Handwritten: 7/10/78

DOE/EIA/8589-2

MASTER

TR-78W-037

Handwritten: DOE/EIA/8589-2

SPENT NUCLEAR FUEL STORAGE
PROGRAM USER'S GUIDE

September 5, 1978

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Prepared for:

Office of Energy Source Analysis
Energy Information Administration
Washington, D.C.

Contract EC-77-C-01-8589

NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE. IT
has been reproduced from the best available
copy to permit the broadest possible avail-
ability.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Handwritten: 8/10/78

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

THE ORKAND CORPORATION

TABLE OF CONTENTS

I.	OVERVIEW	I-1
	PURPOSE	I-1
	MODEL OVERVIEW	I-1
II.	OPERATION	II-1
	GENERAL	II-1
III.	INPUT AND OUTPUT FILE SPECIFICATIONS	III-1
	INPUT FILES	III-1
	MODEL OUTPUT	III-8
IV.	USER PROCEDURES	IV-1
	PURPOSE	IV-1
	SUPERWYLBUR EXECUTION PROCEDURES	IV-1
	TSO EXECUTION PROCEDURES	IV-3
V.	UPDATING PROCEDURES FOR SPENT NUCLEAR FUEL STORAGE MODEL DATA	V-1
	PURPOSE	V-1
	UPDATING INPUT DATA	V-1
VI.	ANNOTATED PROGRAM LISTING	VI-1

THE ORKAND CORPORATION

LIST OF EXHIBITS

I-1	Spent Nuclear Power-Plant Variable Description . . .	I-3
III-1	File Description	III-2
III-2	AFR.INPUT.DATA File Record Description	III-3
III-3	Global Parameters (Interactive Input Parameters) .	III-7
III-4	Output Variables of Spent Nuclear Fuel Storage Model	III-9
III-5	Sample Model Results	III-11
IV-1	Example Execution of Spent Nuclear Fuel Storage Model (In Batch)	IV-4
IV-2	Example Execution of Spent Nuclear Fuel Storage Model (Interactivity)	IV-7
V-1	Model Overview	V-2
V-2	Updating Procedures for AFR.INPUT.DATA AFR.TSOIN,DATA	V-5
V-3	Example of User Initiated Change to Number of Scenarios.	V-6
VI-1	Annotated Program Listing.	VI-2

SPENT NUCLEAR FUEL STORAGE MODEL

I. OVERVIEW

PURPOSE

The purpose of this manual is to present procedures to execute the Spent Nuclear Fuel Storage Model (SNFSM) program. This manual includes an overview of the model, operating environment, input and output specifications and user procedures. An example of the execution of the program is included to assist potential users.

MODEL OVERVIEW

The Spent Nuclear Fuel Storage Model is designed to compute the nuclear spent fuel storage requirements for a specified assemblage of nuclear power plants. The input parameters consists of Global parameters and nuclear power plant specific information. Global parameters are:

- Option selection criteria
- Number of Scenarios
- Description of the Scenarios
- Default capacity factor for each Scenario.

The nuclear power plant specific data are:

- Nuclear power plant identifier
- Power plant reactor type
- Initial capacity of on-site spent fuel storage pool
- Planned incremental capacity of pool
- Year of planned expansion for the new capacity
- Beginning on-site inventory of spent fuel
- Full core size
- Value of initial commercial operation date
- Capacity factors
- Schedule of reference discharges
- Scheduled shipments away from site
- Scheduled receipts of fuel from other sites

These input parameters are defined in detail in Exhibit I-1.

This Exhibit presents the mnemonic used for each variable in the

Spent Nuclear Power-Plant Variable Description

Input Variable	Mnemonic	Variable Description	Units Allowed	Acceptable Range
No. of scenarios	NSCEN	Total number of scenarios requested	Absolute Value	1 to 4
Description of scenarios	DSCEN	Description of each scenario specified by the file or by the user interactively.	Alpha-numeric	
Default Capacity Factor	CFD	Percent capacity factor to which each powerplant will default	Percent	0 - 100
<u>Nuclear Power-Plant Specific Information</u>				
Nuclear Power-plant Identifier	LAB	Label identifier (alphanumeric) for reactor complex (storage pool)	Alpha-numeric	
Powerplant Reactor Type	TYPE	Type of reactor	BWR, PWR	BWR, PWR
Initial Capacity	C1	Size of storage pool on 1/1/77	NOA*	
New Capacity	C2	Planned increment of pool capacity after 1/1/77	NOA*	
Year-New-Capacity	Y2	Year C2 will be available	4-digit integer	1977-1990
Beginning Onsite Inventory	I1	Inventory of spent fuel at pool on 1/1/77	NOA*	0 - C1

*Number of fuel assemblies

Input Variable	Mnemonic	Variable Description	Units Allowed	Acceptable Range
Full Core Size	F	Size of reactor plant core	NOA*	
CO-Dates	COI	Value of Initial Commercial Operation Date consistent with D(I).	4-digit integer	1960-1990
	CO(I)	Value of Initial Commercial Operation Date for each scenario	4-digit integer	1960-1990
Capacity Factors	CFI	Value of capacity factor consistent with reference fuel discharge schedule (D(I))	Percent	0-100
	CF(I)	Value of capacity factor for each scenario	Percent	0-100
Schedule of Reference Discharge	D(I)	Schedule of discharged fuel quantities assuming COI for reactor startup date and CFI for reactor capacity factor	NOA*	
Scheduled Shipments Away From Site	S(I)	Planned shipments away from pool site (contracts or interpool arrangements)	NOA*	
Scheduled Receipts of Fuel	R(I)	Planned receipts of spent fuel (interpool arrangements)	NOA*	

*Number of fuel assemblies

program; the variable description; units allowed; and acceptable range where applicable.

The outputs of the model are the annual discharges and inventories of spent fuel, aggregated by reactor type (boiling-water reactor versus pressurized water reactor) and storage mode (on reactor-site and away-from-reactor-site) for each nuclear power plant.

The model allows variation of nuclear plant capacity factors, shipments of spent fuel between reactor-sites and to away from reactor-sites. No optimization is employed by the model.

II. OPERATION

GENERAL

The Spent Nuclear Fuel Storage Model (SNFSM) is operational on EIA's IBM 370/168 computer system. The model source code is in FORTRAN. The model is run in batch on SUPERWYLBUR, or interactively in TSO. There are two input data files, one allocated to the program run in batch and the other to the program run interactively. The batch file differs from the interactive file in that the batch file has the command variables as input records in the file. The batch file has 13 records more than the interactive file. These records and their occurrences are described later in Chapter III.

The input files and the FORTRAN program reside on disk in the following data set names. The input files are:

- For batch processing in SUPERWYLBUR;
CN6434.GC1.AFR.INPUT.DATA located on FEA034

THE ORKAND CORPORATION

- For interactive processing in TSO;
CN6434.GC1.AFR.TSOIN.DATA located on CATALOG

The FORTRAN program code is:

- CN6434.GC1.AFR.FORT

This job takes approximately one second to execute in batch. The maximum region used for the program is 212K. The source code for the model is documented throughout with comment statements.

THE ORKAND CORPORATION

III. INPUT AND OUTPUT FILE SPECIFICATIONS

INPUT FILES

The Batch process requires one input file. The file contains the default values of the Global parameters (command variables), in addition to the specific nuclear power plant information. The Spent Nuclear Fuel Storage data file used in batch processing is identified as:

CN6434.GC1.AFR.INPUT.DATA

in the JCL file allocation statements. Exhibit III-1 presents the file description and attributes. The file consists of 267 records and each record is 80 characters in length. The file contains 11 distinct record formats. Each record type and its number of occurrences is specified in detail in Exhibit III-2.

