


                                                                F1-->Help
```

After viewing the data, the main menu reappears. Any of the main menu options could be used at this point.

In this sample, the user has obtained all the data he wants at this time, so he decides to exit the database. He enters **X**, to exit the system. The system will ask him to confirm that he wishes to exit. If you respond N to this question, you will remain in the main menu. If you respond Y, you will return to the operating system.

The user enters a **Y** to the confirmation questions, and is returned to the operating system. This concludes the sample session.