**Oak Ridge Research Reactor Quarterly
Report April, May, and
June of 1976**

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MASTER

OAK RIDGE NATIONAL LABORATORY

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OPERATIONS DIVISION

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

APRIL, MAY, AND JUNE OF 1976

S. S. Hurt, III
E. D. Lance

Date Published: November 1976

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SUMMARY

The ORR operated at an average power level of 29.7 MW for 90% of the time during April, May, and June of 1976. Twenty-five fuel elements were declared spent (52.3% average burnup) during the quarter, while twenty-five new elements were placed in service. Two shim-rod elements were retired from service at an average burnup of 62.5%.

The reactor was shut down on thirteen occasions, four of which were unscheduled. One end-of-cycle shutdown accounted for 61.1% of the total downtime. The remaining downtime was used principally for refueling and experiment work.

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

A special test completed during the quarter was the visual inspection of the poolside facility.

OPERATIONS

The basic operating data presented in Table 1 indicates that the ORR operation for the quarter was normal as compared with recent experience.

Details relative to cycles of operation during the quarter are given in Table 2, while Figures 1 and 2 are plots of shim-rod position versus time for these cycles.

Table 1. ORR Basic Operating Data
April, May, and June of 1976

	This Quarter	Last Quarter	Year To Date	January through June, 1975
Total energy, MWd	2,434.8	2,254.5	4,689.2	4,555.1
Average power, MW/operating hr	29.7	29.9	29.8	29.8
Time operating, %	90.0	82.8	86.4	85.2
Availability, %	95.5	90.6	93.1	89.5
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	29,400	28,200	28,800	30,000
Pool water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	580	610	595	670
Reactor water resis- tivity, ohm-cm (av)	844,000	822,000	833,000	850,000
Pool water resis- tivity, ohm-cm (av)	700,000	799,000	749,500	785,000
Fuel elements depleted	9	2	11	45
Average burnup of fuel elements depleted, %	55.3	58.8	56.0	52.9
Shim rods depleted	2	4	6	8
Average burnup of shim rods depleted, %	62.5	64.4	63.5	64.6
Radioisotope samples	2	0	2	19
Research samples	5	1	6	23

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (MWd)
131	April 1, 1976	May 22, 1976	1,423.7
132	May 27, 1976	In progress	1,011.1

Figure 1. Shim Rod Position vs Time (Cycle 131)

Figure 2. Shim Rod Position vs Time (Cycle 132)

FUEL USAGE AND INVENTORY

Twenty-five new fuel elements were placed in service during the quarter and twenty-five were declared spent with an average burnup of 52.3%. Other details of fuel usage and inventory may be found in Tables 1 and 3.

Table 3. ORR Fuel Status

	This Quarter	Last Quarter	Jan.-June 1976	Jan-June 1975
Depleted fuel elements transferred for chemical separation	0	45	45	93
Average percent burnup of fuel elements transferred	--	52.0	52.0	48.7
New fuel elements placed in service	25	28	53	33
New fuel elements available for use	68*	93		
Depleted shim rods transferred for chemical separation	0	6	6	12
Average percent burnup of shim rods transferred	--	65.0	65.0	65.0
New shim rods placed in service	2	4	6	8
New shim rods available for use	0	0		

*Includes 4 partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 218 hours. A summary of the shutdowns is given in Table 4, and details of each are contained in Table 5. Table 6 offers information relative to the unscheduled shutdowns.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hrs)
Scheduled		
Regular, end of Cycle No. 130 continued from the previous quarter	--	7.300
Regular end of Cycle No. 131	1	125.767
Regular, refueling, iodine removal, and research work	4	53.783
Regular, refueling	3	12.684
Special, rewiring of OC-1 experiment	<u>1</u>	<u>17.334</u>
Subtotal	9	216.868
Unscheduled		
Equipment failure, experiment	3	0.917
Equipment failure, reactor	<u>1</u>	<u>0.050</u>
Subtotal	<u>4</u>	<u>0.967</u>
Total	13	217.835

