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**Oak Ridge Research Reactor
Quarterly Report
October, November and December of 1978**

S. S. Hurt, III
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
OCTOBER, NOVEMBER AND DECEMBER OF 1978

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Director, Operations Division

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORTOCTOBER, NOVEMBER, AND DECEMBER OF 1978

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

SUMMARY

The ORR operated at an average power level of 29.0 MW for 80.9% of the time during October, November, and December of 1978.

The reactor was shut down on fourteen occasions, four of which were unscheduled. Reactor downtime needed for refueling, maintenance and checks was normal, with the reactor remaining available for operation 92.2% of the time.

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

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 1978

	This Quarter	Last Quarter	Year 1978	Year 1977
Total energy, MWd	2,160.8	2,089.2	7,981.5	2,830.5
Average power, MW/ operating hr	29.0	26.2 ^a	27.9	29.6
Time operating, %	80.9	86.8	78.4	26.2 ^b
Availability, %	92.2	89.0	88.1	86.7
Reactor water radio- activity, $\frac{\text{c/min}}{\text{ml}}$ (av)	23,900	22,200	24,675	21,978
Pool water radio- activity, $\frac{\text{c/min}}{\text{ml}}$ (av)	510	450	435	506
Reactor water resis- tivity, ohm-cm (av)	4,200,000 ^c	4,838,000 ^c	3,145,500	2,656,258
Pool water resis- tivity, ohm-cm (av)	1,744,000	1,599,000	1,610,000	2,249,075
Fuel elements depleted	10	45	112	18
Average burnup of fuel elements depleted, %	52.6	45.0	50.1	57.0
Shim rods depleted	2	0	8	4
Average burnup of shim rods depleted, %	72.1	-	71.0	71.6
Radioisotope samples	11	7	18	2
Research samples	0	0	0	1

^aAverage operating power level lower than normal due to an experimenter's request.

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

^cTwo reactor demineralizer units in service.

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (MWd)
146	August 5, 1978	October 16, 1978	332.2 ^a
147	October 19, 1978	In Progress	1,828.7 ^a

^aMWh this quarter.

FUEL USAGE AND INVENTORY

Ten fuel elements and two shim rods were declared spent during the quarter, with an average burnup of 52.6% for the fuel elements, and 72.1% for the shim rods. Twenty new fuel elements and two new shim rods were placed in service. Thirty-two fuel elements and two shim rod fuel sections were shipped to Savannah River Plant for chemical separation.

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 1978	Calendar Year 1977
Depleted fuel elements transferred for chemical separation	32	29	79	11
Average percent burnup of fuel elements transferred	43.9	51.3	49.6	56.5
New fuel elements placed in service	20	19	62	28
New fuel elements available for use	48 ^a	40 ^a	-	-
Depleted shim rods transferred for chemical separation	2	4	8	4
Average percent burnup of shim rods transferred	66.0	73.0	71.0	65.7
New shim rods placed in service	2	2	8	4
New shim rods available for use	14	5	-	-

^aIncludes four partial fuel elements.

Shutdowns and Power Reductions

Reactor downtime (power level $<N_L$) totaled approximately 421 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 unscheduled shutdowns, while Table 7 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		
Regular, end of cycle	1	90.800
Regular, iodine removed	2	0.683
Regular, refueling, and iodine removed	3	19.717
Regular, refueling iodine removed, and experiment removed	1	18.817
Regular, refueling, iodine removed, experiment work, and maintenance	1	46.367
Special, end of flux run	1	3.800
Special, low demand for operation	1	232.000
Subtotal:	10	412.184
Unscheduled		
Experiment failure, experiment	3	8.817
Instrument failure, reactor	1	0.200
Subtotal:	4	9.017
TOTAL:	14	421.201

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration	End Cycle	Remarks
10-13-78	46.367	146-E	Shutdown to repair leaks in the junction box for experiment MFE-2. When the reactor was shutdown the No. 5 shim rod stuck at ~8 1/2 inches. The reactor remained down to replace the shim rod and shim rod drive. The reactor was refueled and isotope (iodine-xenon) work was completed.
10-12-78	0.333	-	Shutdown to quick change iodine assembly in CP-D2.
10-16-78	90.800	146-F	The shutdown marked the end of operating cycle 146. Shutdown activities included: (1) refueling; (2) changing the iodine assembly in CP-D2; (3) removal of the experiment (OC-2) from CP-E5; (4) replacing the operator assembly on the No. 1 shim rod drive; (5) replacing the broken gear chain on the No. 1 fission chamber drive; (6) replacing the bearings on the No. 1 reactor secondary pump and cleaning the starter contacts on the No. 2 reactor secondary pump; and (7) programmed maintenance.
10-26-78	7.100	147-A	The shutdown activities included refueling and changing the iodine assembly in CP-D2.
10-26-78	3.800	147-XB	End of a special flux run in P-5 with core 147-XB.
11-9-78	0.350	-	Shutdown to quick change iodine assembly in CP-D2.
11-16-78	5.667	147-C	The shutdown activities included refueling and changing the iodine assembly in CP-D2.

