**Oak Ridge Research Reactor Quarterly Report
April, May, and June of 1977**

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MASTER

OAK RIDGE NATIONAL LABORATORY
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OPERATIONS DIVISION

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

APRIL, MAY, AND JUNE OF 1977

Date Published - January 1978

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SUMMARY

The ORR operated at an average power level of 29.8 MW for 28.2% of the time during April, May, and June of 1977. Ten fuel elements were declared spent (56.0% burnup) during the quarter, while eight new elements were placed in service. Two shim-rod elements were retired from service at an average burnup of 72.0%.

The reactor was shut down on twelve occasions, one of which was unscheduled. Reactor downtime needed for refueling, maintenance and checks was quite low, with the reactor remaining available for operation 85.0% of the time.

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

In-service inspections completed during the quarter included:

1. Examination of welds in the reactor vessel on June 2, 1977.
2. Inspection of pipe welds in the ORR in June, 1977.

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: April, May, and June of 1977

	This Quarter	Last Quarter	Year To Date	January- June, 1976
Total energy, MWd	763.0	620.4	1,383.4	4,689.2
Average power, MW/operating hr	29.8	29.2	29.5	29.8
Time operating, %	28.2*	23.6*	25.9*	86.4
Availability, %	85.0	87.0	86.0	93.1
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	21,700	26,300	24,000	28,800
Pool water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	458	690	574	595
Reactor water resis- tivity, ohm-cm (av)	2,607,200	2,038,000	2,322,600	833,000
Pool water resis- tivity, ohm-cm (av)	2,094,800	1,730,000	1,912,400	749,000
Fuel elements depleted	10	5	15	11
Average burnup of fuel elements depleted, %	56.0	56.3	56.1	56.0
Shim rods depleted	2	0	2	6
Average burnup of shim rods depleted, %	72.0	0	72.0	63.5
Radioisotope samples	0	1	1	2
Research samples	0	1	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)
137	March 13, 1977	April 29, 1977	767.4*
138	May 20, 1977	June 17, 1977	299.3

*463.7 MWd this quarter.

FUEL USAGE AND INVENTORY

Ten fuel elements and two shim-rod elements were spent during the quarter. Eleven fuel elements and four shim-rod elements were transferred to the 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	Jan.-June 1977	Jan.-June 1976
Depleted fuel elements transferred for chemical separation	11	0	11	45
Average percent burnup of fuel elements transferred	56.5	0	56.5	52.0
New fuel elements placed in service	8	5	13	53
New fuel elements available for use	50*	58	0	0
Depleted shim rods transferred for chemical separation	4	0	4	6
Average percent burnup of shim rods transferred	65.7	0	65.7	65.0
New shim rods placed in service	2	0	2	6
New shim rods available for use	0	2		

*Includes four partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 1,568 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	2	813.383
Regular, completed a startup for checking proper operation of reactor instrumentation, experiment installed (shutdown continued from March, 1977)	1	57.250
Regular, refueling and experiment work	2	232.767
Regular, iodine removal and experiment work	1	83.783
Regular, completed a startup for checking proper operation of reactor instrumentation	2	107.801
Special, for investigation of problems related to the reverse circuit	2	28.000
Special, end of a training startup and continuation of regular shutdown work	<u>1</u>	<u>244.750</u>
Subtotal	11	1,567.734
Unscheduled		
Human error	<u>1</u>	<u>0.083</u>
Subtotal	<u>1</u>	<u>0.083</u>
Total	<u>12</u>	<u>1,567.817</u>

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks	
4-1-77 through 4-3-77	57.250		The shutdown continued from March 21, 1977. An experiment for GE was installed in the reactor front face facility P-5 and P-6 positions.	
4-3-77 and 4-4-77	25.883		I&C troubleshooting; investigation of problem with the reverse circuit.	
4-4-77	2.117		I&C continued checks of the reverse circuit.	
4-8-77 and 4-9-77	9.384	137-B	The reactor was shut down to permit the reinstallation of a nose cone experiment cannister at pool-side. Refueling of the reactor was necessary.	
4-15-77 through 4-24-77	223.383	137-C	End of experiment run for GE. The reactor was refueled.	5
4-29-77 through 5-20-77	498.383	137-D	The shutdown marked the end of cycle 137. Shutdown activities included: (1) the replacement of a faulty reverse switch on the No. 2 ΔT recorder; (2) the installation of new mechanical seals on the north facility pump; (3) the installation of a new selsyn motor on the No. 1 reactor primary motorized valve; (4) the addition of shore plates in the pipe trench north of the reactor primary pump house; (5) the installation of new batteries on the dc system in No. 3 reactor primary pump cell; and (6) programmed maintenance and refueling.	
5-20-77 through 5-22-77	41.567	137-D cont.	End of cycle 137 shutdown work was completed following a low power test run for checking start-up instruments including the new noise monitor.	