The second file used in interactive mode can be created from CN6434.GC1.AFR.INPUT.DATA simply by deleting the records containing the Global parameters (the first 13 records of the file). Exhibit III-3 presents Global parameters that can either be entered interactively or read from the file used for batch processing. Also, the user can assess the existing file,

Exhibit III-1

FILE DESCRIPTION

System Name: NUCLEAR ANALYSIS DIVISION SPENT NUCLEAR FUEL STORAGE MODEL PROGRAM

File Name: AFR.INPUT.DATA

DSName: CN6434.GC1.AFR.INPUT.DATA VOL = SER = FEA034

Description: File contains Global parameters and nuclear power-plant specific data.

Security: None

DSORG: PS UNIT: DASD LABEL:

RECFM: FB LRECL: 80 BLKSIZE: 2960

Update Frequency: Retention Period:

Sequence (Major Field to Minor Field):

<u>Field Name</u>	<u>Characters</u>	<u>Form</u>	<u>Location</u>

Program Usage:

<u>Program</u>	<u>I</u>	<u>O</u>	<u>S</u>	<u>Program</u>	<u>I</u>	<u>O</u>	<u>S</u>
<u>CN6434.GC1.AFR.FORT</u>	<u>X</u>	<u></u>	<u></u>		<u></u>	<u></u>	<u></u>

Records:

<u>Record Name (Mnemonics)</u>	<u>Record Length</u>	<u>Approx. Volume</u>
<u>AFR.INPUT.DATA</u>	<u>80</u>	<u>267</u>

Exhibit III-2

AFR.INPUT.DATA
File Record DescriptionData Shared by All Nuclear Power Plant Storage Pools

The first record type contains the responses to the command variable; it occurs four times and is the first four records of the file. The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position From To	Type
CMD	Option selection commands	5A4	1 20	A
	• Print report on terminal?			
	• Print report offline?			
	• Input from terminal?			
	• Save input on external file?			

The second record type contains the maximum number of scenarios requested or desired by the user; it occurs once and it is the 5th record of the file. The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position From To	Type
NSCEN	Number of scenarios requested	I1	1	N

The third record type contains the description of each scenario; it occurs depending on number of scenarios (NSCEN). In the existing file (CN6434.GC1, AFR.INPUT.DATA), NSCEN equals 4. This format occurs in the 6th record and every other record for NSCEN times, (6, 8, 10, 12). The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position From To	Type
DSCEN (I)	Description of each scenario	5A4	1 20	A/N

The fourth record type contains the default capacity factor; it occurs depending on number of scenarios (NSCEN). (Number of scenarios, NSCEN = 4). Its first occurrence is in the 7th record and every other record for NSCEN times (7, 9, 11, 13). The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position		Type
			From	To	
CFD (I)	Default capacity factor	23	1	13	N

Nuclear Power-Plant Specific Data

The fifth record type contains nuclear power-plant Label identifier; it occurs depending on the number of power-plants in the data set. Its first occurrence is in the 14th record and every seventh record thereafter (14, 21, 28 ...). The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position		Type
			From	To	
LAB	Label identifiers for reactor complex	5A4	1	20	A/N

The sixth record type contains storage parameters. These parameters consist of nuclear power-plant type, initial capacity, new capacity, year of planned expansion for the new capacity, inventory, and core size. This record type occurs once for each nuclear power plant in the data set. Its first occurrence in this file is the 15th record and every seventh record thereafter (15, 22, 29, ...). The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position		Type
			From	To	
TYPE	Type of reactor	A4	1	4	A
C1	Size of storage pool on 1/1/77	I10	5	14	N
C2	Planned increment of pool capacity	I9	15	23	N
	after 1/1/77				

Y2	Year of planned expansion for the	I12	24	35	N
	new capacity				N
I1	Inventory of spent fuel at pool on	I11	36	46	N
	1/1/77				
F	Size of reactor plant core	I12	47	57	N

The seventh record type contains value of initial commercial operation data consistent with schedule of reference discharge and each scenario. This record type occurs once for each nuclear power-plant in the data set. Its first occurrence in the existing file is the 16th record and every seventh record thereafter (16, 23, 30, ...). The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position From To	Type
C01	Value of initial commercial opera-	I9	1 9	N
	tion date consistent with schedule			
	of reference discharge			
CO(I)	Value of initial commercial opera-	4I12	10 21	N
	tion date for each scenario			

The eighth record type contains value of capacity factor consistent with stated discharge fuel schedule and each scenario. This record type occurs once for each nuclear power-plant in the data set. Its first occurrence in the existing file is the 17th record and every seventh record thereafter (17, 24, 31, ...). The record description is as follows:

Data Name (Mnemonic)	Description	Format Picture	Position From To	Type
CF1	Value of capacity factor consistent	I9	1 9	N
	with discharged fuel schedule			
CF(I)	Value of capacity factor for each	4I12	10 21	N
	scenario			

The ninth record type contains schedule of reference discharges. This record type occurs once for each nuclear power-plant in the data set. Its first occurrence in the existing file is the 18th record and every seventh record thereafter (18, 25, 32, ...). The record description is as follows:

<u>Data Name (Mnemonic)</u>	<u>Description</u>	<u>Format Picture</u>	<u>Position From To</u>	<u>Type</u>
<u>D(I)</u>	<u>Schedule of discharge fuel quantities</u>	<u>I4</u>	<u>1 4</u>	<u>N</u>
<u>D(I)</u>	<u>Schedule of discharge fuel quantities</u>	<u>13I5</u>	<u>5 69</u>	<u>N</u>

The tenth record type contains scheduled shipments away from site. This record type occurs once for each nuclear power-plant in the data set. Its first occurrence in the existing file is the 19th record and every seventh record thereafter (19, 26, 33, ...). The record description is as follows:

<u>Data Name (Mnemonic)</u>	<u>Description</u>	<u>Format Picture</u>	<u>Position From To</u>	<u>Type</u>
<u>S(I)</u>	<u>Scheduled shipments away from site</u>	<u>I4</u>	<u>1 4</u>	<u>N</u>
<u>S(I)</u>	<u>Scheduled shipments away from site</u>	<u>13I5</u>	<u>5 69</u>	<u>N</u>

The eleventh record type contains the planned receipts of spent fuel. This record type occurs once for each nuclear power-plant in the data set. Its first occurrence in the existing file is the 20th record, and every seventh record thereafter (20, 27, 34, ...). The record description is as follows:

<u>Data Name (Mnemonic)</u>	<u>Description</u>	<u>Format Picture</u>	<u>Position From To</u>	<u>Type</u>
<u>R(I)</u>	<u>Planned receipts of spent fuel</u>	<u>I4</u>	<u>1 4</u>	<u>N</u>
<u>R(I)</u>	<u>Planned receipts of spent fuel</u>	<u>13I5</u>	<u>5 69</u>	<u>N</u>

Global Parameters
(Interactive Input Parameters)

Input Variable	Mnemonic	Variable Description	Units Allowed	Acceptable Range	Default Value
Option Selection Commands	CMD	Options are: <ul style="list-style-type: none"> • Print report on terminal • Print report off line • Input from terminal • Save input on external file 	Alpha-betic yes, no yes, no yes, no yes, no		False (no) False (no) False (no) False (no)
No. of scenarios	NSCEN	Number of scenarios	Absolute Value	1 - 4	0
Description of the scenarios	DSCEN	Description of each scenario specified by the user	Alpha-numeric		Spaces
Default Capacity Factor	CFD	Percent capacity fault to which each powerplant will default	Percent	0 - 100%	

THE ORKAND CORPORATION

CN6434.GC1.AFR.TSOIN.DATA via the interactive mode. The input entered by the user in interactive mode can be saved under any data set name (DSN) desired by the user.

