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MARTIN MARIETTA

Oak Ridge Research Reactor Quarterly Report July, August, and September 1985

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Operations Division
Reactor Operations Section

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
JULY, AUGUST, AND SEPTEMBER 1985

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M. K. Ford

SPONSOR: J. H. Swanks
Operations Division

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
JULY, AUGUST, AND SEPTEMBER 1985

SUMMARY

The ORR operated at an average power level of 29.8 MW for 76.1% of the time during July, August, and September of 1985.

The reactor was shut down on eight occasions, four of which were scheduled. Reactor downtime needed for refueling and checks was normal. The reactor remained available for operation 80.8% of the time.

Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of one Instrumentation and Controls Change memorandum.

In-service inspections completed during the quarter included inspections of primary heat exchangers Nos. 1, 2, 3, and 4 on August 16, 1985, plus the pool primary heat exchanger on August 13, 1985.

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.

ORNL/DWG-85-17531

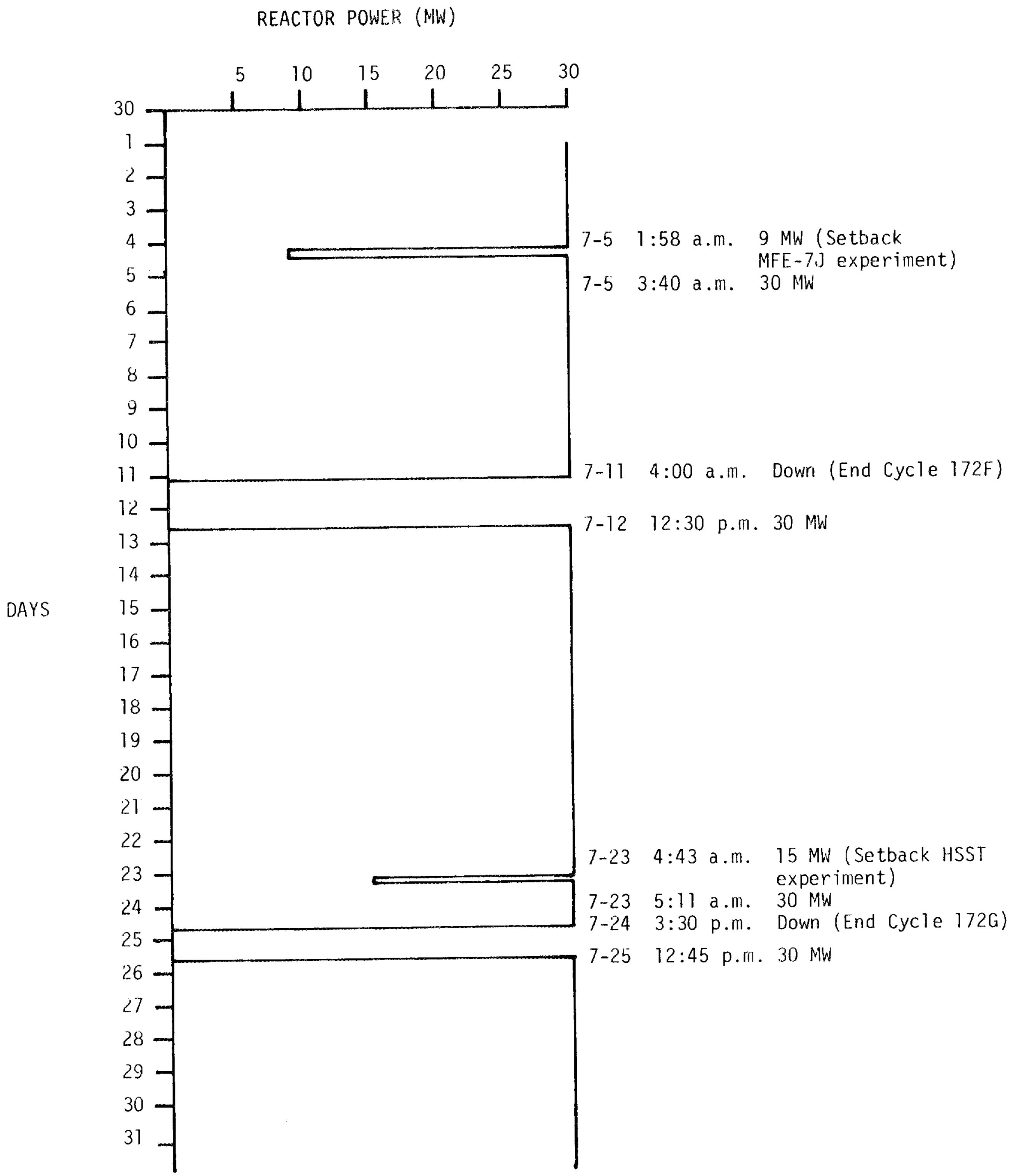

Fig. 1. Reactor power history - July 1985.

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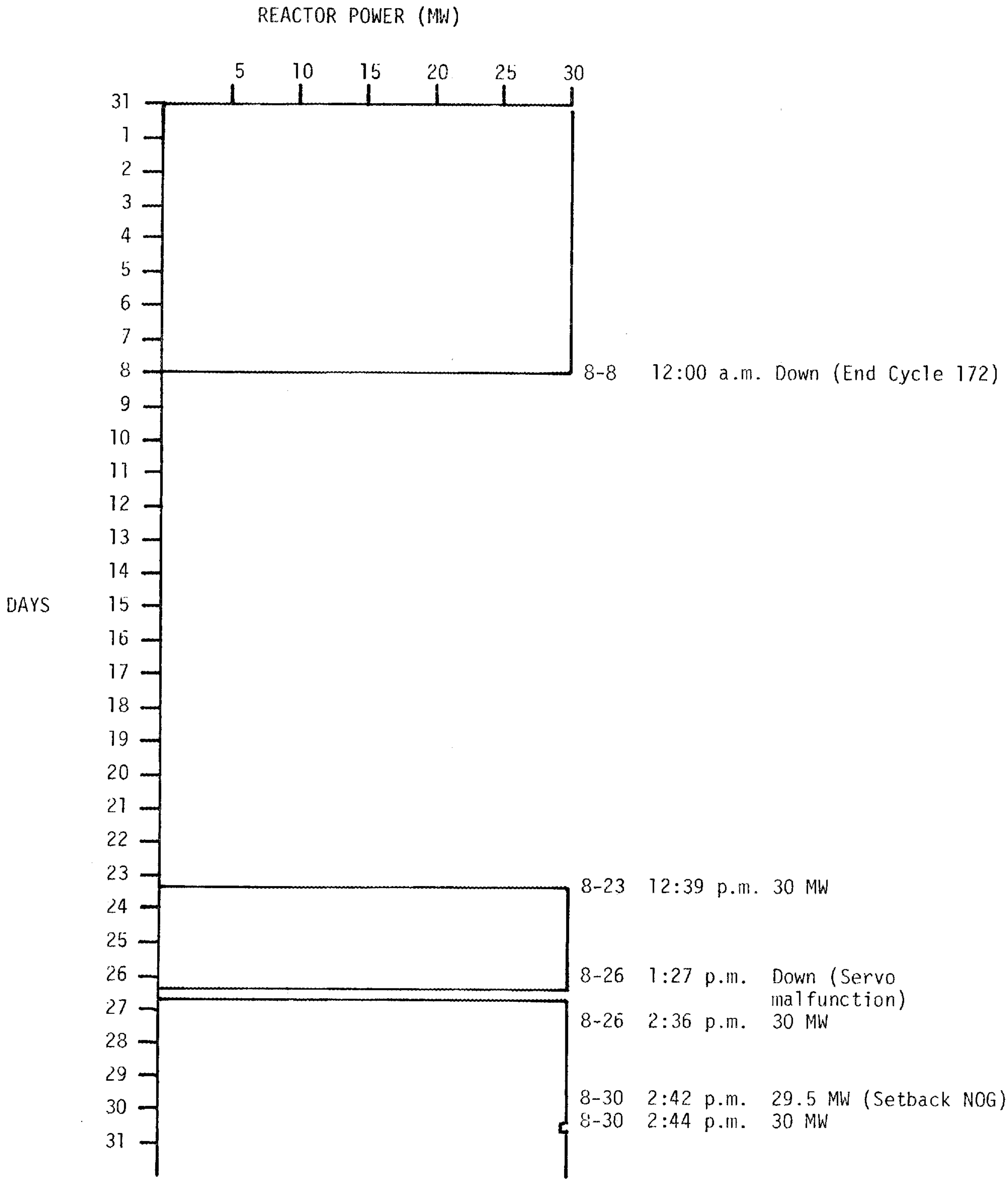

Fig. 2. Reactor power history - August 1985.

