**Bulk Shielding Facility Quarterly Report
July, August, and September of 1975**

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MASTER

OAK RIDGE NATIONAL LABORATORY

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

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Printed in the United States of America: Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy \$4.00; Microfiche \$2.25

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Contract No. W-7405-eng-26

OPERATIONS DIVISION

BULK SHIELDING FACILITY QUARTERLY REPORT
JULY, AUGUST, AND SEPTEMBER OF 1975

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MAY 1976

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SUMMARY

The BSR operated at an average power level of 1,878 kw for 38.00% of the time during July, August, and September. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. There were two unscheduled shutdowns during the quarter.

The PCA was not used during this report period and remains in a secured condition.

BULK SHIELDING REACTOR

Operations

During this quarter the reactor operated 38.00% of the time primarily for the irradiation of research samples. Basic operating data for this period are given in Table 1.

Table 1. Basic Operating Data
(July, August, and September of 1975)

	This Quarter	Last Quarter	Year To Date
Total energy, kwd	65,654	58,126	240,728
Average power, kw/operating hr	1,878	1,722	1,847
Time operating, %	38.00	37.10	47.35
Reactor availability, %	96.30	82.77	89.77
Reactor water radioactivity, counts min ⁻¹ ml ⁻¹ (av)	2,459	2,657	2,407
Reactor water resistivity, ohm-cm (av)	967,000	932,000	977,000
Standard fuel elements depleted	1	1	6
Control fuel elements depleted	0	2	2
Research samples	31	28	76

Shutdowns

There were two unscheduled shutdowns during the quarter when the No. 2 rod dropped. Table 2 gives an analysis of both scheduled and unscheduled shutdowns.

Table 2. Analysis of Shutdowns

Description of Shutdown	Number	Downtime (hrs)
<u>Scheduled</u>		
Experimenters:		
No request to operate	11	1,287.267
Repositioning of the reactor	2	1.117
Experiment insertion, removal, or data taking	3	4.583
Reactor Operations:		
BSR quarterly shutdown	1	75.267
Refueling critical runs	<u>2</u>	<u>0.450</u>
Subtotal	19	1,368.684
<u>Unscheduled</u>		
Experimenters:	0	0.000
Reactor Operations:	<u>2</u>	<u>0.267</u>
Subtotal	<u>2</u>	<u>0.267</u>
Total	21	1,368.951

Maintenance and Changes

Maintenance or changes on the instrumentation and mechanical components in the complex are listed in Tables 3, 4, 5, and 6. Table 7 presents the status of the ionization and fission chambers.

Core loading 28 (Figure 1) was replaced by core loading 29 (Figure 2) on August 7, 1975, to provide adequate excess reactivity for versatile operation. The initial operating mass ($4168 \text{ g } ^{235}\text{U}$) of core loading 28 had been reduced to 4122 g due to burnup, thereby reducing the excess reactivity from 5.45% Δk to $\sim 4.75\% \Delta k/k$ ($\sim 2.20\%$ excess reactivity above xenon equilibrium).

Core loading 29 was accomplished by replacing one depleted BSF-series fuel element with a new MTR-series fuel element. Core loading 29 had an initial operating mass of 4196 g which provided an excess reactivity of 5.25% $\Delta k/k$ (2.70% $\Delta k/k$ excess reactivity above xenon equilibrium). At the end of the quarter, the excess reactivity was $\sim 4.57\%$ $\Delta k/k$ ($\sim 2.02\%$ $\Delta k/k$ excess reactivity above xenon equilibrium).

East
D₂O
Tank

F.C. 81	82	83	84	85	86	87	88	89
71	72	73	74	75	76	77	78	79
FZC 003T 61 197	BSF-S-9 62	BSF-36 148 63	BSF-S-10 71 64	FZC 003U 196 65	66	67	68	69
FZC 003N 51 188	M-194-D 165 52	M-193-E 142 53	M-195-D 165 54	FZC 003P 188 55	56	West 57	58	59
BSF-34 146 41	BSF-S-11 97 42	M-192-L 138 43	BSF-S-14 96 44	BSF-35 145 45	46	D ₂ O 47	48	49
BSF-39 159 31	FZC 003R 32 193	BSF-38 141 33	FZC 003S 34 193	BSF-40 158 35	36	Tank 37	38	39
M-196-D 179 21	BSF-S-11 72 22	BSF-37 145 23	BSF-S-12 72 24	M-323-A 181 25	26	27	28	29
Exp. 11	FZC 003W 12 201	FZC 003Q 13 191	BSF-30 130 14	Exp. 15	16	17	18	19

