**Oak Ridge Research Reactor Quarterly Report
July, August, and September of 1976**

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MASTER

OAK RIDGE NATIONAL LABORATORY

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

JULY, AUGUST, AND SEPTEMBER OF 1976

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SUMMARY

The ORR operated at an average power level of 29.8 Mw for 50.9% of the time during July, August, and September of 1976. One fuel element was declared spent (62.4% burnup) during the quarter, while five new elements were placed in service. Two shim-rod elements were retired from service at an average burnup of 69.0%.

The reactor was shut down on twelve occasions, all of which were scheduled. Reactor downtime needed for refueling, maintenance and checks was quite low, with the reactor remaining available for operation 95.5% of the time.

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

In-service inspections completed during the quarter included:

1. Inspection of the decay tank strainer on 9-21-76.
2. Inspection of the reactor primary heat exchanger No. 3, secondary side, on 9-24-76.

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, 2, and 3 are plots of shim-rod position versus time for these cycles.

Table 1. ORR Basic Operating Data
Period: July, August and September, 1976

	This Quarter	Last Quarter	Year To Date	January Through September, 1975
Total energy, Mwd	1,394.7	2,434.8	6,083.9	6,949.1
Average power, Mw/operating hr.	29.8	29.7	29.8	29.8
Time operating, %	50.9*	90.0	74.6	85.9
Availability, %	95.5	95.5	93.9	89.6
Reactor water radio- activity $\frac{d}{ml}$ (av)	28,300	29,400	28,600	30,400
Pool water radio- activity $\frac{c}{ml}$ (av)	590	580	593	650
Reactor water resis- tivity, ohm-cm (av)	1,234,000	844,000	967,000	854,000
Pool water resis- tivity, ohm-cm (av)	784,000	700,000	761,000	791,000
Fuel elements depleted	1	9	12	73
Average burnup of fuel elements depleted, %	62.4	55.3	56.5	52.3
Shim rods depleted	2	2	8	10
Average burnup of shim rods depleted, %	69.0	62.5	65.1	64.8
Radioisotope samples	2	2	4	25
Research samples	0	5	6	41

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (Mwd)
132	May 27, 1976	August 2, 1976	**1891.9
133	August 10, 1976	September 12, 1976	406.8
134	September 27, 1976	In progress	107.1

* Time operating (%) low due to reduced request for operation.

** MWD this quarter - 880.8

Fig. 1. Shim Rod Position vs. Time (Cycle 132)

Fig. 2. Shim Rod Position vs. Time (Cycle 133)

Fig. 3. Shim Rod Position vs. Time (Cycle 134)

FUEL USAGE AND INVENTORY

Due to curtailed operation only five new fuel elements and two new shim rods were placed in service during the quarter.

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-Sept 1976	Jan-Sept 1975
Depleted fuel elements transferred for chemical separation	13	0	58	121
Average percent burnup of fuel element transferred	53.8	-	52.3	48.9
New fuel elements placed in service	5	25	58	75
New fuel elements available for use	*63	68		
Depleted shim rods transferred for chemical separation	4	0	10	18
Average percent burnup of shim rods transferred	63.0	-	64.1	64.5
New shim rods placed in service	2	2	8	10
New shim rods available for use	2	0		

* Includes 4 partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 1,085 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 power reductions which did not result in a shutdown.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hr)
Scheduled		
Special, an effort to check holdown arm bearing	1	0.317
Regular, end of cycle	2	221.867
Regular, refueling, iodine removal and experimental work	1	15.650
Regular, refueling	1	3.917
Regular, refueling and iodine removal	1	3.950
Regular, refueling and experimental work	2	41.884
Regular, experimental work	3	439.450
Regular, iodine removal and maintenance	<u>1</u>	<u>357.933</u>
Subtotal	12	1,084.968
Unscheduled		
	<u>0</u>	<u>0</u>
Subtotal	<u>0</u>	<u>0</u>
Total	12	1,084.968

