ORNL/TM-10432

OAK RIDGE NATIONAL LABORATORY

MARTIN MARIETTA

Oak Ridge Research Reactor Quarterly Report January, February, and March 1987

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Operations Division
Reactor Operations Section

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT JANUARY, FEBRUARY, AND MARCH 1987

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Operations Division

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
JANUARY, FEBRUARY, AND MARCH 1987

SUMMARY

The ORR operated at an average power level of 29.6 MW for 72.0% of the time during January, February, and March of 1987.

The reactor was shut down on seventeen occasions, six of which were unscheduled. Reactor downtime needed for refueling and checks was normal. The reactor remained available for operation 88.1% of the time.

Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of maintenance on a shim-safety rod drive.

Special tests completed during the quarter included: (1) continuation of the RERTR whole-core demonstration, and (2) core physics measurements completed during the quarter to gather purposeful data to accommodate the RERTR whole-core demonstration.

POWER HISTORY

The power history for the quarter is displayed in Figs. 1 through 3.

OPERATIONS

The basic operating data presented in Table 1 indicate that the ORR operation for the quarter was normal.

Details relative to cycles of operation during the quarter are given in Table 2.

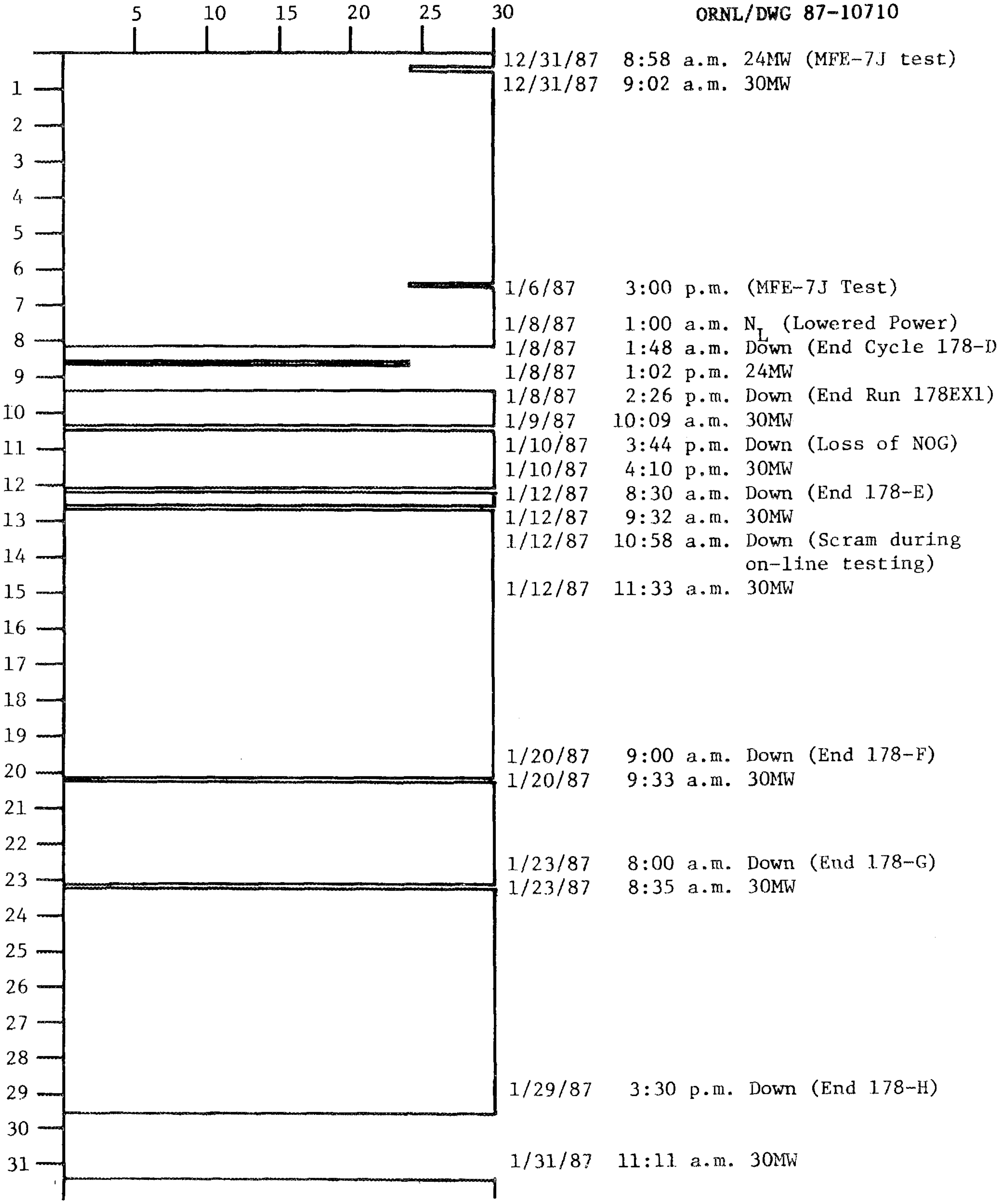

Fig. 1. Reactor power history - January 1987.

