

# ornl

**OAK RIDGE  
NATIONAL  
LABORATORY**

**MARTIN MARIETTA**



ORNL/TM-10275

**Bulk Shielding Facility  
Quarterly Report  
July, August, and September 1986**

T. P. Hamrick  
F. E. Muggridge

OAK RIDGE NATIONAL LABORATORY  
CENTRAL RESEARCH LIBRARY  
CIRCULATION SECTION  
EAST ROOM 171  
**LIBRARY LOAN COPY**  
DO NOT TRANSFER TO ANOTHER PERSON  
If you wish someone else to see this  
report, send in name with report and  
the library will arrange a loan.

OPERATED BY  
MARTIN MARIETTA ENERGY SYSTEMS, INC.  
FOR THE UNITED STATES  
DEPARTMENT OF ENERGY

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  
NTIS price codes—Printed Copy: A03; Microfiche A01

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Operations Division  
Reactor Operations Section

**BULK SHIELDING FACILITY QUARTERLY REPORT  
JULY, AUGUST, AND SEPTEMBER 1986**

T. P. Hamrick  
F. E. Muggridge

SPONSOR: J. H. Swanks  
Operations Division

Date Issued: November 1986

Notice: This document contains information of a preliminary nature. It is subject to revision or correction and, therefore, does not represent a final report.

Prepared by the  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee 37831  
operated by  
Martin Marietta Energy Systems, Inc.,  
for the  
U.S. DEPARTMENT OF ENERGY  
under Contract No. DE-AC05-84OR21400



3 4456 0147858 6



## CONTENTS

	<u>Page</u>
LIST OF FIGURES . . . . .	v
LIST OF TABLES . . . . .	vii
SUMMARY . . . . .	1
BULK SHIELDING FACILITY . . . . .	1
OPERATIONS . . . . .	1
Shutdowns . . . . .	3
Maintenance and Changes . . . . .	3
Operational Activities . . . . .	8
Experiments . . . . .	10
Fuel . . . . .	11
Experiment Facilities Assignments . . . . .	13
Demineralizer Performance . . . . .	13
SUMMARY OF SURVEILLANCE TESTS AT THE BSR . . . . .	13
POOL CRITICAL ASSEMBLY . . . . .	17
OPERATIONS . . . . .	17
SURVEILLANCE TESTS AT THE PCA . . . . .	17
DISTRIBUTION . . . . .	18



LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Core loading 102, BSR . . . . .	2



## LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Basic operating data (July-September 1986) . . . . .	3
2	Analysis of shutdowns . . . . .	4
3	Maintenance and changes, instrumentation and controls . .	5
4	Maintenance and changes, process systems . . . . .	7
5	Maintenance and changes, mechanical systems . . . . .	8
6	Operational activities . . . . .	9
7	Experiment facilities activity, LTNIF . . . . .	11
8	Fuel and shim-safety rod status . . . . .	12
9	Experiment facilities assignments . . . . .	13
10	Deminerizer performance data . . . . .	14
11	Summary of surveillance tests at the BSR . . . . .	15



**BULK SHIELDING FACILITY QUARTERLY REPORT  
JULY, AUGUST, AND SEPTEMBER 1986**

**SUMMARY**

The BSR operated at an average power level of 138 kW for 7.2% of the time during July, August, and September. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory.

The PCA is shutdown for shim-safety rod magnets and associated electronic components upgrading.

**BULK SHIELDING FACILITY**

**OPERATIONS**

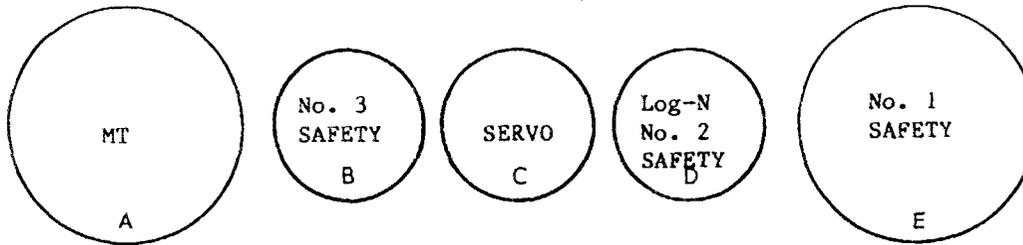
The BSR remained down for most of the quarter due to no request to operate. The brief periods of operation were used for personnel training, ATNIF sample irradiation, functional testing, and LTNIF functional testing and first experiment run.

