**Oak Ridge Research Reactor Quarterly Report
October, November, and December of 1975**

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

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

OCTOBER, NOVEMBER, AND DECEMBER OF 1975

S. S. Hurt, III

E. D. Lance

JULY 1976

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SUMMARY

The ORR operated at an average power level of 29.9 Mw for 84.9% of the time during October, November, and December of 1975. Eleven fuel elements were declared spent (52.5% average burnup) during the quarter, while twenty-nine new elements were placed in service. Four shim-rod elements were retired from service at an average burnup of 63%.

The reactor was shut down on eight occasions, all of which were scheduled. Two end-of-cycle shutdowns accounted for 80.7% of the total downtime. The remaining downtime was used principally for refueling and experiment work.

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

Special tests or measurements during the quarter included:

- (1) Flux mapping for core No. 129A
- (2) Determination of minimum fuel content in ORR fuel elements prior to declaring the element spent
- (3) Reactor vessel, ultrasonic test, and
- (4) Visual inspection of ORR primary pump.

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, while Figures 1, 2, and 3 are plots of shim-rod position versus time for these cycles.

Table 1. ORR Basic Operating Data
October, November, and December 1975

	This Quarter	Last Quarter	Year To Date	Calendar Year 1974
Total energy, Mwd	2,333.4	2,394.1	9,282.6	8,450.7
Average power, Mw/operating hr	29.9	29.8	29.8	29.6
Time operating, %	84.9	87.2	85.6	78.8
Availability, %	86.7	89.7	88.9	82.1
Reactor water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	27,600	30,500	29,725	26,550
Pool water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	640	610	647	505
Reactor water resistivity, ohm-cm (av)	1,050,000	861,000	902,750	815,000
Pool water resistivity, ohm-cm (av)	761,000	801,000	783,250	757,500
Fuel elements depleted	11	28	84	110
Average burnup of fuel elements depleted, %	52.5	51.5	52.3	48.9
Shim rods depleted	4	2	14	12
Average burnup of shim rods depleted, %	63.0	65.5	64.2	62.4
Radioisotope samples	1	6	7	8
Research samples	8	18	26	39

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (Mwd)
127	August 16, 1975	October 5, 1975	1,342.1*
128	October 10, 1975	December 4, 1975	1,625.0
129	December 11, 1975	In Progress	568.4

*140.0 Mwd this report period.

Fig. 1. Shim Rod Position vs. Time (Cycle No. 127)

Fig. 2. Shim Rod Position vs. Time (Cycle No. 128)

Fig. 3. Shim Rod Position vs. Time (Cycle No. 129)

FUEL USAGE AND INVENTORY

Twenty-nine new fuel elements were placed in service during the quarter and eleven were declared spent with an average burnup of 52.5%. Seventeen fuel 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	Calendar Year 1975	Calendar Year 1974
Depleted fuel elements transferred for chemical separation	17	28	138	24
Average percent burnup of fuel elements transferred	53	49.6	49.5	46.5
New fuel elements placed in service	29	42	104	59
New fuel elements available for use	63*	23		
Depleted shim rods transferred for chemical separation	0	6	18	4
Average percent burnup of shim rods transferred	-	63.6	64.5	86.4
New shim rods placed in service	4	2	14	12
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 342 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 power reductions which did not result in a shutdown.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hrs)
Scheduled		
Regular, end of cycle	2	276.050
Regular, refueling, iodine removal and experimental work.	4	36.483
Regular, refueling, iodine removal, maintenance, and experimental work.	1	11.250
Special, end of flux runs and completion of end-of-cycle shutdown.*	<u>1</u>	<u>18.250</u>
Subtotal	8	342.033
Unscheduled		
Subtotal	<u>0</u>	<u>0</u>
Total	8	342.033

* The special shutdown occurred during the regular end-of-cycle No. 128 shutdown following special test.