Table 5. (Continued)

Date	Duration (hr)	End Cycle	Remarks
5-27-77 through 5-31-77	83.783		Isotope (iodine xenon) work was completed. Maintenance work included examination of welds in the ORR reactor vessel and inspection of pipe welds. Refer to In-Service Inspection listed in this report.
5-31-77 through 6-10-77	244.750		The shutdown as listed above (5-27-77) continued after a training start-up of the reactor was made to certify a new reactor operator.
6-10-77 through 6-13-77	66.234		The shutdown of 5-27-77 continued following a short power run for checking a new alarm and setback switch that were installed on the No. 3 safety recorder.
6-17-77 through 6-30-77	315.000	138-A	This shutdown marked the end of cycle 138. Shutdown activities included: (1) the repair of an in-pool air leak on the north experiment facility; (2) the radiography of welds on the reactor primary water lines in the pipe chase and pump cells Nos. 1, 2, and 3 after the primary water system had been drained; (3) the inspection of the 24" strainer; and (4) programmed maintenance.

Table 6. ORR Unscheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
5-22-77	0.083		Human error. Failed to start the reactor secondary cooling water pumps when starting the reactor up to full power (30 MW). A setback and reverse was initiated by contacts in the primary reactor water exit temperature recorder.

Table 7. Reductions in ORR Power Not Resulting in Shutdowns

Date	Source of Signal	Type of Signal	Lowest Power (MW)	Comments
4-3-77	Reverse circuit	Reverse	N _L	See below.
4-3-77	Reverse circuit	Reverse	N _L	See below
4-4-77	Reverse circuit	Reverse	N _L	The unscheduled reverses most probably were caused by dirty recorder contacts in the auxiliary reverse circuit. The intermittent nature of the trouble made analysis difficult.
4-4-77	Manual	Setback	27	The reactor power was lowered from 30 MW to 27 MW to permit replacement of chart paper on the temperature monitor.

Table 7. (Continued)

Date	Source of Signal	Type of Signal	Lowest Power (MW)	Comments
5-22-77	Setback	Automatic	11	When starting the reactor to full power at 24 MW the reactor primary water bypass valve closed due to demand for cooler water. The ΔP decreased to the 22.9 psi setpoint.
5-22-77	Setback	Automatic	21	When raising the power from 27 to 30 MW, an overshoot in Nos. 1 and 2 safeties to setpoint of 110 was experienced - cause unknown.

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 8.

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 configuration used during the quarter is shown in Figure No. 1.

ORR LATTICE LOADING
For Fuel Cycles 137B, 137C, 137D, and 138A

	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	SR	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 - April 1, 1977
through June 30, 1977.

Table 8. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble	Corrective Action
No. 1 Counting-Rate Channel			
4-25-77	Recorder chart drive	Inoperative	The chart drive motor was replaced.
5-11-77	Recorder	Erratic readout	The recorder amplifier was replaced.
6-16-77	Counting-rate meter pre-amplifier	Erratic readout	The pre-amplifier was replaced.
No. 2 Counting-Rate Channel			
			No maintenance or changes were required.
No. 1 Log-N Channel			
			No maintenance or changes were required.
No. 2 Log-N Channel			
5-31-77	Log-N recorder	Erratic readout	The balance motor 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			
4-4-77	Safety recorder	Erratic readout	The level switch was adjusted to read 100% of power at 30 MW.

Table 8. (Continued)

Date	Component	Trouble	Corrective Action
No. 3 Safety Channel (Continued)			
6-1-77	Safety recorder alarm and set-back switches	Dirty or faulty switches	New switches were installed and adjusted to the proper setpoints.
Magnetic Amplifiers			
			No maintenance or changes were required.
No. 1 Gamma Channel			
5-23-77	Recorder	Erratic readout	The faulty recorder amplifier was replaced.
No. 2 Gamma Channel			
			No maintenance or changes were required.
North ^{16}N and South ^{16}N Channels			
			No maintenance or changes were required.
Servo Channel			
5-31-77	Servo amplifier	Erratic readout at recorder	The faulty amplifier was replaced.