MODEL OUTPUT

The output of the Nuclear Spent Fuel Storage program includes a summary of specific nuclear power-plant input variables and their values as follows:

- Nuclear power plant identifier
- Nuclear power plant type
- Present capacity
- Planned expansion
- Beginning onsite inventory
- Full core size.

and the resulting estimations of the schedule reference discharges, full core reserve and normal discharge reserve for years 1977 through 1990 via each scenario specified. Exhibit III-4 presents the output variable of Spent Nuclear Fuel Storage Model.

Exhibit III-5 presents a sample result of the model output.

Output Variables of Spent Nuclear Fuel Storage Model

Output Variable	Mnemonic	Variable Description	Units Allowed
Full Core Reserve	FCR	Full size of reactor plant core reserve, (reserve options at the storage pool)	NOA*
Normal Discharge Reserve	NDC	Normal discharge capability (reserve options at the storage pool)	NOA*
Away From Reactor	AFR	Away from reactor site	
Discharges	DI(J)	(DISCHG) Schedule of annual spent fuel discharges	NOA*
Scheduled Shipments to Site	S(J)	(F-SHIP) Scheduled shipments of spent fuel away from site	NOA*
Scheduled Shipments to Site	R(J)	(RECEIV) Scheduled shipments of spent fuel to site (interpool arrangements)	NOA*
	DFIN	Year-end inventory of spent fuel at reactor-site for full-core reserve assumption	NOA*
Forecasted Annual Shipments	DFAFR(J)	(AFR/YR) Annual forecasted requirements for shipping spent fuel away from site for full-core reserve assumption	NOA*
Normal Discharge Reserve	DNN(J)	Year-end inventory of spent fuel at reactor-site for normal discharge reserve	NOA*
	DNAFR(J)	(AFR/YR) Annual forecasted requirements for shipping spent fuel away from site for normal discharge reserve	NOA*

*Number of fuel assemblies

Exhibit III-4 — Cont.

Output Variable	Mnemonic	Variable Description	Units Allowed
Cumulate Away From Reactor	CUMAFR	Year-end inventory of spent fuel at AFR sites	NOA*
ONSITE	ONSITE	The variable currently lacks complete static file	

*Number of fuel assemblies

Exhibit III-5

Sample Model Results

OPTION SELECTION:
 PRINT REPORT ON TERMINAL?
 PRINT REPORT OFFLINE?
 INPUT FROM TERMINAL?
 SAVE INPUT ON EXTERNAL FILE?
 HOW MANY SCENARIOS (LE 4):
 SCENARIO 1
 -DESCRIPTION: -----
 DEFAULT-CAPACITY-FACTOR
 99
 SCENARIO 2
 -DESCRIPTION: -----
 DEFAULT-CAPACITY-FACTOR
 65
 SCENARIO 3
 -DESCRIPTION: -----
 DEFAULT-CAPACITY-FACTOR
 55
 SCENARIO 4
 -DESCRIPTION: -----
 DEFAULT-CAPACITY-FACTOR
 65

YANKEE RIVE - PWR
 PRESENT CAPACITY = 172 (PLANNED EXPANSION TO 391 IN 1977)
 BEGINNING UNSITE INVENTORY = 112, FULL COPE SIZE = 74

UTIL MAX, UTIL CF

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	31	35	0	31	35	31	0	35	31	35	0	31	35	31
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
UNSITE	103	178	178	209	244	275	275	310	315	315	315	315	315	315
AFR/YR	0	0	0	0	0	0	0	0	26	35	0	31	35	31
CUMAFR	0	0	0	0	0	0	0	0	26	61	61	92	127	158
** NORMAL DISCHARGE RESERVE **														
UNSITE	103	178	178	209	244	275	275	310	341	374	360	354	360	360
AFR/YR	0	0	0	0	0	0	0	0	0	0	16	35	31	31
CUMAFR	0	0	0	0	0	0	0	0	0	0	16	51	82	113

PROB MAX, 65% CF

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	26	29	0	26	29	26	0	29	26	29	0	26	29	26
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
UNSITE	138	167	167	193	222	248	248	277	303	315	315	315	315	315
AFR/YR	0	0	0	0	0	0	0	0	0	17	0	26	29	26
CUMAFR	0	0	0	0	0	0	0	0	0	17	17	43	72	98
** NORMAL DISCHARGE RESERVE **														
UNSITE	138	167	167	193	222	248	248	277	303	332	332	358	355	355
AFR/YR	0	0	0	0	0	0	0	0	0	0	0	0	22	26
CUMAFR	0	0	0	0	0	0	0	0	0	0	0	0	22	48

Exhibit III-5 - (Cont.)

LOW MWE, 55% CF

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	22	25	0	22	25	22	0	25	22	25	0	22	25	22
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
ON SITE	134	159	159	181	206	228	228	253	275	300	300	315	315	315
AFR/YR	0	0	0	0	0	0	0	0	0	0	0	7	25	22
CUMAFR	0	0	0	0	0	0	0	0	0	0	0	7	32	54
** NORMAL DISCHARGE RESERVE **														
ON SITE	134	159	159	181	206	228	228	253	275	300	300	322	347	369
AFR/YR	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CUMAFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0

HILL MWE, 65% CF

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	26	29	0	26	29	26	0	29	26	29	0	26	29	26
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
ON SITE	138	167	167	193	222	248	248	277	303	315	315	315	315	315
AFR/YR	0	0	0	0	0	0	0	0	0	17	0	24	29	26
CUMAFR	0	0	0	0	0	0	0	0	0	17	17	43	72	98
** NORMAL DISCHARGE RESERVE **														
ON SITE	138	167	167	193	222	248	248	277	303	332	332	354	365	365
AFR/YR	0	0	0	0	0	0	0	0	0	0	0	0	22	26
CUMAFR	0	0	0	0	0	0	0	0	0	0	0	0	22	48

Exhibit III-5 - (cont.)

***** TOTALS *****

SCENARIO 11UTIL MWE,UTIL CF

FULL CORE RESERVE - BWR

1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

ON SITE	2267	3407	4732	6336	7561	8419	9411	10223	11287	11737	11782	11782	11782	11782
AFR/YR	96	195	46	324	677	1338	1574	1950	2140	2548	2697	3088	3002	2742
CUMAFR	96	291	337	661	1338	2676	4250	6204	8344	10492	13589	16677	19679	22421

SCENARIO 11UTIL MWE,UTIL CF

NORMAL DISCHARGE RESERVE - BWR

1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

ON SITE	2337	3517	4864	6764	8620	9957	11403	12733	14209	15549	16259	16543	17251	17399
AFR/YR	26	155	24	28	46	859	1120	1435	1728	1658	2032	2804	2294	2594
CUMAFR	26	181	205	233	279	1138	2258	3694	5422	7080	9112	11916	14210	16804

SCENARIO 11UTIL MWE,UTIL CF

FULL CORE RESERVE - PWR

1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

ON SITE	1716	2345	3276	4436	5626	7088	8381	9358	9993	10484	10519	10519	10519	10519
AFR/YR	153	0	0	26	109	214	450	814	1186	1334	1718	1818	1827	1827
CUMAFR	153	153	153	179	288	502	952	1766	2952	4286	6004	7822	9649	11476