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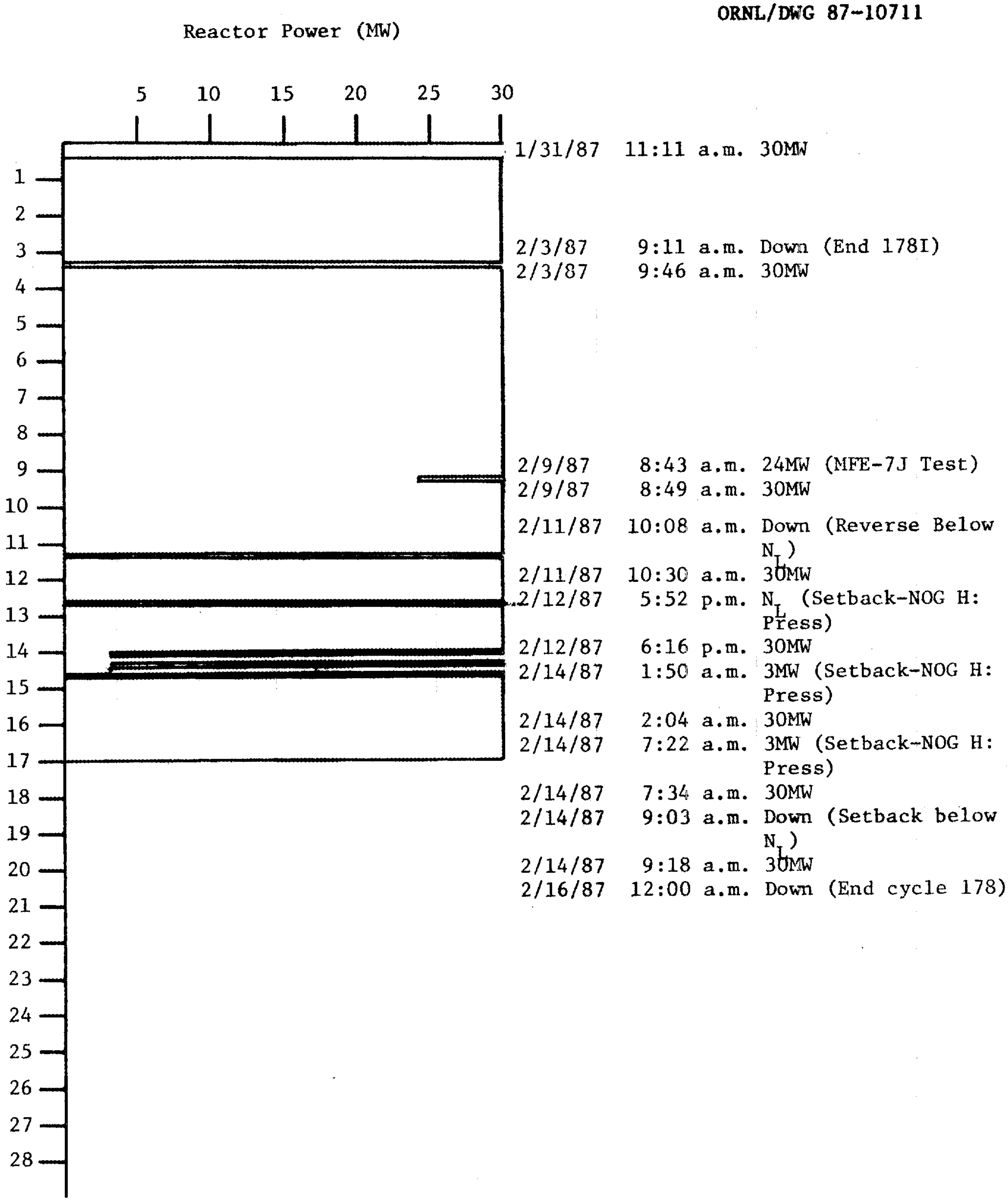

Fig. 2. Reactor Power History - February 1987.

