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Operations Division
Reactor Operations Section

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT APRIL, MAY, AND JUNE 1984

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
APRIL, MAY, AND JUNE 1984

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SUMMARY

The ORR operated at an average power level of 29.9 MW for 83.3% of the time during April, May, and June of 1984.

The reactor was shut down on five occasions, one of which was unscheduled. Reactor downtime needed for refueling and checks was normal. The reactor remained available for operation 93.4% of the time.

Maintenance activities, both mechanical and instrument, were essentially routine in nature.

Special tests completed during the quarter included: (1) results of flux measurements in the HFED experiment, cycles 167-D and 168-A; and (2) results of reactivity worth measurements of MFE-4A Hf core sleeve as installed in core position E-3.

In-service inspection completed during the quarter included the internal and external inspection of the pool heat exchanger.

POWER HISTORY

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

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.

ORNL-DWG 84-17190

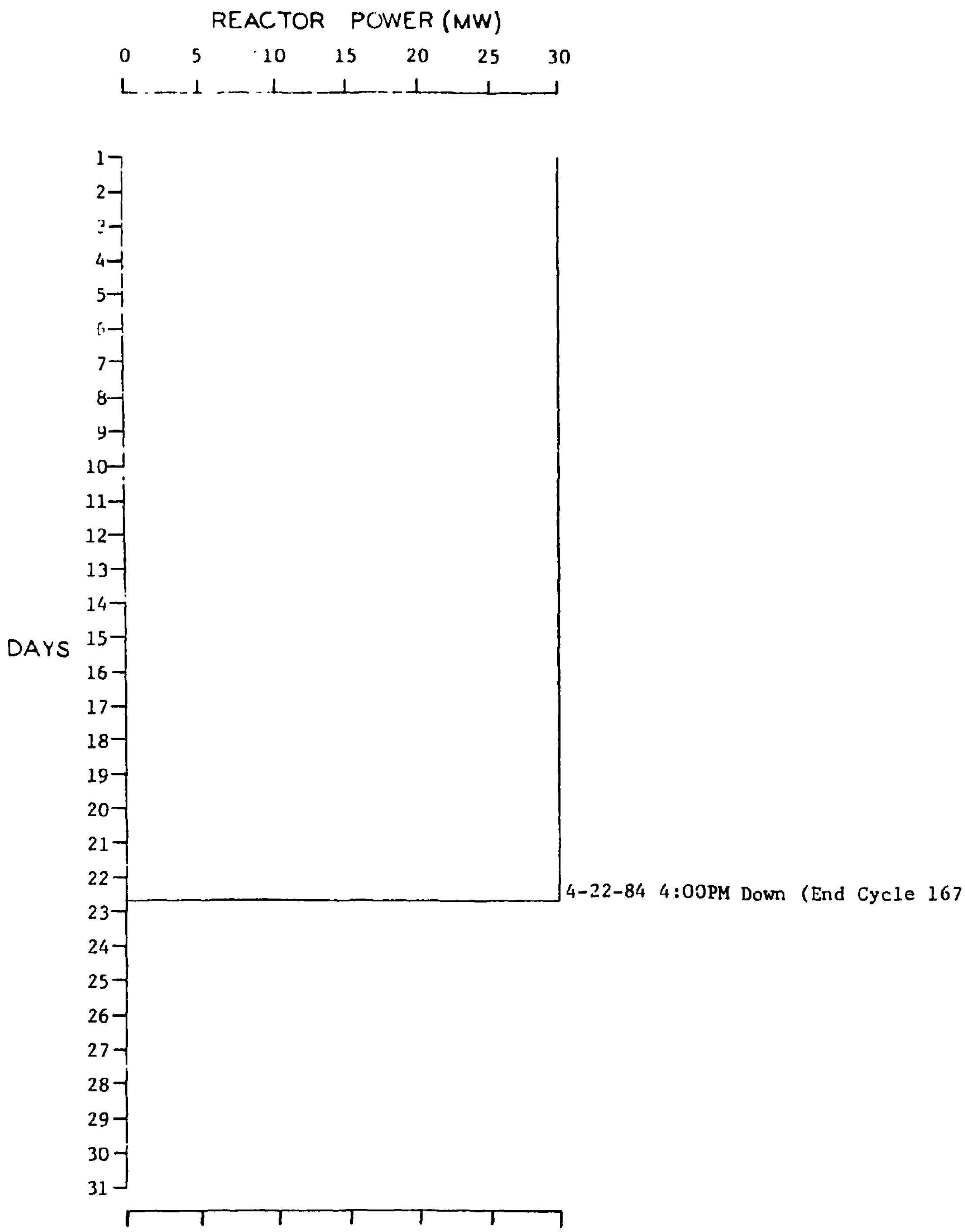

Fig. 1. Reactor power history - April 1984.