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
10-5-75	120.767	127D	This shutdown marked the end of cycle 127. Shutdown activities included: (1) the locating and repairing of a leak in the reactor primary water system on the discharge header downstream from the No. 3 primary water pump, (2) the replacement of worn belts and nuts on the secondary cooling tower, (3) the installation of a new flexible cable running from the reactor secondary tower north fan motor to the north cooling fan, (4) the removal of the obsolete float mechanism in the reservoir tank for the pool demineralizer, (5) the replacement of the manual make-up water valve to pool secondary cooling tower basin, (6) the installation of a new electrical breaker for the pool cooling tower fan and water pump, (7) the installation of piping connecting No. 4 sump drain to the process drain with valve arrangement for water to be sent to the process waste system in case of a leak in the reactor primary water system in this area, and (8) the installation of a button on the left incline panel of the reactor console for testing of all annunciator telealarm stations simultaneously.
10-17-75	7.350	128A	The reactor was refueled and isotope (iodine, xenon) work was completed. Experiment work consisted of (1) removal of an experiment in poolside P-5 position, (2) the installing of a nose cone experiment in poolside P-5, P-6 ⁰ position, and (3) the installing of silicon samples in CP-E5.
10-20-75	5.633	128B	The reactor was refueled. Experiment work consisted of installing a nose cone experiment in poolside P-5, P-6 position.

Table 5 (continued)

Date	Duration (hr)	End Cycle	Remarks
11-3-75	11.250	128C	The reactor was refueled and isotope (iodine, xenon) work was completed. Experiment work consisted of (1) the removal of silicon samples from CP-E5, (2) the installation of a new experiment in poolside P-4A position, and (3) the installation of an experiment in poolside P-5 position. Maintenance work consisted of (1) alignment of motor on the reactor degasifier pump, and (2) the replacement of a faulty relay on the No. 2 dc emergency cooling system.
11-19-75	7.517	128D	The reactor was refueled, isotope (iodine, xenon) work was completed. Experiment work consisted of installing flux monitors in the poolside P-7, P-8 position.
12-5-75	155.283	128E	This shutdown marked the end of cycle 128. Shutdown activities included (1) the repairing of a leak in the reactor primary water system which was discovered on 12-4-75 (the leak was near the Y-pit in the pump house area), (2) the installation of new water seals in the No. 2 reactor primary water pump, (3) the replacement of a faulty No. 3 safety chamber with a new chamber, (4) the installation of an experiment in CP-B8, (5) the removal and installation of an experiment in poolside P-5 position, (6) the removal of an experiment from CP-C3, (7) the removal of the pneumatic tube from poolside P-9+ position, and (8) the installation of a nose cone experiment in poolside P-7, P-8 position.
12-11-75	18.250	--	The shutdown terminated the flux mapping of the reactor core and the shutdown work remaining from end-of-cycle 128 was completed.
12-30-75	15.983	129A	The reactor was refueled and isotope (iodine, xenon) work was completed. Experiment work consisted of installing a nose cone experiment in poolside P-7, P-8 position.

Table 6. Reductions in ORR Power Not Resulting in Shutdowns

Date	Source of Signal	Type of Signal	Lowest Power (mw)	Comments
10-19-75	Servo demand	Manual	N _L	The reactor power was reduced for removal of a nose cone experiment from the front face of the reactor.
10-21-75	Servo demand	Manual	3 MW	The reactor power was reduced for removal of a nose cone experiment from the front face of the reactor.
12-23-75	Servo demand	Manual	15 MW	The reactor power was reduced for removal of a nose cone experiment from the front face of the reactor.

PROCEDURES, ADDITIONS, AND/OR REVISIONS

Additions or revisions to the procedure manual during the quarter are listed in Table 7.

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 8. Table 9 reflects the status of the various fission and ionization chambers.

Table 7: Additions and/or Revisions to the ORR Operating Manual

Date	Section	Title	Pages	Reason for Addition or Revision
9-17-75	1	Operating Procedures	1-7, 8, 31 & 32	Revisions
9-17-75	2	Instrumentation and Controls	2-13, 14, 19d, 19e, 31, and 32	Revisions and Corrections
9-17-75	5	ORR Water Cooling System	5-3→6, 11, 12, 17, 18, 49b, 50, 55→60, 65→68, 71, 72, 72c→76, 79, 80, 101, 102, 107, 108, 115→120, 135j→138a, 141→144, 147→150, 157→162, 165, 166, 169, 193, 194, 199→202; 205 & 205a	Revisions and Additions
9-17-75	6	Special Procedures	6-61 and 62	Revision
9-17-75	7	Emergency Procedures	7-1, 2, 2c, 2d, 2g, 2h, 3→6b, 11b, 12, 17→17q, 17t, 17u, 24e→26, 31, 32, 37J, 37K, 37V, & 38	Revisions and Corrections
9-17-75	8	Records	8-11, 12, 17→20, 25→38, 41→44, 65, 66, & 75→78	Revisions and Additions
9-17-75	9	Facility Radiation and Contamination Alarm System	9-1, 2, 3→6, 11, 12, 17→20	Revisions and Additions