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
4-1-76	7.300	130C	The end-of-cycle shutdown work as listed in the previous ORR quarterly report was completed.
4-6-76	5.250	131A	The reactor was refueled.
4-9-76	6.383	131B	The reactor was refueled and isotope (iodine-xenon) work was completed. Experiment work consisted of inspection of wiring to heaters on the OC-1 experiment.
4-9-76	17.334		The reactor was shut down to permit rewiring of the in-pool electrical connections for the heaters on the OC-1 experiment.
4-21-76	29.000	131C	The reactor was refueled and isotope (iodine-xenon) work was completed. Experiment work consisted of the removal of one experiment and installation of two for the Metals and Ceramics Division. One experiment was installed for the Reactor Division.
5-4-76	3.800	131D	The reactor was refueled.
5-13-76	7.500	131E	The reactor was refueled and isotope (iodine-xenon) work was completed. Experiment work consisted of the installation of a nose cone experiment for General Electric.
5-22-76	125.767	131F	The shutdown marked the end of cycle 131. The first 8.500 hours were for Family Day-Open House. Shutdown activities included: (1) programmed maintenance on the centravac; (2) replacement of tubes in the radiator on the diesel unit; (3) replacement of worn insulation on outside water and steam lines; (4) installation of the pipe supports and grating at the primary water pump house; (5) inspection of the front face of the reactor tank; (6) removal of the OC-1 experiment from CP-E5; and (7) replacement of a broken operator on the reactor primary bypass valve.

Table 5 (continued)

Date	Duration (hr)	End Cycle	Remarks
5-8-76	3.634	132A	The reactor was refueled and isotope (iodine-xenon) work was completed.
6-21-76	10.900	132B	The reactor was refueled and isotope (iodine-xenon) work was completed. Experiment work consisted of removal of experiments B-8 and P-5 for the Metals and Ceramics Division, and the Te-Gen experiment for the Reactor Division.

Table 6. ORR Unscheduled Shutdowns, Details

Date	Duration (hr)	Remarks
4-8-76	0.250	The reactor was shut down when a thermocouple switch on the OC-1 experiment failed causing an instrument power failure.
5-14-76	0.117	A thermocouple failed on the OC-1 experiment.
6-12-76	0.550	The safety power breaker on experiment GB-10 tripped causing the reactor to shut down.
6-30-76	0.050	During a filter change at the stack area on the NOG system, the pressure on the NOG increased to a negative 19 in. H ₂ O resulting in a setback and a momentary power sag below N _L .

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the complex was quite satisfactory and only routine maintenance was required as indicated in Table 7. Table 8 reflects the status of the various fission and ionization chambers.

PROCESS SYSTEM AND MECHANICAL COMPONENTS

Details of maintenance or changes to the process system are given in Table 9. Table 10 summarizes the results of efficiency tests of the various gaseous waste filters. There were no repairs or changes related to the reactor mechanical components (drives, bearings, etc.).

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility usage is given in Table 11. The core configuration used during the quarter is shown in Figures 3, 4, and 5.

SPECIAL TESTS

Visual Inspection of Poolside Facility

On May 24, 1976, a visual examination of the outside of the poolside irradiation facility was made.

The north half of the poolside "window" and the lower quarter of the south half were examined through the use of the underwater omniscope (four power magnification). Superficial scratches, apparently the result of experiment installations, were observed as has been the case in previous examinations. No increase in corrosion, pitting, or any other damage was found.

Table 7. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble or Change	Reason or Maintenance
4-1-76	Chamber drive motor	No. 1 Counting-Rate Channel	
		Units replaced	The motor was replaced to correct an erratic readout.
		No. 2 Counting-Rate Channel	
			No maintenance or changes were required.
4-21-76	No. 1 safety recorder slide-wire	No. 1 Log-N Channel	
			No maintenance or changes were required.
		No. 2 Log-N Channel	
			No maintenance or changes were required.
		No. 1 Safety Channel	
		Unit replaced	The recorder slide-wire was replaced to correct an erratic readout.
		No. 2 Safety Channel	
			No maintenance or changes were required.
		No. 3 Safety Channel	
			No maintenance or changes were required.
		Magnet Amplifiers	
			No maintenance or changes were required.