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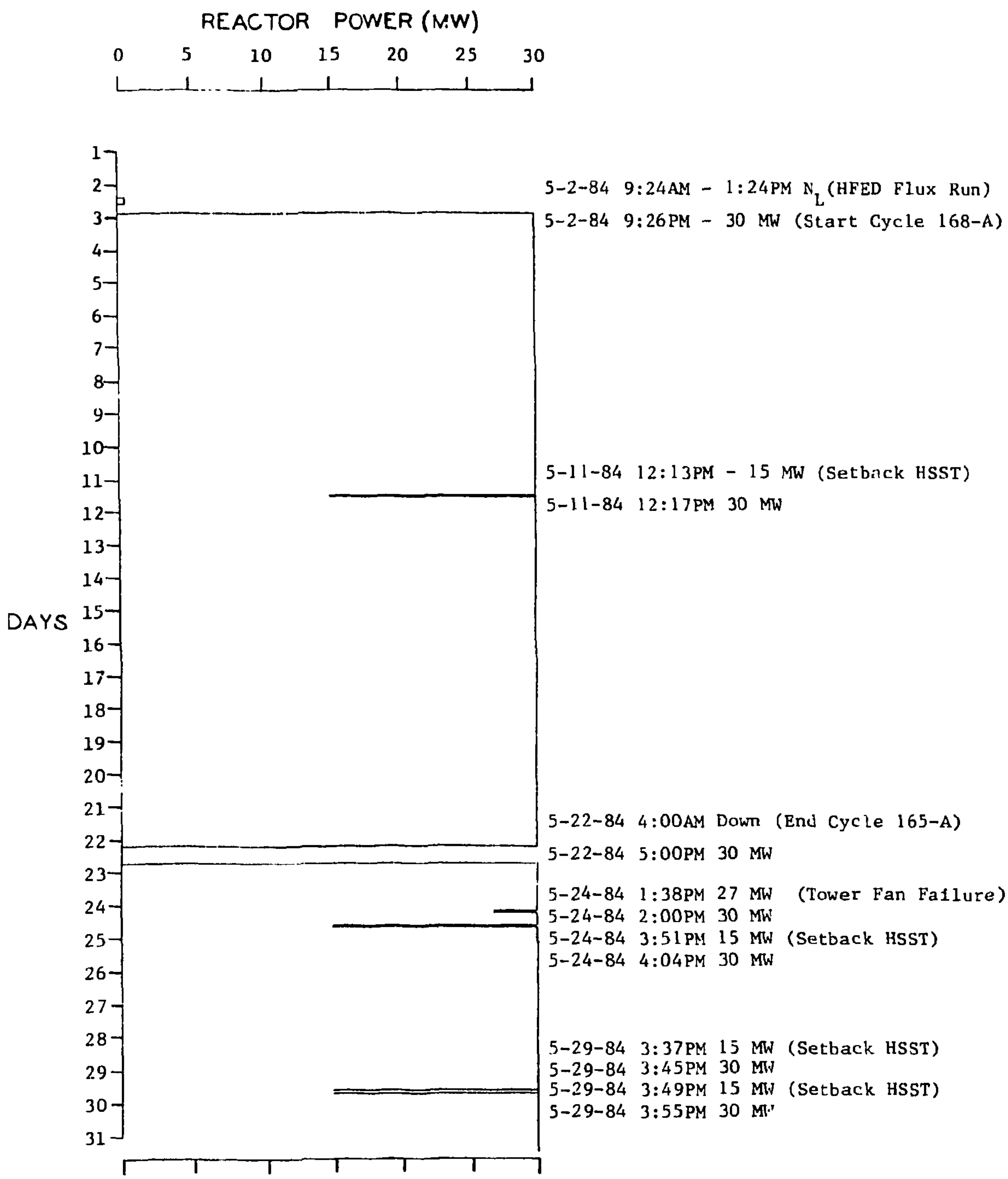

Fig. 2. Reactor power history - May 1984.

