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**Oak Ridge Research Reactor Quarterly Report
July, August, and September of 1977**

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E. D. Lance

OAK RIDGE NATIONAL LABORATORY
OPERATED BY UNION CARBIDE CORPORATION · FOR THE DEPARTMENT OF ENERGY

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OPERATIONS DIVISION

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
JULY, AUGUST, AND SEPTEMBER OF 1977

Date Published - January 1978

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SUMMARY

The ORR operated at an average power level of 29.5 MW for 23.4% of the time during July, August, and September of 1977. Three fuel elements were declared spent (60.7% burnup) during the quarter, while five new elements were placed in service.

The reactor was shut down on seven occasions, none of which were unscheduled. Reactor downtime needed for refueling, maintenance and checks was quite low, with the reactor remaining available for operation 86.5% of the time.

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

In-service inspections completed during the quarter included inspection of the ORR primary heat exchanger No. 2.

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.

Table 1. ORR Basic Operating Data
Period: July, August, and September of 1977

	This Quarter	Last Quarter	Year To Date	January Through September, 1976
Total energy, MWd	634.7	763.0	2,018.1	6,083.9
Average power, MW/operating hr	29.5	29.8	29.5	29.8
Time operating, %	23.4*	28.2*	25.1*	76.5*
Availability, %	86.5	85.0	86.2	93.8
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	18,310	21,700	22,100	28,600
Pool water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	367	458	505	593
Reactor water resis- tivity, ohm-cm (av)	3,638,000	2,607,200	2,761,000	967,000
Pool water resis- tivity, ohm-cm (av)	2,828,000	2,094,800	2,217,333	761,000
Fuel elements depleted	3	10	18	12
Average burnup of fuel elements depleted, %	60.7	56.0	57.0	56.5
Shim rods depleted	0	2	2	8
Average burnup of shim rods depleted, %	-	72.0	72.0	65.1
Radioisotope samples	0	0	1	4
Research samples	0	0	1	6

*Time operating (%) low due to reduced level of funding.

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (MWd)
139	July 8, 1977	August 21, 1977	272.50
140	August 26, 1977	In Progress	362.20

FUEL USAGE AND INVENTORY

Three fuel elements were declared spent during the quarter with average percent burnup of 60.7 and five new elements were placed in service.

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. 1977	Jan.-Sept. 1976
Depleted fuel elements transferred for chemical separation	0	11	11	58
Average percent burnup of fuel elements transferred	--	56.5	56.5	52.3
New fuel elements placed in service	5	8	18	58
New fuel elements available for use	57*	50		
Depleted shim rods trans- ferred for chemical separation	0	4	4	10
Average percent burnup of shim rods transferred	--	65.7	65.7	64.1
New shim rods placed in service	0	2	2	8
New shim rods available for use	0	0		

*Includes four partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 1,691 hours. A summary of the shutdowns is given in Table 4, and details of each are contained in Table 5.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hr)
Scheduled		
Regular, end of cycle	2	678.117
Regular, iodine removal	1	395.350
Regular, refueling, iodine removal, and experiment work	1	203.500
Regular, iodine removal, and experiment work	1	335.950
Special, completed startups for checking proper operation of reactor instrumentation	<u>2</u>	<u>77.800</u>
Subtotal	7	1,690.717
Unscheduled		
	<u>0</u>	<u>0</u>
Subtotal	<u>0</u>	<u>0</u>
Total	<u><u>7</u></u>	<u><u>1,690.717</u></u>