The preliminary work for the Low-Temperature Neutron Irradiation Facility (LTNIF)\* installation continued.

Core loading 102 is shown in Fig. 1.

---

\*Originally identified as the National Low-Temperature Neutron Irradiation Facility, NLTNIF. The word National was deleted about June 1986 at the request of DOE.



### BSR CORE

				FC	Al Can	Al Can	Al Can	Al Can
81	82	83	84	85	86	87	88	89
				Al Can				
71	72	73	74	75	76	77	78	79
		EAST		OR-98-F	BSF-S-17	BSF-A10	BSF-S-18	BSF-A9
61	62	63	64	200	64	188	65	178
				65	66	67	68	69
		D <sub>2</sub> O		BSF-T6	M-111-F	YZP-0049	BSF-T2	BSF-T5
51	52	53	54	218	180	204	182	215
		TANK		BSF-S-T2	BSF-T1	BSF-S-T4	BSF-T3	Al Plug <sup>a</sup>
41	42	43	44	110	173	109	198	49
				45	46	47	48	49
				M-110-F	M-59-H	M-102-F	M-104-F	BSF-T4
31	32	33	34	181	202	198	202	216
				35	36	37	38	39
				M-60-H	BSF-S-T1	M-95-F	BSF-S-T3	M-61-H
21	22	23	24	187	85	185	85	189
				25	26	27	28	29
				Al Plug				
11	12	13	14	15	16	17	18	19

LOADING NO.	102
DATE	March 21, 1985
EXCESS REACTIVITY	4.95% Δk/k
OPERATING MASS	4014 g

#### ROD POSITIONS AT CRITICAL (With Operating Mass)

ROD NO.	IN. WITHDRAWN	
1	9.09	10.88
2	9.09	10.88
3	9.09	10.88
4	9.09	10.88
5	23.00	10.88
6	23.00	10.88

REMARKS:

Rod calibrations made at 4 kW  
and core flow ~1000 gpm.

<sup>a</sup>Core position for the Low-Temperature Neutron Irradiation Facility.

Table 1. Basic operating data  
(July-September 1986)

	This quarter	Last quarter	Year to date
Total energy, kWd	12,767	16,001	34,713
Average operating power, kW	1,934	1,575	1489
Time operating, %	7.2	11.2	8.4
Reactor availability, %	99.9	99.9	99.9
Reactor water radioactivity, cpm/ml (av)	1,675	4,448	2,464
Reactor water resistivity, ohm-cm (av)	1,198,000	2,030,000	1,753,000
Research samples	8	6	17

### Shutdowns

The reactor experienced twenty-six scheduled shutdowns and two unscheduled shutdowns during the quarter. The first unscheduled shutdown occurred when the high bay air activity increased to set off the pool room CAM, at which time the reactor supervisor ordered the reactor shut down. The second unscheduled shutdown occurred when I&C personnel were performing on-line maintenance to the No. 3 safety amplifier. Table 2 gives an analysis of the scheduled and unscheduled shutdowns.

### Maintenance and Changes

Maintenance and changes to the instrumentation components in the complex are listed in Table 3.

Maintenance and changes of the process systems are listed in Table 4.

Maintenance and changes of the mechanical systems are listed in Table 5.

Table 2. Analysis of shutdowns

Description of shutdown	Number
<u>Scheduled</u>	
Experimenters:	
ATNIF samples	9
Other samples	2
Maintenance:	
Systems functional checks	1
Quarterly checks	1
Reactor Operations:	
Training	<u>13</u>
Subtotal:	26
<u>Unscheduled</u>	
Experimenters:	0
Reactor Operations:	<u>2</u>
Subtotal:	2
TOTAL:	<u>28</u>

Table 3. Maintenance and changes, instrumentation and controls.