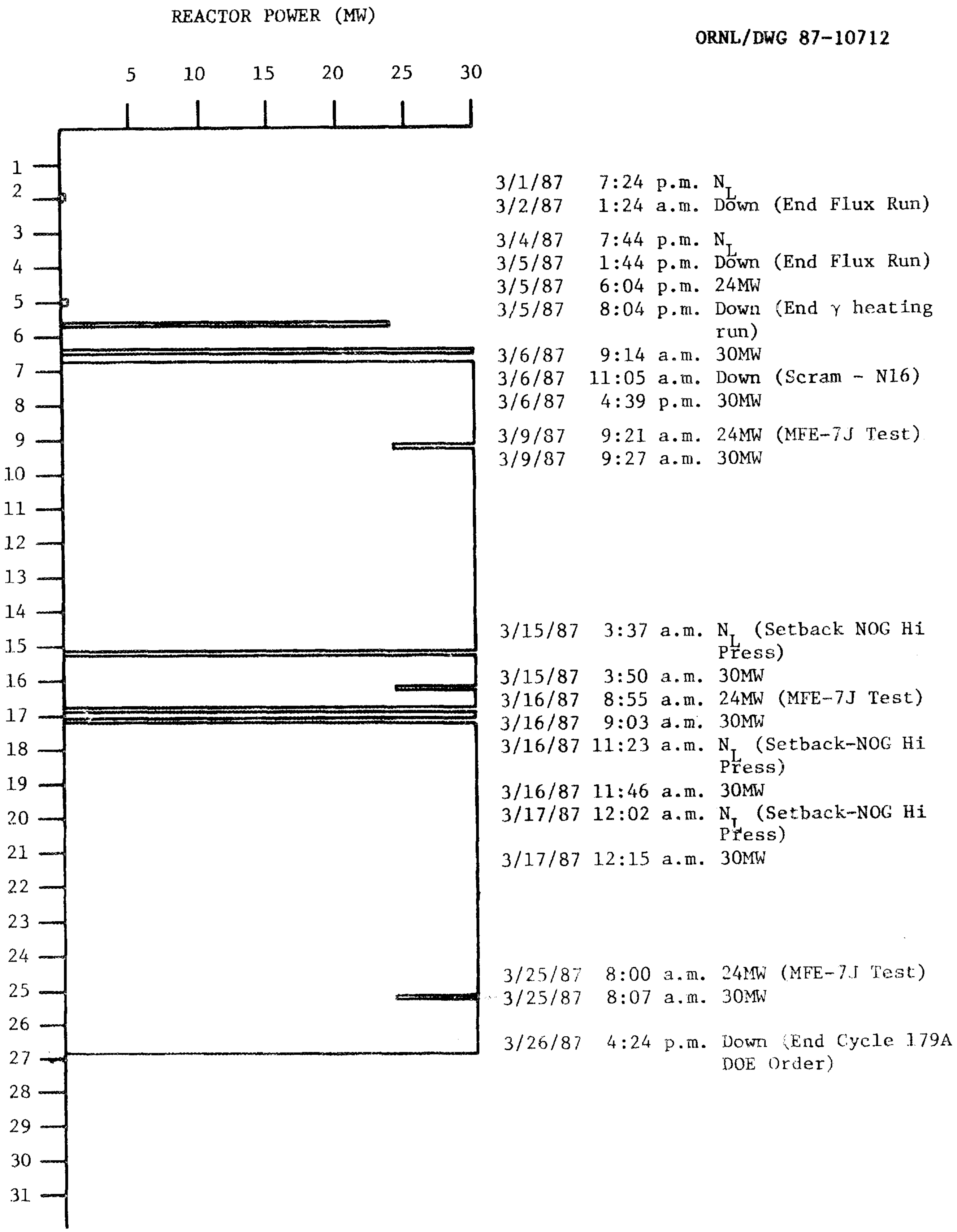

Fig. 3. Reactor power history - March 1987.

Table 1. Basic operating data
(January-March 1987)

	This quarter		Last quarter		Calendar year 1987		Calendar year 1986
Total energy, MWd	1,916.4		2,433.6		1,916.4		2,034.1
Average power, MW	29.6		29.9		29.6		29.8
Time operating, %	72.0		88.5		72.0		75.9
Availability, %	88.1		89.4		88.1		96.7
Reactor water radioactivity, cpm/ml (av)	45,600		42,600		45,600		38,400
Pool water radioactivity, cpm/ml (av)	1,900		2,000		1,900		1,280
Reactor water resistivity, ohm-cm (av)	1,123,000		1,065,000		1,123,000		1,249,000
Pool water resistivity, ohm-cm (av)	899,000		891,000		899,000		933,000
	HEU	LEU	HEU	LEU	HEU	LEU	HEU
Fuel elements depleted	0	0	4	0	4	0	14
Average burnup of fuel elements depleted, %	NA	NA	53.1	NA	53.1	NA	48.5
Shim-safety rods depleted	0	0	2	0	2	0	2
Average burnup of shim-safety rods depleted, %	NA	NA	75.5	NA	75.5	NA	77.5
Radioisotope samples	54		0		54		0
Research samples	7		0		7		37

Table 2. Cycles of operation

Cycle No.	Date begun	Date ended	Accumulated energy (MWd)
178	November 24, 1986	February 16, 1987	2,307.6[a]
179	March 6, 1987	In progress	

[a]MWd this quarter

FUEL USAGE AND INVENTORY

HEU

Forty-seven fuel elements and four shim-safety rods were shipped to Savannah River for chemical separation.

LEU

Eleven new elements and two new shim-safety rods were placed in service.

Other details of fuel usage and inventory may be found in Table 3.