BSR CORE

28
LOADING NO.
6-26-75
DATE
Excess Reactivity - 5.45%
CRITICAL MASS
4168 g
OPERATING MASS

ROD POSITIONS AT CRITICAL (With Operating Mass)

ROD NO.	IN. WITHDRAWN	
1	9.92	11.27
2	9.92	11.27
3	9.92	11.27
4	9.92	11.27
5	23.00	11.27
6	23.00	11.27

REMARKS:

Figure 1 Core Loading 28 - BSR

East
D₂O
Tank

F.C.								
81	82	83	84	85	86	87	88	89
71	72	73	74	75	76	77	78	79
FZC 003T 61 195	BSF-S-9 70 62	BSF-36 146 63	BSF-S-10 70 64	FZC 003U 65 195	66	67	68	69
FZC 003N 51 187	M-194-D 163 52	M-193-D 140 53	M-195-D 163 54	FZC 003P 55 186	56	57	58	59
BSF-34 144 41	BSF-S-11 96 42	M-192-D 136 43	BSF-S-14 95 44	BSF-35 143 45	46	47	48	49
BSF-39 158 31	FZC 003R 32 191	BSF-38 139 33	FZC 003S 34 190	BSF-40 156 35	36	37	38	39
M-196-D 177 21	BSF-S-11 71 22	BSF-37 143 23	BSF-S-12 71 24	M-323-A 179 25	26	27	28	29
Exp. 11	FZC 003W 12 200	FZC 003Q 13 189	FZC 003V 14 203	Exp. 15	16	17	18	19

BSR CORE

29

LOADING NO.
8-7-75
DATE
Excess Reactivity 5.25%
CRITICAL MASS
4196
OPERATING MASS

ROD POSITIONS AT CRITICAL (With Operating Mass)

ROD NO.	IN. WITHDRAWN	
1	10.15	11.40
2	10.15	11.40
3	10.15	11.40
4	10.15	11.40
5	23.00	11.40
6	23.00	11.40

REMARKS:

Figure 2. Core Loading 29-BSR

Table 3. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble or Change	Reason or Maintenance
7-1-75	Coarse selsyn on No. 1 shim rod	Erratic operation	Cleaned and oiled the bearings.
7-2-75	Facility radiation and contamination alarm system	No caution alarm from N. W. CAM	Replaced the bulb in the module.
8-4-75 through 8-7-75	Instrumentation	Routine	Quarterly checks were made.
8-5-75	No. 1 shim rod drive coarse selsyn	Erratic operation	The unit was removed to the shop for repair of bad bearings and gears and the unit returned to service.
8-7-75	Facility radiation and contamination monitoring system	Routine	Quarterly checkout.
8-26-75	Pool inlet temperature recorder TR-TC-13	Routine check	Recalibrated (channel was found to be reading too high).
9-29-75	High bay monitron	Instrument spiking	The monitron was retubed to correct the trouble.

Table 4. Maintenance and Changes, Mechanical System

Date	Component	Trouble or Change	Reason or Maintenance
8-1-75	Cooling tower fans	Routine inspection	The Dodge Flexidyne couplings were inspected and ~6 1/2 lbs. of S. S. shot added to the south fan. The gear box oil was replaced.
8-4-75 and 8-5-75	Secondary cooling and air-conditioning pumps	Leaking packing glands	New packing was installed.

Table 5. Maintenance and Changes, Process System

Date	Component	Trouble or Change	Reason or Maintenance
7-14-75	Secondary pH system	Erratic operation	New 3/8" S. S. line was installed on the output of the pH probe box.
7-31-75	Secondary cooling system	Faulty pressure gauges	Faulty pressure gauges were replaced on the secondary pump discharge and heat exchanger inlet and exit lines.
8-19-75 through 8-21-75	Heat exchanger (secondary side)	Reduction of efficiency	The heads of the secondary side of the heat exchanger were removed and the following work was completed before reinstalling: brushed and flushed the tubes; cleaned the heads; installed new head gaskets.
9-29-75	Secondary acid addition system	Corroded acid line	A new section of S. S. line was installed.

