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**Oak Ridge Research Reactor
Quarterly Report
January, February, and March 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
JANUARY, FEBRUARY, AND MARCH OF 1978

S. S. Hurt, III

E. D. Lance

Date Published - July 1978

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CONTENTS

	<u>PAGE</u>
SUMMARY	1
OPERATIONS	1
FUEL USAGE AND INVENTORY	3
SHUTDOWNS AND POWER REDUCTIONS	4
INSTRUMENTATION AND REACTOR CONTROLS	8
PROCESS SYSTEM AND MECHANICAL COMPONENTS	8
EXPERIMENT FACILITIES AND CORE CHANGES	8
SPECIAL TESTS	25
Reactivity Measurement of ORR-MFE-1 Experiment in CP-C7 . . .	25
Flux Mapping of Core	25
APPENDIX A	26
APPENDIX B	37
DISTRIBUTION	49

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FIGURE LIST

	<u>PAGE</u>
Figure 1. ORR Lattice Configuration - January 1, 1978 through February 9, 1978	18
Figure 2. ORR Lattice Configuration - February 9, 1978	19
Figure 3. ORR Lattice Configuration - February 9, 1978 through February 13, 1978	20
Figure 4. ORR Lattice Configuration - February 13, 1978 through February 15, 1978	21
Figure 5. ORR Lattice Configuration - February 15, 1978 through March 2, 1978	22
Figure 6. ORR Lattice Configuration - March 2, 1978 through March 3, 1978	23
Figure 7. ORR Lattice Configuration - March 3, 1978 through March 31, 1978	24

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT
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S. S. Hurt, III and E. D. Lance

SUMMARY

The ORR operated at an average power level of 28.7 MW for 73.4% of the time during January, February, and March of 1978. Eight new fuel elements were placed in service.

The reactor was shut down on sixteen occasions, one of which was unscheduled. Reactor downtime needed for refueling, maintenance and checks was quite low, with the reactor remaining available for operation 88.9% of the time.

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

Special tests or measurements completed during the quarter included: (1) reactivity measurement of the Metals and Ceramics Division's (ORR-MFE-1) experiment in CP-C7; (2) flux mapping for core No. 143-B; and (3) calibration of all six shim rods on February 12, 1978 (Appendix A), and calibration of shim rods Nos. 2 through 6 on February 16, 1978 (Appendix B).

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 of 1978

	This Quarter	Last Quarter	Year To Date	January Thru March, 1977
Total energy, MWd	1,893.6	812.2	1,893.6	620.4
Average power, MW/operating hr	28.7	29.8	28.7	29.2
Time operating, %	73.4	29.6 ^a	73.4	23.6 ^a
Availability, %	88.9	88.2	88.9	90.6
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	24,300	21,600	24,300	26,300
Pool water radio- activity, $\frac{\text{c/min}}{\text{ml}}$ (av)	460	510	460	690
Reactor water resis- tivity, ohm-cm (av)	1,931,000	2,341,833	1,931,000	2,038,000
Pool water resistivity, ohm-cm (av)	1,643,000	2,343,500	1,643,000	1,730,000
Fuel elements depleted	10	0	10	5
Average burnup of fuel elements depleted, %	54.2	-	54.2	56.3
Shim rods depleted	0	2	0	0
Average burnup of shim rods depleted, %	-	71.2	-	0
Radioisotope samples	0	1	0	1
Research samples	0	0	0	1

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

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (MWd)
142	December 17, 1977	January 26, 1978	521.8 ^a
143	February 3, 1978	In progress	1,371.8

^aMWd this quarter.

FUEL USAGE AND INVENTORY

Ten fuel elements were spent during the quarter with an average burnup of 54.2%. Eight new elements were placed in service. Eighteen fuel elements and two shim-rod elements were shipped 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 1977	Calendar Year 1976
Depleted fuel elements transferred for chemical separation	18	0	18	0
Average percent burnup of fuel elements transferred	57.1	-	57.1	-
New fuel elements placed in service	8	10	-	5
New fuel elements available for use	42 ^a	50	-	-
Depleted shim rods transferred for chemical separation	2	0	2	0
Average percent burnup of shim rods transferred	72.1	-	72.1	-
New shim rods placed in service	0	2	0	0
New shim rods available for use	2	1	2	2