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
7-1-77 through 7-3-77	181.817	138-A	The shutdown activities (which started on 6-17-77) included re-fueling, maintenance work on installing new gaskets where needed in the Y-pit, T-pit, and the sump at the south end of the primary pump house.
7-3-77 through 7-11-77	58.550	138 Cont.	After a low power run of 6.0 MW was made for checking activity of the primary water and startup instrumentation, the end of cycle 138 shutdown work was completed.
7-15-77 through 8-1-77	395.350	139-A	The shutdown activities included iodine-xenon work and the installation of an in-core experiment.
8-5-77 through 8-26-77	496.300	139-B	The shutdown marked the end of cycle 139. The shutdown activities included refueling, iodine-xenon work, experiment and maintenance work which included a routine inspection of the secondary side of the No. 2 primary heat exchanger.
8-26-77 and 8-27-77	19.250	139 Cont.	The shutdown marked the end of a critical run made for checking the reactivity of an experiment for the Spire Corporation in P-5 position. Programmed maintenance work was completed.
9-2-77 through 9-16-77	335.950	140-A	The shutdown activities included iodine-xenon work, the removal of a flux monitor capsule experiment, and some routine maintenance work.
9-22-77 through 9-30-77	203.500	140-A	The shutdown activities included iodine-xenon work, the removal of a flux monitor capsule experiment, refueling, and some routine maintenance work.

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 6.

PROCESS SYSTEM AND MECHANICAL COMPONENTS

Details of maintenance or changes to the process system are given in Table 7. Table 8 summarizes the results of efficiency tests of the various gaseous waste filters.

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility usage is given in Table 9. The core configurations used during the quarter are shown in Figure Nos. 1, 2, and 3.

ORR LATTICE LOADING
For Fuel Cycle 139-A

	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

<u>LATTICE COMPONENT</u>	<u>NUMBER</u>
Fuel	<u>24</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>31</u>
Experiment (E)	<u>0</u>
Iodine Sleeve (¹³¹ I)	<u>1</u>
Isotope Stringer (Iso)	<u>0</u>
Hydraulic Tube (HT)	<u>1</u>

Figure 1. ORR Lattice Configuration - July 8, 1977
Through July 28, 1977

ORR LATTICE LOADING
For Fuel Cycle 139-B

	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	F	E	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	<u>24</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>30</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>

Figure 2. ORR Lattice Configuration - August 1, 1977
Through August 5, 1977

ORR LATTICE LOADING
For Fuel Cycles 140-A and 140-B

	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

<u>LATTICE COMPONENT</u>	<u>NUMBER</u>
Fuel	<u>24</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>31</u>
Experiment (E)	<u>0</u>
Iodine Sleeve (¹³¹ I)	<u>1</u>
Isotope Stringer (Iso)	<u>0</u>
Hydraulic Tube (HT)	<u>1</u>

Figure 3. ORR Lattice Configuration - August 26, 1977
Through September 30, 1977

Table 6. Maintenance and Charges, Instrumentation and Controls

Date	Component	Trouble	Corrective Action
No. 1 Counting Rate Channel			
No maintenance or changes were required.			
No. 2 Counting Rate Channel			
7-11-77	Counting-rate meter pre-amplifier	Faulty transistors	The transistors were replaced.
No. 1 Log-N Channel			
7-11-77	Log-N recorder amplifier	Faulty amplifier	The recorder amplifier was replaced.
9-1-77	Log-N recorder amplifier	Defective power supply	The compensated power supply was replaced.
No. 2 Log-N Channel			
7-1-77	Log count-rate meter amplifier	Erratic readout	The amplifier was re-tubed.
7-25-77	Log-N amplifier	Erratic readout	The amplifier was replaced.
No. 1 Safety Channel			
7-13-77	Safety recorder amplifier	Erratic readout	The amplifier was replaced.
7-25-77	Safety pre-amplifier	Erratic readout	The pre-amplifier was re-tubed.
7-26-77	Safety recorder amplifier	Erratic readout	The recorder amplifier was replaced.

