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**OAK
RIDGE
NATIONAL
LABORATORY**

**UNION
CARBIDE**

**Oak Ridge Research Reactor
Quarterly Report
January, February, and
March of 1980**

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

MASTER

**OPERATED BY
UNION CARBIDE CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY**

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OPERATIONS DIVISION

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

JANUARY, FEBRUARY, AND MARCH OF 1980

S. S. Hurt, III

E. D. Lance

SPONSOR: J. A. Cox
Director, Operations Division

Date Published - October 1980

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CONTENTS

SUMMARY	1
OPERATIONS	1
FUEL USAGE AND INVENTORY	3
SHUTDOWNS AND POWER REDUCTIONS	4
INSTRUMENTATION AND REACTOR CONTROLS	7
REACTOR INSTRUMENTATION DESIGN CHANGE	7
PROCESS SYSTEM	7
MECHANICAL COMPONENTS	7
EXPERIMENT FACILITIES, GASEOUS WASTE FILTERS, AND CORE CHANGES . . .	7
DISTRIBUTION	19

FIGURE LIST

Figure

1	ORR Lattice Configuration-January 1, 1980-March 11, 1980. .	16
2	ORR Lattice Configuration-March 11, 1980-March 24, 1980 . .	17
3	ORR Lattice Configuration-March 24, 1980-March 31, 1980 . .	18

TABLE LIST

Table

1	ORR Basic Operating Data	2
2	Cycles of Operation	2
3	ORR Fuel Status	3
4	Summary of Shutdowns	4
5	ORR Scheduled Shutdowns, Details	5
6	ORR Unscheduled Shutdowns, Details	6
7	Reductions in ORR Power not Resulting in Shutdowns	6
8	Maintenance and Changes, Instrumentation and Controls	8
9	Reactor I&C Design Change Memo	9
10	Process Systems, Maintenance and Changes	10
11	Mechanical Components - Maintenance and Changes	13
12	Experiment Facility Usage	13
13	Status of Filters - Gaseous Waste System	15

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

JANUARY, FEBRUARY, AND MARCH OF 1980

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

SUMMARY

The ORR operated at an average power level of 29.9 MW for 91.3% of the time during January, February, and March of 1980.

The reactor was shut down on twelve occasions, six of which were unscheduled. Reactor downtime needed for refueling, maintenance and checks was normal, with the reactor remaining available for use 93.7% of the time.

Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of one Reactor Instrument and Controls Design Change Memo, as described on page 9.

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: January, February, and March

	This Quarter	Last Quarter	Year To Date	Jan thru Mar 1980
Total energy, MWd	2,480.4	2,317.7	2,480.4	2,180.6
Average power MW/operating hr	29.9	29.7	29.9	28.9
Time operating, %	91.3	84.9	91.3	84.2
Availability, %	93.7	89.9	93.7	93.6
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	21,600	23,000	21,600	26,800
Pool water radio- activity, $\frac{\text{c/min}}{\text{ml}}$ (av)	560	460	560	820
Reactor water resis- tivity, ohm-cm (av)	1,671,000	1,200,429	1,671,000	1,077,000
Pool water resis- tivity, ohm-cm (av)	855,000	807,143	855,000	796,385
Fuel elements depleted	21	14	21	21
Average burnup of fuel elements depleted, %	45.1	43.2	45.1	50.0
Shim rods depleted	2	2	2	2
Average burnup of shim rods depleted, %	75.0	76.4	75.0	56.7
Radioisotope samples	25.0	32.0	25.0	7
Research samples	0	0	0	0

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (MWd)
151	October 23, 1979	January 20, 1980	581.4 ^a
152	January 25, 1980	In Progress	1,899.0

^aMWd this quarter

FUEL USAGE AND INVENTORY

Twenty-one standard fuel elements and two shim-rod fuel elements were declared spent during the quarter, with an average burnup of 45.1% for the fuel elements and 75.0% for the shim rods. Forty-eight fuel elements and four shim rods were shipped to Savannah River Plant for chemical separation. Twenty-six new fuel 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	Jan-Mar 1980	Jan-Mar 1979
Depleted fuel elements transferred for chemical separation	48	49	48	17
Average percent burnup of fuel elements transferred	52.7	48.5	52.7	48.0
New elements start of quarter	44	45	44	-
New elements received	21	28	21	-
New elements placed in service	26	29	26	29
New elements end of quarter	39	44	39	-
Special or test elements	27	27	27	-
Depleted shim rods transferred for chemical separation	4	2	4	-
Average percent burnup of rods transferred	77.3	77.8	77.3	-
New shim rod elements start of quarter	6	8	6	-
New shim rod elements received	7	-	7	-
New shim rod elements placed in service	2	2	2	2
New shim rod elements end of quarter	11	6	11	-