Date	Components	Trouble/change	Maintenance performed
7-1-86	TV Camera	Lens failure	Replaced camera lens
7-30-86	Excessive servo action annunciator	Frequent alarms at low power	Inhibited alarm in the low power range and at less than 600 kW when operating in the high power range
8-4-86	FRCAS	Routine	Made quarterly functional test
8-4-86	Nuclear instruments	Routine	Made functional checks on the three safeties, the log-N, and the servo chambers
8-5-86	CAMs	Routine	Calibrated
8-8-86	NW CAM	Failure	Removed to shop for repairs
8-13-86	E panel switches	New	Made functional test on circuits connecting LTNIIF
8-15-86	TV camera iris	Failure	Replaced iris focus motor
8-15-86	Multi-point recorder	Inking mechanism failure	Repaired
8-18-86	Resistivity meter	Zero off	Rezeroed instrument and returned to service
8-20-86	Safety amplifiers	Zero shift	Rezeroed three safety amplifiers and placed in service
8-25-86	pH meter amplifier	Failed	Replaced amplifier
8-28-86	FRCAS	Routine	Health Physics personnel performed functional checks
9-3-86	E panel switches	Routine	Made functional test on circuits

Table 3. (Continued)

Date	Components	Trouble/change	Maintenance performed
9-9-86	Indicator lamp	New	To inform the emergency control center and shift superintendent of high radiation and containment
9-16-86	Servo	Failure	Replaced analog output module
9-16-86	Servo chamber	Routine	Adjusted chamber position
9-16-86	Flow and $\Delta T$ isolation amplifier	Routine	Calibration check
9-22-86 thru 9-30-86	Instruments	Routine	Made quarterly checks
9-24-86	No. 3 safety amplifier	Failed	Replaced
9-25-86	Servo	Battery failed	Replaced servo battery pack

Table 4. Maintenance and changes, process systems

Date	Components	Trouble/change	Maintenance performed
7-14-86	Tower makeup water float	Became loose from mount	Returned to mount and secured
7-16-86	Cell vent filters	Routine	Replaced charcoal and HEPA filters
7-18-86	Primary water expansion joints	Joints were deteriorating	Replaced the 12-in. and the 10-in. joints located in the valve pit
7-21-86 thru 7-25-86	Primary water expansion joint	Deteriorating joint	Replaced the 8-in. joint located at the 8-ft pool depth position
7-21-86	Swivel joint	Bolt's threads stripped	Reworked bolts and nuts and inspected the nylon gasket. Old gasket is in excellent condition
7-22-86	Drip pan	New	Installed drip pan under demineralizer pump
7-31-86	Skimmer filter	Routine	Replaced filters and returned skimmer to service
9-15-86 thru 9-17-86	Demineralizer	Routine	Oriented spool pieces for regenerating demineralizer, then re-oriented for service

Table 5. Maintenance and changes, mechanical systems

Date	Components	Trouble/change	Maintenance performed
7-17-86 thru 7-31-86	Lead shielding in valve pit	Access for repair	Removed lead shield and support structure to gain access to reactor exit water line expansion joints for replacement, then restored for normal service
7-22-86	Primary water pipe	Weld, lack of fusion (sidewall)	Repaired weld flow by grinding and welding
7-25-86	D <sub>2</sub> O tank support rods	Rods rusty	Replaced rusty rods with stainless steel
7-31-86	Scram switch	New	Installed a new scram switch on west pool room wall adjacent to LTNIF
8-5-86	Experiment racks	New	Installed along north east pool room wall
8-6-86 thru 8-7-86	Electrical transformer	Electrical short	Replaced pool room lighting transformer so that lights may be dimmed to show off blue glow
9-22-86	Bridge stops	Security	Tack welded bridge stops and bolts on both reactor bridge and core carriage

#### Operational Activities

The operational activities for the quarter are listed in Table 6.