Table 6. Maintenance and Changes, BSR Services

Date	Component	Trouble or Change	Reason or Maintenance
9-30-75	Air-conditioning unit No. 4 (BSR Control Room)	Inoperative	A burned out condenser fan motor was replaced.

Table 7. Status of Ionization Chambers

Chamber Serial No.	Location	Date Present Service Started	Previous Service	Remarks
Chambers in Service				
CTC-3 (J-118)	Position A, No. 2 safety	10-8-69	LITR	The chamber was modified for underwater service in 1969.
PCP-III-106, SN-72-1	Position B, servo	5-12-75	None	This new chamber was installed in the BSR in May, 1975.
CTC-4 (C-771)	Position C, No. 1 safety	12-1-69	LITR	The chamber was modified for underwater service in 1969.
PCP-III-106A, SN-72-2	Position D, log-N and No. 3 safety	11-13-73	None	This new dual chamber was in- stalled in the BSR in November, 1973.
C-1045	CP-81, fission chamber	10-1-69	PCA	This fission chamber assembly was transferred to the BSR from the PCA in October, 1969.
Chambers Not in Service				
PCP (old type, no serial number)	Warehouse storage		BSR	This chamber is of the old type and will be repaired if needed.
CIC (No. 62)	BSR storage		BSR	This chamber is reserved for the PCA but can be used in an emergency for the BSR.
CIC (No. 63)	BSR storage		BSR	This chamber is reserved for the PCA but can be used in an emergency for the BSR.

Table 7 (continued)

Chamber Serial No.	Location	Date Present Service Started	Previous Service	Remarks
PCP (Q975), No. 2)	BSR storage		BSR	This chamber is reserved for the PCA but can be used in an emergency for the BSR.
PCP-III-106, SN-66-1	BSR storage		BSR	The uncompensated section of this dual chamber failed on June 16, 1969, while in service as the No. 2 safety and servo. While in service as servo the noise to signal ratio increased to an unsatisfactory level and in May, 1975, the chamber was removed for repairs.
PCP-III-106, SN-66-3	ORR beam tube storage		BSR and ORR	This dual chamber was installed in the BSR in December, 1967. In March, 1969, the chamber was removed for repairs due to failure of the uncompensated section. In November, 1969, the chamber was installed in the BSR. In April, 1970, the uncompensated section failed. The chamber was removed for repairs. In May, 1971, the chamber was installed in the ORR. In November, 1971, the chamber was removed for repairs. In October, 1972, the chamber was installed in the BSR as

Table 7 (continued)

Chamber Serial No.	Location	Date Present Service Started	Previous Service	Remarks
PCP-III-106, SN-66-3	ORR beam tube storage		BSR and ORR	a spare chamber. In January 1973, the chamber was transferred from Position E (spare chamber location) to Position D. In November, 1973, the chamber was removed for repairs due to failure of the uncompensated section.
PCP-III-106, SN-66-4	ORR instrument shop		BSR	This dual chamber was installed in the BSR in June, 1968. In May, 1969, the uncompensated section failed. The chamber was removed for repairs. In August, 1970, the chamber was reinstalled in the BSR. In January, 1973, the chamber was removed from Position D for maintenance. The uncompensated section had an abnormal condition of not being fully saturated on saturation characteristic checks.

Fuel

Changes in the fuel inventory are reflected in Table 8.

Table 8. Fuel and Shim Rod Status

	This Quarter	Last Quarter	Year To Date
Fuel elements depleted	1	1	6
Control-rod fuel elements depleted	0	2	2
New fuel elements placed in service	1	1	6
New control-rod fuel elements placed in service	0	2	2
New fuel elements available for use	11	12	11
New control-rod fuel elements available for use	6	6	6
Partially depleted fuel elements available for use	0	0	0
New shim rods placed in service	0	0	0
Boron stainless steel shim rods in use	6	6	6
Boron stainless steel shim rods available for use	2	2	2

Experiment Facilities Assignment

Facility assignments are listed in Table 9. The tubes of the east D_2O tank are not permanently assigned; they are used by various Laboratory personnel for short-term sample irradiations.

