27
10/31/79

MASTER

ornl

ORNL/TM-7087

**OAK
RIDGE
NATIONAL
LABORATORY**

**UNION
CARBIDE**

**High Flux Isotope Reactor
Quarterly Report
April, May, and June of 1979**

B. L. Corbett
R. V. McCord
K. H. Poteet

**OPERATED BY
UNION CARBIDE CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY**

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

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.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

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 nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use or the results of such use of any information, apparatus, product or process disclosed in this report, or represents that its use by such third party would not infringe privately owned rights.

MASTER

ORNL/TM-7087

Contract No. W-7405-eng-26

Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
APRIL, MAY, AND JUNE OF 1979

B. L. Corbett
R. V. McCord
K. H. Poteet

Sponsor: J. A. Cox
Director, Operations Division

DISCLAIMER

This book 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.

Date Published - October 1979

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

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
DEPARTMENT OF ENERGY

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

**THIS PAGE
WAS INTENTIONALLY
LEFT BLANK**

CONTENTS

	<u>Page</u>
SUMMARY	1
OPERATIONS	1
SHUTDOWNS	2
OPERATIONAL NOTES AND SPECIAL TESTS	3
Servo Control System Malfunction	3
PLANT MAINTENANCE	4
INSTRUMENTATION AND CONTROLS	5
SYSTEM SURVEILLANCE TESTS AND RESULTS	6
Vessel Head Studs	6
Component Replacement	6
Stack Filters	6
Summary of Surveillance Tests	8
UNUSUAL OCCURRENCES	9
REACTOR EXPERIMENTS	9
Experimental Facilities	9
HFIR Target Loading	11
DISTRIBUTION	17

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
APRIL, MAY, AND JUNE OF 1979

B. L. Corbett, R. V. McCord, and K. H. Poteet

SUMMARY

Routine reactor operation with four end-of-cycle shutdowns, one scheduled shutdown for analysis of servo problems, and one unscheduled shutdown resulted in an on-stream time of 87.4%. Scheduled reactor component replacement and the semiannual reactor component inspection were completed.

OPERATIONS

Basic operating data for the quarter are listed in Table 1.

Table 1. HFIR Basic Operating Data
 (April 1, 1979 through June 30, 1979)

	This Quarter	Last Quarter	Year to Date
Total energy, MWd	7,940	8,471	16,411
Average power, MW/operating hr	99.8	99.9	99.9
Time operating, %	87.4	94.0	90.8
Reactor availability, %	87.8	94.2	91.0
Reactor water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	318,000	352,000	
Pool water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	59	49	

The starting and ending dates for Cycles 175, 176, 177, 178, and 179 are presented in Table 2.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
175	3-15-79	4-5-79	2139
176	4-6-79	4-28-79	2175
177	5-4-79	5-28-79	2213
178	5-29-79	6-21-79	2229
179	6-22-79	In progress	871

The status of the HFIR fuel and control-plate inventory is indicated in Table 3.

Table 3. HFIR Material Inventory

Item	This Quarter	Last Quarter
New fuel elements placed in service	4	4
New fuel elements available for use	45	45
Spent fuel elements on hand	14	14
Spent fuel elements shipped	4	0
New sets of shim plates placed in service	0	0
New sets of shim plates available for use	5	5

SHUTDOWNS

There were four end-of-cycle shutdowns, one scheduled midcycle shutdown, and one unscheduled shutdown for a total downtime of 274.450 hrs. Table 4 gives further details.

Table 4. Description of HFIR Shutdowns

Date	Downtime (hrs)	Remarks
Scheduled		
4-5-79	32.884	Fuel Cycle 175 was completed at 12:30 PM. A total power generation of 2139 MWd was obtained on fuel elements 176 O&I.
4-28-79	137.583	Fuel Cycle 176 was completed at 3:55 PM. A total power generation of 2175 MWd was obtained on fuel elements 177 O&I. The shutdown was extended to replace the removable beryllium reflector, the upper and lower track bearings, and the control rod extension tubes and shock absorbers and to install a spare set of outer control plates.
5-16-79	52.333	Abnormal behavior of the servo control system resulted in a decision to shut the reactor down at 5:00 PM for analysis and subsequent corrective maintenance.
5-28-79	27.166	Fuel Cycle 177 was completed at 7:22 PM. A total power generation of 2113 MWd was obtained on fuel elements 178 O&I. The shutdown was extended approximately eight hours for isotope work.
6-21-79	22.868	Fuel Cycle 178 ended at 8:00 AM. A total power generation of 2229 MWd was obtained on fuel elements 179 O&I.
Unscheduled		
5-29-79	1.600	At startup for fuel Cycle 178, the critical rod position failed to fall within the limits ($\pm 0.25''$) of the predicted value. The reactor was shut down from 10 MW at 11:03 PM until analysis of the discrepancy was made. The predicted value was subsequently adjusted to allow resumption of operation.