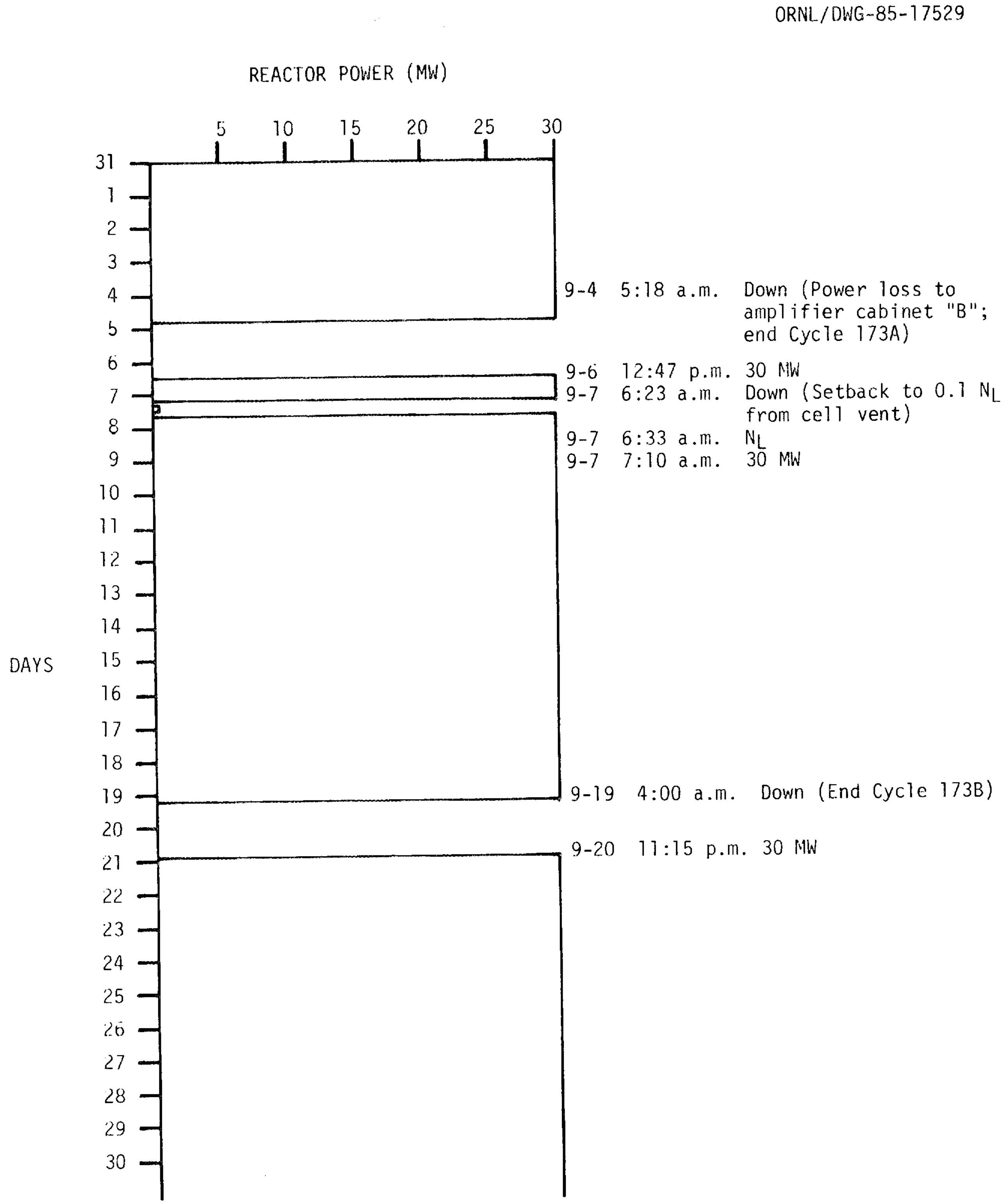

Fig. 3. Reactor power history - September 1985.