Table 3. Fuel status

	This quarter	Last quarter	Jan.-March 1987	Jan.-March 1986
HEU				
Depleted fuel elements transferred for chemical recovery	47	0	47	0
Average percent burnup of fuel elements transferred	50.2	—	50.2	—
New elements, start of quarter	139	139	—	141
New elements received	0	0	0	0
New elements placed in service	0	0	0	2
New elements, end of quarter	139	139	—	139
Special or test elements	21	21	21	21
Depleted shim-safety rod elements transferred for chemical recovery	4	0	4	0
Average percent burnup of shim-safety rods transferred	76.2	—	76.2	—
New shim-safety rod elements, start of quarter	8	8	—	10
New shim-safety rod elements received	0	0	0	0
New shim-safety rod elements placed in service	0	0	0	2
New shim-safety rod elements, end of quarter	8	8	8	8

Table 3. (continued)

	This quarter	Last quarter	Jan.-March 1987	Jan.-March 1986
<u>LEU</u>				
Depleted fuel elements transferred for chemical recovery	0	0	0	—
Average percent burnup of fuel elements transferred	—	—	—	—
New elements start of quarter	41	52	41	—
New elements received	0	0	0	—
New elements placed in service	11	11	11	—
New elements end of quarter	30	41	30	—
Special or test elements	0	0	0	—
Depleted shim-safety rod elements transferred for chemical recovery	0	0	0	—
Average percent burnup of shim-safety rods transferred	—	—	—	—
New shim-safety rod elements start of quarter	6	8	6	—
New shim-safety rod elements received	0	0	0	—
New shim-safety rod elements placed in service	2	2	2	—
New shim-safety rod elements end of quarter	4	6	4	—

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 557 hours. A summary of the shutdowns is given in Table 4, and details of each scheduled shutdown are contained in Table 5. Table 6 describes unscheduled shutdowns, while Table 7 describes power reductions which did not result in shutdowns.

Table 4. Analysis of shutdowns

Description of shutdown	Number	Downtime (h)
Scheduled		
Regular, end of cycle	1	307.400
Regular, refueling and experiment work	2	52.583
Special, gamma heating measurements	2	29.200
Special, HFIR sample	4	1.533
Special, flux runs	2	81.733
Subtotal:	11	472.449
Unscheduled		
Equipment failure, reactor	2	0.150
Instrument failure, reactor	2	5.067
Human error	1	0.117
Department of Energy order	1	79.600
Subtotal:	6	84.934
TOTAL:	17	557.383

Table 5. Scheduled shutdowns, details

Date	Duration (h)	End cycle	Remarks
1-8-87	9.750	178-D	The reactor was refueled, and a gamma heating measurement device was installed
1-8-87	18.767	178-EX1	Gamma heating measurements were completed on core 178-EX1, and core 178-E was established
1-12-87	0.417	178-E	The reactor was shut down for removal of a HFIR sample specimen, and core 178-F was established
1-20-87	0.383	178-F	The reactor was shut down for installation of a HFIR sample specimen, and core 178-G was established
1-23-87	0.383	178-G	The reactor was shut down for removal of a HFIR sample specimen, and core 178-H was established
1-29-87	42.833	178-H	The reactor was refueled, isotope stringers worked, and a HFIR sample specimen was installed
2-3-87	0.350	178-I	The reactor was shut down for removal of a HFIR sample specimen and core 178-J was established
2-17-87	307.400	178	The shutdown activities included (1) refueling, (2) rod calibrations, (3) β_{eff}/L measurements, and (4) isothermal temperature coefficient measurements
3-2-87	66.333	179.AX2	A six-hour core flux map at N_L was completed. Other activities included: (1) reactivity checks on various isotopes, and (2) rod calibrations
3-5-87	15.400		A six-hour core flux map at N_L was completed and a gamma heating measurement device was installed
3-5-87	10.433		Gamma heating measurements were completed and the gamma heating measurement device was removed

Table 6. Unscheduled shutdowns, details

Date	Duration (h)	End cycle	Remarks
1-10-87	0.067		A setback from NOG high pressure was received, and power was reduced below 300 kW (N_L)
1-12-87	0.250		A reactor scram occurred during reactor protection system "on-line" checks
2-11-87	0.117		A five-rod insert below N_L (300 kW) ac- loss of "run" operating mode occurred when the No. 2 log N channel was disconnected while No. 1 log-N channel was on "ground" setting
2-14-87	0.083		A setback below N_L (300 kW) was received from NOG high pressure
3-6-87	4.817		A scram was received from the south ^{16}N channel
3-26-87	79.600	179-A	The Department of Energy ordered all ORNL reactors to be shut down until further notice

Table 7. Reductions in power not resulting in shutdowns

Date	Source of signal	Type of signal	Lowest power (MW)	Comments
1-6-87	Manual	Demand decrease	24	The power was momentarily lowered for continuity checks on MFE-7J
1-26-87	Manual	Demand decrease	24	The power was momentarily lowered for continuity checks on MFE-7J
2-9-87	Manual	Demand decrease	24	The power was momentarily lowered for continuity checks on MFE-7J
2-12-87	NOG	Setback	N_L	A setback was received due to NOG high pressure
2-14-87	NOG	Setback	3	A setback was received due to NOG high pressure
3-9-87	Manual	Demand decrease	24	The power was momentarily lowered for continuity checks on MFE-7J
3-15-87	NOG	Setback	N_L	A setback was received due to NOG high pressure
3-16-87	Manual	Demand decrease	24	The power was momentarily lowered for continuity checks on MFE-7J
3-16-87	NOG	Setback	N_L	A setback was recieved due to NOG high pressure
3-17-87	NOG	Setback	N_L	A setback was received due to NOG high pressure
3-25-87	Manual	Demand decrease	24	The power was momentarily lowered for continuity checks on MFE-7J

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the facility was satisfactory, and maintenance required is indicated in Table 8.