^aIncludes four partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 475 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.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hr)
Scheduled		
Regular, end of cycle	1	201.317
Regular, refueling, iodine removal, and experiment work	continued ^a	9.933
Regular, refueling, iodine removal, and experiment work	1	12.650
Regular, iodine removal	4	119.699
Regular, refueling, and iodine removal	4	74.217
Regular, refueling, iodine removal, experiment installation, and maintenance work	1	56.500
Special, end of core mapping	1	40.133
Special, core configuration change	2	58.933
Special, maintenance	1	1.050
<u>Subtotal:</u>	15	574.432
Unscheduled		
Instrument failure, reactor	1	0.250
<u>Subtotal:</u>	1	0.250
<u>TOTAL:</u>	16	574.682

^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
1-1-78	9.933	142-B	The shutdown (continued from last quarter) was completed.
1-5-78	59.933	142-C	Isotope (iodine-xenon) work was completed.
1-13-78	59.950	142-C	The shutdown activities included refueling and isotope (iodine-xenon) work.
1-20-78	59.033	142-D	Isotope (iodine-xenon) work was completed.
1-26-78	201.317	142-D	The shutdown marked the end of operating cycle 142. Shutdown activities included: (1) the replacement of the shaft and coupling on the No. 1 reactor secondary cooling pump; (2) the repair of a leak in the reactor tank gas removal system (north side); (3) programmed maintenance; (4) the cleaning of the pool and reactor secondary cooling tower basins; (5) the removal of obsolete exterior shields from HB-1 and HB-2; and (6) the removal of HB-4 plug to clean aluminum oxide flow restrictions from the water service lines.
2-9-78	56.500	143-A	The shutdown activities included: (1) refueling; (2) isotope (iodine-xenon) work; (3) the installation of an experiment in core position C-7; and (4) installation of flux-monitor wires for mapping the core.
2-11-78	40.133	143-A	The shutdown activities included: (1) removal of the flux-monitor wires; and (2) calibration of the shim rods.

Table 5. (Continued)

Date	Duration (hr)	End Cycle	Remarks
2-13-78	58.583	143-B	The shutdown activities included: (1) the changing of the core configuration to reduce the C-7 experiment operating temperatures; and (2) the calibration of shim rods 2 through 6 necessitated by the core changes.
2-16-78	1.050	143-B	An electronic tube was replaced in the No. 1 Sigma Amplifier.
2-23-78	0.400	143-C-1	Isotope (iodine-xenon) work was completed.
3-2-78	4.900	143-C-2	The reactor was refueled and isotope (iodine-xenon) work was completed.
3-3-78	0.350	-	Special shutdown to exchange beryllium and fuel in core positions F-2 and F-8. The exchange was made to reduce C-7 experiment temperatures.
3-9-78	4.517	143-D	The reactor was refueled and isotope (iodine-xenon) work was completed.
3-16-78	4.850	143-E	The reactor was refueled and isotope (iodine-xenon) work was completed.
3-23-78	12.650	143-F	The reactor was refueled, isotope (iodine-xenon) work was completed, and a nose cone experiment was mounted in the front face facility (P-5 and P-6).
3-30-78	0.333	143-G-1	Isotope (iodine-xenon) work was completed.

Table 6. ORR Unscheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
2-18-78	0.250	-	A false fast scram was received from the Period Sigma Amplifier.

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 7.

PROCESS SYSTEM AND MECHANICAL COMPONENTS

Details of maintenance or changes to the process system are given in Table 8. Table 9 summarizes the results of efficiency tests of the various gaseous waste filters.

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility usage is given in Table 10. The core configurations used during the quarter are shown in figure Nos. 1, 2, 3, 4, 5, 6, and 7.

Table 7. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble	Corrective Action
No. 1 Counting-Rate Channel			
1-24-78	Count-rate recorder pen action	Broken cable	The broken cable was replaced.
2-14-78	Recorder drive motor	Faulty motor	The drive motor was replaced.
No. 2 Log-N Channel			
2-22-78	Log-N amplifier	Erratic readout	The amplifier was replaced.
No. 1 Safety Channel			
3-16-78	No. 1 safety recorder	Slow response to power changes	The balance motor gear was adjusted.
2-16-78	Sigma amplifier	Erratic readout	A voltage regulator tube was replaced and calibration checked.
No. 3 Safety Channel			
2-9-78	Sigma amplifier	Erratic readout	The sigma amplifier was replaced.
No. 1 Gamma Channel			
3-16-78	Gamma recorder	Erratic readout	The regulated voltage power supply was replaced.
North ^{16}N Channel			
2-9-78	^{16}N recorder	Erratic readout	The electrometer was replaced.