Table 8. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble or Change	Reason or Maintenance
No. 1 Counting-Rate Channel			
11-7-75	Count rate recorder	Chart drive not turning	The chart drive motor was replaced to correct the trouble.
No. 2 Counting-Rate Channel			
			No maintenance or changes were required.
No. 1 Log-N Channel			
			No maintenance or changes were required.
No. 1 Safety Channel			
10-27-75	Safety recorder	Slow power response	The recorder slidewire and contacts were cleaned.
12-1-75	Safety recorder	Recorder response failure	The slidewire was cleaned to correct the trouble.
No. 2 Safety Channel			
			No maintenance or changes were required.
No. 3 Safety Channel			
11-3-75	Safety chamber cable drive	Faulty cable drive	The cable drive was replaced to correct the trouble.

Table 8 (continued)

Date	Component	Trouble or Change	Reason or Maintenance
No. 3 Safety Channel			
12-12-75	Safety chamber	Erratic readout	Chamber PCP-II-1-6-66-3 in position 4 was replaced with chamber CTC-2(C-768) in position 3.
Magnet Amplifiers			
			No maintenance or changes were required.
Nos. 1 and 2 Gamma Channels			
			No maintenance or changes were required.
North N ¹⁶ and South N ¹⁶ Channels			
			No maintenance or changes were required.
Micromicroammeter Channel			
			No maintenance or changes were required.
Servo Channel			
			No maintenance or changes were required.
Process Instrumentation			
10-24-75	Primary pump bearing temperature recorder	Faulty chart drive cable	The chart drive cable was replaced.

Table 8 (continued)

Date	Component	Trouble or Change	Reason or Maintenance
Process Instrumentation			
10-3-75	Reactor water resistivity Dynalog	Erratic readout	The dynalog was retubed.
12-2-75	Reactor secondary P.H. recorder amplifier	Replacement	The faulty recorder amplifier was replaced.
11-20-75	No. 2 ΔT recorder amplifier	Replacement	The amplifier was replaced to correct an erratic readout.

Table 9. Present Status of Ionization Chambers and Fission Chambers

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
Installed Chambers					
PCP-III-106-66-9	Position 7	No. 1 safety and No. 2 Log N	September, 1966 (safety)	None	No trouble; fabricated at ORNL. Compensated section used from February, 1969, until March, 1970, as No. 1 log N. Used as No. 2 log N from May 28, 1973.
CTC-2 (C-768)	Position 3	No. 3 safety	December 12, 1975	LITR-BSR	Served as LITR safety chamber from February, 1963, to July, 1965. Modified for underwater service in 1969. Installed in the BSR in April, 1970, and in August the chamber was removed to storage.
PCP-III-106A, SN-72-3	Position 2	No. 2 safety and No. 1 log N	May 15, 1975	None	None.
PCP-II-106-66-3	Position 4	No. 3 safety	May, 1974 (safety) March, 1970 (log N) Removed from service December 12, 1975	None	Fabricated by ORNL; chamber failed December 12, 1975.

Table 9 (continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
PCP-II-106-63-4	Position 5	Servo and micromicro- ammeter	June, 1964	None	No trouble; fabricated by ORNL.
TSM-2-F45	Poolside	No. 1 counting rate north	August 8, 1975	ORR	Used as No. 1 counting rate from April 26, 1971, until December 5, 1972.
CTC-5 (C-770)	Position 8	Chamber dis- connected	October, 1971	LITR	Used as No. 1 safety at the LITR; modified for ORR-BSR underwater ser- vice.
PCP-II-105-63-2	Poolside, south	No. 1 gamma, south	April 26, 1972	ORR	Used as No. 2 gamma, north, from April, 1964, until December, 1970.
PCP-II-105-63-3	Poolside, north	No. 2 gamma, north	August 17, 1971	ORR	Used as No. 1 gamma, south, from April, 1964 until March, 1970.
TSM-3-F29	Poolside	No. 2 count- ing rate	October 24, 1972	None	Replaced fission chamber "snake" assembly TSM- 1-F52.
Spare Chambers					
PCP-II-105-63-1	Instrumenta- tion and controls shop	Awaiting repair	April 26, 1972	ORR	Used as No. 1 gamma, south, from March 31, 1970, until April 26, 1972.