PROCESS SYSTEM

The performance of the process system was satisfactory, and maintenance required is indicated in Table 9.

MECHANICAL COMPONENTS

The performance of the mechanical systems was satisfactory, and maintenance is indicated in Table 10.

EXPERIMENT FACILITIES, GASEOUS-WASTE FILTERS, AND CORE CHANGES

Experiment facility usage is given in Table 11. Table 12 summarizes the results of efficiency tests of the various gaseous-waste filters. The core configurations used during the quarter are shown in Figs. 4 through 20.

Table 8. Maintenance and changes, instrumentation and controls

Date	Component	Trouble or change	Reason or maintenance
1-7-87	Reactor secondary pH control system	Loss of pH control	The pH controller was changed out
1-8-87	Reactor exit temperature channel No. 1	Spiking	The recorder amplifier was replaced and calibrated
1-8-87	Primary pump bearing temperature channel	Faulty readings	The thermocouple was replaced on the No. 1 main pump
1-8-87	South ^{16}N channel	Recorder pen sticking	The balance motor was replaced
1-30-87	Servo system (digital meter on flux level)	Spurious readouts	The ribbon cable and connector to the readout module were replaced
2-6-87	Log-N channel No. 1	Noisy	The period amplifier was replaced and calibrated
2-7-87	ΔT recorder No. 2	Erratic	The sensitivity on the recorder amplifier was adjusted
2-17-87	Micromicroammeter channel	Unsatisfactory chamber saturation calibration	The chamber was removed

Table 8. (Continued)

Date	Component	Trouble or change	Reason or maintenance
2-20-87	Micromicroammeter channel	Unsatisfactory chamber saturation calibration (see 2-17-87 entry)	A new chamber was installed
2-22-87 thru 2-23-87	Log-N and reactor protection systems	Sensitivity adjustments	The sensitivity of the systems was modified for the RERTR program special tests
2-26-87	Log-N and reactor protection channels	Return channels to normal parameter settings	The channels were adjusted and checked after the RERTR program special tests were completed
3-6-87	South ^{16}N channel	Spiking	The current amplifier module was replaced
3-12-87	Reactor secondary pH control system	Unstable response	The controller was adjusted and calibrated

Table 10. Process systems, maintenance and changes

Date	Component	Remarks
		<u>Reactor primary cooling system</u>
3-5-87	Syphon break	The gas removal portion of the system connected to the reactor vessel check valves was repaired
3-31-87	Motorized exit valves	The motors were cleaned and inspected
		<u>Reactor secondary cooling system</u>
2-20-87	Tower fans	The north fan starter was cleaned and inspected

Table 11. Mechanical systems, maintenance and changes

Date	Component	Remarks
2-27-87	No. 4 rod drive	The operator and engagement mechanism assemblies were removed, the shock absorber assembly cleaned and inspected, and all assemblies reassembled and checked for reliability
2-27-87	No. 4 rod drive selsyn	The spring-loaded tensioner was replaced

Table 12. Experiment facility usage

Facility	Access flange	Date installed	Date removed	Description of experiment	Division or sponsor
C-3	V-10	6-28-85		Material test, fusion program (MFE-7J)	Engineering Technology
C-7	V-2	6-28-85		Material test, fusion program (MFE-6J)	Engineering Technology
E-3	None	6-28-85		Aluminum-base, dispersion-type fuel plates (HFED)	Engineering Technology
HB-1	None	9-78		Neutron spectrometer	Solid State Physics
HB-2	None	11-1-58		Neutron diffraction experiments	Solid State Physics
HB-4	None	9-78		Neutron spectrometer	Solid State Physics
HB-6	None	4-76		Neutron small-angle scattering facility	Solid State Physics
HN-3	None	11-59		Activation analysis	Analytical Chemistry
HN-4	None	12-15-63		Neutron diffraction experiment Controls	Instrumentation and
South facility	None	12-16-63		Cold-finger plug[a]	Operations

[a]The facility is on standby.

Table 13. Status of filters, gaseous waste systems

Type filter	Bank designation	Date last changed	Date last tested	Type test	Retention efficiency (%)
		Cell-ventilation system			
CWS	Overall[a]	North, 4-16-80 South, 8-14-85	3-25-87	DOP	99.990
Charcoal	Both banks	North, 11-9-83 South, 8-14-85	1-13-87	Elemental iodine	99.900
		Basement hood exhaust			
CWS	South	3-11-80	3-25-87	DOP	99.997
CWS	North	3-11-80	3-25-87	DOP	99.998
		Normal off-gas			
CWS	West	8-14-85	3-25-87	DOP	99.998
Charcoal	West	8-14-85	10-28-86	Elemental iodine	99.986
CWS	East[b]	9-5-86	3-25-87	DOP	99.850[c]
Charcoal	East[b]	9-5-86	10-3-86	Elemental iodine	99.985

[a]The CWS filters in the cell-ventilation system were checked in series.
[b]Not in service.
[c]Failed efficiency test.