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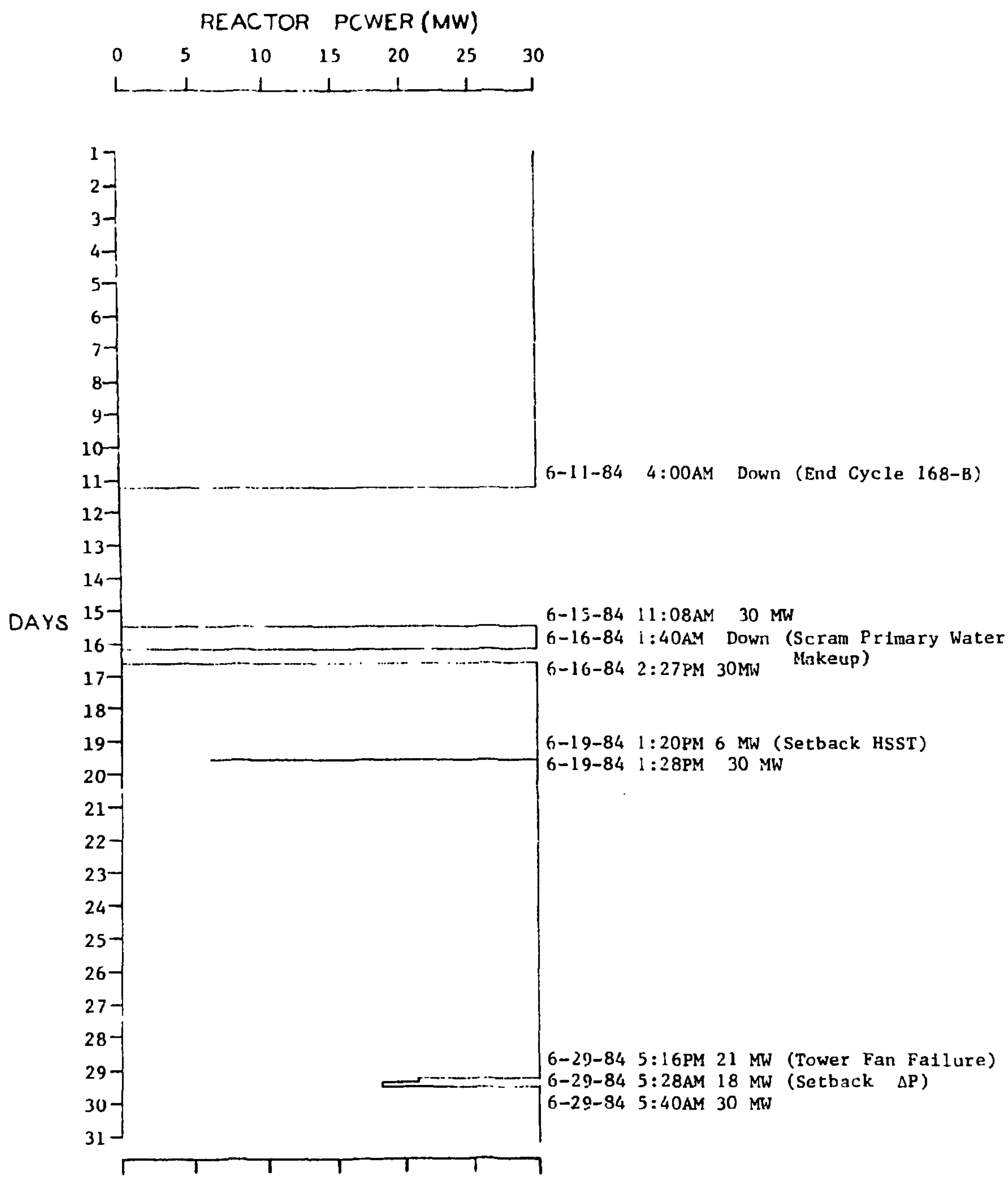

Fig. 3. Reactor power history - June 1984.