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 191 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)
<u>Scheduled</u>		
Regular, end of cycle	1	113.483
Regular, refueling and experiment work	3	22.400
Regular, refueling, maintenance and experiment work	1	7.300
Regular, refueling, isotope and experiment work	1	33.634
Subtotal:	6	176.817
<u>Unscheduled</u>		
Electrical power outage	2	13.550
Human error	1	0.200
Loss of normal off-gas	3	0.083
Subtotal:	6	13.833
TOTAL:	<u>12</u>	<u>190.650</u>

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
1-11-80	4.750	151-E	Shutdown activities included refueling and a special test on Triga-Leu experiment in CP-F9.
1-20-80	113.483	151-F	The shutdown marked the end of operating cycle 151. Shutdown activities included: 1) refueling; 2) the replacement of filters in the reactor and pool primary flow bypass filter columns; 3) the cleaning of the primary side of the pool heat exchanger; 4) the replacement of No. 4 shim-rod drive gear and operator; 5) the replacement of depleted resin in the cation and anion columns of the degasifier demineralizer; 6) the inspection of No. 5 shim-rod gear box; 7) the rearrangement of fuel pins in the Triga-Leu experiment in CP-F9; and 8) the completion of programmed maintenance.
2-11-80	7.300	152-A	Shutdown activities included refueling and the installation of a locating post on the bed plate at the poolside facility P-5, P-6.
2-25-80	4.250	152-B	Shutdown activities included refueling and the installation of a nose cone experiment at poolside facility P-5, P-6 for General Electric.
3-11-80	13.400	152-D	Shutdown activities included: 1) refueling; 2) the removal of Triga-Leu experiment from core position F-9 to rearrange fuel pins in the experiment; 3) the removal of the nose cone experiment from the poolside P-5, P-6 facility, and 4) the installation of ⁹⁹ Mo plating integrity test irradiation in core position E1.
3-24-80	33.634	152-F	Shutdown activities included: 1) refueling; 2) iridium isotope sample work; and 3) the reinstallation of the Triga-Leu experiment in core position F-9.

Table 6. ORR Unscheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
1-18-80	0.200	-	P&E inadvertently cut off the building air supply.
2-26-80	0.033	-	Setback and reverse due to loss of normal off-gas. ^a
3-7-80	8.433	152-C	Insulators failed on main transformer at sub-station 0901 resulting in a power outage. The reactor was refueled.
3-18-80	0.033	-	Setback and reverse due to loss of normal off-gas. ^a
3-18-80	0.017	-	Setback and reverse due to loss of normal off-gas. ^a
3-19-80	5.117	152-E	Power outage caused by backhoe coming in contact with power lines. The reactor was refueled.

^aOccurred during filter bank switching at the Tank Farm.

Table 7. Reductions in ORR Power not Resulting in Shutdowns

Date	Source of Signal	Type of Signal	Lowest Power (MW)	Comments
1-11-80	Low reactor ΔP	Setback	9 MW	The setback was due to erratic control of the reactor primary water bypass system.
1-28-80	Servo demand	Manual	15 MW	The power was lowered to check the accuracy of ΔT .
2-11-80	Servo demand	Manual	6 MW	Scheduled variable power levels to check ΔT on the Triga-Leu experiment in core position F-9.
3-18-80	Low normal off-gas	Setback	6 MW	The readout dropped below the setback point during a filter bank switch at the Tank Farm.

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the complex was satisfactory and only routine maintenance was required as indicated in Table 8. A Reactor Instrument Design Change is given in Table 9.

REACTOR INSTRUMENTATION DESIGN CHANGE

Reactor Instrument and Controls Design Change Memoranda which describes work completed this quarter are tabulated in Table 9.

PROCESS SYSTEM

The performance of the process system was satisfactory and only routine maintenance was required as indicated in Table 10.

MECHANICAL COMPONENTS

The performance of the mechanical components was satisfactory and only routine maintenance was required with the exception of No. 4 shim-rod drive maintenance as listed in Table 11.

EXPERIMENT FACILITIES, GASEOUS WASTE FILTERS, AND CORE CHANGES

Experiment facility usage is given in Table 12. Table 13 summarizes the results of efficiency tests of the various gaseous waste filters. The core configurations used during the quarter are shown in Figs. 1, 2, and 3.

