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**Oak Ridge Research Reactor Quarterly Report
October, November, and December of 1977**

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

OAK RIDGE NATIONAL LABORATORY
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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
OCTOBER, NOVEMBER, AND DECEMBER OF 1977

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

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
OCTOBER, NOVEMBER, AND DECEMBER OF 1977

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

SUMMARY

The ORR operated at an average power level of 29.8 MW for 29.6% of the time during October, November, and December of 1977. Ten new fuel elements were placed in service. Two shim-rod elements were retired from service at an average burnup of 71.2%.

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 88.2% 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 decay tank and the ORR pool heat exchanger.

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: October, November, and December of 1977

	This Quarter	Last Quarter	Calendar Year 1977	Calendar Year 1976
Total energy, MWd	812.2	634.7	2,830.3	6,638.2
Average power, MW/operating hr	29.8	29.5	29.6	29.7
Time operating, % ^a	29.6	23.4	26.2	61.1
Availability, %	88.2	86.5	86.1	92.0
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	21,600	18,310	21,978	27,800
Pool water radio- activity, $\frac{\text{c/min}}{\text{ml}}$ (av)	510	367	506	588
Reactor water resis- tivity, ohm-cm (av)	2,341,833	3,638,000	2,656,258	1,159,000
Pool water resis- tivity, ohm-cm (av)	2,343,500	2,828,000	2,249,075	902,000
Fuel elements depleted	0	3	18	18
Average burnup of fuel elements depleted, %	-	60.7	57.0	56.9
Shim rods depleted	2	0	4	8
Average burnup of shim rods depleted, %	71.2	-	71.6	65.1
Radioisotope samples	1	0	2	4
Research samples	0	0	1	7

^aTime operating (%) low due to reduced level of funding.

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (MWd)
140	August 26, 1977	October 21, 1977	133.9 ^a
141	November 11, 1977	December 8, 1977	390.6
142	December 17, 1977	In progress	287.7

^aMWd this quarter.

FUEL USAGE AND INVENTORY

Two shim rods were declared spent during the quarter with average percent burnup of 71.2. Ten new elements and two new shim rods 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	Calendar Year 1977	Calendar Year 1976
Depleted fuel elements transferred for chemical separation	0	0	11	71
Average percent burnup of fuel elements transferred	-	-	56.5	52.8
New fuel elements placed in service	10	5	28	58
New fuel elements available for use	50 ^a	57	-	-
Depleted shim rods transferred for chemical separation	0	0	4	14
Average percent burnup of shim rods transferred	-	-	65.7	64.2
New shim rods placed in service	2	0	4	8
New shim rods available for use	1	0	-	-

^aIncludes four partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 1,555 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	710.783
Regular, refueling, iodine removal, and experiment work	continued ^a	393.283
Regular, refueling, iodine removal, and experiment work	1	50.000
Regular, refueling	1	236.000
Regular, iodine removal	1	60.467
Regular, iodine removal, and experiment work	1	59.517
Special, completed startup to check shielding at a beam hole facility	<u>1</u>	<u>45.250</u>
<u>Subtotal:</u>	7	1,555.300
	Unscheduled	
	<u>0</u>	<u>0</u>
<u>Subtotal:</u>	<u>0</u>	<u>0</u>
TOTAL	<u>7</u>	<u>1,555.300</u>

^aDowntime hours continued from the shutdown in progress at the beginning of this quarter.

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
10-1-77	393.283	140-A	The shutdown (continued from last quarter) was completed with the cleaning of the primary and secondary sides of the pool heat exchanger.
10-21-77	497.633	140-B	The shutdown marked the end of operating cycle 140. Shutdown activities included: (1) iodine-xenon work; (2) an audio inspection of the reactor primary water decay tank; (3) the alignment of the No. 1 reactor secondary cooling pump was checked; and (4) several unsuccessful attempts were made to free blockage in the return water line to the HB-4 liner.
11-11-77	45.250	140-B continued	The shutdown ended a short power run to check the radiation level in front of HB-4. A temporary shield had been installed.
11-17-77	236.000	141-A	An iodine-xenon run that was in progress was cancelled. The reactor was refueled.
12-1-77	60.467	141-B	The shutdown activities included iodine-xenon work.
12-8-77	213.150	141-C	The shutdown marked the end of operating cycle 141. Shutdown activities included: (1) iodine-xenon work; (2) refueling; (3) routine end-of-cycle checks; and (4) programmed maintenance.
12-22-77	59.517	142-A	The shutdown activities included iodine-xenon work, and the insertion of four Sb capsules in core position E-3.