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Lattice loading

For fuel cycles 178D, F, H, J

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Eu	Ir	F	SR	F	SR	F	Ir	Eu
C	Be	F	MFE 7J E	F	F	F	MFE 6J E	F	Be
D	Eu	F	F	SR	F	SR	F	F	Eu
E	Be	F	HFED E	F	F	F	Ir	F	Be
F	Eu	Ir	F	SR	F	SR	F	Be	Eu
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	14
Experiment (E)	3
Isotope stringer (Iso)	10
Dummy fuel (DF)	4

Fig. 4. Lattice configuration - December 23, 1986-January 8, 1987, January 12-20, January 23-29, and February 3-17, 1987.

ORNL/DWG 87-10715

Lattice loading

For fuel cycles 179E, G, I

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	HFIR Spec.
B	Eu	Ir	F	SR	F	SR	F	Ir	Eu
C	Be	F	MFE 7J E	F	F	F	MFE 6J E	F	Be
D	Eu	F	F	SR	F	SR	F	F	Eu
E	Be	F	HFED E	F	F	F	Ir	F	Be
F	Eu	Ir	F	SR	F	SR	F	Be	DF
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	14
Experiment (E)	3
Isotope Stringer	9
Dummy fuel (DF)	4
HFIR Specimen	1

Fig. 5. Lattice configuration - January 9-11, January 20-23, January 31-February 3, 1987.

ORNL/DWG 87-10714

Lattice loading

For fuel cycles 179-AX1

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	MFE 7J E	F	F	F	MFE 6J E	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Al	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	23
Experiment (E)	2
Aluminum (AI)	2
Dummy fuel (DF)	4

Fig. 6. Lattice configuration - February 17-20, 1987.

ORNL/DWG 87-10716

Lattice loading

For fuel cycles 179-AX2

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	Al	F	F	F	Al	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Al	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	23
Aluminum (Al)	4
Dummy fuel (DF)	4

Fig. 7. Lattice configuration - February 20-21, February 28, and March 2, 1987.

ORNL/DWG 87-10717

Lattice loading

For fuel cycles 179-AX3

	1	2	3	4	5	6	7	8	9
A	DF	Be	Be	F	F	F	Be	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	Al	F	F	F	Al	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Al	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	24
Shim-safety rod (SR)	6
Beryllium (Be)	25
Aluminum (Al)	4
Dummy fuel (DF)	4

Fig. 8. Lattice configuration - February 21-22, 1987.

ORNL/DWG 87-10718

Lattice loading

For fuel cycles 178-AX4

	1	2	3	4	5	6	7	8	9
A	DF		F	F	F	F	F		DF
B			F	SR	F	SR	F		
C		F	Al	F	F	F	Al	F	
D		F	F	SR	F	SR	F	F	
E		F	Al	F	F	F	Al	F	
F			F	SR	F	SR	F		
G	DF								DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Aluminum (Al)	4
Dummy fuel (DF)	4

Fig. 9. Lattice configuration - February 22-23, 1987.

ORNL/DWG 87-10719

Lattice loading

For fuel cycles 179-AX5

	1	2	3	4	5	6	7	8	9
A									
B									*
C				F	F	F			
D			F	SR	F	SR	F		
E			F	F	F	F	F		
F	FC		F	SR	F	SR	F		FC
G									

*Micromicroammeter.

Lattice component	Number
Fuel (F)	14
Shim-safety rod (SR)	4
Fission chamber (FC)	2

Fig. 10. Lattice configuration - February 24, 1987.

ORNL/DWG 87-10720

Lattice loading

For fuel cycles 179-AX6

	1	2	3	4	5	6	7	8	9
A									
B									*
C		Be	Be	Be	Be	Be	Be	Be	
D		Be	Be	SR	F	SR	Be	Be	
E		Be	Be	F	F	F	Be	Be	
F	FC	Be	Be	SR	F	SR	Be	Be	FC
G		Be	Be	Be	Be	Be	Be	Be	

*Micromicroammeter.

Lattice component	Number
Fuel (F)	5
Shim-safety rod (SR)	4
Beryllium (Be)	26
Fission chamber (FC)	2

Fig. 11. Lattice configuration - February 24-28, 1987.

ORNL/DWG 87-10721

Lattice loading

For fuel cycles 179-AX7

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	MFE 7J E	F	F	F	Al	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Al	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	23
Experiment (E)	1
Aluminum (Al)	3
Dummy fuel (DF)	4

Fig. 12. Lattice configuration - February 28, 1987.