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
7-6-76	15.650	132C	The reactor was refueled and isotope (iodine, xenon) work was completed. Experiment work consisted of removing an experiment from core position E-3.
7-6-76	0.317	-	The reactor was scrammed in an effort to check the possibility of a stuck bearing in the south hold down arm.
7-7-76	3.917	132D	The reactor was refueled. The south hold down arm was replaced.
7-19-76	3.950	132E	The reactor was refueled and isotope (iodine, xenon) work was completed.
7-21-76	33.767	132F	The reactor was refueled. Experiment work consisted of the installation of the radiography facility in the reactor pool and removal of experiment GB-10 from the poolside facility for neutron radiography.
7-29-76	8.117	132G	The reactor was refueled. Experiment work consisted of the reinstallation of the GB-10 experiment in the poolside facility.
8-2-76	198.850	132E	This shutdown marked the end of operating cycle 132. Shutdown activities included (1) the repairing of piping insulation on the reactor heat exchangers, (2) the installation of transformer No. 2 at electrical station 3-3 while area power was being supplied by the diesel generator, (3) the installation of a new governor and change of oil on the diesel generator, (4) the installation of a new electrical outlet for the No. 3 sump pump, (5) the removal of experiments GB-10 and OF-2 from the reactor experimental facilities, (6) the preparation of experiment OC-1 for the radiography facility, and (7) core configuration change.
8-16-76	23.017	133A	The shutdown activities included (1) refueling, (2) iodine-xenon work, and (3) programmed maintenance.

Table 5 (continued)

Date	Duration (hr)	End Cycle	Remarks
8-17-76	207.783	-	The reactor was shut down after unsuccessful attempts to obtain radiographs of experiment OC-1 in the neutron radiography facility.
8-26-76	18.050	-	The reactor was shut down after two radiographs were made of the OC-1 experiment in the neutron radiography facility. The results were not satisfactory due to the type of film used.
8-27-76	213.617	-	This shutdown ended a successful attempt to obtain radiographs of the OC-1 experiment in the neutron radiography facility.
9-12-76	357.933	133B	The reactor was shut down after radiographing of the OF-2 experiment in the neutron radiography facility. Isotope (iodine-xenon) work was completed. The routine end-of-operating-cycle maintenance was started on 9-12-76 and completed on 9-22-76.

Table 6. Reductions in ORR Power Not Resulting in Shutdowns

Date	Source of Signal	Type of Signal	Lowest Power (Mw)	Comments
8-26-76	Setback	Automatic	N _L	The reactor primary water by-pass valve closed due to demand for cooler water. The ΔP decreased to the 22.9 PSI setpoint.
9-9-76	Setback	Automatic	6	The reactor primary water by-pass valve closed when switching from manual to automatic position. The ΔP decreased to the 22.9 PSI setpoint.

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the complex was quite satisfactory and only rather 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, while Table 10 lists the maintenance on the mechanical components. Table 11 summarizes the results of efficiency tests of the various gaseous waste filters.

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility usage is given in Table 12. The core configurations used during the quarter are shown in Figure Nos. 4 and 5.

PROCEDURES, ADDITIONS, AND/OR REVISIONS

There were two revisions to the "ORR Operating Manual" listed in Table 13.

For Fuel Cycles 132-C, D, E, F, G, H

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

<u>LATTICE COMPONENT</u>	<u>NUMBER</u>
Fuel (F)	<u>28</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>26</u>
Experiment (E)	<u>1</u>
Iodine Sleeve (¹³¹ I)	<u>1</u>
Isotope Stringer (Iso)	<u>0</u>
Hydraulic Tube (HT)	<u>1</u>

Fig. 4. ORR Lattice Configuration-July 1, 1976, through August 4, 1976.

For Fuel Cycles 133A, B, 134A

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

LATTICE COMPONENTNUMBER

Fuel (F)

24

Shim Rod (SR)

6

Beryllium (Be)

31

Experiment (E)

0Iodine Sleeve (¹³¹I)1

Isotope Stringer (Iso)

0

Hydraulic Tube (HT)

1Fig. 5. ORR Lattice Configuration-August 4, 1976,
through September 30, 1976.

Table 7. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble or Change	Reason or Maintenance
No. 1 Counting-Rate Channel			
No maintenance or changes were required.			
No. 2 Counting-Rate Channel			
9-20-76	No. 2 fission chamber	Chamber failure	The faulty chamber was replaced with chamber TSM-4-566.
No. 1 Log-N Channel			
8-16-76	Log-N recorder power supply	Replacement	The unit was replaced to correct an erratic readout on the Log-N recorder.
No. 2 Log-N Channel			
8-10-76	Log-N amplifier power supply	Replacement	The faulty power supply was replaced.
No. 1 Safety Channel			
No maintenance or changes were required.			
No. 2 Safety Channel			
No maintenance or changes were required.			
No. 3 Safety Channel			
No maintenance or changes were required.			

Table 7 (continued)

Date	Component	Trouble or Change	Reason or Maintenance
Magnet Amplifiers			
8-2-76	Magnet amplifiers one through six	Retubed	Routine maintenance.
		Nos. 1 and 2 Gamma Channel	No maintenance or changes were required.
		North N ¹⁶ Channel	
7-12-76			The faulty amplifier 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.
Reactor Noise Monitor			
9-14-76	Noise chamber power supply	Removal	The unit was removed for modification.