Table 5. (Continued)

Date	Duration (hr)	End Cycle	Remarks
12-29-77	50.000	142-B	The shutdown activities included refueling, iodine-xenon work, and the removal of the four Sb capsules from core position E-3. The shutdown work will be continued into the first quarter of 1978.

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 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 and 2.

Table 6. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble	Corrective Action
No. 1 Log-N Channel			
11-29-77	Log-N amplifier	Erratic readout	Two voltage regulator tubes were replaced.
No. 1 Safety Channel			
12-27-77	Safety recorder amplifier	Erratic readout	The recorder amplifier was replaced.
Process Instrumentation			
10-18-77	No. 1 AT recorder	Erratic readout	The recorder amplifier was replaced.
11-15-77	Pool pH recorder	Dirty probes	The probes were cleaned.
12-19-77	Pool cooling temperature transmitter	Erratic control	The transmitter was cleaned so that automatic control could be obtained.
Water Activity			
11-29-77	Scintillation counter	False readings	The pulse height of the counter was adjusted.

Table 7. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Cooling System		
10-24-77 through 10-26-77	Reactor primary decay tank	An inspection of the interior welds, braces, baffles, and strainer was performed. There was no change since the last inspection.
12-12-77	Reactor primary water pump motors	The motor coils resistance to ground was checked as part of the programmed maintenance.
12-14-77 through 12-17-77	No. 3 reactor primary water pump	A dc-operated-starting assembly was installed to replace a faulty ac-starting unit.
Reactor Secondary Cooling System		
11-1-77	Reactor primary cooling pump No. 1	The alignment of pump to motor was checked. The results showed the coupling to be defective. A new coupling was ordered.
11-28-77	Reactor secondary cooling tower (acid pump)	A coupling on the east pump was repaired.
12-12-77	Reactor secondary cooling tower (water pump)	The electrical operating current on each pump was checked as part of the programmed maintenance.
Pool Primary Cooling System		
10-3-77 and 10-4-77	Pool heat exchanger	The primary and secondary sides of the heat exchanger were cleaned.
11-21-77 and 11-22-77	Pool demineralizer	The diaphragm on the automatic control valve was replaced. The housing around the valve was replaced.

Table 7 (Continued)

Date	Component	Remarks
Pool Primary Cooling System (Continued)		
12-21-77	Pool demineralizer	The flange on valve P-1 was tightened to stop a water leak. The strainer on the inlet side of the demineralizer pump was cleaned.
Emergency Cooling System		
10-26-77	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms were completed with satisfactory results.
12-12-77	No. 2 dc unit	The coupling came loose at the connection to the primary motor. Satisfactory repairs were performed.
Electrical System		
10-31-77 through 11-2-77	End-of-cycle shutdown work	The programmed maintenance was completed. A faulty light switch in the diesel room was replaced.
Emergency Electrical System		
10-25-77	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
11-2-77	Diesel generator	The Electrical and Fire Departments made the necessary changes to permit testing of the generator without accidentally actuating the fire alarm system in Building 3042.
12-13-77	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.