Table 5. (Continued)

Date	Duration	End Cycle	Remarks
11-29-78	18.817	147-D	The shutdown activities included refueling, changing the iodine assembly in CP-D2, and removing the experiment (MFE-2) from CP-E7.
12-14-78	6.950	147-E	The shutdown activities included refueling and changing the iodine assembly in CP-D2.
12-22-78	232.000	-	Shutdown to change the iodine assembly in CP-D2. The reactor remained down through the end of this report period due to the low demand for operation.

Table 6. ORR Unscheduled Shutdowns, Details

Date	Duration	End Cycle	Remarks	
11-5-78	0.217	-	Pressure switch PSA-2B on experiment MFE-2 in CP-E7 gave a false alarm and scram.	
11-6-78	0.233	-	Pressure switch PSA-2B on experiment MFE-2 in CP-E7 was accidentally bumped by maintenance personnel resulting in a scram.	
11-7-78	8.367	147-B	Low pressure on MFE-2 experiment, resulting in a scram.	∞
12-11-78	0.200	-	A false fast scram was received from the Log-N Sigma Amplifier when it was jarred by closing the amplifier cabinet door.	

Table 7. Reductions in ORR Power Not Resulting in Shutdowns

Date	Type of Signal	Source of Signal	Lowest Power (MW)	Comments
11-3-78	Experiment	Setback	3.0	MFE-2 Experiment, high pressure
11-6-78	Primary flow ΔP	Setback	15.0	Human error. Adjustable temperature setpoint for the primary cooling system was left at a lower than normal position. Automatic action of the control valve caused a low ΔP setback.
12-4-78	Normal off-gas negative pressure	Setback	18.0	During a filter change at the stack area on the NOG system, the pressure on the NOG increased to a negative 19 inches H ₂ O resulting in a setback.

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the complex was satisfactory and only routine maintenance was required.

PROCESS SYSTEM

The performance of the process system was satisfactory and only routine maintenance was required.

MECHANICAL COMPONENTS

The performance of the mechanical components was satisfactory with the exception of maintenance on Nos. 1 and 5 shim rod drives as listed in Table 8.

EXPERIMENT FACILITIES, GASEOUS WASTE FILTERS, AND CORE CHANGES

Experiment facility usage is given in Table 9. Table 10 summarizes the results of efficiency tests of the various gaseous waste filters. The core configurations used during the quarter are shown in figure Nos. 1, 2, 3, 4, 5, and 6.

Table 8. Mechanical Components - Maintenance and Changes

Date	Component	Remarks
10-4-78	NO. 5 shim rod drive	The presence of foreign material (a piece of aluminum tubing ~3/16 inch in diameter and ~5 inches long) required the following maintenance: (1) repair of the shock absorber, (2) replacement of the engagement mechanism, (3) replacement of the seal housing, and (4) replacement of the seat switch and the seat switch push rod.
10-19-78	NO. 1 shim rod drive	The Operator Assembly for the No. 1 Shim Rod Drive was replaced after the drop current and release time were found to be slightly outside specifications. The discrepancies were found during routine end-of-cycle tests.

Table 9. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
D-2	None	2-13-78		Radioisotopes (Iodine and Xenon)	Operations
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production and short term irradiations	Operations
E-5	V-6	6-28-78	10-16-78	HTGR creep irradiation capsule OC-2	Engineering Technology Division
E-7	V-5	9-1-78	11-29-78	Nickel based alloys and stainless steel	Metals and Ceramics
HB-1	None	9-78		Neutron spectrometer	Solid State Physics
HB-2	None	9-78		Neutron spectrometer	Solid State Physics
HB-3	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		"Fly's Eye" two dimensional neutron detector for neutron diffraction and radiography	Instrumentation and Controls

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 ^a	North, 6-20-73 South, 1-12-75	9-27-78	DOP	99.994
Charcoal	Both banks	North, 9-16-74 South, 12-12-77	11-28-78	Elemental Iodine	99.96
Charcoal	Both banks	North, 9-16-74 South, 12-12-77	11-30-78	Methyl Iodine	76.54
Pressurizable Off-Gas ^b					
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

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

^bThe POG system is not being used; therefore, all filter tests have been discontinued for the present.