SCENARIO 11UTIL MWE,UTIL CF

NORMAL DISCHARGE RESERVE - PWR

1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

ON SITE	1739	2368	3299	4485	5735	7339	8896	10179	11241	12084	12388	12404	12404	12404
AFR/YR	130	0	0	0	49	72	186	508	759	982	1449	1802	1827	1827
CUMAFR	130	130	130	130	179	251	437	945	1704	2686	4135	5937	7764	9591

* MTHM = SUM OF PWR AND BWR *

SCENARIO 11UTIL MWE,UTIL CF

FULL CORE RESERVE - PWR

1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

ON SITE	1229	1739	2424	3269	4054	4893	5680	6287	6786	7099	7124	7124	7124	7124
CUMAFR	89	124	135	210	392	750	1262	2015	2976	4084	5398	6833	8256	9628

NUM/YR	9	8	4	6	10	12	16	22	28	33	36	36	36	36
--------	---	---	---	---	----	----	----	----	----	----	----	----	----	----

SCENARIO 11UTIL MWE,UTIL CF

NORMAL DISCHARGE RESERVE - PWR

1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

THE ORKAND CORPORATION

IV. USER PROCEDURES

PURPOSE

The purpose of this section is to illustrate the Spent Nuclear Fuel Storage program execution for potential users. The procedures assume that the user is able to logon to SUPERWYLBUR for batch process of the program or to TSO for the interactive mode. However, detailed knowledge of SUPERWYLBUR or TSO is not necessary in executing the model.

SUPERWYLBUR EXECUTION PROCEDURES

The Spent Nuclear Fuel Storage Model is a FORTRAN program which is executed in batch from SUPERWYLBUR. The program is named CN6434.GC1.AFR.FORT and is located on FEA034. In order to execute the model, the user must sign on to SUPERWYLBUR and execute the program JCL, which calls in the FORTRAN program. To execute the program the user should enter the following commands:

THE ORKAND CORPORATION

USE FROM &6434GC1.AFR.CNTL ON FEA034 CLR

CH 'GC1' to 'initials' in 1

CH '6434' to 'account no.' in 1

where the initials and account number are the user's current initials and account number.

The system in all cases regarding the change command will respond back by displaying the line with the change. Next, the user should submit the job for execution by entering the following command:

RUN HOLD

The system will respond back by displaying a job number. The user should either logoff the system or continue in their work by providing a proper amount of time to execute the program. In order for the user to find out whether the program has been executed or is still awaiting execution. They could enter the following commands:

SHO JOBS

or:

LOCATE job #.

The system will respond by displaying the status of the user's jobs or job. If the job is awaiting FETCH, the user can either

THE ORKAND CORPORATION

print the job on the terminal or direct the output to the high speed printers by the following commands:

```
ROUTE job # REM 2
```

```
PRINT job #
```

These commands will direct the output to high speed printers at 1200 Pennsylvania Avenue.

Exhibit IV-1 is an example of execution of Spent Nuclear Fuel Storage program in SUPERWYLBUR. The Global parameters provided in CN6434.GC1.AFR.INPUT.DATA file can be changed according to user specifications, providing that the user is familiar with the data. The user should be aware that any newly created data set names should be updated in the existing JCL according to their new designation.

TSO EXECUTION PROCEDURES

The Spent Nuclear Fuel Storage Model can also be executed interactively in TSO. The procedures assume that the user is able to logon to TSO, however, detailed knowledge of TSO is not necessary in executing the model. There are user input requirements; the program requires user responses. These requirements

Exhibit IV-1

Example Execution of Spent Nuclear Fuel
Storage Model (In Batch)

```
? USE FROM &6434GC1.AFR.CNTL ON FEA034 CLR
? CH 'GC1' TO 'FM6' IN 1
  1.      //FM6UAFR1 JOB (6434,D01,1,,0,,1),'G CLARK'
? CH '6434' TO '6057' IN 1
  1.      //FM6UAFR1 JOB (6057,D01,1,,0,,1),'G CLARK'
```

```
? RUN HOLD
1787 IS YOUR JOB NUMBER
?
```

To locate the job, enter:

```
? LOCATE 1787
JOB 1787 FM6UAFR1 AWAITING EXECUTION 5 FET  PRI0  7
?
```

or, to show all jobs under the "initial" signed on, enter:

```
? SHO JOBS
JOB 1787 FM6UAFR1 AWAITING EXECUTION 5 FET  PRI0  7
?
```

If the job is awaiting Fetch?

```
? LOCATE 1787
JOB 1787 FM6UAFR1 AWAITING FETCH PRI0  1
?
```

Exhibit IV-1 — Cont.

Enter the following to print the job:

? ROUTE 1787 REM 2

OK

? PRINT 1787

JOB 1787 PM6UAFR1 Awaiting output prio 1

?

THE ORKAND CORPORATION

were presented earlier in Exhibit III-3. However, the user must select responses carefully because the read formats require strict adherence to the specified formats. For example, to enter the default capacity factors, the user should enter 21 spaces before the actual value is entered. If the user does not follow the proper format, the program abends. Exhibit IV-2 presents a sample execution of interactive process.

Exhibit IV-2

Example Execution of Spent Nuclear Fuel Storage Model (Interactivity)

```

READY
FREEALL
READY
TERMINAL LINESIZE(133)
READY
ALLOC FI(FT05F001) DA('CN6434.GC1.AFR.TSOIN.DATA') SHR
READY
ALLOC FI(FT03F001) DA(0)
READY
RUN 'CN6434.GC1.AFR.FORT' FORT
G1 COMPILER ENTERED
SOURCE ANALYZED
PROGRAM NAME = MAIN
* NO DIAGNOSTICS GENERATED
OPTION SELECTION:
PRINT REPORT ON TERMINAL?
YES
PRINT REPORT OFFLINE?
NO
INPUT FROM TERMINAL?
NO
SAVE INPUT ON EXTERNAL FILE?
NO
HOW MANY SCENARIOS (LE 4)?
1
SCENARIO 1
-DESCRIPTION: -----
USER SPECIFIED NAME
DEFAULT-CAPACITY-FACTOR
65
65
YANKEE ROWE - PWR
PRESENT CAPACITY = 172 (PLANNED EXPANSION TO 391 IN 1977)
BEGINNING ONSITE INVENTORY = 112, FULL CORE SIZE = 76

```

USER SPECIFIED NAME

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	31	35	0	31	35	31	0	35	31	35	0	31	35	31
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
ONSITE	143	178	178	209	244	275	275	310	315	315	315	315	315	315
AFR/YR	0	0	0	0	0	0	0	0	26	35	0	31	35	31
CUMAFR	0	0	0	0	0	0	0	0	26	61	61	92	127	158
** NORMAL DISCHARGE RESERVE **														
ONSITE	143	178	178	209	244	275	275	310	341	376	360	356	360	360
AFR/YR	0	0	0	0	0	0	0	0	0	0	16	35	31	31
CUMAFR	0	0	0	0	0	0	0	0	0	0	16	51	82	113

Exhibit IV-2 - (cont.)