Table 1. Basic operating data
(July-September 1985)

	This quarter	Last quarter	Jan.-Sept. 1985	Jan.-Sept. 1984
Total energy, MWd	2125.6	2,355.6	6,410.9	6,813.2
Average power, MW	29.9	29.9	29.9	29.6
Time operating, %	76.1	86.7	78.6	83.9
Availability, %	80.8	91.6	82.2	91.6
Reactor water radio-activity, cpm/ml (av)	27,800	27,300	29,033	32,717
Pool water radioactivity, cpm/ml (av)	910	850	877	877
Reactor water resistivity, ohm-cm (av)	1,569,000	1,795,000	1,602,667	1,429,567
Pool water resistivity, ohm-cm (av)	1,065,000	1,038,000	1,082,667	1,202,767
Fuel elements depleted	32	21	67	64
Average burnup of fuel elements depleted, %	46.0	47.2	45.9	45.3
Shim-safety rods depleted	1	3	6	6
Average burnup of shim-safety rods depleted, %	81.4	71.7	77.1	82.8
Radioisotope samples	0	0	0	0
Research samples	12	7	19	25

Table 2. Cycles of operation

Cycle No.	Date begun	Date ended	Accumulated energy (MWd)
172	May 4, 1985	August 8, 1985	1,074.3[a]
173	August 23, 1985	In progress	1,051.3

[a]MWd this quarter

FUEL USAGE AND INVENTORY

Seventeen spent fuel elements were shipped for chemical separation. Thirty-two fuel elements and one shim-safety rod were declared spent during the quarter. Twenty-five fuel elements and two shim-safety rods were placed in service this quarter.

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

Table 3. Fuel status

	This quarter	Last quarter	Jan.-Sept. 1985	Jan.-Sept. 1984
Depleted fuel elements transferred for chemical recovery	17	27	44	88
Average percent burnup of fuel elements transferred	44.1	44.0	44.0	44.6
New elements start of quarter	132	149	--	--
New elements received	25	--	57	97
New elements placed in service	15	17	41	53
New elements end of quarter	142	132	--	--
Special or test elements	21	21	21	21
Depleted shim-safety rod elements transferred for chemical recovery	0	4	4	10
Average percent burnup of shim-safety rods transferred	--	82.2	82.2	82.8
New shim-safety rod elements start of quarter	13	15	--	--
New shim-safety rod elements received	1	0	1	12
New shim-safety rod elements placed in service	2	2	6	6
New shim-safety rod elements end of quarter	12	13	--	--

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 503 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. Analysis of shutdowns

Description of shutdown	Number	Downtime (h)
Scheduled		
Regular, end of cycle	1	369.117
Special, refueling and experiment	2	51.666
Special, refueling and maintenance	1	38.717
Subtotal:	4	459.500
Unscheduled		
Equipment failure, reactor	1	0.167
Instrument failure, reactor	2	42.766
Human error	1	0.400
Subtotal:	4	43.333
TOTAL:	8	502.833

Table 5. Scheduled shutdowns, details

Date	Duration (h)	End cycle	Remarks
7-11-85	31.233	172F	The reactor was refueled and leak repairs were made on the MFE-7J experiment
7-24-85	20.433	172G	The reactor was refueled and leak repairs were completed on the MFE-7J experiment
8-8-85	369.117	172	Shutdown activities included: (1) refueling, (2) the installation of the new servo system, (3) cleaning of the pool heat exchanger and the tubes of the reactor heat exchangers, (4) maintenance on the reactor secondary cooling tower structure, (5) the repair of the relief dampers on the cell ventilation system, and (6) the isolation of a leaking tube on No. 2 reactor heat exchanger
9-19-85	38.717	173	The reactor was refueled and the three recorders were rebuilt, as a result of burning. This was due to a loose wire connection from the power supply

Table 6. Unscheduled shutdowns, details

Date	Duration (h)	End cycle	Remarks
8-26-85	0.400	--	The reactor was manually scrammed when servo started raising power after an I&C engineer adjusted the controller deadband
9-4-85	42.433	173A	The sola transformer on the unclean power system failed, resulting in a loss of power to the sigma amplifiers and the magnet amplifiers. The reactor was refueled
9-7-85	0.167	--	Reactor power fell to 0.1 N_L after receiving a setback from the loss of cell ventilation
9-7-85	0.333	--	A fast scram was received due to a spurious signal from No. 2 log N period channel