Table 8. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble	Corrective Action
<u>No. 2 Counting-Rate Channel</u>			
1-22-80	Count-rate recorder	Upscale spikes	The recorder amplifier was replaced and slide wire cleaned.
<u>No. 1 Log-N Channel</u>			
3-24-80	Period amplifier	Incorrect readout	The gain was reset.
<u>Servo Channel</u>			
1-22-80	Servo amplifier	Occasional erratic operation	Replaced tubes in amplifier and limit switch power supply.
<u>Process Instrumentation</u>			
1-17-80	Primary pump bearing temperature recorder	Printing mechanism stuck	The printing mechanism was cleaned.
2-14-80	Normal off-gas recorder	Erratic readout	The battery was replaced.
2-14-80	Reactor and pool temperature recorder	High temperature readings	The recorder was calibrated.
2-14-80	Degasifier activity recorder	Erratic readout	The power supply was replaced.
2-21-80	Reactor primary water activity recorder module	Downscale spikes	The module was replaced.
3-21-80	Normal off-gas radiation recorder	Erratic readout	The amplifier was replaced.

Table 9. Reactor I&C Design Change Memo

Memo No.	Date	Subject	General Description
ORR 112, Add. 2	2-20-80	Modification of experiment tie-in system	ORR Change Memo 112 and Addendum 1 authorized modifications to the experiment tie-in system to limit setback requests from certain experiments to a power level of not less than $0.6 N_F$. At that time only one experiment tie-in "E" module was connected to the limited setback circuits. A second "E" module is now included in the limited setback circuits for experimenter's use. The necessary circuit modifications were completed to "E" module unit No. 24 to be used in the limited setback circuit.

Table 10. Process Systems, Maintenance and Changes

Date	Component	Remarks	
<u>Reactor Primary Cooling System</u>			
1-21-80 and 1-22-80	Degasifier demineralizer	Installed new resin in cation and anion columns.	
<u>Reactor Secondary Cooling System</u>			
2-28-80	Acid tank retaining wall	A broken drain line was replaced.	
<u>Pool Primary Cooling System</u>			
1-21-80	Heat exchanger	Removed head for cleaning primary side. Reinstalled after cleaning.	5
<u>Pool Secondary Cooling System</u>			
2-19-80	Cooling tower	Steam tracing lines were repaired.	
3-3-80	Cooling tower	A faulty steam tracing line was replaced.	
<u>Emergency Cooling Systems</u>			
1-23-80	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms were performed and adjustments made where needed.	
3-14-80	No. 3 dc unit	Water was added to the batteries.	

Table 10. Process Systems (Cont'd)

Date	Component	Remarks
<u>Electrical Systems</u>		
1-21-80 through 1-25-80	Miscellaneous panels for electric meters, dc batteries, battery racks control room instrument cabinets, and control room electrical wiring	Routine end-of-cycle inspection and cleaning were performed. Dust filters for the control room instrument cabinets were changed as needed, defective electrical wiring was replaced, and programmed maintenance was completed.
3-17-80	Building 3003 auxiliary electrical blower	Replaced overload relay and fuses. The blower is a backup unit for the main blower that keeps a negative pressure on the Graphite Reactor in Building 3001.
<u>Emergency Electrical Systems</u>		
1-24-80	Diesel generator	The end-of-cycle load test was performed with satisfactory results.
<u>Normal Off-Gas System</u>		
3-18-80	Filter banks	The prefilter and hepa filter were replaced in the west bank. The prefilter was replaced in the east bank.
<u>Cell-Ventilation</u>		
1-24-80	B-9 cubicle	The filters were replaced.

Table 10. Process Systems (Cont'd)

Date	Component	Remarks
<u>Miscellaneous</u>		
1-7-80	Spare hold-down arm	New parts were installed as needed.
1-17-80	Shim-rod handling tool	A new tool was fabricated.
1-18-80	Center pool underwater saw	A rebuilt underwater saw motor with new bearings and seals was installed.
2-4-80	Potable water lines	A break in the potable water line between Buildings 3085 and 3080 was repaired.
2-11-80	Reactor tank access top	New port-hold covers were installed.
2-14-80	Obsolete experiment cleanup	The hydraulic shears were operated for cutting the obsolete experiments in the west pool storage for loading into scrap carrier.
2-21-80	Ionization chambers	Three positioning mechanism gears were reworked.
2-28-80	Grating level water pump	The pump was replaced after becoming defective.
3-13-80	Trane coolers	The coolers were used for the secondary cooling when the ORR operated at 20 MW. The insulation has been removed from all the piping.
3-24-80	No. 4 sump pump	The float switch was replaced.

Table 11. Mechanical Components - Maintenance and Changes

Date	Component	Remarks
1-21-80	No. 4 shim-rod drive assembly	The drive and recocking mechanism No. 3 was replaced with No. 1 unit due to an oil leak. The operator No. C3 was replaced with No. A1 due to a sluggish operating snubber unit.