Table 7. (Continued)

Date	Component	Trouble	Corrective Action
Process Instrumentation			
1-12-78	No. 1 ΔT recorder	Erratic readout	The recorder amplifier was replaced.
1-16-78	Reactor water activity recorder	Erratic readout	The regulated voltage power supply was replaced.
2-9-78	Normal off-gas (NO ₂) temperature recorder	Inoperative alarm	The switch was replaced.
2-14-78	Reactor ΔP	Switches reset	The alarm, setback, scram, and safety sensitivity switches were reset to conform with a new core configuration.
3-27-78	Primary pump bearing temperature recorder	Erratic chart	A worn gear in the gear train was replaced.
1-20-78	Public address system	No output	Re-tubed amplifier.

Table 8. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Cooling System		
2-2-78	No. 2 primary water pump	The pump and motor were aligned.
Reactor Secondary Cooling System		
1-5-78	Cooling tower	Replaced the steam trap on the north and south riser steam tracing lines. The strainer was replaced on the south riser.
1-27-78 through 2-1-78	Cooling tower (water pump)	The No. 1 cooling pump was removed to the maintenance shop for replacement of a faulty shaft and coupling. The pump was then reinstalled. Performance checks were satisfactory.
Pool Primary Cooling System		
2-7-78	Pool demineralizer pump	The inboard and outboard bearings and seals were replaced.
3-6-78	Pool demineralizer	The diaphragm in the control valve was repaired.
Emergency Cooling System		
1-20-78	No. 1 dc unit	A faulty high motor ammeter was replaced.
1-30-78	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms were completed with satisfactory results.

Table 8. (Continued)

Date	Component	Remarks
Emergency Cooling System (Continued)		
2-15-78	No. 3 dc unit	The ammeter on the battery amps was adjusted to clear a false annunciator alarm.
2-22-78	Emergency gasoline engine pump motor	A faulty starter was replaced.
Electrical System		
1-20-78	Motorized bridge over pools	The electrical supply cable, which was beginning to show signs of wear, was replaced with a new cable.
Emergency Electrical System		
1-31-78	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results.
Miscellaneous		
1-20-78	Underwater saw	A new tool was fabricated for replacing the saw blade holder.
1-26-78	Storage rack	A new thirty-place rack was fabricated and delivered to the ORR. It is to be used for storage of beryllium and aluminum core pieces.

Table 8. (Continued)

Date	Component	Remarks
Miscellaneous (Continued)		
1-26-78 through 3-31-78	Beam hole facilities, shielding, and asso- ciated work	The work consisted of the following activities: (1) the removal of the existing HB-1, -2, and -4 ORR wedge-shaped shields and the installation of new shields (adapted to the Ames Laboratory's neutron spectrometers); (2) the removal and reinstallation of the HB-4 plug, following removal of aluminum oxide from the liner and associated piping; and (3) installation of a nitrogen purge system for the beam hole liners in an effort to eliminate aluminum oxide buildup in the liners.
2-17-78	Nash Hytor pump	A leaking section of the southwest cooling water line was replaced.
3-3-78	West bay truck doors	The hydraulic air pistons were adjusted to allow the doors to operate as designed.
3-31-78	Heating and ventila- tion (Room 308)	A faulty motor was replaced.

Table 9. 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	1-9-78	Methyl Iodine	98.78
Pressurizable Off-Gas					
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
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

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

Table 9. (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
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
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	1-10-78	Methyl Iodine	44.81
Charccal	East	1-26-77	11-10-77	Methyl Iodine	70.57

Table 10. 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
C-7	V-2	2-10-78		Austenitic alloys (sheet tensile and flat discs specimens)	Metals and Ceramics
D-2		2-9-78		Radioisotopes (Iodine and Xenon)	Operations
E-7	V-5	8-4-76	2-9-78	Radioisotopes (Iodine and Xenon)	Operations
P-5, P-6	None	3-23-78		Graphite nose cones in helium-filled aluminum canisters	Spire Corporation
HB-1 ^a	None			Neutron spectrometer	Solid State Physics
HB-2 ^a	None			Neutron spectrometer	Solid State Physics
HB-3	None	11-1-58		Neutron diffraction experiments	Solid State Physics
HB-4 ^a	None			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

^aInstallation in progress.