Table 9 (continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
S27-34R-F29	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 1 counting rate from July 28, 1970, to April 26, 1971.
S3-8R-F22	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 2 counting rate from January 14, 1970, to April 26, 1971.
TSM-1-F52	ORR plug storage	Awaiting repair	December 5, 1973		Used as No. 2 counting rate (south) from April 26, 1972, until October 24, 1972.
CTC-1	Instrumenta- tion & Controls Shop	Awaiting repair	October, 1971	ORR	Used as noise monitor from March, 1962, until October 1, 1971.
CTC-4 (C-769)	ORR plug storage			LITR	Used as No. 2 safety in the LITR; modified for ORR-BSR underwater ser- vice.
PCP-III-106-66-5	Instrumenta- tion & Controls Shop	Awaiting repair		ORR	Used as No. 2 safety and log N from September 27, 1968, to July 22, 1970, and from May 7, 1971, to May 20, 1971; from November, 1971, to January 24, 1973, as No. 2 safety and until May 28, 1973, as No. 2. log N.

PROCESS SYSTEM AND MECHANICAL COMPONENTS

Details of maintenance or changes to the process system are given in Table 10. Table 11 summarized the results of efficiency tests of the various gaseous waste filters. There were no repairs or changes related to the reactor mechanical components (drives, bearings, etc.). Table 12 summarized the condition of corrosion test samples that were removed from the secondary systems following extended exposure to the secondary water.

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility usage is given in Table 13. The core configurations used during the quarter are shown in Figure Nos. 4, 5, 6, 7, and 8.

	1	2	3	4	5	6	7	8	9
A	Be	Be	^{131}I	F	F	F	Be	Be	Be
B	Be	F	F	SR	F	SR	F	Be	Be
C	Be	F	E	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	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	<u>27</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>25</u>
Experiment (E)	<u>3</u>
Iodine Sleeve (^{131}I)	<u>1</u>
Isotope Stringer (Iso)	<u>0</u>
Hydraulic Tube (HT)	<u>1</u>

Fig. 4. ORR Lattice Configuration (Fuel Cycle No. 128A)

	1	2	3	4	5	6	7	8	9
A	Be	Be	^{131}I	F	F	F	Be	Be	Be
B	Be	F	F	SR	F	SR	F	Be	Be
C	Be	F	E	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	F	E	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)	25
Experiment (E)	4
Iodine Sleeve (^{131}I)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Fig. 5. ORR Lattice Configuration (Fuel Cycle No. 128B, C)

	1	2	3	4	5	6	7	8	9
A	Be	Be	^{131}I	F	F	F	Be	Be	Be
B	Be	F	F	SR	F	SR	F	Be	Be
C	Be	F	E	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	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

LATTICE COMPONENTNUMBER

Fuel

27

Shim Rod (SR)

6

Beryllium (Be)

25

Experiment (E)

3Iodine Sleeve (^{131}I)1

Isotope Stringer (Iso)

0

Hydraulic Tube (HT)

1

Fig. 6. ORR Lattice Configuration (Fuel Cycle No. 128D)

	1	2	3	4	5	6	7	8	9
A	Be	Be	^{131}I	F	F	F	F	F	Be
B	Be	F	F	SR	F	SR	F	Be	Be
C	Be	F	E	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	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

LATTICE COMPONENTNUMBER

Fuel

29

Shim Rod (SR)

6

Beryllium (Be)

23

Experiment (E)

3Iodine Sleeve (^{131}I)1

Isotope Stringer (Iso)

0

Hydraulic Tube (HT)

1

Fig. 7. ORR Lattice Configuration (Fuel Cycle No. 128E)

	1	2	3	4	5	6	7	8	9
A	Be	Be	^{131}I	F	F	F	F	F	Be
B	Be	Be	F	SR	F	SR	F	E	Be
C	Be	Be	F	F	F	F	F	F	Be
D	Be	F	F	SR	F	SR	F	HT	Be
E	Be	F	E	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

LATTICE COMPONENTNUMBER

Fuel

28

Shim Rod (SR)

6

Beryllium (Be)

24

Experiment (E)