Table 7 (continued)

Date	Component	Trouble or Change	Reason or Maintenance
No. 1 Gamma Channel			
			No maintenance or changes were required.
No. 2 Gamma Channel			
4-5-76	Gamma recorder	Reference power supply failed	Unit replaced.
North N ¹⁶ Channel			
5-7-75	North N ¹⁶ recorder	Erratic readout	The reference power supply was replaced.
South N ¹⁶ Channel			
			No maintenance or changes were required.
Servo Channel			
			No maintenance or changes were required.
Micromicroammeter Channel			
			No maintenance or changes were required.
Process Instrumentation			
4-5-76	No. 2 ΔT recorder amplifier	Erratic readout	The amplifier was replaced and the contacts cleaned.
4-7-76	No. 2 ΔT recorder chart drive motor	Failed to turn	The chart drive motor was replaced.

Table 7 (continued)

Date	Component	Trouble or Change	Reason or Maintenance
5-12-76	No. 2 ΔT recorder	Incorrect readout	The recorder slide-wire was replaced.
4-29-76	No. 2 outlet temperature recorder	Erratic readout	The amplifier was replaced and the slide-wire was cleaned.
6-1-76	No. 2 outlet temperature recorder	Erratic readout	The amplifier was replaced.
6-16-76	No. 2 outlet temperature recorder	Erratic readout	The amplifier and the balance motor were replaced.
6-16-76	Normal off-gas (NOG) filter pits temperature recorder	Erratic readout	The battery was replaced.
6-1-76	Pool water activity recorder	Erratic readout	The amplifier was replaced.

Table 8. Present Status of Ionization Chambers and Fission Chambers

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
Installed Chambers					
PCP-III- 106-66-9	Position 7	No. 1 safety and No. 2 log N	September, 1966 (safety)	None	No trouble; fabricated at ORNL. Compensated section used from February, 1969, until March, 1970, as No. 1 log N. Used as No. 2 log N from May 28, 1973.
CTC-2 (C-768)	Position 3	No. 3 safety	December 12, 1975	LITR-BSR	Served as LITR safety chamber from February, 1963, to July, 1965. Modified for underwater service in 1969. Installed in the BSR in April, 1970, and in August the chamber was removed to storage.
PCP-III- 106A, SN-72-3	Position 2	No. 2 safety and No. 1 log N	May 15, 1976	None	None.
PCP-II- 106-66-3	Position 4	Inactive	May, 1974 (safety) March, 1970 (log N) removed from service December 12, 1975	None	Fabricated by ORNL. Chamber failed December 12, 1975.
PCP-II- 106-63-4	Position 5	Servo and micromicro- ammeter	June, 1964	None	No trouble; fabricated by ORNL.

Table 8 (continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
TSM-2-F45	Poolside	No. 1 counting rate north	March 29, 1976	ORR	Used as No. 1 counting rate from April 26, 1971 until December 5, 1972. December 5, 1973 until August 8, 1975.
CTC-5 (C-770)	Position 8	Chamber dis- connected	October, 1971	LITR	Used as No. 1 safety at the LITR; modified for ORR-BSR underwater ser- vice.
PCP-II- 105-63-2	Poolside, south	No. 1 gamma south	April 26, 1972	ORR	Used as No. 2 gamma, north, from April, 1964, until March, 1970.
TSM-3-F29	Poolside	No. 2 count- ing rate	October 24, 1972	None	Replaced fission chamber "snake" assembly TSM-1 F52.
Spare Chambers					
PCP-II-105- 63-1	Instrumen- tation & controls shop	Awaiting repair	April 26, 1972	ORR	Used as No. 1 gamma, south, from March 31, 1970 until April 26, 1972.
S27-34R-F29	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 1 counting rate from July 28, 1970 to April 26, 1971.

Table 8 (continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
S3-8R-F22	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 2 counting rate from January 14, 1970 to April 26, 1971.
CTC-1	Instrumen- tation & controls shop	Awaiting repair	October, 1971	ORR	Used as noise monitor from March, 1962 until October 1, 1971.
CTC-4 (C-769)	ORR plug storage			LITR	Used as No. 2 safety in the LITR; modified for ORR- BSR underwater service.
PCP-III- 106-66-5	Instrumen- tation & controls shop	Awaiting repair		ORR	Used as No. 2 safety and log N from September 27, 1968 to July 22, 1970 and from May 7, 1971 to May 20, 1971; from November, 1971 to January 24, 1973 as No. 2 safety and until May 28, 1973 as No. 2 log N.
TSM-2-F45	Poolside I&C shop	Awaiting repair	August 8, 1975	ORR	Used as No. 1 counting rate from April 26, 1971 until December 5, 1972. Removed March 30, 1976 to shop for repair.