Table 10. (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
Basement Hood Exhaust					
CWS	South	10-4-76	9-28-78	DOP	99.998
CWS	North	10-4-76	9-27-78	DOP	99.996
Normal Off-Gas					
CWS	West	10-17-78	10-17-78	DOP	99.998
Charcoal	West	10-17-78	10-26-78	Elemental Iodine	99.99
CWS	East	12-14-78	12-14-78	DOP	99.998
Charcoal	East	12-14-78	C	Elemental Iodine	C
Charcoal	West	10-17-78	11-2-78	Methyl Iodine	99.75
Charcoal	East	12-14-78	C	Methyl Iodine	C

14

^C Not tested since filter change.

ORR LATTICE LOADING

For Fuel Cycles 146-E, 146-F

	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	F	F	F	F	F	F	F	Be
D	Be	I ¹³¹	F	SR	F	SR	F	HT	Be
E	Be	F	F	F	E	F	E	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	25
Shim Rod (SR)	6
Beryllium (Be)	28
Experiment (E)	2
Iodine Sleeve (I ¹³¹)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Figure 1. ORR Lattice Configuration - October 1, 1978 through October 15, 1978

ORR LATTICE LOADING
For Fuel Cycles 147-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	I ¹³¹	F	S R	F	SR	F	HT	Be
E	Be	F	F	F	F	F	E	F	Be
F	Be	Be	F	S R	F	SR	F	F	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

<u>LATTICE COMPONENT</u>	<u>NUMBER</u>
Fuel	25
Shim Rod (SR)	6
Beryllium (Be)	29
Experiment (E)	1
Iodine Sleeve (I ¹³¹)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Figure 2. ORR Lattice Configuration - October 16, 1978 through October 25, 1978.

ORR LATTICE LOADING
For Fuel Cycles 147-XB

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

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

Figure 3. ORR Lattice Configuration - October 26, 1978. Special core for a flux map (P-5 position in pool window) for the future Benchmark Experiment.

ORR LATTICE LOADING
For Fuel Cycles 147-B, 147-C

	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	I ¹³¹	F	SR	F	SR	F	HT	Be
E	Be	F	F	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

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

Figure 4. ORR Lattice Configuration - October 26, 1978 through November 16, 1978.

ORR LATTICE LOADING
For Fuel Cycles 147-D

	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	F	F	F	F	F	F	F	Be
D	Be	I ¹³¹	F	SR	F	SR	F	HT	Be
E	Be	F	F	F	^a OC-2	F	E	F	Be
F	Be	F	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	26
Shim Rod (SR)	6
Beryllium (Be)	27
Experiment (E)	1
Iodine Sleeve (I ¹³¹)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Figure 5. ORR Lattice Configuration - November 16, 1978 through November 29, 1978

^a Core Piece

ORR LATTICE LOADING
For Fuel Cycles 147-E, 147-F

	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	F	F	F	F	F	F	F	Be
D	Be	I ¹³¹	F	SR	F	SR	F	HT	Be
E	Be	F	F	F	^a OC-2	F	F	F	Be
F	Be	F	F	SR	F	SR	F	Be	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

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

Figure 6. ORR Lattice Configuration - November 29, 1978 through December 31, 1978

^a Core Piece

UNUSUAL OCCURRENCES

There was one unusual occurrence at the ORR during this quarter. An Unusual Occurrence Report entitled "Foreign Object in Shock Absorber for No. 5 Shim Rod" describes the incident which occurred on October 3, 1978 immediately following a scheduled shutdown of the ORR to permit experiment work.

FLUX MEASUREMENT AT ORR POOLSIDE

Flux measurements for the future Benchmark Experiment were made at poolside at the ORR on Thursday, October 26, 1978.

A number of flux monitor disks were loaded into cadmium boxes which are 7/8" diameter by 1/4" thick with 40 mil thick walls. Each box was loaded with 200 mg of rhodium and indium, 2.5 g of nickel, 0.8 g of aluminum, and 2.2 g of iron. Five of the cadmium boxes, which were not water-tight, were placed in the holder and irradiated wet for 3 hours at 300 kW. The holder placed the array of boxes at 6 cm from the reactor face. Following the irradiation, the rig and foils were allowed to decay until the boxes could be removed and transported to the counting facilities.

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