HUMBOLDT BAY - BWR
 PRESENT CAPACITY = 230 (PLANNED EXPANSION TO 430 IN 1979)
 BEGINNING ONSITE INVENTORY = 46, FULL CORE SIZE = 172

USER SPECIFIED NAME

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	46	46	46	46	46	46	46	46	46	46	46	46	46	46
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
ON SITE	92	138	184	230	258	258	258	258	258	258	258	258	258	258
AFR/YR	0	0	0	0	18	46	46	46	46	46	46	46	46	46
CUMAFR	0	0	0	0	18	64	110	156	202	248	294	340	386	432
** NORMAL DISCHARGE RESERVE **														
ON SITE	92	138	184	230	276	322	368	384	384	384	384	384	384	384
AFR/YR	0	0	0	0	0	0	0	30	46	46	46	46	46	46
CUMAFR	0	0	0	0	0	0	0	30	76	122	168	214	260	306

LACROSSE - BWR
 PRESENT CAPACITY = 134 (PLANNED EXPANSION TO 134 IN 1976)
 BEGINNING ONSITE INVENTORY = 81, FULL CORE SIZE = 72

USER SPECIFIED NAME

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	24	24	24	24	24	24	24	24	24	24	24	24	24	24
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
ON SITE	62	62	62	62	62	62	62	62	62	62	62	62	62	62
AFR/YR	43	24	24	24	24	24	24	24	24	24	24	24	24	24
CUMAFR	43	67	91	115	139	163	187	211	235	259	283	307	331	355
** NORMAL DISCHARGE RESERVE **														
ON SITE	105	110	110	110	110	110	110	110	110	110	110	110	110	110
AFR/YR	0	19	24	24	24	24	24	24	24	24	24	24	24	24
CUMAFR	0	19	43	67	91	115	139	163	187	211	235	259	283	307

SIG ROCK POINT - BWR
 PRESENT CAPACITY = 120 (PLANNED EXPANSION TO 145 IN 1979)
 BEGINNING ONSITE INVENTORY = 40, FULL CORE SIZE = 84

USER SPECIFIED NAME

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DISCHG	22	21	22	22	22	22	22	22	22	22	22	22	22	22
F-SHIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** FULL CORE RESERVE **														
ON SITE	61	61	61	61	61	61	61	61	61	61	61	61	61	61
AFR/YR	1	21	22	22	22	22	22	22	22	22	22	22	22	22
CUMAFR	1	22	44	66	88	110	132	154	176	198	220	242	264	286
** NORMAL DISCHARGE RESERVE **														
ON SITE	62	83	105	123	123	123	123	123	123	123	123	123	123	123
AFR/YR	0	0	0	4	22	22	22	22	22	22	22	22	22	22
CUMAFR	0	0	0	4	26	48	70	92	114	136	158	180	202	224

Exhibit IV-2 - (cont.)

***** TOTALS *****

SCENARIO 1:USER SPECIFIED NAME
 FULL CORE RESERVE - BWR
 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
 ONSITE 2267 3407 4732 6336 7561 8419 9411 10223 11287 11737 11782 11782 11782 11782
 AFR/YR 96 195 46 324 677 1338 1574 1954 2140 2548 2697 3088 3002 2742
 CUMAFR 96 291 337 661 1338 2676 4250 6204 8344 10892 13589 16677 19679 22421

SCENARIO 1:USER SPECIFIED NAME
 NORMAL DISCHARGE RESERVE - BWR
 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
 ONSITE 2337 3517 4864 6764 8620 9957 11403 12733 14209 15549 16259 16543 17251 17399
 AFR/YR 26 155 24 28 46 859 1120 1436 1728 1658 2032 2804 2294 2594
 CUMAFR 26 181 205 233 279 1138 2258 3694 5422 7080 9112 11916 14210 16804

SCENARIO 1:USER SPECIFIED NAME
 FULL CORE RESERVE - PWR
 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
 ONSITE 1716 2345 3276 4436 5626 7088 8381 9358 9993 10484 10519 10519 10519 10519
 AFR/YR 153 0 0 26 109 214 450 814 1186 1334 1718 1818 1827 1827
 CUMAFR 153 153 153 179 288 502 952 1766 2952 4286 6004 7822 9649 11476

SCENARIO 1:USER SPECIFIED NAME
 NORMAL DISCHARGE RESERVE - PWR
 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
 ONSITE 1739 2368 3299 4485 5735 7339 8896 10179 11241 12084 12388 12404 12404 12404
 AFR/YR 130 0 0 0 49 72 186 508 759 982 1449 1802 1827 1827
 CUMAFR 130 130 130 130 179 251 437 945 1704 2686 4135 5937 7764 9591

* MTHM - SUM OF PWR AND BWR *

SCENARIO 1:USER SPECIFIED NAME
 FULL CORE RESERVE - PWR
 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
 ONSITE 1229 1739 2424 3269 4054 4893 5680 6287 6786 7099 7124 7124 7124 7124
 CUMAFR 89 126 135 210 392 750 1262 2015 2976 4084 5398 6833 8256 9628
 NUM/YR 9 8 4 6 10 12 16 22 28 33 36 36 36 36

SCENARIO 1:USER SPECIFIED NAME
 NORMAL DISCHARGE RESERVE - PWR
 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
 ONSITE 1253 1771 2461 3375 4310 5307 6304 7152 7927 8575 8852 8915 9052 9081
 CUMAFR 64 94 99 105 136 336 639 1151 1835 2609 3669 5042 6328 7671
 NUM/YR 0 1 1 1 2 4 6 11 14 17 23 29 34 35

V. UPDATING PROCEDURES FOR SPENT NUCLEAR FUEL STORAGE MODEL DATA

PURPOSE

This section contains instructions for the user to update the Spent Nuclear Fuel Storage Model program. It is assumed that the user is familiar with SUPERWYLBUR.

The type of updates that will be discussed in this section are ones involving the input data. The program code and execution procedures will remain unchanged.

UPDATING INPUT DATA

As discussed in Chapter III, the Spent Nuclear Fuel Storage Model program requires one input file for the Batch process, the data set:

CN6434.GC1.AFR.INPUT.DATA

is located on catalog. The general flow of the data file into the program, basic processing steps and the resulting output is presented in Exhibit V-1. The information in the file has been

Exhibit V-1
Model Overview

THE ORKAND CORPORATION

obtained from "U.S. AND FREE-WORLD, Discharged Nuclear Fuel Storage and Transportation Analysis"¹ and "U.S. AND NON-U.S., Light Water Reactor Spent Fuel Storage"² documentations. If the user desires to change, modify or insert new data from the above sources to the file, it has to be put in the format described in Exhibit III-2. In order to update this input file, the user would use the existing data set and make the appropriate changes. The data can be saved in a different data set name but corresponding changes to the program JCL would need to be made for the DSN and volume.

There is an input data file allocated for the interactive process. This data set is:

CN6434.GC1.AFR.TSOIN.DATA

located on catalog. Any updating to this file will be identical

¹U.S. AND FREE-WORLD, Discharged Nuclear Fuel Storage and Transportation Analysis, Vol. 2, prepared for U.S. Energy Research and Development Administration, Savannah River Operations Office, under contract number EY-77-C-09-0989, Nuclear Assurance Corporation.

²U.S. AND NON-U.S., Light Water Reactor Spent Fuel Storage, prepared for U.S. Energy Research and Development Administration, Savannah River, under purchase order EY-77-X-09-0183, Nuclear Assurance Corporation.

to the one used in batch. The process of obtaining data and updating the two files are presented in Exhibit V-2. As a result, the updated file can be created from CN6434.GC1.AFR.INPUT.DATA simply by deleting the records containing the Global parameters (the first 13 records of the file). Exhibit III-3 presents the Global parameters that can either be entered interactively or read from the file used for Batch processing.

The Global parameters provided in CN6434.GC1.AFR.INPUT.DATA file can be changed according to the user specifications, providing that the user is familiar with the data. Exhibit V-3 displays an example of user changing the number of scenarios (NSCEN) in the input data file. The user may also have to change the new capacity of the power-plant storage pool size variable from time to time.