Table 7 (continued)

Date	Component	Trouble or Change	Reason or Maintenance
Process Instrumentation			
7-26-76	Normal off gas (NOG) filter pit temperature recorder	Replacement	The recorder drive motor was replaced.
8-9-76	Reactor core ΔP setpoints	Reset	The setpoints were reset due to recent core changes as follows (ΔP versus flow): 22.9 PSI - 17,000 gpm 16.4 PSI - 14,000 gpm 12.4 PSI - 12,000 gpm
Reactor Primary By-Pass Filter Flow			
9-14-76	ΔP cell	Replacement	The faulty ΔP cell was replaced.

Table 8. Present Status of Ionization Chambers and Fission Chambers

Chamber Serial No.	Location	Present Status	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 sec- tion 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. In- stalled 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, 1975	None	None.
PCP-II-106-63-4	Position 5	Servo and micromicro- ammeter	June, 1964	None	No trouble; fabricated by ORNL.
TSM-1-F52	Poolside	No. 1 counting rate north	March 29, 1976	JRR	Used as No. 2 counting rate (south) from April 26, 1972, until October 24, 1972.

Table 8 (continued)

Chamber Serial No.	Location	Present Status	Date Present Service Started	Previous Service	Remarks
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 December, 1970.
PCP-II-105-63-3	Poolside, north	No. 2 gamma, north	August 17, 1971	ORR	Used as No. 1 gamma, south, from April, 1964, until March, 1970.
TSM-4-566 IC-2634	Poolside	No. 2 count- ing rate	September 20, 1976	None	Replaced fission chamber "snake" assembly TSM-3- F29.
Spare Chambers					
PCP-II-105-63-1	Instrumenta- tion & cor- trols 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 3 (continued)

Chamber Serial No.	Location	Present Status	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	Instrumenta- tion & 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 ser- vice.
PCP-III-106-66-5	Instrumenta- tion and 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	I&C shop	Awaiting repair	August 8, 1975	ORR	Used as No. 1 counting rate from April 26, 1971, until December 5, 1972. Removed 3/30/76 to shop for repair.

Table 8 (continued)

Chamber Serial No.	Location	Present Status	Date Present Service Started	Present Service	Remarks
PCP-II-106-66-3	I&C shop	Awaiting repair	May, 1974 (safety) March, 1970 (log-N) removed from service December 12, 1975	None	Fabricated by ORNL. Chamber failed December 12, 1975. Removed 9/2/76 to shop for repair.
TSM-3-F29	I&C shop	Awaiting repair		ORR	Used as No. 2 counting rate from October 24, 1972, until September 29, 1976.

Table 9. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Cooling System		
8-26-76	Heat exchangers	Insulation was replaced on damaged areas of the water lines to the four heat exchangers.
8-23-76 and 8-26-76	Degasifier demineralizer (cation column)	The lead shielding was removed to permit removal of spent resin and replaced after new resin was installed.
9-21-76	24-in. strainer	Cleaned and inspected. No change from last inspection.
9-21-76	Decay tank	The strainer in the decay tank was inspected. No change from last inspection.
Reactor Secondary Cooling System		
7-9-76	Cooling tower	A pump and associated lines were installed to start treatment of the secondary cooling water with Dearborn Chemical Company's Endcor 4630.
8-4-76	Cooling tower (acid area)	Acid resistant sealer was installed around the acid pumps.
8-5-76	Cooling tower (water lines)	The damaged insulation was replaced on the lines west side of the cooling tower.
8-9-76	Cooling tower (water pumps)	The current on each pump was checked as part of programmed maintenance.
9-21-76	No. 3 heat exchanger	The secondary side was inspected as part of programmed maintenance.

Table 9 (continued)

Date	Component	Remarks
Emergency Cooling System		
8-6-76	Nos. 2 and 3 dc units	New micro-sentry relays were installed in the No. 2 dc low amperage circuit.
Electrical Systems		
7-6-76	Tele-alarm system	A faulty annunciator alarm unit in the ORR control room was replaced.
8-3-76	Transformer No. 2 (Station 3-3)	A new transformer was installed at station 3-3 located on the east side of Building 3001.
8-4-76	Electrical breaker 4B41 (Station 4-4)	The breaker located at station 4-4 was removed and sent to the electrical shop for a routine check-out. A meter base was installed at the station so a KWH meter could be installed at a later date.
8-6-76	Sump pump No. 3	A new electrical outlet for the pump was installed.
Emergency Electrical Systems		
8-3-76 and 8-4-76	Diesel generator	The routine end-of-cycle load test was performed. The governor was replaced because the motor RPM cycled while test was being performed.
8-30-76	Diesel generator	A faulty oil heating thermostat was replaced.