Table 9. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Water System		
4-9-76	Degasifier system	A ruptured diaphragm was replaced in the No. 2 valve.
4-26-76	Degasifier demineralizer	A faulty diaphragm and gasket were replaced in valve No. D-8.
5-25-76	Bypass filters	The filter cartridges were changed.
5-25-76	Reactor primary bypass valve	A broken operator was replaced.
5-26-76	Reactor primary water line modifications at the pump house (Bldg. 3085)	The floor grating and water line supports were installed in the new excavated areas around and under the primary water lines.
Reactor Secondary Cooling System		
4-1-76	Fan controller (north fan)	A broken wire to the fan was repaired.
6-25-76 through 6-28-76	Acid addition system	A leak in the acid line was repaired.
Pool Primary Cooling System		
5-26-76	Demineralizer system	The strainers were checked and cleaned as needed.
Emergency Cooling System		
4-13-76	Emergency (1000 gpm) gasoline engine	The annual checks were performed. The oil was changed, new spark plugs were installed, and the motor was tuned.
5-26-76	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms confirmed that the systems were in satisfactory condition.

Table 9 (continued)

Date	Component	Remarks
Electrical Systems		
5-24-76	Miscellaneous breaker panels for electric motors, dc batteries, battery racks, overhead crane, and control room instrument cabinets	Routine end-of-cycle inspection and cleaning were performed. Dust filters for the control room instrument cabinets were changed as needed.
Emergency Electrical System		
5-24-76	Diesel generator	Two sections of faulty radiator tubes were replaced.
5-26-76	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
Normal Off-Gas System		
4-13-76	East bank	New filters were installed.
Miscellaneous		
4-23-76	Main steam line entering ORR (Bldg. 3042)	A meter was installed in the steam line on the north side of the building over the laboratory in the ORR basement.
4-28-76	Steam supply	A leak on the main supply line over the laboratory in the ORR basement was repaired.
4-28-76	Heating and ventilation unit No. 3	A steam leak to the unit was repaired.
5-3-76	Steam supply	A faulty valve on the main supply line located over the laboratory in the ORR basement was replaced. The steam line was then insulated.
5-6-76		
5-7-76	Caustic supply line in the ORR basement	A ruptured diaphragm in valve No. 23 was replaced.

Table 9 (continued)

Date	Component	Remarks
5-18-76	Fuel reloading tool	A new foot piece was installed on one fuel reloading tool. The one removed was inoperative.
5-18-76 5-21-76	Air conditioning	An air-conditioning unit was installed in Room No. 300 because computers located in this room require a backup system.
5-25-76	Air-conditioner cooling towers	Several faulty louvers were replaced.
5-25-76	New pump, south of Eldg. 3085	A receptacle and light were installed.
6-22-76 6-28-76	Sump pump No. 3	A faulty switch was replaced. A sticking float switch was repaired.

Table 10. Status of Filters - Gaseous Waste System

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
Cell Ventilation System					
CWS	Overall*	North, 6-20-73 South, 1-12-65	3-24-76 3-24-76	DOP	99.993
Charcoal	Both banks	North, 9-16-74 South, 10-17-67	3-2-76	Elemental Iodine	99.97
Charcoal	Both banks	North, 9-16-74 South, 10-17-67	3-4-76	Methyl Iodine	34.22
Pressurizable Off-Gas					
CWS	North	5-5-76	3-24-76	DOP	99.965
CWS	South	10-18-67	3-24-76	DOP	99.992
Charcoal	North	2-26-73	10-7-75	Elemental Iodine	87.97
Charcoal	South	8-11-75	10-8-75	Elemental Iodine	97.48
Charcoal	North	2-26-73	1-28-76	Methyl Iodide	99.94
Charcoal	South	8-11-75	8-13-75	Methyl Iodide	99.993

*The CWS filters in the cell ventilation system were checked in series.