Table 6. Operational activities

Date	Remarks
7-2-86 thru 7-3-86	Conducted startup training session for 2 operators
7-2-86	Irradiated sample 86-06-01 in ATNIF
7-2-86 thru 7-3-86	Irradiated sample 86-06-02 in ATNIF
7-13-86	TVA electrical power failure due to windstorm, power off 4.067 h
7-15-86 thru 7-18-86	Made preparations and lowered pool water about 9 ft in order to replace three expansion joints in the primary cooling water lines
7-16-86	Conducted emergency electrical and containment quarterly test
7-17-86	Verified that the syphon-break system worked as designed (while draining pool water)
7-26-86 thru 7-29-86	Returned pool to normal level by adding 54,000 gal of demineralized water
8-3-86 thru 8-20-86	Conducted 18 operator startup training sessions
8-4-86	Irradiated sample 86-08-01 in ATNIF
8-7-86	Operated reactor for cryostat radiation leakage
8-15-86	Irradiated sample 86-08-02 in ATNIF
8-28-86	Health Physics personnel performed FRCAS functional checks
9-4-86 thru 9-23-86	Conducted 7 operator startup training sessions
9-4-86 thru 9-11-86	Irradiated sample 86-09-01 in ATNIF
9-15-86	Operated reactor at 2 MW for I&C to calibrate TSR ion chamber

Table 6. (continued)

Date	Remarks
9-15-86 thru 9-17-86	Regenerated demineralizer and placed in service
9-18-86 thru 9-19-86	Irradiated sample 86-09-02 in ATNIF
9-22-86	Installed temporary NOG line on skimmer vent
9-23-86	Operated reactor for LTNIF-1 experiment
9-24-86	Cleaned secondary tower basin and returned it to service
9-30-86	Started sweeping and cleaning the pool
9-30-86	Inspected valve pit for water leaks

### Experiments

Work related to the Low-Temperature Neutron Irradiation Facility, LTNIF, is listed in Table 7.

Table 7. Experiment facilities activity, LTNIF

Date	Remarks
7-24-86	Installed 900 lb ballast weights on 300 liter dewar
7-25-86	Installed the underwater dewar support at the southeast poolside
7-30-86	Installed access neck on 300 liter dewar and placed dewar on support underwater at the southeast poolside location
8-7-86	Made cryostat radiation leakage test
8-11-86	Installed stored-energy experiment into cryostat
9-23-86	Began first LTNIF experiment run. Test discontinued due to helium compressor rupture disk failure

Fuel

Changes in the fuel inventory are reported in Table 8.

Table 8. Fuel and shim-safety rod status

	This quarter	Last quarter	Year to date
Fuel elements depleted	0	34*	34
Shim-safety rod fuel elements depleted	0	0	0
New fuel elements placed in service	0	0	0
New shim-safety rod fuel elements placed in service	0	0	0
Partially depleted shim-safety rod fuel elements	6	6	6
New fuel elements available for use	17	17	17
New shim-safety rod fuel elements available	7	7	7
Partially depleted fuel elements available for use (includes core)	28	28	28
New boron stainless steel shim-safety rods placed in service	0	0	0
Boron stainless steel shim-safety rods in service	6	6	6
Boron stainless steel shim-safety rods available for use	1	1	1

\*PCA fuel elements shipped to Savannah River Plant for reprocessing.

### Experiment Facilities Assignments

Experiment facilities assignments are listed in Table 9. The tubes of the east D<sub>2</sub>O tank are not permanently assigned; they have been used by various Laboratory personnel for short-term sample irradiations.