Table 1. Basic operating data
(April-June 1984)

	This quarter	Last quarter	Jan.-June 1984	Jan.-June 1983
Total energy, MWd	2,264.2	2,213.7	4,477.9	3,420.1
Average power, MW	29.9	29.3	29.6	29.5
Time operating, %	83.3	83.0	83.2	64.2
Availability, %	93.4	92.6	93.0	67.3
Reactor water radioactivity, cpm/ml (av)	34,000	35,835	34,918	20,150
Pool water radioactivity, cpm/ml (av)	940	840	890	573
Reactor water resistivity, ohm-cm (av)	1,347,000	1,330,770	1,338,850	1,027,000
Pool water resistivity, ohm-cm (av)	1,148,000	1,397,300	1,272,650	863,000
Fuel elements depleted	25	16	41	23
Average burnup of fuel elements depleted, %	47.0	48.5	47.8	48.7
Shim rods depleted	2	2	4	2
Average burnup of shim rods depleted, %	81.1	86.5	83.8	73.9
Radioisotope samples	0	0	0	7
Research samples	6	16	22	5

Table 2. Cycles of operation

Cycle No.	Date begun	Date ended	Accumulated energy (MWd)
167	February 5, 1984	April 22, 1984	649.5[a]
168	May 2, 1984	In progress	1,614.6

[a]MWd this quarter.

FUEL USAGE AND INVENTORY

Twenty-eight fuel elements and two shim rods were shipped for chemical separation. Twenty-five fuel elements and two shim rods were declared spent during the quarter. Fifteen new fuel elements and two new shim rods were placed in service. Thirty-four new fuel elements and four new shim rods were received from the vendor.

Other details of fuel usage and inventory may be found in Tables 1 and 3.

Table 3. Fuel status

	This quarter	Last quarter	Jan.-June 1984	Jan.-June 1983
Depleted fuel elements transferred for chemical recovery	28	13	41	33
Average percent burnup of fuel elements transferred	44.5	47.9	45.6	48.9
New elements start of quarter	58	54	--	--
New elements received	34	21	55	20
New elements placed in service	15	17	32	13
New elements end of quarter	77	58	--	--
Special or test elements	21	21	21	21
Depleted shim rod elements transferred for chemical recovery	2	4	6	6
Average percent burnup of shim rods transferred	87.4	79.3	82.0	75.7
New shim rod elements start of quarter	7	7	--	--
New shim rod elements received	4	2	6	2
New shim rod elements placed in service	2	2	4	2
New shim rod elements end of quarter	9	7	--	--

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 365 hours. A summary of the shutdowns is given in Table 4, and details of each are contained in Table 5. Table 6 describes unscheduled shutdowns, while Table 7 describes power reductions which did not result in shutdowns.

Table 4. Summary of shutdowns

Description of shutdown	Number	Downtime (h)
Scheduled		
Regular, end of cycle	1	232.400
Special, refueling and experiment work	2	114.150
Special, flux run	1	6.783
Subtotal:	4	353.333
Unscheduled		
Instrument failure, reactor	1	11.833
Subtotal:	1	11.833
TOTAL:	5	365.166

Table 5. Scheduled shutdowns, details

Date	Duration (h)	End cycle	Remarks
4-22-84	232.400	167	The shutdown activities included: (1) refueling, (2) the cleaning of the reactor pool walls and gutters, (3) the installation of a new sprinkler system at 3103 tower, (4) the installation of two new HSST capsules, and (5) the inspection of the pool window
5-2-84	6.783	—	A four-hour flux run at N_L for HFED experiment was completed
5-22-84	11.967	168A	The reactor was refueled, and research personnel measured HFED and fuel element BSI-202
6-11-84	102.183	168B	Shutdown activities included: (1) refueling, (2) the replacement of No. 3 primary pump exit valve, and (3) fuel element measurements on the LEU units

Table 6. Unscheduled shutdowns, details

Date	Duration (h)	End cycle	Remarks
6-16-84	11.883	168C	The reactor was manually scrammed when a false leak rate indication was observed. Refueling was completed