OPERATIONAL NOTES AND SPECIAL TESTS

Servo Control System Malfunction

The performance of the two-out-of-three servo control system had been erratic since the start of fuel Cycle 177 on May 4, 1979. Although the reactor power was being controlled within an acceptable range, failures

occurred in two of the servo channels at different times. Finally, on May 16 simultaneous failures occurred in two servo channels. The third servo channel continued to maintain the reactor power at the proper level, but it was decided to shut the reactor down and thoroughly investigate the servo problems.

Servo Channels 1 and 2 were found to have incapacitating faults; Channel 3 was in operable condition but required some "tune-up" maintenance.

Electrical connectors at the servo motors on Channels 1 and 2 were found in a partially "shorted" condition. These partial connector "shorts" were evidently responsible for damaging the servo motors on these channels since they could not be made to operate satisfactorily after all other problems were corrected. An intermittent ground condition was also found in a cable connecting two instrument chassis modules in Channel 1.

Servo Channel 3 was found to be in reasonably good condition, but a detailed evaluation of its operating characteristics revealed that its performance could be improved by replacing an operational amplifier in one of its gain circuits.

The operating characteristics of all servo channels were evaluated in detail. Components were replaced or adjusted as required on Channels 2 and 3 to return them to original design conditions. All components in Channel 1 were made operable except for the servo motor. Another motor has been procured and installed in this position.

PLANT MAINTENANCE

Maintenance and changes in the various process systems are listed in Table 5.

Table 5. Process Systems - Maintenance and Changes

Date	Component	Remarks
Primary System		
4-6-79	Rupture discs	The two primary system rupture discs were replaced after they began to leak through to the underground storage tank.
4-6-79	Valve	A new diaphragm was installed in the afterfilter inlet valve HCV-1036 because of excessive leakage.
4-6-79	Seal housing	The No. 3 control plate drive rod seal housing was replaced because of leaky seals.
5-8-79	Pump seal	The outboard shaft seal on pressurizer pump PU-4A was replaced because of excessive leakage.
5-8-79	Pump seal	All three seals on primary pump PU-1A were replaced because of excessive leakage.

INSTRUMENTATION AND CONTROLS

Maintenance and changes in the various instrumentation systems are listed in Table 6.

Table 6. Instrumentation - Maintenance and Changes

Date	Component	Remarks
4-11-79	Selsyn	The No. 5 control cylinder position transmitter became erratic and was replaced.
5-2-79	Fission chamber motor	The No. 3 fission chamber motor burned out and was replaced.
5-18-79	Servo motor	The performance of the No. 2 servo motor under load did not meet the minimum requirements and it was replaced.
5-18-79	Amplifier	The operating characteristics of the No. 3 servo preamplifier had deteriorated and it was replaced.
6-15-79	Servo motor	The performance of the No. 1 servo motor under load did not meet the minimum requirements and it was replaced.

SYSTEM SURVEILLANCE TESTS AND RESULTS

Vessel Head Studs

The accumulated number of tensioning cycles on the reactor vessel head studs is presented in Table 7. These studs were designed for a fatigue life of 40 cycles loading due to tensioning of the bolts and 730 full-pressure (1000 psig) cycles. Installation of new reactor vessel head studs was completed in June, 1972. The numbers in Table 7 represent the maximum cycles to which any new stud has been exposed.

Table 7. Vessel Head Stud-Tensioning Cycles.

	This Quarter	Last Quarter	Total to Date
Head bolts tensioned	0	0	6
1500 psig			0
950 psig	0	0	7
750 psig	5	8	52
650 psig	0	0	117

Component Replacement

At the end of fuel Cycle 176, a new removable beryllium reflector was installed. The old reflector had accumulated a total of 89,009 MWd. New upper and lower track bearings were installed in addition to shock absorbers and control plate extension tubes with newly replaced bearings. A semiannual core inspection was also performed.