Table 9. Experiment facilities assignments

Facility	Location	Division or sponsor
Dry thermal-neutron tubes (D-3-1 and -2)	East D <sub>2</sub> O tank	Operations
Wet thermal-neutron tubes (D-4-1 and -2, D-6-1, -2, -3, -4, and -5)	East D <sub>2</sub> O tank	Operations
Low-Temperature Neutron Irradiation Facility (LTNIF)	Southwest corner of pool	Solid State

### Demineralizer Performance

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

### SUMMARY OF SURVEILLANCE TESTS AT THE BSR

Table 11 is a tabulation of the completion dates of the surveillance tests required by the Technical Specifications. This table contains all the surveillance tests scheduled for frequencies of one test per month or longer. Other surveillance requirements which are not reported are satisfied by routine completion of daily and weekly check sheets, start-up checklists, hourly data sheets, the operating log book, and miscellaneous quality assurance tests.

Table 10. Demineralizer performance data

Run No.	Initiation date	Termination date	Throughput (gal)	Gross gamma (cpm/ml)		pH		Specific resistance (ohm-cm)	
				In	Out	In	Out	In	Out
58	4-9-80	5-29-80	1,000,000	1,979	123	5.3	5.5	808,000	1,832,000
59	5-30-80	6-2-80	5,000	1,950	125	5.3	5.6	774,000	1,538,000
60 <sup>a</sup>	6-3-80	8-4-80	1,750,000	1,929	106	5.4	5.6	1,278,000	3,466,000
61	8-5-80	10-30-80	1,850,000	1,824	118	5.4	5.6	1,148,000	2,600,000
62	11-4-80	2-26-81	2,600,000	1,587	110	5.4	5.6	1,368,000	4,319,000
63	3-2-81	6-20-81	2,200,000	1,271	151	5.5	5.7	1,233,000	3,960,000
64	6-29-81	8-11-81	1,250,000	1,941	141	5.4	5.7	896,000	2,258,000
65	8-12-81	9-8-81	425,000	2,163	142	5.2	5.4	445,000	1,126,000
66 <sup>a</sup>	9-19-81	1-3-82	850,000	1,666	119	5.4	5.6	1,138,000	1,980,000
67	1-4-82	4-5-82	2,400,000	1,874	150	5.4	5.6	970,000	1,691,000
68	4-7-82	7-8-82	2,000,000	1,841	138	5.3	5.5	915,000	1,841,000
69	7-9-82	7-27-82	750,000	1,962	129	5.2	5.4	720,000	1,136,000
70 <sup>a</sup>	9-22-84	8-30-83	1,900,000	527	59	5.2	5.4	1,180,000	2,034,000
71 <sup>b</sup>	8-31-83	5-15-84	2,693,560	2,961	166	5.6	5.8	1,030,000	1,830,000
72	6-5-84	9-11-84	2,851,200	--	--	5.5	5.7	1,025,000	2,000,000
73	9-13-84	2-8-85	2,650,000	2,467	230	5.6	5.9	758,000	1,289,000
74	2-16-85	4-1-85	1,114,560	2,565	--	5.6	6.1	468,000	1,501,000
75 <sup>a</sup>	4-2-85	7-16-85	3,389,760	3,337	282	5.7	6.1	736,000	1,590,000
76	7-19-85	12-6-85	4,354,460	3,727	196	5.7	5.9	840,000	1,818,000
77	12-10-85	4-9-86	3,543,400	1,268	104	5.7	5.8	1,023,000	2,033,000
78	4-11-86	9-15-86	4,521,600	3,238	365	5.9	6.2	686,000	1,613,000
79	9-17-86	--	--	--	--	--	--	--	--

<sup>a</sup>New resin in the demineralizer columns.

<sup>b</sup>The demineralizer operated on low flow (approximately 7 gpm) from September 26, 1983, to January 17, 1984, due to a failure of the booster pump.