ORNL/DWG 87-10722

Lattice loading

For fuel cycles 179-AX8

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	F	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Al	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	28
Shim-safety rod (SR)	6
Beryllium (Be)	23
Aluminum (Al)	2
Dummy fuel (DF)	4

Fig. 13. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10723

Lattice loading

For fuel cycles 179-AX9

	1	2	3	4	5	6	7	8	9
A	DF	Be	Be	F	F	F	Be	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	F	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Al	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	25
Aluminum (Al)	2
Dummy fuel (DF)	4

Fig. 14. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10724

Lattice loading

For fuel cycles 179-AX10

	1	2	3	4	5	6	7	8	9
A	DF	Be	Be	Be	Be	Be	Be	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	F	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	F	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	24
Shim-safety rod (SR)	6
Beryllium (Be)	28
Aluminum (Al)	1
Dummy fuel (DF)	4

Fig. 15. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10725

Lattice loading

For fuel cycles 179-AX11

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	F	Ir	F	F	F	Ir	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	Al	F	F	F	Ir	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	23
Isotope stringer (Iso)	3
Aluminum (Al)	1
Dummy fuel (DF)	4

Fig. 16. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10726

Lattice loading

For fuel cycles 179-AX12

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Eu	Be	F	SR	F	SR	F	Be	Eu
C	Be	F	Ir	F	F	F	Ir	F	Be
D	Eu	F	F	SR	F	SR	F	F	Eu
E	Be	F	Al	F	F	F	Ir	F	Be
F	Eu	Be	F	SR	F	SR	F	Be	Eu
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	17
Isotope stringer (Iso)	9
Aluminum (Al)	1
Dummy fuel (DF)	4

Fig. 17. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10727

Lattice loading

For fuel cycles 179-AX13

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Eu	Be	F	SR	F	SR	F	Be	Eu
C	Be	F	Al	F	F	F	Al	F	Be
D	Eu	F	F	SR	F	SR	F	F	Eu
E	Be	F	Al	F	F	F	Al	F	Be
F	Eu	Be	F	SR	F	SR	F	Be	Eu
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	17
Isotope stringer (Iso)	6
Aluminum (Al)	4
Dummy fuel (DF)	4

Fig. 18. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10728

Lattice loading

For fuel cycles 179-AX14

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Eu	Ir	F	SR	F	SR	F	Ir	Eu
C	Be	F	Al	F	F	F	Al	F	Be
D	Eu	F	F	SR	F	SR	F	F	Eu
E	Be	F	Al	F	F	F	Ir	F	Be
F	Eu	Ir	F	SR	F	SR	F	Be	Eu
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	14
Isotope stringer (Iso)	10
Aluminum (Al)	3
Dummy fuel (DF)	4

Fig. 19. Lattice configuration - March 2, 1987.

ORNL/DWG 87-10729

Lattice loading

For fuel cycles 179-A

	1	2	3	4	5	6	7	8	9
A	DF	Be	F	F	F	F	F	Be	DF
B	Eu	Ir	F	SR	F	SR	F	Ir	Eu
C	Be	F	MFE 7J E	F	F	F	MFE 6J E	F	Be
D	Eu	F	F	SR	F	SR	F	F	Eu
E	Be	F	Al	F	F	F	Ir	F	Be
F	Eu	Ir	F	SR	F	SR	F	Be	Eu
G	DF	Be	Be	Be	Be	Be	Be	Be	DF

Lattice component	Number
Fuel (F)	26
Shim-safety rod (SR)	6
Beryllium (Be)	14
Experiment (E)	2
Isotope stringer (Iso)	10
Aluminum (Al)	1
Dummy fuel (DF)	4

Fig. 20. Lattice configuration - March 3-26, 1987.

SPECIAL TESTS CONDUCTED FOR THE RERTR PROGRAM WHOLE-CORE DEMONSTRATION
(R. W. Hobbs)

An extensive set of core physics measurements were conducted from February 19 through March 6, 1987. A total of 15 different core configurations were involved. The measurements made on these configurations are listed below:

1) Configurations 179-AXI, 179-AX2, 179-AX8, 179-AX9, 179-AX10, 179-AX11, 179-AX12, 179-AX13, and 179-AX14.

   Critical rod positions for these configurations were determined to access the reactivity effects of the MFE and isotope production irradiations and to determine the feasibility of running "junk cores" of 24 fuel elements. The measurements show that the isotopes have a reactivity effect comparable to the MFE experiments. They also show that operation of "junk cores" to maximize the burnup of the LEU fuel is definitely possible.

2) Configuration 179-AX2. This configuration contains no in-core or ex-core experiments or isotope proooduction facilities.

   A. Shim-safety rod calibrations.

   B. Core flux mapping by activation of cobalt wire.

3) Configuration 179-AX3

   This configuration is similar to 179-AX2. The irradiated shim-safety rods in B-4, B-6, F-4 and F-6 were replaced with fresh shim-safety rods. Fuel in A-3 and A-7 was removed to reduce the core excess reactivity. Shim-safety rod calibrations were made on this core to evaluate the effect of cadmium burnup in the shim-safety rods (by comparison with 179-AX2).

4) Configuration 179-AX4

   This configuration is similar to 179-AX3. The beryllium reflector was removed and fuel returned A-3 and A-7. Shim-safety rod calibrations were made on this core to evaluate the effects of the photo-neutron source on the differential rod worths.