Exhibit V-2

Updating Procedures for

AFR.INPUT.DATA

AFR.TSOIN.DATA

Discharge Nuclear Fuel
Storage and Transportation
Analysis

Light Water Reactor
Spent Fuel Storage

U.S. and Free World

U.S. and Non-U.S.

Obtaining the Updating
Information on Spent
Nuclear Fuel Storage

Keying

AFR.INPUT.DATA

AFR.TSOIN.DATA

Exhibit V-3

Example of User Initiated Change to Number of Scenarios

```
? USE FROM 8434GC1.AFR.INPUT.DATA ON FEA034
? L 1/13
  1. NO
  2. YES
  3. NO
  4. NO
  5. 4
  6. UTIL MWE,UTIL CF
  7. 99
  8. PROB MWE, 65% CF
  9. 65
 10. LOW MWE, 55% CF
 11. 55
 12. UTIL MWE,65% CF
 13. 65
? CHANGE '4' TO '3' IN 5 DEL 12/13
  5. 3
? SAVE INTO AFR.INPUT2.DATA ON FEA009
"AFR.INPUT2.DATA" SAVED ON FEA009
?
```


THE ORKAND CORPORATION

VI. ANNOTATED PROGRAM LISTING

The purpose of this section of our documentation is to expand upon the level of documentation provided in the program code. Exhibit VI-1 presents a listing of the Spent Nuclear Fuel Storage Models (SNFSM) which has been annotated with additional comments concerning the methodology, input data, interim processes and results of the analysis. The program is stored as DSN:

CN6434.GC1.AFR.FORT

Exhibit VI-1

Annotated Program Listing

Spent Nuclear Fuel Storage Model (SNFSM) Program

This program is designed to compute the nuclear spent fuel storage requirements for a specified assemblage of nuclear power-plants.

```

1.      C
2.      C   SPENT FUEL STORAGE CODE - ENERGY INFORMATION ADMINISTRATION
3.      C   BUREAU OF APPLIED ANALYSIS           10/5/77
4.      C
5.      C   GENE CLARK (566-6186)

```

The following "INTEGER, REAL, LOGICAL and EQUIVALENCE" statements define the initial fixed or unvarying quantities of the variables used in the computations of the program.

```

6.      INTEGER NFC(4,14)/56*0/,NND(4,14)/56*0/,LOOK/2/
7.      REAL BMTU/0.194/,PMTU/0.46/
8.      INTEGER CF(4),CFD(4),CF1
9.      INTEGER YES/'YES'//,CMD,END/'END'//,NO/'NO'//
10.     INTEGER DIN,TMI/3/,XIN/5/,TMO/6/,LP/6/,OUT/6/
11.     LOGICAL TERM/.FALSE./,PRNT/.FALSE./,SAVE/.FALSE./
12.     LOGICAL TIN/.FALSE./
13.     INTEGER LAB(5)/5*''//,TP(2)/' BWR',' PWR'
14.     INTEGER DSCEN(4,5),FINV(2,4,14)/112*0/,NY/14/,PWR/' PWR'
15.     INTEGER FAFR(2,4,14)/112*0/,NAFR(2,4,14)/112*0/,DFIN(14)
16.     INTEGER NINV(2,4,14)/112*0/,C(14),S(14),DNN(14)
17.     INTEGER TYPE,C1/0/,C2/0/,Y2/2000/,I1,F,NSCEN/1/
18.     INTEGER CO(4),CO1,D(14)/14*0/,R(14)/14*0/,D1(14)/14*0/
19.     INTEGER DFAFR(14),DNAFR(14)
20.     INTEGER NIN(2,4,14)/112*0/,FIN(2,4,14)/112*0/
21.     EQUIVALENCE (CMD,LAB(1)),(FINV(1,1,1),FIN(1,1,1))
22.     EQUIVALENCE (NIN(1,1,1),NINV(1,1,1))

```

The following "WRITE and READ" statements are designed for interactive process. The WRITE statements display the option selection criteria in interactive mode. And the READ statements read the information supplied by the user interactively or from the input file if program is run in Batch. The information consists of the commands, number of scenarios, description of scenarios and the default capacity factor for each scenario.

```

23.      WRITE(TMO,9001)
24.      9001 FORMAT(' OPTION SELECTION:','/',' PRINT REPORT ON TERMINAL?')
25.      READ(TMI,13)CMD
26.      IF(CMD.EQ.YES)TERM=.TRUE.

```

Exhibit VI-1 — Cont.

```

27.      WRITE(TMO,9002)
28. 9002 FORMAT(' PRINT REPORT OFFLINE?')
29.      READ(TMI,13)CMD
30.      IF(CMD.EQ.YES)PRNT=.TRUE.
31.      WRITE(TMO,9003)
32. 9003 FORMAT(' INPUT FROM TERMINAL?')
33.      READ(TMI,13)CMD
34.      DIN=TMI
35.      IF(CMD.EQ.YES)TIN=.TRUE.
36.      IF(CMD.EQ.NO)DIN=XIN
37.      WRITE(TMO,9004)
38. 9004 FORMAT(' SAVE INPUT ON EXTERNAL FILE?')
39.      READ(TMI,13)CMD
40.      IF(CMD.EQ.YES)SAVE=.TRUE.
41.      WRITE(TMO,11)
42. 11  FORMAT(' HOW MANY SCENARIOS (LE 4)?')
43.      READ(TMI,412)NSCEN
44. 412  FORMAT(I1)
45.      DO 100 I=1,NSCEN
46.      WRITE(TMO,12) I
47. 12  FORMAT(' SCENARIO',I2,/, ' -DESCRIPTION: -----')
48.      READ(TMI,13) (DSCEN(I,J),J=1,5)
49. 13  FORMAT(SA4)
50.      WRITE(TMO,14)
51. 14  FORMAT(' DEFAULT-CAPACITY-FACTOR')
52.      READ(TMI,15)CFD(I)
53. 15  FORMAT(I23)
54. 100  WRITE(TMO,16)CFD(I)
55. 16  FORMAT(I4)
56. 1000 IF(TIN)WRITE(TMO,1001)
57. 1001 FORMAT(' NEXT CASE:')
58.      READ(DIN,1002)LAF
59.      IF(SAVE)WRITE(OUT,1002)LAF
60. 1002 FORMAT(SA4)
61.      IF(CMD.NE.END)GO TO 1500

```

When the end of input file is read the program will compute the totals for each scenario specified by reserve options for the storage pool and each nuclear power-plant type.

```

62.      C
63.      C      PRINT TOTALS
64.      C
65.      IF(.NOT.TERM)GO TO 1300
66.      LPR=TMO
67. 1110 CONTINUE
68.      WRITE(LPR,1003)
69. 1003 FORMAT('1',30X,'***** TOTALS *****',/)
70.      DO 1200 K=1,NSCEN
71.      DO 1160 M=1,2
72.      WRITE(LPR,1004) K,(DSCEN(K,I),I=1,5),TF(M)
73. 1004 FORMAT(/, ' SCENARIO',I2,/, 'SA4,/,
74.      X 10X,'FULL CORE RESERVE - ',A4,/, ' ',
75.      X 7X,'1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987',
76.      X ' 1988 1989 1990',/)
77.      WRITE(LPR,1005)(FINV(M,K,J),J=1,NY)
78. 1005 FORMAT(' ONSITE',14I5)
79.      WRITE(LPR,1006)(FAFR(M,K,J),J=1,NY)
80. 1006 FORMAT(' AFR/YR',14I5)
81.      DO 1007 J=2,NY
82. 1007 FAFR(M,K,J)=FAFR(M,K,J-1) + FAFR(M,K,J)
83.      WRITE(LPR,1008) (FAFR(M,K,J),J=1,NY)
84. 1008 FORMAT(' CUMAFR',14I5,/)
85.      WRITE(LPR,1014) K,(DSCEN(K,I),I=1,5),TF(M)
86. 1014 FORMAT(/, ' SCENARIO',I2,/, 'SA4,/,
87.      X 10X,'NORMAL DISCHARGE RESERVE - ',A4,/, ' ',
88.      X 7X,'1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987',
89.      X ' 1988 1989 1990',/)
90.      WRITE(LPR,1005)(NINV(M,K,J),J=1,NY)