Table 10 (continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
Basement Hood Exhaust					
CWS	South	2-16-72	3-15-76	DOP	99.996
CWS	North	2-16-72	3-15-76	DOP	99.995
Normal Off-Gas					
CWS	West	2-12-76	3-24-76	DOP	99.996
CWS	East	6-12-75	3-24-76	DOP	99.998
Charcoal	West	2-12-76	2-17-76	Elemental Iodine	99.99
Charcoal	East	7-29-75	4-13-76	Elemental Iodine	99.99
Charcoal	West	2-12-76	4-20-76	Methyl Iodide	99.93
Charcoal	East	7-29-75	4-20-76	Methyl Iodide	94.14

Table 11. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
A-3	None	8-15-75	6-21-76	Radioisotopes (iodine and xenon)	Isotopes
B-8	V-1	1-27-76	4-21-76	Four internally pressurized Zr capsules	Metals and Ceramics
B-8	V-1	4-21-76	6-21-76	Four internally pressurized Zr capsules	Metals and Ceramics
B-8	None	6-21-76		Radioisotopes (iodine and xenon)	Operations
C-3	None	3-21-76	4-21-76	Silicon sample	Solid State
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production and short-term irradiations	Operations
E-3	V-9	5-6-75		P-13T capsule experiment	Reactor
E-5	V-6	3-29-76	5-21-76	OC-1 capsule experiment	Reactor
E-7	V-5	6-20-75		OF-2 capsule experiment	Reactor
P-4A	None	4-21-76	6-21-76	TeGen IV capsule experiment	Reactor
P-5	None	4-21-76	6-21-76	Tensile specimens	Metals and Ceramics
P-7-P8	None	5-13-76	5-18-76	Nose cone experiment	General Electric
GCR-P7-A	None	8-8-72		GB-10 capsule experiment	Reactor

Table 11 (continued)

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
HB-2	None	7-58		Neutron diffraction experiment	Solid State-Physics
B-3	None	11-59		Neutron diffraction experiment	Solid State-Physics
HB-4	None	7-58		Neutron diffraction experiment	Chemistry
HB-6	None				Solid State
HN-3	None	11-59		Activation analysis	Analytical Chemistry
HN-4	None	12-15-63		Void determination in irradiated materials	Solid State-Physics
HN-4	None	12-15-63		"Fly's Eye" two-dimensional neutron diffraction and radiography	Instrumentation and Controls

ORR LATTICE LOADING

For Fuel Cycles 131-A, B

	1	2	3	4	5	6	7	8	9
A	Be	Be	I ¹³¹	F	F	F	F	F	Be
B	Be	Be	F	SR	F	SR	F	E	Be
C	Be	F	E	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	F	E	F	E	F	Be
F	Be	F	F	SR	F	SR	F	F	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENTNUMBER

Fuel

27

Shim Rod (SR)

6

Beryllium (Be)

23

Experiment (E)

5Iodine Sleeve (¹³¹I)1

Isotope Stringer (Iso)

0

Hydraulic Tube (HT)

1Figure 3. ORR Lattice Configuration - April 1, 1976
through April 21, 1976

ORR LATTICE LOADING

For Fuel Cycles 131-C, D, E, F

	1	2	3	4	5	6	7	8	9
A	Be	Be	I ¹³¹	F	F	F	F	F	Be
B	Be	Be	F	SR	F	SR	F	E	Be
C	Be	Be	F	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	F	E	F	E	F	Be
F	Be	F	F	SR	F	SR	F	F	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENT

NUMBER

Fuel

27

Shim Rod (SR)

6

Beryllium (Be)

24

Experiment (E)

4

Iodine Sleeve (¹³¹I)

1

Isotope Stringer (Iso)

0

Hydraulic Tube (HT)

1

Figure 4. ORR Lattice Configuration - April 21, 1976 through May 22, 1976

ORR LATTICE LOADING

For Fuel Cycles 132-A, B

	1	2	3	4	5	6	7	8	9
A	Be	Be	¹³¹ I	F	F	F	F	F	Be
B	Be	Be	F	SR	F	SR	F	E	Be
C	Be	Be	F	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	F	F	F	E	F	Be
F	Be	F	F	SR	F	SR	F	F	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENTNUMBER

Fuel	<u>28</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>24</u>
Experiment (E)	<u>3</u>
Iodine Sleeve (¹³¹ I)	<u>1</u>
Isotope Stringer (Iso)	<u>0</u>
Hydraulic Tube (HT)	<u>1</u>

Figure 5. ORR Lattice Configuration - May 27, 1976
through June 21, 1976

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