Table 7. Reductions in power not resulting in shutdowns

Date	Source of signal	Type of signal	Lowest power (MW)	Comments
7-5-85	ORRDAC	Setback	9	A setback was received from ORRDAC on MFE-7J due to computer noise
7-23-85	HSST	Setback	15	A setback was received when the heaters were lost on the HSST experiment
8-30-85	Normal off gas	Setback	29.5	A setback was received due to a momentary drop in normal off gas vacuum

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the facility was satisfactory, and maintenance required is indicated in Table 8. One instrumentation and controls design change memorandum was completed this quarter as shown in Table 9.

PROCESS SYSTEM

The performance of the process system was satisfactory, and maintenance required is indicated in Table 10.

MECHANICAL COMPONENTS

The performance of the mechanical components was satisfactory.

Table 8. Maintenance and changes, instrumentation and controls

Date	Component	Trouble or change	Reason or maintenance
7-1-85	Pool tower basin	Upgrading	The sensing element from the pool tower basin was relocated to the pool secondary pump sump
7-11-85	No. 2 outlet temper-ture recorder	Recorder malfunc-tion	The balance motor on the No. 2 outlet temperature recorder was replaced
7-16-85	FRCAS	Spurious horn trouble lights	The pressure switches on the basement evacuation horn were set
7-26-85	FRCAS	Spurious horn trouble lights	The pressure switches on the basement evacuation horn were reset
8-8-85 thru 8-15-85	Servo control system	Upgrading	The new servo reactor automatic control system was installed
8-12-85	Pool cooling pump	Defective pressure switch	The defective "no pool cooling pump" annunciator pressure switch was replaced
8-27-85	No. 2 ΔT recorder channel	Recorder malfunction	The amplifier for the No. 2 ΔT recorder was replaced
8-30-85	PA system	Instrument upgrade	A solid-state amplifier was installed in the PA system
9-5-85	Servo control system	Noisy servo action	A tachometer feedback from the servo rod drive was installed

Table 8. (Continued)

Date	Component	Trouble or change	Reason or maintenance
9-5-85	Control room computer printout	Additional control room data	A connection was made between the setback and reverse annunciators for the control room computer printout
9-5-85	Magnet amplifier	Defective amplifier	Magnet amplifier 3A was replaced
9-6-85	Magnet amplifiers	Defective amplifiers	Magnet amplifier 6B was retubed and magnet amplifier 6A was replaced
9-6-85	Servo control system	Noisy servo	The tachometer amplifier on the servo rod drive was replaced
9-6-85	Servo control system	Noisy servo	The modular power converter (-5 to 15 volts) was replaced
9-12-85	No. 3 safety recorder channel	Defective recorder	The recorder amplifier was replaced and returned to the sigma bus
9-19-85	No. 2 log N channel	Erratic	The No. 2 log N amplifier was replaced
9-19-85	No. 1 count rate, No. 1 count rate period, No. 1 log N, and No. 1 log N period channels	Electrical short	Each of these recorders was replaced, and calibrated, and switches checked satisfactory
9-23-85	Pool water activity channel	Erratic	The recorder amplifier was replaced

Table 9. Instrumentation and controls design change memorandums

Change memo number	Title of change	Reason for change	General description of change
ORR-132	ORR servo replacement	To upgrade the servo system instrumentation	A new flux controller (servo) consisting of a programmable controller (PC), a flux signal conditioner with range-select capability for three ranges of two decades each, and new solid-state auxiliary equipment was installed this quarter. This equipment replaces a Dolecam amplifier, servo amplifier, and obsolete vacuum-tube equipment The PC generates a demand set point under operator control (except during an automatically generated setback), manipulates the regulating rod based on the error between the flux signal and demand set point, calculates heat power for display, and calibrates the flux signal automatically to maintain heat power at the level selected by the demand set point. The servo limit switches, the rod drive ON-OFF relays, and the rod drive motor were not modified in the change Demand setback logic is modified from the present design to permit operation in the two lower power ranges, 3 kW and 300 kW, without primary cooling flow. The temperature difference is measured by two resistive-temperature devices (RTDs). Flow