Table 6. (Continued)

Date	Component	Trouble	Corrective Action
No. 2 Safety Channel			
7-13-77	Sigma amplifier	Erratic readout	The sigma amplifier was replaced.
9-1-77	Pre-amplifier	Erratic readout	The pre-amplifier was re-tubed.
No. 3 Safety Channel			
			No maintenance or changes were required.
Magnet Amplifier			
			No maintenance or changes were required.
No. 1 Gamma Channel			
			No maintenance or changes were required.
No. 2 Gamma Channel			
			No maintenance or changes were required.
North ^{16}N Channel			
7-11-77	Recorder chart drive motor	Chart drive inoperative	The drive motor was replaced.
South ^{16}N Channel			
			No maintenance or changes were required.

Table 5. (Continued)

Date	Component	Trouble	Corrective Action
Micro-Microammeter Channel			
7-6-77	Power supply rectifiers	Erratic readout	The rectifiers were replaced.
9-16-77	Recorder amplifier	Erratic readout	The amplifier was replaced.
9-20-77	Recorder amplifier	Erratic readout	The amplifier and the slide wire contacts were replaced.
Process Instrumentation			
7-8-77	Pool pH recorder	Alarms	The alarms points were reset due to the change in the water treatment from chromate to phosphate.
9-30-77	No. 2 outlet temperature recorder	Erratic readout	The battery was replaced.
Chamber Changes			
7-6-77	ORR noise chamber (CTC-5)	Chamber failure	Removed chamber position No. 8 and placed in the ORR plug storage.

Table 7. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Cooling System		
7-1-77	Primary water lines at Building 3085	(Continued from the previous quarter.) On June 26, 1977, with the primary water drained and the drain valves open, a rainstorm flooded the exit manifold trench and overflowed into sump Nos. 1 and 2. Some of the muddy water entered the exit manifold line via the south sump drain line and the return water line via the strainer drain line. The water lines had been drained for in-service inspection of pipe welds. Using a fire hose equipped with a fog nozzle, process water was used to flush the exit manifold from the Y-pit into the south sump and the return water line was flushed from the T-pit via the strainer drain into sump No. 1. This operation cleaned the lines and no additional problems were encountered.
7-5-77	Primary bypass filter column pad	The installation of a concrete pad support was completed.
7-26-77 through 7-28-77	Degasifier pump	Faulty bearings were replaced.
8-3-77	Primary decay pump	An audio inspection was performed. There was no change since the last inspection.
9-16-77	No. 2 primary water pump	The spring tension was tightened on contacts in the starting mechanism and the magnet was cleaned on the running mechanism to prevent chattering.

Table 7. (Continued)

Date	Component	Remarks
Reactor Secondary Cooling System		
8-15-77	No. 2 heat exchanger	The heads were removed for routine inspection of the secondary side by Inspection Engineering. The results were satisfactory. New head gaskets were installed when heads were replaced.
Pool Secondary Cooling System		
8-18-77	Cooling tower fan cylinder	The fan cylinder sheet metal was repaired.
Emergency Cooling System		
8-23-77	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms were completed with satisfactory results.
Electrical System		
7-1-77 through 9-30-77	Electrical wiring for the control instrumentation	Wiring was replaced (routine upgrading) as time permitted during the reactor downtime.
7-6-77	Control room instrument cabinet "E"	A faulty cooling fan motor was repaired.
7-30-77 and 7-31-77	Electrical station 4-4	The three transformers were replaced with new units after one of the transformers failed.

Table 7. (Continued)

Date	Component	Remarks
Electrical System (Continued)		
3-24-77	Miscellaneous breaker panels for electric meters, dc batteries, battery rack, and control room instrument cabinets	Routine end-of-cycle inspection and cleaning were performed. Dust filter for the control room instrument cabinets were changed as needed, and programmed maintenance was completed.
Emergency Electrical System		
7-6-77	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
7-27-77	Diesel generator	The semiannual inspection was performed. The oil and filter were changed.
8-23-77	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
Miscellaneous		
7-1-77	Obsolete one-fourth inch thermocouple lines from the reactor vessel	Each obsolete line was capped.
7-7-77	No. 1 sump pump	The pump was repaired. A new breaker was installed in the No. 3 reactor primary pump cell.
7-12-77	Radiography facility off-gas line	A broken place in the line was replaced.
8-1-77	Sump pump in tunnel north of Building 3085	The faulty pump was replaced.