3Iodine Sleeve (^{131}I)1

Isotope Stringer (Iso)

0

Hydraulic Tube (HT)

1

Fig. 8. ORR Lattice Configuration (Fuel Cycle No. 129A)

Table 10. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Cooling System		
10-6-75 through 10-10-75	Discharge manifold for the reactor primary water pumps	Part of the concrete and gravel was excavated starting at the north end of the pumphouse. On 10-9-75, the discharge water line was exposed enough for leak checking. A leak was found approximately two feet south of the No. 3 pump cell north wall on the 24" discharge manifold header at a 5:30 o'clock position looking north. The leak was repaired from inside the water line by drilling and tapping with a one-fourth inch stainless steel plug. The repairs had to be made from inside the line because of rock on the outside being too close to the area in which the leak had been located.
10-6-75 through 10-9-75	Reactor vessel weld checking	Ultrasonic equipment was used with very little success because of too many obstructions in and around the reactor vessel.
11-3-75	Degasifier	The motor to the pump was aligned.
12-1-75 through 12-6-75	Discharge manifold for the reactor primary water pumps	The primary cooling piping from the north end of the pumphouse (Bldg. 3085) to the Y-pit was exposed for leak checks. On 12-4-75, a primary water leak was uncovered near the Y-pit area. The leak was in the weld on the water line that branched off and was formerly used when the Trane coolers were in service. Because of the water leak, the end-of-cycle shutdown was changed to 12-5-75 instead of the planned 12-7-75. The leak area was cleaned and rewelded. A three foot section of water line leading to the Trane coolers was cut off and a flange placed on the line. Another leak was found in the 24 in. line approximately 18 in. south of the 8 in. emergency gasoline pump line at a 3:00 o'clock position looking north. The leak was repaired by drilling the hole, tapping and installing a three-eighths inch stainless steel plug.

Table 10 (continued)

Date	Component	Remarks
Reactor Primary Water System		
12-5-75 through 12-10-75	No. 2 primary water pump	New water seals were installed.
12-15-75 through 12-31-75	Primary cooling system in the primary pump area (discharge manifold & 24 inch line to the Y-pit)	Excavation of gravel and dirt from around the 24" line from the north side of the pumphouse to the Y-pit was completed. Concrete walls on each side of the line are being installed. The object of the work is to expose the line for inspection and provide the line with supports. Boiler plate will be placed over the opening. Also the pump discharge manifold inside the pumphouse (Building 3085) will be exposed for inspection in a similar manner.
Reactor Secondary Cooling System		
10-6-75 through 10-9-75	Cooling tower	All corroded bolts and nuts were replaced. A new flexible conduit was installed running from the north cooling fan motor to the cooling fan. Oil was changed in the north and south cooling fan gear boxes.
10-10-75	Cooling tower, north fan motor	The new flexible conduit that was installed on 10-26-75 failed, causing the vibration switch to open. The faulty conduit was replaced and satisfactory checks were performed.
10-13-75	Acid addition system	A faulty check valve on the discharge line was replaced. The No. 2 acid addition pump was removed for repairs.
12-24-75	Acid addition system	The inlet and exit lines to acid pump were cleaned of obstructions to correct the troubles of losing acid flow to the tower basin.

Table 10. (continued)

Date	Component	Remarks
Pool Primary Cooling System		
10-6-75	Pool reservoir tank	The obsolete float mechanism was removed from the tank.
11-11-75	West pool level alarm	Replaced a faulty float control unit.
11-26-75	Pool demineralizer	Replaced a faulty gasket on the spool piece section.
Pool Secondary Cooling System		
10-6-75 and 10-7-75	Cooling tower	The manual make-up water valve was found to be inoperative. The valve was replaced.
10-8-75	Cooling tower	A new electrical breaker was installed for the cooling fan and water pump.
10-21-75	Cooling tower	The suction line on the Orocol pump was repaired.
Emergency Cooling System		
10-7-75 and 10-9-75	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms confirmed that the systems were in satisfactory condition. The motor brushes were checked on each unit and found to be in good condition.
11-3-75	Nos. 2 dc unit	A faulty relay was replaced. This corrected a problem of false high-battery voltage alarms.
12-12-75	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms confirmed that the systems were in satisfactory condition.