Stack Filters

Stack filtering systems in the special building hot exhaust (SBHE) and hot off-gas (HOG) systems were tested for particulate and iodine removal efficiency. Results of the most recent tests are tabulated in Table 8.

Table 8. Particulate and Iodine Removal Efficiency

Filter Bank	Methyl Iodide				Elemental Iodine				Filter Position	Particulate Retention			
	Last Test		Previous Test		Last Test		Previous Test			Last Test		Previous Test	
	Date	Eff., %	Date	Eff., %	Date	Eff., %	Date	Eff., %		Date	Eff., %	Date	Eff., %
SBHE, west	5-8-79	99.9	10-25-78	46	5-3-79	99.99	9-21-78	99.96	South	3-9-79	99.988	9-7-79	99.990
									North	3-9-79	99.995	9-7-79	99.990
SBHE, center	4-5-79	49	10-19-78	63	3-20-79	99.92	9-27-78	99.96	South	3-9-79	99.991	9-7-79	99.997
									North	3-9-79	99.992	9-7-79	99.996
SBHE, east	4-3-79	99.6	12-14-78	99.9	3-13-79	99.99	12-5-78	99.98	South	3-9-79	99.993	9-7-79	99.995
									North	3-9-79	99.998	9-7-79	99.976
HOG, west	4-19-79	99.8	10-12-78	96	4-11-79	99.99	10-5-78	99.99					
HOG, center	4-26-79	50	10-18-78	78	4-12-79	99.97	10-10-78	99.99					
HOG, east	4-24-79	23	10-17-78	94	4-17-79	99.97	10-11-78	99.99					

Summary of Surveillance Tests

Table 9 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 month or longer. Other surveillance requirements which will not be reported are satisfied by the routine completion of daily and weekly check sheets, startup check lists, hourly data sheets, the operating log books, and miscellaneous quality assurance tests.

Table 9. Summary of Surveillance Tests

Test	Most Recent Test	Previous Test	Previous Test
Annual Tests			
Count rate channel A calibration	9-15-78	10-11-77	
Count rate channel B calibration	9-15-78	12-16-77	
Count rate channel C calibration	9-15-78	8-11-77	
Normal-emergency systems	4-30-79	9-14-78	1-10-78
Poison injection system	1-4-79	2-1-78	3-27-77
Pressurizer pump high pressure cutoff	9-19-78	3-1-78	10-6-77
Pressure relief valves	4-6-79	9-14-78	10-5-77
Pressure vessel head studs	9-14-78	10-5-77	
Radiation block valve test	1-4-79	2-1-78	3-27-77
Reactor bay in-leakage test	1-4-79	2-28-78	7-25-77
Reactor components	5-1-79	9-14-78	2-1-78
Safety channel A calibration	9-27-78	3-10-78	9-20-77
Safety channel B calibration	9-29-78	3-10-78	12-8-77
Safety channel C calibration	10-12-78	3-9-78	8-3-77
Servo channel A calibration	9-15-78	2-15-78	9-27-77
Servo channel B calibration	9-15-78	2-15-78	11-14-77
Servo channel C calibration	9-15-78	2-15-78	7-14-77
Speed of shim and regulating drives	9-14-78	10-6-77	
Switchgear battery load test	1-4-79	2-1-78	6-6-77

Table 9. (continued)

Test	Most Recent Test	Previous Test	Previous Test
Semiannual Tests			
Main pump low pressure cutoff	4-30-79	9-14-78	2-2-78
Pony motor battery E	5-29-79	2-19-79	11-22-78
Pony motor battery F	6-21-79	3-14-79	12-14-78
Pony motor battery G	4-5-79	10-7-78	9-4-78
Pony motor battery H	4-28-79	1-28-79	10-28-78
Radiation monitoring equipment	5-14-79	1-10-79	9-7-78
SBHE filter efficiency	3-20-79	9-7-78	3-23-78
Monthly Test			
Cadmium nitrate tests	6-16-79	5-19-79	4-21-79
Diesel run test, No. 1	6-12-79	5-15-79	4-17-79
Diesel run test, No. 2	6-12-79	5-15-79	4-17-79

UNUSUAL OCCURRENCES

There were no unusual occurrences at the HFIR during this quarter, and all outstanding Unusual Occurrence Reports have been completed in final form.

REACTOR EXPERIMENTS

Experimental Facilities

Assignment of the various HFIR experimental facilities is tabulated in Table 10.