Table 12. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
C-1	None	6-26-79		Isotopes (iridium samples)	Operations
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production	Operations
E-1	None	3-11-80	3-24-80	⁹⁹ Mo plating integrity test irradiation	Union Carbide Medical Products
E-7	V-5	5-3-79 (Reinstalled)	3-24-80	Nickel based alloys and stainless steels	Metals and Ceramics
F-9	V-4	12-13-79	3-11-80	Test to verify the endurance and integrity of low enriched fuel pins designed for Triga reactors	General Atomics

Table 12. Experiment Facility (Cont'd)

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
F-9	V-4	3-25-80 (Reinstalled)		Test to verify the endurance and integrity of low enriched fuel pins designed for Triga reactors	General Atomics
Poolside Window (P-5)	None	12-14-79	1-14-80	Tritium breeder capsule experiment	Argonne National Laboratory
Poolside Window (P-5)	None	1-31-80	2-9-80	HEDL dosimetry experiment	Westinghouse
Poolside Window (P-5)	None	2-25-80	3-11-80	GE/RESO nose cones	General Electric
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		Neutron diffraction experiment	Instrumentation and Controls

Table 13. Status of Filters - Gaseous Waste System

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
<u>Cell-Ventilation System</u>					
CWS	Overall ^a	North, 6-20-73 South, 1-12-75	3-11-80	DOP	99.997
Charcoal	Both banks	North, 9-16-74 South 10-15-79	10-17-79	Elemental Iodine	99.98
Charcoal	Both banks	North, 9-16-74 South 10-15-79	10-17-79	Methyl Iodide	99.16
<u>Basement Hood Exhaust</u>					
CWS	South	3-10-80	3-11-80	DOP	99.995
CWS	North	3-10-80	3-11-80	DOP	99.997
<u>Normal Off-Gas</u>					
CWS	West	3-18-80	3-18-80	DOP	99.98
Charcoal	West	3-18-80	3-21-80	Elemental Iodine	99.99
CWS	East	11-28-79	3-11-80	DOP	99.99
Charcoal	East	11-28-79	11-29-79	Elemental Iodine	99.98
Charcoal	West	3-18-80	3-25-80	Methyl Iodide	98.30
Charcoal	East	11-28-79	12-3-79	Methyl Iodide	98.83
<u>Pressurizable Off-Gas^b</u>					

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

^bThe POG system is on standby; therefore, all filters test have been discontinued.

ORR LATTICE LOADING

For Fuel Cycles 151-D, -E, -F, 152-A, -B, -C, -D

	1	2	3	4	5	6	7	8	9
A	BE	BE	F	F	F	F	F	BE	BE
B	BE	F	F	SR	F	SR	F	BE	BE
C	ISO	F	AL	F	F	F	AL	F	BE
D	BE	F	F	SR	F	SR	F	HT	BE
E	BE	F	AL	F	AL	F	E	F	BE
F	BE	F	F	SR	F	SR	F	F	E
G	BE	BE	BE	BE	BE	BE	BE	BE	BE

LATTICE COMPONENT

NUMBER

Fuel (F)

27

Shim Rod (SR)

6

Beryllium (BE)

22

Experiment (E)

2

Xenon Sleeve (^{133}Xe)

0

Isotope (ISO)

1

Hydraulic Tube (HT)

1

Aluminum (AL)

4

Fig. 1. ORR Lattice Configuration - January 1, 1980 - March 11, 1980

ORR LATTICE LOADING

For Fuel Cycles 152-E, -F

	1	2	3	4	5	6	7	8	9
A	BE	BE	F	F	F	F	F	BE	BE
B	BE	F	F	SR	F	SR	F	BE	BE
C	ISO	F	AL	F	F	F	AL	F	BE
D	BE	F	F	SR	F	SR	F	HT	BE
E	E	F	AL	F	AL	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 (F)

27

Shim Rod (SR)

6

Beryllium (BE)

22

Experiment (E)

1

Xenon Sleeve (^{133}Xe)

0

Isotope (ISO)

1

Hydraulic Tube (HT)

1

Aluminum (AL)

4

Fig. 2. ORR Lattice Configuration - March 11, 1980 - March 24, 1980

ORR LATTICE LOADING

For Fuel Cycle(s) 152-G

	1	2	3	4	5	6	7	8	9
A	BE	BE	F	F	F	F	F	BE	BE
B	BE	F	F	SR	F	SR	F	BE	BE
C	ISO	F	AL	F	F	F	AL	F	BE
D	BE	F	F	SR	F	SR	F	HT	BE
E	BE	F	AL	F	AL	F	AL	F	BE
F	BE	F	F	SR	F	SR	F	F	E
G	BE	BE	BE	BE	BE	BE	BE	BE	BE

LATTICE COMPONENT

NUMBER

Fuel (F)	<u>27</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>22</u>
Experiment (E)	<u>1</u>
Xenon Sleeve (^{133}Xe)	<u>0</u>
Isotope Stringer (ISO)	<u>1</u>
Hydraulic Tube (HT)	<u>1</u>
Aluminum (AL)	<u>5</u>

Fig. 3. ORR Lattice Configuration - March 24, 1980 - March 31, 1980

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