Table 10 (continued)

Date	Component	Remarks
Electrical Systems		
10-6-75 through 10-10-75	Miscellaneous breaker panels for electric motors, dc batteries, battery racks, and control room instrument cabinets	Routine inspection and cleaning were performed. Dust filters for the control room instrument cabinets were changed as needed. Checks for proper ground on electrical circuits were performed, and programmed maintenance was completed.
Emergency Electrical System		
10-7-75	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
10-10-75	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
Miscellaneous		
10-6-75 through 10-10-75	No. 4 water sump drain	An underground piping system was installed connecting the sump drain to the process water drain. If radioactivity of the water in the sump increases because of a water leak in the reactor primary water system, then the water from the sump will be diverted from the storm drain to the process drain.
10-7-75 through 10-10-75	Annunciator test button installation	The button was installed on the left incline panel of the reactor console (Instrument and Controls Design Change Memo ORR-111). The button, when depressed, will actuate all the annunciators; thereby all of the telealarm stations will be tested simultaneously to verify their ability to respond to alarm conditions.

Table 10 (continued)

Date	Component	Remarks
Micellaneous (continued)		
10-20-75	No. 3 water sump pump	A faulty water pump was replaced.
10-21-75	Water demineralizers, Bldg. 3004	Steam lines to and from the mix tanks were insulated.
10-23-75	Hot cell in Bldg. 3042	The north gate on top of the hot cells was repaired.
10-29-75	Centravac unit for building air- conditioning	New flex conduit on electrical leads were installed, new ground wires to motors were installed, and the insulation on the chilled water lines was repaired.
11-3-75	No. 3 safety chamber	The cable drive for the chamber was replaced.
11-4-75	Steel chokers	A routine inspection was performed by the Inspection Engineers. All chokers were tagged.
11-24-75	Steam trap on steam tracing line at the air-conditioning cooling tower	The steam trap, which was faulty, was replaced.
12-15-75	Sub-pile room air- conditioner	The unit became inoperative. Satisfactory repairs were performed.
12-16-75	Constant air monitron in ORR basement, northwest	A faulty breaker in the CAM was replaced.

Table 10 (continued)

Date	Component	Remarks
Miscellaneous (continued)		
12-17-75	Fuel transfer tool	A faulty transfer tool was repaired.
12-22-75	Potable water line	A broken water line west of Bldg. 3042 was repaired.

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, 1-12-65	9-19-75	DOP	99.997
Charcoal	Both Banks	North, 9-16-74 South, 10-17-67	9-18-75	Elemental Iodine	99.940
Charcoal	Both Banks	North, 9-16-74 South, 1-17-67	9-27-75	Methyl Iodide	62.17
Pressurizable Off-Gas					
CWS	North	5-5-75		DOP	99.955
Charcoal	North	2-26-73	5-7-75	Elemental Iodine	99.985
Charcoal	North	2-26-73	10-8-75	Methyl Iodide	87.97
CWS	South	10-18-67	9-19-75	DOP	99.996
Charcoal	South	8-11-75	8-11-75	Elemental Iodine	99.993
Charcoal	South	8-11-75	10-8-75	Methyl Iodide	97.48

* The CWS filter 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 (%)
Basement Hood Exhaust					
CWS	South	2-16-72	3-12-75	DOP	99.998
CWS	North	2-16-72	3-21-75	DOP	99.998
Normal Off-Gas					
CWS	West	6-18-75	9-19-75	DOP	99.998
Charcoal	West	6-18-75	12-22-75	Elemental Iodine	99.48
CWS	East	6-12-75	9-19-75	DOP	99.999
Charcoal	East	7-29-75	8-12-75	Elemental Iodine	99.997
Charcoal	West	6-18-75	8-26-75	Methyl Iodide	99.74
Charcoal	East	7-29-75	8-27-75	Methyl Iodide	99.41