Table 10. Experiment Facility Usage

Facility	Description	Division
PTP-A1	Materials studies	Metals and Ceramics
PTP-A4	Materials studies	Metals and Ceramics
PTP-D1	Materials studies	Metals and Ceramics
PTP-D7	Materials studies	Metals and Ceramics
PTP-G4	Materials studies	Metals and Ceramics
PTP-G7	Materials studies	Metals and Ceramics
RB-1	Isotope production	Operations
RB-2	Isotope production	Operations
RB-3	Isotope production	Operations
RB-4	Isotope production	Operations
RB-5	HTGR fuel irradiations	Engineering Technology
RB-6	Isotope production	Operations
RB-7	HTGR fuel irradiations	Engineering Technology
RB-8	Isotope production	Operations
CR-1	Isotope production	Operations
CR-2	Isotope production	Operations
CR-3	Isotope production	Operations
CR-4	Isotope production	Operations
CR-5	Isotope production	Operations
CR-6	Isotope production	Operations
CR-7	Isotope production	Operations
CR-8	Isotope production	Operations
VXF-1	Isotope production	Operations
VXF-3	HFIR corrosion specimen	Operations
VXF-5	Isotope production	Operations
VXF-7	Pneumatic tube	Analytical Chemistry
VXF-9	Isotope production	Operations
VXF-13	Isotope production	Operations
VXF-18	Isotope production	Operations
VXF-22	Isotope production	Operations
EF-2	Noise analysis studies	Instrumentation and Controls and Operations

Table 10. (continued)

Facility	Description	Division
HB-1	Neutron diffractometer	Solid State
HB-2	Neutron diffractometer	Chemistry
HB-3	Neutron diffractometer	Solid State
HB-4	Neutron diffractometer	Solid State

HFIR Target Loading

A description of the HFIR target loading for each of the operating cycles this quarter is presented in Figures 1, 2, 3, 4, and 5.

HFIR TARGET LOADING

CYCLE NO. 175DATE 3-15-79

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

14

CURIUM (Cm)

16

STAINLESS STEEL (SST)

1

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

Figure 1

HFIR TARGET LOADING

CYCLE NO. 176DATE 4-6-79

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

141151

Figure 2

HFIR TARGET LOADING

CYCLE NO. 177DATE 5-4-79

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

14

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

15

HYDRAULIC TUBE (HT)

1

Figure 3

HFIR TARGET LOADING

CYCLE NO. 178DATE 5-30-79

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

20181

Figure 4

HFIR TARGET LOADING

CYCLE NO. 179DATE 6-22-79

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

20

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

1

ALUMINUM (Al)

8

HYDRAULIC TUBE (HT)

1

Figure 5

INTERNAL DISTRIBUTION

1. D. S. Asquith	26. J. R. McGuffey
2. J. E. Bigelow	27. L. C. Oakes
3. F. T. Binford	28. H. Postma
4. G. H. Burger	29. K. H. Poteet
5. C. D. Cagle	30. M. E. Ramsey
6. W. R. Casto	31. T. M. Sims
7-8. J. A. Conlin	32. M. J. Skinner
9-10. B. L. Corbett	33. J. H. Swanks
11. J. A. Cox	34. D. B. Trauger
12. W. H. Culbert	35. K. W. West
13. T. P. Hamrick	36. F. W. Wiffen
14. R. W. Hobbs	37. M. K. Wilkinson
15. C. C. Hopkins	38. A. Zucker
16. S. S. Hurt, III	39-40. Central Research Library
17. G. H. Jenks	41. Document Reference Section
18. O. L. Keller	42-43. Laboratory Records Department
19. W. C. Koehler	44. Laboratory Records, ORNL R.C.
20-25. R. V. McCord	

EXTERNAL DISTRIBUTION

- 45-71. Technical Information Center, Oak Ridge
72. J. L. Burnett, Division of Physical Research, DOE, Washington, D. C. 20545
73. H. N. Culver, DOE, Oak Ridge
74. M. Jacquemain, Head, Technical Department ILL, Institute Max von Laue-Paul Langevin, CEDEX 156, 38 Grenoble-Gare, France
75. G. L. Rogosa, Division of Physical Research, DOE, Washington, D. C. 02545
76. Assistant Manager, Office of Energy Research and Development, DOE, Oak Ridge
77. A. C. Wood, Australian AEC, Nuclear Science and Technology Branch, Private Mail Bag, Sutherland 2232, New South Wales, Australia