Table 7. Reductions in power not resulting in shutdowns

Date	Source of signal	Type of signal	Lowest power (MW)	Comments
4-17-84	Cell ventilation	Setback	12	A momentary loss of cell ventilation resulted in a setback. Power was returned to 30 MW
4-17-84	Manual	Lowered demand	N_L	Power was lowered to N_L when it was discovered that the cell-ventilation main blower had been lost
5-11-84	HSST experiment	Manual setback	21	A manual setback was received when I&C checked out the hand switch and 60% setback circuit
5-11-84	HSST experiment	Setback	15	A setback was received due to computer noise
5-24-84	Manual	Lowered demand	27	The power was lowered when No. 1 cooling tower fan was lost
5-24-84	HSST experiment	Setback	15	A setback was received due to computer noise
5-29-84	HSST experiment	Setback	15	A setback was received due to computer noise
5-29-84	HSST experiment	Setback	15	A setback was received due to computer noise
6-19-84	HSST experiment	Setback	6	A setback was received when the flow switch for the cooling water pump was bumped
6-29-84	Manual	Lowered demand	21	Power was lowered when electrical power was lost to reactor cooling tower fans
6-29-84	Reactor ΔP	Setback	18	While operating at 21 MW (see above), a setback was received due to low ΔP across the core

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 is indicated in Table 9.

MECHANICAL COMPONENTS

The performance of the mechanical components was satisfactory.

EXPERIMENT FACILITIES, GASEOUS WASTE FILTERS, AND CORE CHANGES

Experiment facility usage is given in Table 10. Table 11 summarizes the results of efficiency tests of the various gaseous waste filters. The core configurations used during the quarter are shown in Figs. 4, 5, and 6.

Table 8. Maintenance and changes, instrumentation and controls

Date	Component	Trouble or change	Reason or maintenance
4-6-84	No. 2 safety ionization chamber	Routine	A saturation characteristic curve was made with satisfactory results
4-30-84	Cell-ventilation low steam pressure alarm	Inoperative	The pressure switch was replaced
4-30-84	Flow switch regulator No. 731B	Defective	The regulator was replaced
5-24-84	24-in. valve	Noisy	A noise monitor recorder and teletalk box were installed
5-30-84	Reactor tower pH controller	Inoperative	The pH controller was replaced
6-12-84	Reactor primary flow transmitter	Future use	A new flow transmitter was installed in the Venturi pit
6-14-84	No. 1 safety channel	Bad ionization chamber	The old chamber was removed and a new CIC chamber was installed
6-15-84	No. 1 Log N channel	No response to negative voltage inhibit	A cable connector was repaired
6-15-84	Startup timer	Increased rod withdrawal speed during startup	The timer which controls the intermittant shim rod withdrawal was changed from 1 s "on" and 5 s "off" to 5 s "on" and 3 s "off." This appreciably increases the rod withdrawal speed during a startup. The 30-s or 20-s period bypass features are not used unless Log N confidence has been attained

Table 8. Continued

Date	Component	Trouble or change	Reason or maintenance
6-15-84	No. 1 safety ionization chamber		A saturation characteristic curve was made with satisfactory results
6-16-84	No. 6B magnet amplifier	Defective	The magnet amplifier was replaced
6-28-84	Ionization chambers	Routine	The saturation characteristic curves were made on the μμA, the No. 3 safety, and the No. 2 Log N ionization chambers. The No. 2 Log N chamber failed to meet the required specifications and was removed from service
6-29-84	No. 1 Log N ionization chamber	Routine	A saturation characteristic curve was made with satisfactory results

Table 9. Process systems, maintenance and changes

Date	Component	Remarks
		Reactor primary cooling system
5-2-84	Degasifier	P&E repaired a leak on the sightglass
5-4-84	Degasifier	A leak on the pump discharge line was repaired
6-14-84	No. 1 primary pump exit valve	The motorized-valve bonnet failed and was replaced with a manually operated valve
		Reactor secondary cooling system
5-2-84	Cooling tower	The sprinkler system for fire protection was replaced
5-24-84	No. 1 cooling tower fan	The fan starter relay was replaced
		Pool secondary cooling system
4-10-84	Tower fan	The fan coupling was replaced
		Emergency cooling system
4-25-84	No. 3 dc motor	The motor was removed, refurbished, and remounted
		Reactor control system
5-2-84	No. 6 shim rod	The withdraw relay was replaced