Table 12. Corrosion Test Results

Specimen Number	Date Installed	Date Removed	Days Exposed	Sample Material	Average Penetration (Mils/year)	Location
L-704	7-27-72	10-17-75	1177	1100 AL	0.0	Pool Heat Exchanger Secondary Exit Leg
L-712	10-12-71	10-17-75	1467	3003 AL	0.1	Pool Heat Exchanger Secondary Exit Leg
L-742	1-11-72	10-17-75	1739	5052 AL	0.1	Pool Heat Exchanger Secondary Exit Leg
W-329	7-22-72	10-17-75	1177	6061 AL	0.1	Pool Heat Exchanger Secondary Exit Leg
FA-249	6-1-72	10-3-75	1219	Mild Steel	0.3	ORR Secondary, South Riser
FA-250	6-1-72	10-3-75	1219	Mild Steel	0.3	ORR Secondary, South Riser
GJ-160	7-27-72	10-3-75	1163	Mild Steel	0.3	ORR Secondary, South Riser
GJ-161	7-27-72	10-3-75	1163	Mild Steel	0.4	ORR Secondary, South Riser
GJ-162	7-27-72	10-3-75	1163	Mild Steel	0.6	ORR Secondary, South Riser
GJ-163	7-27-72	10-3-75	1163	Mild Steel	0.3	ORR Secondary, South Riser
L-714	6-1-72	10-3-75	1219	3003 AL	0.0	ORR Pool Secondary Tower Sump
L-715	6-1-72	10-3-75	1219	3003 AL	0.0	ORR Pool Secondary Tower Sump
L-738	7-27-72	10-3-75	1219	6061 AL	0.1	ORR Pool Secondary Tower Sump

Table 13. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
B-8	V-1	12-10-75		Pressurized capsule	Metals and Ceramics
C-3	V-10	6-20-75	12-9-75	OG-3 capsule experiment	Reactor
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production and short term irradiations	Operations
E-3	V-6	5-6-75		Pl3T capsule experiment	Reactor
E-5	None	10-17-75	11-3-75	Silicon Experiment	Solid State
E-7	V-5	6-20-75		OF-2 capsule experiment	Reactor
A-3	None	8-15-75		Radioisotopes (Iodine & Xenon)	Isotopes
P-4A	None	11-3-75		TeGen II capsule experiment	Reactor
P-5	None	10-8-75	10-17-75	Tensile Specimens	Metals and Ceramics
P-5	None	11-3-75	12-9-75	Tensile Specimens	Metals and Ceramics
P-5	None	12-10-75		Tensile Specimens	Metals and Ceramics
P-5-P-6	None	10-17-75	10-19-75	Nose cone experiment	General Electric
P-5-P-6	None	10-20-75	10-21-75	Nose cone experiment	General Electric
P-7-P-8	None	12-13-75	12-23-75	Nose cone experiment	General Electric
P-7-P-8	None	12-30-75		Nose cone experiment	General Electric

Table 13 (continued)

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
P-9+	None	10-8-57	12-9-75	Pneumatic tube	Chemistry
GCR-P-7A	None	8-8-72		GB-10 capsule experiment	Reactor
HB-2	None	7-58		Neutron diffraction experiment	Solid States-Physics
HB-3	None	11-1-58		Neutron diffraction experiment	Solid States-Physics
HB-4	None	7-58		Neutron diffraction experiment	Chemistry
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 States-Physics
HN-4	None	12-15-53		"Fly's Eye" two dimensional neutron detector for neutron diffraction and radiography	Instrumentation & Controls

SPECIAL TESTS

Flux Mapping of Core - Changes to the core configuration for cycle 129A (Figure 8) necessitated flux measurements in the fuel and shim-rod positions. The results of the measurements will be used for fuel burnup calculations and for flux estimating purposes.

Determination of Minimum Fuel Content in ORR Fuel Elements Prior to Declaring the Elements Spent - Special runs were made during the end of cycle 128 shutdown to determine the minimum fuel contents to declare a fuel element spent. The results are reported in Appendix A.

Reactor Vessel, Ultrasonic Test - Ultrasonic testing of the welds inside the reactor vessel was attempted during the end of cycle 127 shutdown. The ultrasonic testing equipment developed for the HFIR was used for the test. The attempt at the ORR was a failure due to obstructions such as experiment facility tubes. The equipment will be redesigned for the ORR vessel and another test will be conducted at a later date.

Visual Inspection of ORR Primary Pump - ORR primary coolant pump No. 2 was visually inspected by Inspection Engineering on May 28, 1975, while it was disassembled for maintenance work. The inside surface of the housing and the rotor are in good condition with no evidence of erosion, pitting, or other mode of deterioration.