Table 7. (Continued)

Date	Component	Remarks
Cell-Ventilation System		
12-12-77	Filter system	Nine down-stream charcoal filters were replaced. The elemental iodine retention efficiency test of the new filters was satisfactory.
Miscellaneous		
10-5-77 and 10-6-77	Outside steam system	Steam was turned on in preparation for cold weather. Lines, valves, and traps were checked and repairs were made where needed.
10-27-77	No. 6 sump	440-volt power was run to the sump. A new pump was installed 10-31-77.
10-24-77	Ground area north of Building 3085	To relieve Building 3085 from potential flooding during rainstorms, a fifteen-inch corrugated pipe was installed in a trench which will drain the ground water run-off north of Building 3085 to the creek.
10-26-77 and 10-27-77	Building 3004	The drain line on the newly-installed neutralization tank was wrapped with heat tape and then insulated.
11-2-77 through 11-11-77	Nos. 1, 3, 4, and 5 beam hole liners	Al oxide buildup in the liners has reduced the air flow purge to the normal off-gas system. A program is planned to remove the beam hole plug from the affected liners and remove the Al oxide on a schedule to coincide with future end-of-cycle shutdowns.

Table 7. (Continued)

Date	Component	Remarks
Miscellaneous (Continued)		
12-1-77	Experimental beam hole work (1st level east)	The obsolete beam hole plug piping was removed. A leak on the off-gas connection to HB-3 plug piping was repaired. A process water line and drain line were installed to the HB-3 magnet.
12-2-77	ORR overhead crane	The one- and twenty-ton cranes were load tested. The results were satisfactory.
12-6-77 through 12-31-77	Spare holddown arm No. 1	New bearings and springs are being installed.

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 ^a	North, 6-20-73 South, 1-12-75	9-23-77	DOP	99.997
Charcoal	Both banks	North, 9-16-74 South, 12-12-77	12-13-77	Elemental Iodine	99.995
Charcoal	Both banks	North, 9-16-74 South, 12-12-77	3-3-77	Methyl Iodine	26.100
Pressurizable Off-Gas					
CWS	North	5-5-75	9-23-77	DOP	99.780
Charcoal	North	2-25-73	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
Normal Off-Gas					
CWS	West	6-2-77	9-23-77	DOP	99.98
Charcoal	West	6-2-77	12-8-77	Elemental Iodine	99.90

^aThe CWS filters in the cell ventilation system were checked in series.

Table 8. (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
Normal Off-Gas (Continued)					
CWS	East	1-26-77	9-23-77	DOP	99.960
Charcoal	East	1-26-77	11-3-77	Elemental Iodine	99.97
Charcoal	West	6-2-77	6-9-77	Methyl Iodine	99.030
Charcoal	East	1-26-77	11-10-77	Methyl Iodine	70.57

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		12-25-77	12-29-77	Antimony sources.	Instrumentation and Controls
E-7	None	8-4-76		Radioisotopes (Iodine and 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 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 and Controls

ORR LATTICE LOADING

For Fuel Cycles 140-B, 141-A, 141-B, and 142-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

LATTICE COMPONENT

NUMBER

Fuel	24
Shim Rod (SR)	6
Beryllium (Be)	31
Experiment (E)	0
Iodine Sleeve (¹³¹ I)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Figure 1. ORR Lattice Configuration - October 1, 1977 through December 22, 1977

ORR LATTICE LOADING

For Fuel Cycle 142-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 COMPONENT

NUMBER

Fuel	24
Shim Rod (SR)	6
Beryllium (Be)	30
Experiment (E)	1
Iodine Sleeve (¹³¹ I)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Figure 2. ORR Lattice Configuration - December 25, 1977
through December 29, 1977

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IN-SERVICE INSPECTION OF THE ORR

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ORR Decay Tank (10-24-77)

An internal visual inspection was made October 24 during the period of time in which the reactor was out of service. The vessel was filled with water and illuminated by an immersed floodlight. A mirror was used to view the less conspicuous areas. The filter, baffling and bracing were inspected and found intact and also the welding appeared to be in good condition. In general, the vessel was clean and in condition for continued service.

ORR Pool Heat Exchanger (10-26-77)

During the recent outage of the reactor for inspection and maintenance an internal inspection was performed on the heat exchanger. A head was removed and the tube bundle taken out. The bundle was cleansed of light residue of mud by washing with a hose. After washing, the tube bundle and shell interior were examined and found to be clean. The heat exchanger is considered to be satisfactory for continued service.

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