Table 10. (Continued)

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
HN-4	None	12-15-63		"Fly's Eye" two dimension- al neutron detector for neutron diffraction and radiography	Instrumentation and Controls

ORR LATTICE LOADING
For Fuel Cycles 142-C, 142-D, and 143-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 COMPONENTNUMBER

Fuel	24
Shim Rod (SR)	6
Beryllium (Be)	31
Iodine Sleeve (^{131}I)	1
Hydraulic Tube (HT)	1

Figure 1. ORR Lattice Configuration - January 1, 1978
through February 9, 1978

ORR LATTICE LOADING
For Fuel Cycle 143-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	F	Be
C	Be	F	F	F	F	F	E	F	Be
D	Be	^{131}I	F	SR	F	SR	F	HT	Be
E	Be	F	F	F	F	F	F	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENTNUMBER

Fuel	26
Shim Rod (SR)	6
Beryllium (Be)	28
Experiment (E)	1
Iodine Sleeve (^{131}I)	1
Hydraulic Tube (HT)	1

Figure 2. ORR Lattice Configuration - February 9, 1978

ORR LATTICE LOADING
For Fuel Cycle 143-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	F	F	F	F	F	E	Be	Be
D	Be	¹³¹ I	F	SR	F	SR	Be	HT	Be
E	Be	F	F	F	F	F	F	F	Be
F	Be	Be	F	SR	F	SR	F	Be	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENTNUMBER

Fuel	23
Shim Rod (SR)	6
Beryllium (Be)	31
Experiment (E)	1
Iodine Sleeve (¹³¹ I)	1
Hydraulic Tube (HT)	1

Figure 3. ORR Lattice Configuration - February 9, 1978
through February 13, 1978

ORR LATTICE LOADING
For Fuel Cycle 143-C-1

	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	Be	Be	Be
C	Be	F	F	F	F	F	E	Be	Be
D	Be	^{131}I	F	SR	F	SR	Be	HT	Be
E	Be	F	F	F	F	F	F	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	22
Shim Rod (SR)	6
Beryllium (Be)	32
Experiment (E)	1
Iodine Sleeve (^{131}I)	1
Hydraulic Tube (HT)	1

Figure 4. ORR Lattice Configuration - February 13, 1978
through February 15, 1978

ORR LATTICE LOADING
For Fuel Cycle 143-C-2

	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	Be	Be	Be
C	Be	F	F	F	F	F	E	Be	Be
D	Be	^{131}I	F	SR	F	SR	Be	HT	Be
E	Be	F	F	F	F	F	F	F	Be
F	Be	F	F	SR	F	SR	F	Be	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENTNUMBER

Fuel	23
Shim Rod (SR)	6
Beryllium (Be)	31
Experiment (E)	1
Iodine Sleeve (^{131}I)	1
Hydraulic Tube (HT)	1

Figure 5. ORR Lattice Configuration - February 15, 1978
through March 2, 1978

ORR LATTICE LOADING
For Fuel Cycle 143-D

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

LATTICE COMPONENTNUMBER

Fuel	23
Shim Rod (SR)	6
Beryllium (Be)	31
Experiment (E)	1
Iodine Sleeve (^{131}I)	1
Hydraulic Tube (HT)	1

Figure 6. ORR Lattice Configuration - March 2, 1978
through March 3, 1978

ORR LATTICE LOADING

For Fuel Cycles 143-D-1, 143-E, 143-F, and 143-G

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

LATTICE COMPONENT

NUMBER

Fuel	23
Shim Rod (SR)	6
Beryllium (Be)	31
Experiment (E)	1
Iodine Sleeve (¹³¹ I)	1
Hydraulic Tube (HT)	1

Figure 7. ORR Lattice Configuration - March 3, 1978 through March 31, 1978

SPECIAL TESTS

Reactivity Measurement of ORR-MFE-1 Experiment in CP-C7

The reactivity worth of the experiment in core position C-7 was measured and found to be positive 0.21% $\Delta k/k$ (compared to water only in CP-C7).

Flux Mapping of Core

Changes to the core configuration necessitated flux measurements in the fuel and shim-rod positions in core No. 143-B (Figure 2). The results of the measurements will be used for fuel burnup calculations and for flux estimating purposes.