APPENDIX A

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

December 19, 1975

TO: F. T. Binford

FROM: T. P. Hamrick

SUBJECT: Determination of Minimum Fuel Content in ORR Fuel Elements Prior to Declaring the Element Spent

Up to this point in time, Operations has been using the criteria of 120 grams of ^{235}U remaining in a burned down element prior to declaring the element spent. This value was not arbitrarily selected but is a negotiated value which depends on three (3) main points:

1. The reduced reactivity worth of the burned down element,
2. The amount of storage space for partially burned down elements since 150 days decay is required prior to shipping spent elements, and
3. The length of the ORR operating cycle.

In view of the shortage of fuel elements on hand and the delay in obtaining new fuel, it was felt that a more detailed study should be made and perhaps in particular, reevaluate Item 3 above. In order to make the study, the core was loaded as shown in Figure 9 with D-2 being used as the test core position. The primary reason for picking D-2 was the ease of changing fuel since the position lies outside the upper shim rod bearing frames.

The reactor was taken critical with a Beryllium Reflector in position D-2 and the critical rod position determined. The critical positions are shown in Table 1.

Table 1

<u>Shim Rod No.</u>	<u>Critical Position</u>	<u>Adjusted Critical Position</u>
1	UL	UL
2	UL	UL
3	13.765	13.750
4	13.765	13.750
5	13.765	13.750
6	13.765	13.785

Subsequent criticals were run by repeating the positions for Shim Rods 1-5 and obtaining a critical rod position for Shim Rod No. 6. Table 2 shows the results of the study.

ORR CORE

Figure 9

POOL
W

Test Core Pos. 5

A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9
Be	Be	Xe	F	F	F	F	F	Be
B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9
Be	Be	F	SR	F	SR	F	Exp	Be
C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9
Be	F	F	F	F	F	F	F	Be
D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9
Be		F	SR	F	SR	F	HT	Be
E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
Be	F	Exp	F	F	F	Exp	F	Be
F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9
Be	F	F	SR	F	SR	F	F	Be
G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8	G-9
Be	Be	Be	Be	Be	Be	Be	Be	Be

N

E

Core for Fuel Element Study

F - Fuel Element

Be - Beryllium Reflector

SR - Fuel Follower Shim Rod

Exp - Experiment

HT - Hydraulic Tube

Xe - Xenon Production Piece

Run No.	New Element Weight (gm)	Present Element Weight (gm)	No. 6 Rod Position (in.)	Reactivity From Rod Cal. *(% $\frac{\Delta k}{k}$)	Reactivity Worth **(% $\frac{\Delta k}{k}$)
1	Be	-	13.785	2.703	0.881
2	H ₂ O	-	16.150	3.584	0.000
3	240	201	9.850	1.288	2.295
4	265	204	10.083	1.370	2.214
5	265	167	11.280	1.795	1.789
6	200	165	10.692	1.586	1.997
7	240	122	12.400	2.198	1.385
8	265	135	12.184	2.120	1.464
9	200	132	11.970	2.043	1.540
10	240	107	13.111	2.456	1.127
11	265	117	12.787	2.338	1.246
12	200	113	12.550	2.252	1.331
13	200	115	12.510	2.238	1.345
14	265	114	12.800	2.343	1.241
15	240	105	13.170	2.477	1.106

* From most recent rod calibration (8-18-75).

** Based on H₂O with zero reactivity.

The most recent shim rod data for No. 6 Shim Rod was analyzed over the range used during the experiment and an empirical equation developed as shown in Figure 10.

The data was analyzed for the three groups of elements (beginning weights of 265, 240, and 200 grams). These results are shown in Figures 11, 12, and 13.

The data was then analyzed collectively and this is shown in Figure 14. Statistical analysis shows that a 2nd power least squares fit is superior to a 1st power least squares fit since the standard deviation is less (± 0.0418 vs ± 0.454). By solution of the quadratic equation, the minimum fuel remaining prior to the element being declared spent (that value at which the element has the same reactivity worth as a Beryllium Reflector) is ~ 90 grams. For this reason, I propose that as a trial, the element not be declared spent until it has been depleted to 100 grams of ^{235}U remaining. At some point, a compromise may have to be made later as to storage space and cycle length.

T. P. Hamrick

TPH:dsp

cc: R. K. Branam
C. D. Cagle
J. A. Cox
S. S. Hurt

ORNL-DWG 76-8104

Figure 10

ORNL-DWG 76-8105

Figure 11

ORNL-DWG 76-8106

Figure 12

ORNL-DWG 76-8107

Figure 13

ORNL-DWG 76-8108

Figure 14

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