Table 9. (Continued)

Change memo number	Title of change	Reason for change	General description of change
ORR-132 (cont'd)			and temperature calculations are averaged and are used to calculate heat power. Flux calibration is handled by controlling heat power on a long time constant but controlling flux on a short time constant A new servo Nim Bin is installed with (1) flux signal conditioner, (2) range-select equipment, (3) a compensated ionization chamber high-voltage supply, (4) a tachometer amplifier, and (5) amplifier power supplies The flux signal conditioner consists of a Keithley amplifier which converts the chamber current to a voltage and an amplifier which converts the voltage signal to a 4 to 20 mA current signal that is applied to the input of the PC. The gain to the Keithley amplifier is adjusted by the range-select switch A special feature, demand oscillation, is added. This mode of operation oscillates demand in a $\pm 4\%$ range for one-second intervals and will be used for testing

Table 9. (Continued)

Change memo number	Title of change	Reason for change	General description of change
ORR-132 (cont'd)			The control panel and servo Nim Bin contain essential operator controls and displays. The panel contains the demand control switch, 3 three-digit panel meter displays of demand (%), flux (%), and heat power (MW), lamps indicating withdraw and insert requests, and lamps indicating demand upper limit and lower limit. The servo Nim Bin contains an analog panel meter of the chamber current signal (%), lamps indicating upper and lower limits of the flux calibration gain constant, and power range-select switch

Table 10. Process systems, maintenance and changes

Date	Component	Remarks
		Reactor primary cooling system
8-15-85	No. 2 reactor heat exchanger	A leaking tube was plugged
		Reactor secondary cooling system
8-21-85	Reactor secondary cooling tower	Maintenance on the tower structure was completed
		Normal off gas system
8-20-85	Steam blower	The steam supply valve to the turbine was replaced
		Pool primary cooling system
9-5-85	Pool cooling pump	The bearings were replaced
		Miscellaneous
8-30-85	Basement process sump	The spring water was re-routed to the storm drain system

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 and 5.

IN-SERVICE INSPECTION

INTERNAL AND EXTERNAL INSPECTION OF ORR POOL HEAT EXCHANGER

On August 12, 1985, a visual inspection of the subject vessel was performed. The internal and external surfaces of the shell and heads showed little evidence of corrosion or pitting.

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, showed no significant change. The heat exchanger was acceptable for further service.

QUALITY DEPARTMENT INSPECTION OF PRIMARY HEAT EXCHANGERS NOS. 1, 2, 3, AND 4

On August 16, 1985, the reactor primary heat exchangers Nos. 1, 2, 3, and 4 were inspected. The internal inspection of the four heat exchangers revealed some corrosion and pitting on the heads and baffles of each of the heat exchangers plus a leak on the No. 2 heat exchanger tubing. The tube was plugged and no other leaks were found. The vessels are considered satisfactory for continued use.

Table 11. 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	6-28-83		Aluminum-base, dispersion-type fuel plates (HFED)	Engineering Technology
Poolside[a] facility	None	5-30-85	9-5-85	Material test (HSST-5, Nos. 9 and 10)	Engineering Technology
Poolside[a] facility	None	9-5-85		Material test (HSST-5, Nos. 11 and 12)	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	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. The Heavy Section Steel Technology (HSST) Program uses the facility for irradiations.

[b]The facility is on standby.

Table 12. 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	9-26-85	DOP	99.994
Charcoal	Both banks	North, 11-9-83 South, 8-14-85	8-15-85	Elemental iodine	99.940
		Basement hood exhaust			
CWS	South	3-11-80	9-26-85	DOP	99.997
CWS	North	3-11-80	9-26-85	DOP	99.998
		Normal off-gas			
CWS	West[b]	8-14-85	9-26-85	DOP	99.996
Charcoal	West[b]	8-14-85	9-26-85	Elemental iodine	99.995
CWS	East	5-1-85	9-26-85	DOP	99.995
Charcoal	East	5-1-85	6-20-85	Elemental iodine	99.976
		Pressurizable off-gas[c]			

[a]The CWS filters in the cell-ventilation system were checked in series.
[b]Not in service.
[c]The POG system is on standby; therefore, all filter tests have been discontinued.