Table 8. (Continued)

Date	Component	Trouble	Corrective Action
Reactor Noise Monitor			
5-13-77			The flux noise monitor was relocated from amplifier cabinet "A" to amplifier cabinet "C" and removed from chamber position No. 8 to the micro-micrometer chamber in position No. 5. These changes were in accordance with Reactor Controls Design Request No. ORR 76-2.
Process Instrumentation			
4-1-77	No. 2 outlet temperature recorder	Faulty setback, alarm and scram switches	The switches were replaced.
4-4-77	No. 1 outlet temperature recorder	Faulty setback switch	The switch was replaced.
5-4-77	No. 2 ΔT recorder	Inoperative chart drive and faulty reverse switch	The reverse switch and chart drive motor were replaced.
5-10-77	No. 2 ΔT channel	Inaccurate ΔT measurement	A new resistance bulb was installed.
5-12-77	Normal off-gas (NOG) temperature recorder	Inoperative chart drive	The chart drive motor was replaced.

Table 8. (Continued)

Date	Component	Trouble	Corrective Action
Process Instrumentation (Continued)			
5-23-77	Normal off-gas (NOG) temperature recorder	Loss of power to recorder	A blown fuse was replaced - cause undetermined.

Table 9. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Water System		
4-1-77	No. 1 heat exchanger	A ruptured gasket on the west head was replaced.
4-6-77	Heat exchanger pit	A leak in valve 129-A was repaired.
4-13-77 through 4-21-77	Degasifier system	The pump motor was sent to the maintenance shop for replacement of faulty bearings.
4-22-77	No. 1 primary water pump motor	The timer delay relay coil burned out. A replacement could not be located; so until one could be ordered, an agastat was removed from one of the standby Trane Coolers and installed. Service was satisfactory.

Table 9. (Continued)

Date	Component	Remarks
Reactor Primary Water System (Continued)		
4-27-77	Decay tank	An audio inspection of the decay tank was performed. There was no change in results since the last inspection.
5-3-77	North facility pump	New mechanical seals were installed.
5-4-77	No. 1 primary motorized valve	A new selsyn motor was installed.
5-11-77	No. 3 primary pump	A new 220-volt coil was installed in the starter circuit.
6-1-77 through 6-2-77	Reactor vessel	Inspection Engineering made ultrasonic tests on vessel welds and vessel head stud bolts. No defects were found.
6-2-77	Primary water lines (pipe chase)	Inspection Engineering ultrasonically measured the thickness of welds for reference when radiographs are made.
6-7-77	Reactor vessel access cover	A new O-ring was installed.
6-27-77 through 6-30-77	Reactor primary water lines	Pipe welds on line 101 in the pipe chase and on inlet and exit piping at the primary pumps were inspected using X-ray techniques. The resulting films will be compared with previously obtained films and/or will be retained for future comparisons. No serious defects were found.
6-27-77	24" strainer	The top was removed for an inspection.

Table 9. (Continued)

Date	Component	Remarks
Reactor Primary Water System (Continued)		
6-27-77 and 6-28-77	Water lines at T-pit and Y-pit	The flanges were removed at these locations to allow inspection and to permit flushing of the lines.
Reactor Secondary Cooling System		
5-2-77	Pool primary strainers	Routine programmed inspection was performed on the pool primary inlet, pool demineralizer inlet, pool cation inlet, and the exit from the pool demineralizer.
Pool Secondary Cooling System		
5-10-77	Cooling tower	A new ball float valve was installed at the basin.
5-18-77	Cooling tower	The inside of the lines to the pH probes were cleaned so that an accurate pH readout could be obtained.
Emergency Cooling System		
5-5-77	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms confirmed that the systems were in satisfactory condition.
5-6-77	No. 3 pump cell	All batteries were replaced with new batteries.

Table 9. (Continued)

Date	Component	Remarks
Electrical Systems		
5-5-77	Miscellaneous breaker panels for electric motors, dc batteries, battery racks, and control room instrument cabinets	Routine end-of-cycle inspection and cleaning were performed. Dust filters for the control room instrument cabinets were changed as needed, and programmed maintenance was completed.
Emergency Electrical System		
5-7-77	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
5-18-77	Diesel generator	The diesel was actuated to supply power to the emergency bus in checking the relay in the fire alarm system.
Normal Off-Gas System		
6-2-77	Filters, west bank	New hepa, roughing, and charcoal filters were installed in the west bank.
Miscellaneous		
4-19-77	Constant air monitron, ORR first level south	The pump motor, which was faulty, was replaced.
5-4-77	Area sump No. 5	A new pump was installed.
5-4-77	Pipe trench at north of reactor primary pump house	Additional shoring (metal plate) was installed.