```

Exhibit VI-1 — Cont.

```

91.      WRITE(LPR,1006)(NAFR(M,K,J),J=1,NY)
92.      DO 1017 J=2,NY
93.      1017 NAFR(M,K,J)=NAFR(M,K,J-1) + NAFR(M,K,J)
94.      WRITE(LPR,1008) (NAFR(M,K,J),J=1,NY)
95.      1160 CONTINUE
96.      DO 1170 J=1,NY
97.      NINV(1,K,J)=(NINV(1,K,J)*BMTU) + (NINV(2,K,J)*PMTU)
98.      FINV(1,K,J)=(FINV(1,K,J)*BMTU) + (FINV(2,K,J)*PMTU)
99.      NAFR(1,K,J)=(NAFR(1,K,J)*BMTU) + (NAFR(2,K,J)*PMTU)
100.      1170 FAFR(1,K,J)=(FAFR(1,K,J)*BMTU) + (FAFR(2,K,J)*PMTU)
101.      WRITE(LPR,1171)
102.      1171 FORMAT(' ',20X,'* MTHM - SUM OF FWR AND BWR *',/)
103.      WRITE(LPR,1004) K,(DSCEN(K,I),I=1,5),TP(M)
104.      WRITE(LPR,1005)(FINV(1,K,J),J=1,NY)
105.      WRITE(LPR,1008)(FAFR(1,K,J),J=1,NY)
106.      WRITE(LPR,1172)(NFC(K,J),J=1,NY)
107.      1172 FORMAT(' NUM/YR',14I5,/)
108.      WRITE(LPR,1014) K,(DSCEN(K,I),I=1,5),TP(M)
109.      WRITE(LPR,1005)(NINV(1,K,J),J=1,NY)
110.      WRITE(LPR,1008)(NAFR(1,K,J),J=1,NY)
111.      WRITE(LPR,1172)(NND(K,J),J=1,NY)
112.      1200 CONTINUE
113.      IF(LP.EQ.0)STOP
114.      1300 IF(.NOT.PRNT)STOP
115.      LPR=LF
116.      LP=0
117.      GO TO 1110

```

The program now reads in nuclear power-plant specific information. This information consists of the following:

- Type or reactor (TYPE)
- Size of storage pool (C1)
- Planned increment of pool capacity (C2)
- Year planned expansion will be available (Y2)
- Inventory of spent fuel at pool (I1)
- Size of reactor plant core (F)

```

118.      C
119.      C      READ IN STORAGE PARAMETERS
120.      C
121.      1500 IF(TIN)WRITE(THO,1501)
122.      1501 FORMAT(' READ IN: ',/, ' TYPE INIT-CAP NEW-CAP',
123.      X, ' YR-NEW-CAP INVENTORY CORE-SIZE')
124.      READ(DIN,1502)TYPE,C1,C2,Y2,I1,F
125.      1502 FORMAT(A4,I10,I9,I12,I11,I11)
126.      IF(SAVE)WRITE(OUT,1502)TYPE,C1,C2,Y2,I1,F
127.      IF(C2.EQ.0)C2=C1
128.      IF(Y2.EQ.0)Y2=1976
129.      IF(TIN)WRITE(THO,1503,

```

Next, the program reads in value of initial commercial operation date consistent with schedule of discharged fuel quantities (C01) and value

Exhibit VI-1 — Cont.

of initial commercial operation date for each scenario specified (CO(I)).

```

130.      1503 FORMAT(' READ IN CO DATES: ',/, ' REFERENCE ',
131.      X ' SCENARIO-1 SCENARIO-2 SCENARIO-3 SCENARIO-4')
132.      READ(DIN,1504)CO1,(CO(I),I=1,NSCEN)
133.      IF(SAVE)WRITE(OUT,1504)CO1,(CO(I),I=1,NSCEN)
134.      1504 FORMAT(I9,4I12)
135.      DO 9990 I=1,NSCEN
136.      9990 IF(CO(I).EQ.0)CO(I)=CO1
137.      IF(TIN)WRITE(TMO,1505)

```

In the following code, the program reads in value of capacity factors consistent with stated discharged fuel schedule (CFI), and value of capacity factor for each scenario.

```

138.      1505 FORMAT(' READ IN CAPACITY FACTORS: ',/, ' REFERENCE ',
139.      X ' SCENARIO-1 SCENARIO-2 SCENARIO-3 SCENARIO-4')
140.      READ(DIN,1504)CF1,(CF(I),I=1,NSCEN)
141.      IF(SAVE)WRITE(OUT,1504)CF1,(CF(I),I=1,NSCEN)
142.      DO 1600 I=1,NSCEN
143.      1600 IF(CF(I).EQ.0)CF(I)=CF1(I)
144.      IF(CF1.EQ.0.0)CF1=100.0

```

Next, the program determines the storage capacities for years 1977 through 1990, depending on the year of planned expansion capacity.

```

145.      C
146.      C      COMPUTE CAPACITIES
147.      C
148.      DO 1510 I=1,NY
149.      C(I) = C1
150.      IY = I + 1976
151.      IF(IY.GE.Y2) C(I) = C2
152.      1510 CONTINUE

```

The program then reads in schedule of discharged fuel quantities for specific power-plant.

```

153.      C
154.      C      READ IN DISCHARGE, SHIPMENT, RECEIPT SCHEDULES
155.      C
156.      IF(TIN)WRITE(TMO,1511)
157.      1511 FORMAT(' SCHEDULE OF REFERENCE DISCHARGES: ',/,
158.      X ' 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986',
159.      X ' 1987 1988 1989 1990')
160.      READ(DIN,1512)(D(I),I=1,NY)
161.      IF(SAVE)WRITE(OUT,1512)(D(I),I=1,NY)
162.      1512 FORMAT(I4,13I5)

```

Exhibit VI-1 — Cont.