Table 11. Summary of surveillance tests at the BSR

Test	Most recent test	Previous test
<u>Biennial tests</u>		
Inspection of the shim-safety rods	9-23-85	8-28-84
<u>Annual tests</u>		
Core $\Delta T$ channel calibration	6-29-86	3-21-86
Primary coolant flow channel calibration	9-30-86	12-13-85
Pool water-level channel calibration	9-30-86	6-30-86
Maximum rate of reactivity addition by the shim-safety rods	9-25-86	3-20-86
Reactivity assigned to the servo-control system	5-2-86	3-22-85
Subcriticality with each shim-safety rod at its upper limit while all other shim-safety rods are fully inserted	9-25-86	6-30-86
<u>Semiannual</u>		
Cell-ventilation filter efficiency		
A. Elemental iodine	7-23-86	12-19-85
B. Dioctyl phthalate	6-2-86	12-19-85
Radiation monitoring equipment calibration	8-28-86	5-28-86
Stack radiation monitor calibration	5-6-86	4-30-86
<u>Quarterly</u>		
Safety channel No. 1 calibration	9-24-86	6-30-86
Safety channel No. 2 calibration	9-24-86	6-30-86
Safety channel No. 3 calibration	9-24-86	6-30-86
Log-N channel calibration	9-24-86	6-30-86

Table 11. (Continued)

Test	Most recent test	Previous test
<u>Quarterly (continued)</u>		
Fission chamber channel calibration	9-24-86	6-30-86
Flapper valve position channel functional test	9-30-86	6-30-86
Measurement of release time and time of flight for the shim-safety rods	9-25-86	6-30-86
Containment closure system functional test	7-16-86	3-20-86
In-leakage during containment mode	7-16-86	3-20-86
<u>Others</u>		
Calibration of shim-safety rods	5-2-86	3-22-85
LTNIF, pool water level, functional test	4-2-86	1-3-86

## POOL CRITICAL ASSEMBLY

## OPERATIONS

The Pool Critical Assembly (PCA) is shutdown for shim-safety rod magnets and associated electronic components to be upgraded. The fuel elements have been shipped to Savannah River for reprocessing.

## SURVEILLANCE TESTS AT THE PCA

Shim-safety-rod magnets and associated electronic components are being upgraded at the PCA. Until this work is completed, it will not be possible to make all the surveillance tests required at this facility by the Technical Specifications. Thus, a waiver of the PCA Technical Specifications surveillance test requirements during the proposed modification and component replacement period was granted.<sup>1</sup>

---

<sup>1</sup>Letter to B. L. Corbett from K. H. Poteet, subject "Waiver of Surveillance Tests at the PCA," March 26, 1985.



## INTERNAL DISTRIBUTION

- |                    |                                      |
|--------------------|--------------------------------------|
| 1. S. J. Ball      | 16. M. W. Kohring                    |
| 2. G. H. Burger    | 17. R. V. McCord                     |
| 3. C. D. Cagle     | 18-19. F. E. Muggridge               |
| 4. H. D. Cochran   | 20. E. Newman                        |
| 5. G. H. Coleman   | 21. K. H. Poteet                     |
| 6. B. L. Corbett   | 22. J. A. Ray                        |
| 7. W. A. Duggins   | 23. R. M. Stinnett                   |
| 8. M. K. Ford      | 24. J. H. Swanks                     |
| 9. T. P. Hamrick   | 25. K. W. West                       |
| 10. E. E. Hill     | 26. R. S. Wiltshire                  |
| 11. R. W. Hobbs    | 27-28. Laboratory Records Department |
| 12. S. A. Hodge    | 29. Laboratory Records, ORNL R.C.    |
| 13. S. S. Hurt     | 30-31. Central Research Library      |
| 14. E. B. Johnson  | 32. Document Reference Section       |
| 15. H. R. Kerchner | 33. ORNL Patent Section              |

## EXTERNAL DISTRIBUTION

34. Safety and Environmental Control Division, DOE, Oak Ridge, Tennessee 37831
35. N. Goldenberg, Director, Safety, QA, and Safeguards, Office of Support Programs, Department of Energy, Germantown, Maryland 20545
36. J. A. Lenhard, Office of Assistant Manager for Energy Research and Development, Department of Energy, Oak Ridge Operations Office, Oak Ridge, Tennessee 37831
37. L. E. Temple, Director, Construction Management, Office of Energy Research, Department of Energy, Washington, D. C. 20585
- 38-67. Technical Information Center, DOE, Oak Ridge, Tennessee 37831