Table 9. Facilities Assignment

Facility	Location	Division or Sponsor
Liquid helium cryostat	Southwest corner of pool using west D_2O tank	Solid State
Liquid nitrogen cryostat	On instrument bridge	Solid State
Ambient temperature facility	North face of core	Solid State
Front-face tube	North face of core	Solid State
Fast-neutron tube	Core position 15	Solid State
Water-cooled tube	Core position 11	Solid State
Dry thermal-neutron tubes* (N-4 and S-3)	East D_2O tank	Operations
Dry thermal-neutron tubes* (east, center, southwest, and northwest)	East D_2O tank	Operations

*These facility tubes are for sample irradiations and are used by personnel of several divisions, primarily Analytical Chemistry and Solid State Division.

Demineralizer Performance

Table 10 gives detailed information on the condition of the primary water system for the preceding year and pertinent data on the performance of the bypass demineralizer.

Table 10. Demineralizer Performance Data

Run No.	Initiation Date	Termination Date	Throughput (gal)	Gross Gamma (Counts min ⁻¹ ml ⁻¹)		pH		Specific Resistance (ohm-cm)	
				In	Out	In	Out	In	Out
33	1-4-73	3-5-73	1,614,000	1,280	115	5.7	5.8	1,008,000	1,430,000
34	3-6-73	4-30-73	1,393,200	1,848	181	5.7	5.7	873,000	1,363,000
35	5-2-73	7-2-73	2,060,000	2,072	120	5.8	5.8	896,000	1,209,000
36	7-3-73	9-4-73	1,900,000	1,672	116	5.8	5.8	792,000	1,270,000
37	9-4-73	11-12-73	1,300,000	2,021	107	5.9	6.0	682,000	1,144,000
38	11-14-73	1-7-74	1,692,000	1,353	98	5.7	5.7	738,000	1,102,000
39	1-9-74	3-13-74	1,320,000	1,931	101	6.2	6.0	666,000	908,000
*40	3-15-74	7-30-74	1,400,000	9	0	6.2	6.0	364,000	1,132,000
41	8-16-74	12-4-74	1,500,000	2,316	385	5.8	5.8	630,000	895,000
**42	12-17-74	4-15-75	3,850,000	2,116	119	5.8	6.0	1,018,000	1,611,000
43	4-16-75	7-7-75	2,550,000	2,712	174	5.7	5.8	937,000	1,823,000
44	7-10-75	In Service	2,120,000	2,459	160	5.8	6.0	967,000	1,473,000

* The reactor was shutdown during the entire run.

** New resin in the demineralizer columns.

Special Tests

Efficiency Tests

Tests were performed by Inspection Engineering on the cell ventilation filters. Details are given in Table 11.

Table 11. Efficiency Tests Results, Filters

Date	Unit	Type Test	Efficiency (%)
8-28-75	Center Bank	Elemental Iodine	99.720
9-3-75	South Bank	Elemental Iodine	99.960

Operational Activities

Date	Remarks
8-4-75	The valve pit was inspected. Water seepage via the grout-filled annulus in the concrete wall continues to leak from the pool into the valve pit as previously reported. The leak rate is ~10 gal/day.
8-4-75	The emergency electrical power quarterly test was completed with satisfactory results. The test was performed by turning the emergency power transfer switch (circuit 18 in electrical power panel DP-1) to "OFF", thereby starting the ORR diesel generator which supplied electrical power to designated circuits in the BSR control and pool rooms.
8-4-75	Annual reactor control cables and messengers were inspected with satisfactory results.
8-7-75	The containment system quarterly functions checks were performed with satisfactory results.

Building Evacuation Drill

An unannounced building evacuation test of the BSR was successfully completed on August 7, 1975, during the day shift. This particular time was chosen to involve a maximum number of personnel in the exercise. Participating were personnel of the operating group and the experimenters. All components of the building evacuation system functioned as designed, and personnel responded in an acceptable manner.

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