In the following statements, the program reads in planned shipments away from pool site (contracts or interpool arrangements) for specific power-plant.

```

163.      IF(TIN)WRITE(TMO,1513)
164.      1513 FORMAT(' SCHEDULED SHIPMENTS AWAY FROM SITE: ',/
165.      X ' 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 '
166.      X ' 1987 1988 1989 1990 ')
167.      READ(DIN,1512)(S(I),I=1,NY)
168.      IF(SAVE)WRITE(OUT,1512)(S(I),I=1,NY)

```

This code reads in planned receipts of spent fuel (interpool arrangements) for specific power-plant.

```

169.      IF(TIN)WRITE(TMO,1514)
170.      1514 FORMAT(' SCHEDULED RECEIPTS OF FUEL: ',/
171.      X ' 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 '
172.      X ' 1987 1988 1989 1990 ')
173.      READ(DIN,1512)(R(I),I=1,NY)
174.      IF(SAVE)WRITE(OUT,1512)(R(I),I=1,NY)

```

The following statements write out a summary of input variables for a specific power-plant. This summary consists of power-plant identifier; type; initial capacity; new capacity; year of planned expansion; beginning onsite inventory, and full core size.

```

175.      C
176.      C      RESET ARRAYS
177.      C
178.      C
179.      C      COMPUTATION LOOP
180.      C
181.      IF(TERM)WRITE(TMO,1951)LAB,TYPE
182.      IF(PRNT)WRITE(LP,1951)LAB,TYPE
183.      1951 FORMAT('1',SA4,' - ',A4)
184.      IF(TERM)WRITE(TMO,1952)C1,C2,Y2
185.      IF(PRNT)WRITE(LP,1952)C1,C2,Y2
186.      1952 FORMAT(' PRESENT CAPACITY = ',I4,
187.      X ' (PLANNED EXPANSION TO ',I5,' IN ',I4,
188.      X ')')
189.      IF(TERM)WRITE(TMO,1953)I1,F
190.      IF(PRNT)WRITE(LP,1953)I1,F
191.      1953 FORMAT(' BEGINNING ONSITE INVENTORY = ',I4,
192.      X ' , FULL CORE SIZE = ',I4)
193.      1990 CONTINUE
194.      DO 2000 I=1,NSCEN
195.      J1=CO(I)-CO1

```

The following code computes the schedule of discharges for years 1977 through 1990 as function of capacity factors, scheduled shipments away

Exhibit VI-1 — Cont.

from site and scheduled receipts of spent fuel.

```

196.      C
197.      C          SHIFT DISCHARGES
198.      C
199.      DO 1799 J=1,NY
200.      1799 D1(J)=0
201.      DO 1800 J=1,NY
202.      JJ=J+J1
203.      IF(JJ.LE.0)GO TO 1800
204.      IF(JJ.GT.NY)GO TO 1800
205.      D1(JJ)=D1(J)
206.      1800 CONTINUE
207.      DO 1801 J=1,NY
208.      1801 D1(J)=(D1(J)*CF1)/CF1 + 0.9999
209.      DNN(1) = 11 + D1(1) + R(1) - S(1)
210.      DFIN(1) = DNN(1)
211.      DO 1900 J=2,NY
212.      DNN(J) = DNN(J-1) + D1(J) + R(J) - S(J)
213.      1900 DFIN(J) = DNN(J)

```

These statements determine the numbers of reactors without full core reserve or normal discharge capability (without reserve options at the storage pool).

```

214.      C
215.      C          NUMBER OF REACTORS WITHOUT FCR OR NDC
216.      C
217.      DO 1904 J=1,NY
218.      DEL = C(J) - DFIN(J)
219.      IF(DEL.LT.F)NFC(I,J)=NFC(I,J) + 1
220.      1904 IF(DEL.LT.0)NND(I,J)=NND(I,J) + 1

```

This code determines full size of reactor plant core reserve away from reactor site for a specific power-plant.

```

221.      C
222.      C          FULL CORE RESERVE AFR
223.      C
224.      DO 1910 J=1,NY
225.      JJ=J+LOOK
226.      IF(JJ.GT.NY)JJ=NY
227.      DFAFR(J)=DFIN(J) - (C(JJ) - F)
228.      DELTA=DFIN(J)-DFAFR(J)
229.      IF(DELTA.LT.0)DFAFR(J)=DFAFR(J)-DELTA
230.      IF(DFAFR(J).GE.0)GO TO 1905
231.      DFAFR(J) = 0.0
232.      GO TO 1910
233.      1905 DO 1909 K=J,NY
234.      1909 DFIN(K) = DFIN(K)-DFAFR(J)
235.      1910 CONTINUE

```

Exhibit VI-1 — Cont.

The following code determines normal discharge capability of a specific power-plant away from reactor site.

```

236.      C
237.      C          NORMAL DISCHARGE RESERVE AFR
238.      C
239.      DO 1920 J=1,NY
240.          JJ = J+1
241.          IF(J.EQ.NY)JJ=NY
242.          DNAFR(J) = DNN(J) - (C(J) - D1(JJ))
243.          IF(DNAFR(J).GE.0)GO TO 1915
244.          DNAFR(J) = 0.0
245.          GO TO 1920
246.      1915 DO 1919 K=J,NY
247.          1919 DNN(K) = DNN(K) - DNAFR(J)
248.      1920 CONTINUE

```

These program statements compute the totals for each power-plant type (pressurized water reactor and boiler water reactor), for each scenario and for years 1977 through 1990.

```

249.      C
250.      C          REACTOR DONE - ADD TO NATIONAL TOTAL
251.      C
252.      IT=1
253.      IF(TYPE.EQ.PWR)IT=2
254.      DO 1950 J=1,NY
255.          NAFR(IT,I,J) = NAFR(IT,I,J)+DNAFR(J)
256.          FAFR(IT,I,J) = FAFR(IT,I,J) + DNAFR(J)
257.          FIN(IT,I,J) = FIN(IT,I,J) + DFIN(J)
258.      1950 NIN(IT,I,J) = NIN(IT,I,J) + DNN(J)

```

The following code prints out the final results for a specific power-plant by scenario for years 1977 through 1990.

```

258.      1950 NIN(IT,I,J) = NIN(IT,I,J) + DNN(J)
259.      C
260.      C          SCENARIO DONE - PRINT RESULTS
261.      C
262.      IF(.NOT.TERM)GO TO 6799
263.      LPR=THO
264.      1798 CONTINUE
265.      WRITE(LPR,1971)(DSCEN(I,J),J=1,5)
266.      1971 FORMAT(//,30X,5A4,/)
267.      WRITE(LPR,1972)
268.      1972 FORMAT(' ',7X,'1977 1978 1979 1980 1981 1982 1983'
269.      X ' 1984 1985 1986 1987 1988 1989 1990',/)
270.      WRITE(LPR,1973) (D1(J),J=1,NY)
271.      1973 FORMAT(' DISCHG',14I5)
272.      WRITE(LPR,1974) (S(J),J=1,NY)
273.      1974 FORMAT(' F-SHIP',14I5)
274.      WRITE(LPR,1975) (R(J),J=1,NY)
275.      1975 FORMAT(' RECEIV',14I5)
276.      WRITE(LPR,1976)(DFIN(JJ),JJ=1,NY)
277.      1976 FORMAT(/,30X,'** FULL CORE RESERVE **',/, ' ONSITE',14I5)
278.      WRITE(LPR,1977)(DNAFR(J),J=1,NY)
279.      1977 FORMAT(' AFR/YR',14I5)

```


Exhibit VI-1 — Cont.

```

280.      DO 5000 J=2,NY
281.      5000 DFAFR(J) = DFAFR(J) + DFAFR(J - 1)
282.      WRITE(LPR,5001) (DFAFR(J),J=1,NY)
283.      5001 FORMAT(' CUMAFR',14I5)
284.      WRITE(LPR,1978)(DNN(J),J=1,NY)
285.      1978 FORMAT(/,27X,'** NORMAL DISCHARGE RESERVE **',/,
286.      X ' ONSITE',14I5)
287.      WRITE(LPR,1979)(DNAFR(J),J=1,NY)
288.      1979 FORMAT(' AFR/YR',14I5)
289.      DO 6000 J=2,NY
290.      6000 DNAFR(J) = DNAFR(J) + DNAFR(J - 1)
291.      WRITE(LPR,5001) (DNAFR(J),J=1,NY)
292.      IF(LPR.EQ.LF)GO TO 1980
293.      6799 IF(.NOT.PRNT)GO TO 2000
294.      LPR=LF
295.      GO TO 1798
296.      1980 CONTINUE
297.      2000 CONTINUE
298.      GO TO 1000

```