ORNL/DWG-85-17436

Lattice loading

For fuel cycles 172-F, G, H, and 173-A, B

	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	MFE 7J	F	F	F	MFE 6J	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	HFED	F	Ir	F	Ir	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-safety rod (SR)	6
Beryllium (Be)	25
Experiment (E)	3
Iridium (Ir)	2

Fig. 4. Lattice configuration - June 28-September 19, 1985.

ORNL/DWG-85-17437

Lattice loading

For fuel cycles 173-C

	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	133 Xe Be	Be
C	Be	F	MFE 7J	F	F	F	MFE 6J	F	Be
D	Be	F	F	SR	F	SR	F	F	Be
E	Be	F	HFED	F	Ir	F	Ir	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-safety rod (SR)	6
Beryllium (Be)	24
Experiment (E)	3
Xenon production sleeve (^{133}Xe)	1
Iridium (Ir)	2

Fig. 5. Lattice configuration - September 20-30, 1985.

SUMMARY OF SURVEILLANCE TESTS

Table 13 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 log book, and miscellaneous quality assurance tests.

Table 13. Summary of surveillance tests

Test	Most recent	Previous
Biennially		
Primary cooling flow channel calibration		
Direct flow channel	8-8-85	8-15-84
Core ΔP channel	8-14-85	8-15-84
^{16}N channel calibration	8-19-85	5-3-85
North-facility flow channel calibration	4-25-84	7-27-83
South-facility flow channel calibration	4-25-84	7-27-83
Normal off-gas vacuum monitor calibration	8-12-85	7-26-84
Pressurizable off-gas vacuum monitor calibration	Out of service	
Building ventilation flow monitor calibration	10-25-84	7-27-84
The dc pony motor battery bank		
Load-test No. 1 bank	8-8-85	7-22-84
Load-test No. 2 bank	5-1-85	4-22-84
Load-test No. 3 bank	1-20-85	2-4-84
Annually		
Safety-level channels calibration	8-19-85	5-3-85
Log-N channels calibration	8-19-85	5-2-85
ΔT channels calibration	8-21-85	7-26-84
Reactor water exit temperature channels calibration	8-21-85	7-26-84
Fission chamber channels calibration	8-21-85	5-2-85
Speed measurements of the shim-safety rod drive motors	8-21-85	5-3-85

Table 13. (Continued)

Test	Most recent	Previous
Annually (continued)		
Calibration of shim-safety rods	2-4-85	2-4-84
Reactivity assigned to the servo-control system	2-4-85	2-4-84
Semiannually		
Pressure drop measurements across NOG filters	9-29-85	6-30-85
Pressure drop measurements across POG filters	Out of service	
NOG filter system efficiency		
Elemental iodine test - east bank	6-20-85	11-29-84
Elemental iodine test - west bank	6-18-85	11-15-84
Dioctyl phthalate test - east bank	6-20-85	3-13-85
Dioctyl phthalate test - west bank	9-25-85	3-13-85
POG filter system efficiency	Out of service	
Containment closure system function test	8-15-85	5-2-85
Cell-ventilation filter system efficiency		
Elemental iodine measurements	8-15-85	11-27-84
Dioctyl phthalate measurements	9-26-85	3-13-85
Radiation monitoring equipment calibration	9-12-85	4-1-85
Stack radiation monitor calibration	6-28-85	12-18-84
Quarterly		
Primary coolant flow channels tested	8-21-85	5-30-85
^{16}N channels tested	8-19-85	5-3-85
North-facility flow channels tested	8-21-85	5-30-85

Table 13. (Continued)

Test	Most recent	Previous
Quarterly (continued)		
South-facility flow channels tested	8-21-85	5-30-85
Normal off-gas vacuum monitor tested	8-21-85	5-30-85
Pressurizable off-gas vacuum monitor tested	Out of service	
Building ventilation flow monitor tested	8-21-85	5-30-85
Manual scrams tested	8-21-85	5-30-85
Measurement of release time and time of flight for the shim-safety rods	8-21-85	5-3-85
Subcriticality with each shim-safety rod at its upper limit while all other shim-safety rods are fully inserted	8-21-85	5-3-85

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