Table 10. Experiment facility usage

Facility	Access flange	Date installed	Date removed	Description of experiment	Division or sponsor
B-8	None	5-2-84	5-22-84	Xenon	Operations
C-3	None	7-18-81		Aluminum-base, dispersion-type fuel plate (HFED)	Engineering Technology
E-3	V-7	9-26-82		Material test, fusion program (MFE-4A)	Engineering Technology
E-7	V-5	7-29-83		Material test, fusion program (MFE-4B)	Engineering Technology
Poolside[a] facility	None	4-24-84		Material test (HSST-5, Nos. 1 and 2)	NRC
HB-1	None	9-78		Neutron spectrometer	Solid State Physics
HB-2	None	9-78		Neutron spectrometer	Solid State Physics
HB-3	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	Instrumentation and Controls
South facility	None	12-16-63		Cold-finger plug[b]	Operations

[a]The LWR metallurgical pressure vessel benchmark facility was installed on 4-21-80 and identified as the Poolside Facility. The Heavy Section Steel Technology (HSST) Program will utilize the facility for irradiations.

[b]The facility is on standby.

Table 11. 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, 1-12-75	3-19-84	DOP	99.997
Charcoal	Both banks	North, 11-9-83 South, 2-2-81	6-14-84	Elemental iodine	99.935
		Basement hood exhaust			
CWS	South	3-11-80	3-19-84	DOP	99.950
CWS	North	3-11-80	3-19-84	DOP	99.950
		Normal off-gas			
CWS	West	12-7-83	3-19-84	DOP	99.998
Charcoal	West[b]	12-7-83	6-5-84	Elemental iodine	99.756
CWS	East	3-27-84	5-15-84	DOP	99.997
Charcoal	East	3-27-84	4-17-84	Elemental iodine	99.992
		Pressurizable off-gas[c]			

[a]The CWS filters in the cell-ventilation system were checked in series.

[b]New filters will be installed before use and the filters will be tested before unit is placed in service.

[c]The POG system is on standby; therefore, all filter tests have been discontinued.

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Lattice loading

For fuel cycles 167-D

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

Lattice component	Number
Fuel (F)	27
Shim rod (SR)	6
Beryllium (Be)	25
Experiment (E)	3
Aluminum (Al)	2

Fig. 4. Lattice configuration - March 27-April 22, 1984.

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Lattice loading

For fuel cycles 168-A

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

Lattice component	Number
Fuel (F)	27
Shim rod (SR)	6
Beryllium (Be)	24
Experiment (E)	3
Xenon (Xe)	1
Aluminum (Al)	2

Fig. 5. Lattice configuration - May 2-22, 1984.

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Lattice loading

For fuel cycles 168-B, C, D

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

Lattice component	Number
Fuel (F)	27
Shim rod (SR)	6
Beryllium (Be)	25
Experiment (E)	3
Aluminum (Al)	2

Fig. 6. Lattice configuration - May 22-June 30, 1984.

SPECIAL TESTS

RESULTS OF FLUX MEASUREMENTS IN THE HFED EXPERIMENT, CYCLE 167-D AND 168-A

Flux measurements were made in the HFED Experiment in cores 167-D (Fig. 4) and 168-A (Fig. 5).

The HFED module configuration for the flux run in 167-D was as follows:

Module position 1: Fuel module No. 17

Module position 2: Fuel module No. 18

Module positions 3, 4, and 5: Unfueled modules with dummy Al plates

The module configuration for the flux run in 168-A was:

Module position 1: Fuel module No. 22

Module position 2: Fuel module No. 17

Module position 3: Fuel module No. 18

Module positions 4 and 5: Unfueled modules with dummy Al plates

The maximum "thermal" fluxes of interest measured for core 168-A were 7.35×10^{13} $n \cdot cm^{-2} \cdot s^{-1}$ in module position 1, 1.18×10^{14} $n \cdot cm^{-2} \cdot s^{-1}$ in module position 2, and 1.77×10^{14} $n \cdot cm^{-2} \cdot s^{-1}$ in module position 3.

Based on the results of the flux measurements in cores 167-AX1 (quarterly report January, February, and March 1984), 167-D, and 168-A, and the irradiation received on modules Nos. 17 and 18, the maximum areal U-235 loading (g/m^2) for module No. 17 is estimated to be between 528 and 560 g/m^2 and for module No. 18 between 332 and 357 g/m^2.