APPENDIX A

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

February 15, 1978

To: Distribution
 From: T. P. Hamrick, S. S. Hurt, and E. D. Lance
 Subject: Calibration of ORR Shim Rods

The ORR shim rods were calibrated on February 12, 1978. The reactor was fueled with loading 143-B which contained 5115 grams of ^{235}U .

This calibration was necessary since the configuration was changed due to experiment insertions in CP-67.

A summary of the calibration is given along with previous results in Table 1.

The minimum shim rod positions at critical for all operation is:

- a. Shim rods 1 through 6 ganged at 14.6 inches withdrawn; or
- b. Shim rods 3 through 6 ganged at 13.0 inches withdrawn with shim rods 1 and 2 at the upper limit.

The differential and integral worth curves are attached.

Table 1. Results of Shim-Rod Calibration $\left(\% \frac{\Delta k}{k}\right)$

Shim Rod No.	6-22-73 Cycle 113-A 4893g ^a	8-26-73 Cycle 114-A 5097g ^a	12-6-73 Cycle 116-A 5164g ^a	3-1-75 Cycle 124-A 4767g ^b	8-15-75 Cycle 127-A 5754g ^c	2-12-78 Cycle 143-B 5115g ^d
1	2.215	1.787	1.758	2.195	2.367	1.935
2	2.070	2.341	2.604	2.443	2.643	2.172
3	2.750	4.270	4.306	4.379	3.840	4.492
4	5.220	6.253	6.501	6.182	5.777	6.368
5	3.440	4.002	2.867	4.507	3.588	3.205
6	6.350	5.712	4.372	5.524	5.510	4.487
1-2	4.285	4.128	4.362	4.638	5.010	4.107
3-6	17.600	20.237	18.046	20.592	18.715	18.552
1-6	22.045	24.365	22.408	25.230	23.725	22.659

^a31 fuel positions, including shim rods.

^b28 fuel positions, including shim rods.

^c33 fuel positions, including shim rods.

^d32 fuel positions, including shim rods.

TPH:33H:FDL:ksm

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APPENDIX B

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

February 16, 1978

To: Distribution
 From: T. P. Hamrick and S. S. Hurt
 Subject: Calibration of ORR Shim Rods

The ORR shim rods were calibrated on February 16, 1978. The reactor was fueled with loading 143-C2 which contained 4737 grams of ^{235}U .

This calibration was necessary since the configuration was changed to reduce the neutron flux in the core area of the CP-C7 experiment.

A summary of the calibration is given along with previous results in Table 1.

The minimum shim rod positions at critical for all operation is:

- a. Shim rods 1 through 6 ganged at 14.3 inches withdrawn; or
- b. Shim rods 3 through 6 ganged at 12.7 inches withdrawn with shim rods 1 and 2 at the upper limit. It should be noted that the Integral Worth curve indicates 12.0 inches withdrawn; however, for good heat transfer area on the shim rods, the minimum position should not be below 12.7 inches withdrawn.

The differential and integral worth curves are attached.

Table 1. Results of Shim-Rod Calibration $\left(\% \frac{\Delta k}{k} \right)$

Shim Rod No.	8-26-73 Cycle 114-A 5097g ^a	12-6-73 Cycle 116-A 5164g ^a	3-1-75 Cycle 124-A 4767g ^b	8-15-75 Cycle 127-A 5754g ^c	2-12-78 Cycle 143-B 5115g ^d	2-15-78 Cycle 143-C2 4737g ^e
1	1.787	1.758	2.195	2.367	1.935	1.935
2	2.341	2.604	2.443	2.643	2.172	3.253
3	4.270	4.306	4.379	3.840	4.492	3.712
4	6.253	6.501	6.182	5.777	6.368	6.978
5	4.002	2.867	4.507	3.588	3.205	1.344
6	5.712	4.372	5.524	5.510	4.487	3.229
1-2	4.128	4.362	4.638	5.010	4.107	5.188
3-6	20.237	18.046	20.592	18.715	18.552	15.263
1-6	24.365	22.408	25.230	23.725	22.659	20.451

^a31 fuel positions, including shim rods.

^b28 fuel positions, including shim rods.

^c33 fuel positions, including shim rods.

^d32 fuel positions, including shim rods.

^e29 fuel positions, including shim rods.

TPH:SSH:ksm

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