Table 11. 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	9-30-76 9-30-76	DOP	99.997
Charcoal	Both Banks	North, 9-16-74 South, 10-17-67	3-2-76 9-8-76	Elemental Iodine	99.93
Charcoal	Both Banks	North, 9-16-74 South, 10-17-67	3-4-76 1-10-76	Methyl Iodide	41.37
Pressurizable Off-Gas					
CWS	North	5-5-75	9-30-76	DOP	99.920
Charcoal	North	2-26-73	10-7-75	Elemental Iodine	87.97
Charcoal	North	2-26-73	1-28-76	Methyl Iodide	99.94
CWS	South	10-18-67	9-30-76	DOP	99.986
Charcoal	South	8-11-75	8-13-75	Elemental Iodine	99.98
Charcoal	South	8-11-75	10-8-75	Methyl Iodide	97.48

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

Table 11 (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	9-30-76	DOP	99.998
Charcoal	West	2-12-76	8-3-76	Elemental Iodine	99.94
CWS	East	6-12-75	9-30-76	DOP	99.995
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 12. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
B-8	V-1	6-21-76	8-4-76	Radioisotopes (iodine & xenon)	Operations
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotopes production and short term irradiations	Operations
E-3	V-9	5-6-75	7-6-76	P-137 capsule experiment	Reactor
E-7	V-5	6-20-75	8-3-76	OF-2 capsule experiment	Reactor
E-7	V-5	8-4-76		Radioisotopes (iodine & xenon)	Operations
P-5, P-6	None	8-10-76	8-13-76	Nose cone experiment	General Electric
GCR P7-A	None	8-8-72	8-2-76	GB-10 capsule experiment	Reactor
HB-2	None	7-58		Neutron diffraction experiments	Solid State Physics
HB-3	None	11-1-58		Neutron diffraction experiments	Solid State Physics
HB-4	None	7-58		Neutron diffraction experiments	Chemistry
HB-6	None				Solid States
HN-3	None	11-59		Activation analysis	Analytical Chemistry
HN-4	None	12-15-63		Void determinations in irradiated materials	Solid State Physics
HN-4	None	12-15-63		"Fly's Eye" two-dimensional neutron detector for neutron diffraction and radiography	Instrumentation & Controls

Table 13. Procedures, Additions, and/or Revisions

Date	Section	Title	Remarks
7-19-76	2.61	Low level scrams	This revision reflects the setpoint changes made on the ΔP channel due to a change in the core configuration.
7-26-76	4.3	Handling and scheduling of small irradiation targets	This revision and addition reflects the change in handling and scheduling procedure for sample irradiation in the ORR.

IN-SERVICE INSPECTIONS

1. Decay Tank Inspection

On 9-21-76, the water was drained down in the decay tank and an inspection of the decay tank strainer was made with satisfactory results.

2. Dearborn Chemical Division Consulting Service Report

On 7-1-76, switched from chromate to polyphosphate treatment of the ORR reactor secondary water. On 9-24-76 an inspection of the No. 3 heat exchanger secondary side indicated the heads and water boxes to be very clean and free from any heavy fouling or corrosion tubercules.

The tubes were very clean with the exception of a light mineral deposition in the tubes on the outlet. This deposition appeared to extend approximately 2-3 ft. into the exchanger.

This deposition should pose no problems and should gradually clean up using the Endcor 4630 and adhering to the proper pH and Ca levels recommended.

3. Visual Inspection of ORR Primary Coolant Heat Exchanger No. 3, Pit Area 3102

On 9-23-76, a visual inspection of the secondary side of the subject heat exchanger revealed the tube-to-tube sheet welds to be in good condition with the tubes proper being reasonably clean and free of obstructions (except in the thermocouple areas.) A pitting condition however existed on all visible head and shell surfaces with the maximum pit size measuring approximately 1/3 inch in diameter by 3/64 inch deep (on the return closure head).

The general condition of the vessel is considered satisfactory for continued service.

4. Visual Inspection of ORR 24-Inch Primary Coolant Line Strainer, Building 3085

On 9-23-76, a visual inspection of the subject strainer revealed the four baskets to be secure, clean, and free of extraneous debris. The accessible surface of the housing and closure head were also examined and found to be in satisfactory condition.

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