REACTIVITY WORTH MEASUREMENT OF MFE-4A Hf CORE SLEEVE IN ORR CORE POSITION E-3

The reactivity worth of the Hf sleeve installed around the MFE-4A experiment in E-3 was measured as -0.94 %Δk/k. The previous worth of the Hf sleeve around the MFE mockup in C-3 position was determined as > -1.54 %Δk/k. The reduction in worth of the Hf sleeve in E-3 is probably due to two effects: (1) the relative importance of positions

C-3 and E-3; and (2) the MFE experiment in E-3 is probably more absorbing than the mockup used in C-3, which would tend to reduce the relative effect of the Hf sleeve.

Based on a reactivity usage of +0.3 %Δk/k day this would result in a shortening of the fuel cycle by approximately three days and should be easy to accommodate.

IN-SERVICE INSPECTION

INTERNAL AND EXTERNAL INSPECTION OF ORR POOL HEAT EXCHANGER, QA&I NO. 29304, BUILDING 3042, APRIL 25, 1984

The internal and external surfaces of the vessel shell and heads showed very little evidence of corrosion. The accessible surfaces of the tube bundle, including the tube sheet, tube ends, tube OD surfaces, and baffle plates were visually inspected. The pitting and corrosion on the baffle plates, as noted on previous reports, does not show any significant change. The heat exchanger is acceptable for further service.

SUMMARY OF SURVEILLANCE TESTS

Table 12 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 12. Summary of surveillance tests

Test	Most recent test	Previous test
Biennially		
Primary cooling flow channel calibration		
Direct flow channel	7-25-83	7-27-82
Core ΔP channel	7-29-83	2-8-82
^{16}N channel calibration	11-9-83	8-2-83
North facility flow channel calibration	7-27-83	3-8-83
South facility flow channel calibration	7-27-83	3-8-83
Normal off-gas vacuum monitor calibration	7-27-83	3-7-83
Pressurizable off-gas vacuum monitor calibration	Out of service	
Building ventilation flow monitor calibration	3-28-84	7-27-83
The dc pony motor battery bank		
Load-test No. 1 bank	11-9-83	7-24-82
Load-test No. 2 bank	4-22-84	7-24-83
Load-test No. 3 bank	2-4-84	1-14-83
Annually		
Safety level channels calibration	11-9-83	7-28-83
Log N channels calibration	11-9-83	8-2-83
ΔT channels calibration	7-26-83	3-7-83
Reactor water exit temperature channels calibration	8-2-83	3-7-83
Fission chamber channels calibration	4-28-84	2-24-84
Speed measurements of the shim-safety rod drive motors	5-1-84	2-4-84
Semiannually		
Pressure drop measurements across NOG filters	6-24-84	6-17-84
Pressure drop measurements across POG filters	Out of service	
NOG filter system efficiency		
Elemental iodine test - east bank	4-17-84	12-15-83
Elemental iodine test - west bank	6-5-84	12-8-83
Dioctyl phthalate test - east bank	5-15-84	10-10-83
Dioctyl phthalate test - west bank	3-19-84	12-7-83

Table 12. (Continued)

Test	Most recent test	Previous test
Semiannually (continued)		
POG filter system efficiency	Out of service	
Containment closure system function test	4-27-84	2-4-84
Cell-ventilation filter system efficiency		
Elemental iodine measurements	5-14-84	11-10-83
Dioctyl phthalate measurements	3-19-84	10-10-83
Radiation monitoring equipment calibration	6-6-84	3-6-84
Stack radiation monitor calibration	6-18-84	2-20-84
Quarterly		
Primary coolant flow channels tested	4-27-84	3-28-84
^{16}N channels tested	4-26-84	2-23-84
North facility flow channels tested	4-27-84	3-28-84
South facility flow channels tested	4-27-84	3-28-84
Normal off-gas vacuum monitor tested	4-25-84	3-28-84
Pressurizable off-gas vacuum monitor tested	Out of service	
Building ventilation flow monitor tested	4-25-84	3-28-84
Manual scrams tested	4-27-84	3-28-84
Measurement of release time and time of flight for the shim-safety rods	5-1-84	2-4-84
Subcriticality with each shim-safety rod at its upper limit while all other shim-safety rods are fully inserted	5-1-84	2-4-84
Others		
Calibration of shim-safety rods	2-4-84	3-9-83
Reactivity assigned to the servo-control system	2-4-84	3-9-83

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