Table 7. (Continued)

Date	Component	Remarks
Miscellaneous (Continued)		
8-10-77	Building 3004	The top to the No. 2 anion resin column was removed and replaced after the depleted resin was replaced with new resin.
8-16-77	Building 3004	A level alarm was installed on the new neutralization tank.
8-23-77 through 8-29-77	Outside equipment	Outside equipment was painted as needed.
8-30-77 through 9-30-77	West pool underwater cleanup	The bottom sections from A-2, Loop I, F-9, F-1, A-9, F-2, B-9, C-1, and F-3 experiments were removed. All pieces not too radioactive were transferred to the hot dumpster. Pieces that were too radioactive such as the foot pieces from the old experiments listed above were transferred to the hot cell (underwater) for loading into carrier and transferring to the burial grounds.
9-12-77 and 9-16-77	No. 3 sump pump	A faulty mercury switch was replaced 9-12-77. The pump was replaced 9-16-77.
9-19-77	Beam hole No. 4 experiment facility	The pressure relief valve was repaired.
9-23-77	Building 3085 (reactor primary water pump house)	The roof to the building was repaired.

Table 8. 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	9-23-77	DOP	99.997
Charcoal	Both Banks	North, 9-16-74 South, 10-17-67	9-28-77	Elemental Iodine	99.705
Charcoal	Both Banks	North, 9-16-74 South, 10-17-67	3-3-77	Methyl Iodine	26.100
Pressurizable Off-Gas					
CWS	North	5-5-75	9-23-77	DOP	99.780
Charcoal	North	2-26-73	1-28-76	Elemental Iodine	99.940
Charcoal	North	2-26-73	10-7-75	Methyl Iodine	87.970
CWS	South	10-18-67	9-23-77	DOP	99.992
Charcoal	South	8-11-75	8-13-75	Elemental Iodine	99.993
Charcoal	South	8-11-75	10-8-75	Methyl Iodine	97.480
Basement Hood Exhaust					
CWS	South	10-4-76	10-4-76	DOP	99.997
CWS	North	10-4-76	10-4-76	DOP	99.998

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

Table 3. (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
Normal Off-Gas					
CWS	West	6-2-77	9-23-77	DOP	99.980
Charcoal	West	6-2-77	6-2-77	Elemental Iodine	99.993
CWS	East	1-26-77	9-23-77	DOP	99.960
Charcoal	East	1-26-77	1-26-77	Elemental Iodine	99.960
Charcoal	West	6-2-77	6-9-77	Methyl Iodine	99.030
Charcoal	East	1-26-77	6-9-77	Methyl Iodine	75.250

Table 9. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production and short term irradiations	Operations
E-3	None	7-28-77	8-7-77	Antimony sources	Instrumentation and Controls
E-7	V-5	8-4-76		Radioisotopes (iodine & xenon)	Operations
P-5	None	8-26-77	9-22-77	Flux monitor capsules	Spire Corporation
HB-3	None	11-1-58		Neutron diffraction experiments	Solid State Physics
HB-6	None				Solid State
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 and Controls

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IN-SERVICE INSPECTION OF THE ORR

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Reactor Primary Heat Exchanger

No. 2, August 8, 1977

by

The Department of Quality Assurance and Inspection

Vessel is considered to be in satisfactory condition for present use.

The following comments are made as reference for future inspections:

1. Both heads have light pitting (inside).
2. The head-to-shell bolts and nuts have some rust but are adequate at present.
3. A light particulate coating was found on the tubes in the second pass. Most was located at the exit end of the tubes.
4. Supports are adequate, some corrosion but not serious.

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