5) Configuration 179-AX5

   This is a water-reflected assembly consisting of all fresh LEU fuel elements and shim-safety rods. Shim-safety rod calibrations were made on this core.

6) Configuration 179-AX6

   This is a beryllium-reflected assembly consisting of all fresh LEU fuel elements and shim-safety rods. Shim-safety rod calibrations were made on this core.

7) Configuration 179-AX7

A. Isothermal temperature.

B. Shim-safety rod calibrations - Note: Calibrations were made at both normal low flow (approximately 1200 gpm) and at high flow approximately 18,000 gpm) to determine if negative temperature reactivity effects are significant.

8) Configuration 179-A. This is the operating configuration.

A. B_{eff}/l - Dry tubes containing a ^{235}U fission chamber were placed in D-1 and D-9 and the cross power spectral density measured.

B. Core flux mapping by activation of cobalt wire.

C. Shim-safety rod calibrations.

D. Gamma heating measurements - These measurements were unsuccessful due to incorrect temperature readings. This problem is being investigated.

A large portion of the above measurements was aimed toward investigating the anomalies between calculated and measured differential rod worths. Differential rod worths are measured using the positive period method.

IN-SERVICE INSPECTION

Pool Window, Vessel Interior Welds, and Coolant Nozzles.

The pool window, vessel interior welds, and coolant nozzles (including gaskets) were inspected visually February 17-18, 1987. An underwater video camera was used for this inspection with results recorded on tape.

Comparison of the 1987 pool window inspection results with those done in 1985 showed no detectable changes. The coolant nozzle gaskets were intact and appeared to be damage free. The vessel interior welds examined were all welds above the fuel grid. The welds and vessel walls showed oxidation and pitting typical of what was seen in earlier inspections. No cracks were detected in any of the welds.

SUMMARY OF SURVEILLANCE TESTS

Table 14 is a tabulation of the completion dates of the surveillance tests required by the Technical Specifications. This table contains all the surveillance tests scheduled for frequencies of one quarter or longer. Other surveillance requirements which are not reported are satisfied by routine completion of daily and weekly check sheets, start-up checklists, hourly data sheets, the operating logbook, and miscellaneous quality assurance tests.

Table 14. Summary of surveillance tests

Test	Most recent	Previous
Biennially		
Primary cooling flow channel calibration		
Direct flow channel	2-20-87	9-5-86
Core ΔP channel	9-5-86	8-14-85
^{16}N channel calibration	2-19-87	9-5-86
North-facility flow channel calibration	5-8-86	4-25-84
South-facility flow channel calibration	5-8-86	4-25-84
Normal off-gas vacuum monitor calibration	9-5-86	8-12-85
Building ventilation flow monitor calibration	11-19-86	11-22-85
The dc pony motor battery bank		
Load-test No. 1 bank	9-1-86	11-3-85
Load-test No. 2 bank	5-4-86	11-3-85
Load-test No. 3 bank	2-17-87	2-20-86
Annually		
Safety-level channels calibration	2-19-87	11-21-86
Log-N channels calibration	2-19-87	11-20-86
ΔT channels calibration	2-19-87	3-6-86
Reactor water exit temperature channels calibration	2-19-87	3-6-86
Fission chamber channels calibration	2-19-87	11-20-86
Speed measurements of the shim-safety rod drive motors	3-3-87	12-10-86

Table 14. (Continued)

Test	Most recent	Previous
Annually (continued)		
Calibration of shim-safety rods	3-3-87	11-23-86
Reactivity assigned to the servo-control system	3-3-87	11-23-86
Semiannually		
Pressure-drop measurements across NOG filters	3-29-87	12-28-86
NOG filter system efficiency		
Elemental iodine test - east bank	10-3-86	9-23-86
Elemental iodine test - west bank	10-28-86	5-20-86
Dioctyl phthalate test - east bank	3-25-87	9-23-86
Dioctyl phthalate test - west bank	3-25-87	10-28-86
Containment closure system function test	2-18-87	11-19-86
Cell-ventilation filter system efficiency		
Elemental iodine measurements	1-13-87	5-31-86
Dioctyl phthalate measurements	3-25-87	9-23-86
Radiation monitoring equipment calibration	1-7-87	10-13-86
Stack radiation monitor calibration	3-16-87	9-5-86
Quarterly		
Primary coolant flow channels tested	3-3-87	11-21-86
^{16}N channels tested	2-19-87	11-21-86
North-facility flow channels tested	3-3-87	11-21-86
South-facility flow channels tested	3-3-87	11-21-86
Normal off-gas vacuum monitor tested	3-3-87	11-19-86

Table 14. (Continued)

Test	Most recent	Previous
Quarterly (continued)		
Building ventilation flow monitor tested	3-3-87	11-19-86
Manual scrams tested	3-3-87	11-21-86
Measurement of release time and time of flight for the shim-safety rods	3-3-87	12-10-86
Subcriticality with each shim-safety rod at its upper limit while all other shim-safety rods are fully inserted	3-3-87	12-10-86
Seismic channels	3-3-87	11-21-86

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