Table 9. (Continued)

Date	Component	Remarks
Miscellaneous (Continued)		
5-9-77	Flanges in reactor pool	Excess gasket material was trimmed from flanges on the north and south walls of the pool.
5-10-77	Shim rod gear box	The sight glass fittings on the oil reservoirs were tightened.
5-19-77 and 5-20-77	Bldg. 3042 elevator	An emergency light was installed. It is a battery light and will come on when TVA power is interrupted.
6-22-77 through 6-24-77	North engineering test facility	The gasket air-purge line (inlet side) was repaired.
6-28-77	Area sump No. 1	The pump in this sump was rewired.

Table 10. Reactor Mechanical Components, Maintenance and Changes

Date	Component	Remarks
4-30-77	South hold-down arm	Hold-down arm No. 1 was removed and replaced with No. 3 which had been rebuilt.

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, 1-12-75	3-25-77	DOP	99.996
Charcoal	Both banks	North, 9-16-74 South, 10-17-67	3-1-77	Elemental Iodine	99.900
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	3-25-77	DOP	99.894
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	3-25-77	DOP	99.998
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 11. (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
Normal Off-Gas					
CWS	West	6-2-77	6-2-77	DOP	99.996
Charcoal	West	6-2-77	6-2-77	Elemental Iodine	99.993
CWS	East	1-26-77	3-25-77	DOP	99.997
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 12. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
L-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production and short term irradiations	Operations
E-7	V-5	8-4-76		Radioisotopes (iodine & xenon)	Operations
F-5 and P-6	None	4-3-77	4-15-77	Nose cones	General Electric
EB-3	None	11-1-58		Neutron diffraction experiments	Solid State Physics
HE-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

IN-SERVICE EXAMINATION OF WELDS
IN THE ORR REACTOR VESSEL, JUNE 2, 1977

By

The Department of Quality Assurance and Inspection

The accessible sections of the longitudinal and circumferential welds in the top tank section of the ORR reactor vessel were ultrasonically inspected. The scanning level was performed in accordance with I-5112, Article I-5000, Section IX of the ASME Code and no indications were found as great as the indications received from the calibration block.

The calibration block for this examination was as shown in Fig. I-3131 of Section XI with the following exceptions:

- (1) the block thickness was 1-1/2"; and
- (2) the calibration holes were 1/8" diameter.

The welds and adjacent sections of the base metal were scanned at 0° and 45° from the inside surface of the reactor vessel.

Scanning was performed with the use of a hand-held examination device to which the transducer head had been attached. The attached sketches (Figures 2, 3, and 4) indicate the approximate extent of the coverage.

In addition, the 42 top studs were ultrasonically inspected and no indications were found as great as the indication received from the side of a 1/4" diameter hole in the reference standard.

Figure 2. Ultrasonic Examination of North Side of Upper Tank Section of ORR Reactor Vessel
 (inaccessible areas - no ultrasonic inspection)

(~~Un~~inaccessible areas - no ultrasonic inspection)

Figure 4. Ultrasonic Examination of East Side of
Upper Tank Section of ORR Reactor Vessel
(inaccessible areas - no ultrasonic inspection)

IN-SERVICE INSPECTION OF PIPE WELDS

IN THE ORR IN JUNE, 1977

By

The Department of Quality Assurance and Inspection

Welds in the primary coolant lines in the pipe chase below the reactor and in the pump house were examined by radiography. A total of 142 exposures were made on 45 welds. These totals include:

- (1) 46 exposures of 11 circumferential welds in the pipe. Complete coverage was achieved on 4 of these welds.
- (2) 12 exposures of 10 longitudinal welds in the pipe chase. These exposures were taken where the longitudinal welds join a circumferential weld.
- (3) 84 exposures of 24 welds on the discharge side of the pumps in three pump rooms. Complete coverage was achieved on 21 of these welds.

Results:

Pipe Chase - One radiograph revealed several cracks appearing in longitudinal weld #3(L3) near where it joins circumferential weld #2(W2). See attached sketch (Figure 5) for location. These cracks are generally transverse to the weld, short in length, and confined to a small area (<1" sq.).

Pump-Rooms #1, #2, and #3 - Radiographs were compared with those taken in 1973 and 1974. They show no evidence of new cracks or growth of existing flaws. See attached sketches (Figures 6, 7, and 8) for location of welds radiographed.

Figure 5. RADIOGRAPHIC LAYOUT ORR PRIMARY PIPE
NEAREST EAST WALL PIPE CHASE - P-1
(Welds Radiographed in ORR in June, 1977)

ORR-PUMP ROOM #1

Figure 6. Welds Radiographed in June, 1977

ORR PUMP ROOM #2

Figure 7. Welds Radiographed in June, 1977

JRR PUMP ROOM #3

Figure 8. Welds Radiographed in June, 1977

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