High Flux Isotope Reactor Quarterly Report October, November, and December of 1976

B. L. Corbett
R. V. McCord

MASTER

OAK RIDGE NATIONAL LABORATORY

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

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

27
4-27-77
25 copy to NTIS

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
Price: Printed Copy \$3.50; Microfiche \$3.00

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the Energy Research and Development Administration/United States Nuclear Regulatory Commission, nor any of their employees, nor any of their contractors, subcontractors, or 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.

Contract No. W-7405-eng-26

Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
OCTOBER, NOVEMBER, AND DECEMBER OF 1976

B. L. Corbett
R. V. McCord

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or 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.

Date Published - April 1977

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
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

eb

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

CONTENTS

	<u>Page</u>
SUMMARY	1
OPERATIONS	1
SHUTDOWNS	2
PLANT MAINTENANCE	3
INSTRUMENTATION AND CONTROLS	3
SYSTEM SURVEILLANCE TESTS AND RESULTS	6
Vessel Head Studs	6
Stack Filters	6
REACTOR DESIGN CHANGES	8
REVISIONS TO THE HFIR OPERATING MANUAL	8
REACTOR EXPERIMENTS	8
Experimental Facilities	8
HFIR Target Loading	9
DISTRIBUTION	15

SUMMARY

Routine reactor operation with only three end-of-cycle shutdowns this quarter resulted in an on-stream time of 96.5%. Total on-stream time for the year was 93.8%.

OPERATIONS

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

Table 1. HFIR Basic Operating Data
(October 1, 1976 through December 31, 1976)

	This Quarter	Last Quarter	Total for 1976
Total energy, MWd	8,323	8,085	33,656
Average power, MW/operating hr	99.0	99.9	99.6
Time operating, %	96.5	88.0	93.8
Reactor availability, %	96.8	88.3	94.7
Reactor water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	313,000	459,000	
Pool water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	52	116	

The starting and ending dates for cycles 138, 139, and 140 are presented in Table 2. Cycle 141 was still in progress at the end of the quarter and 1508 MWd had been accumulated.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
138	9-27-76	10-21-76	2392
139	10-21-76	11-14-76	2394
140	11-15-76	12-14-76	2404
141	12-15-76	In progress	1508

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	3	4
New fuel elements available for use	49	47
Spent fuel elements on hand	9	13
Spent fuel elements shipped	7	2
New sets of shim plates placed in service	0	0
New sets of shim plates available for use	2	2

SHUTDOWNS

A summary of the HFIR shutdowns for the quarter is presented in Table 4. Table 5 gives further details of the shutdowns.

Table 4. Summary of HFIR Shutdowns

Type	Number	Downtime (hr)
	Scheduled	
End of cycle	3	76.423
	Unscheduled	
Equipment failure	3	0.350

Table 5. Description of HFIR Shutdowns

Date	Downtime (hr)	Remarks
Scheduled		
10-21-76	14.583	Fuel cycle 138 was terminated at 4:00 a.m. A total power generation of 2392 MWd was obtained on fuel elements 135-0 and 135-I. The No. 1 control plate drive was replaced.
11-14-76	25.840	Fuel cycle 139 was completed at 4:33 p.m. A total power generation of 2394 MWd was obtained on fuel elements 136-0 and 136-I. The shutdown was extended ~8 hours to complete experiment installation and removal.
12-14-76	36.000	Fuel cycle 140 was completed at 4:00 a.m. This cycle had been operated at less than full power because of temperature limitations of HTGR experiment HRB-13. A total power generation of 2404 MWd was obtained on fuel elements 137-0 and 137-I. The shutdown was extended to change the control plates and install experiments.
Unscheduled		
11-15-76	0.133	All safety plates dropped while the Channel No. 3 FFED test was being made on the safety instrumentation.
11-16-76	0.117	All safety plates dropped while the Channel No. 3 FFED test was being made on the safety instrumentation.
12-27-76	0.100	All safety plates dropped while the Channel No. 2 FFED test was being made on the safety instrumentation.

PLANT MAINTENANCE

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

INSTRUMENTATION AND CONTROLS

Maintenance and changes in the various instrumentation systems are listed in Table 7.

Table 6. Process System - Maintenance and Changes

Date	Component	Remarks
Primary System		
10-21-76	Control rod drives	The No. 1 control rod drive rod was replaced for routine maintenance.
11-15-76	Pony motors	New brushes were installed in pony motors PU-1E and PU-1F.
12-8-76	Pony motor battery charger	The PU-1E pony motor battery charger failed. Repairs consisted of diode replacement and rewinding of a voltage regulator coil.
Miscellaneous		
10-13-76	Air compressor	Instrument air compressor C-1A was overhauled with new valves and piston rings.

Table 7. Instrumentation - Maintenance and Changes

Date	Component	Remarks
Servo System		
10-18-76	Servo motor	The No. 3 servo motor failed with shorted windings. A new motor was installed.
Safety System		
11-15-76	Trip comparator	The safety channel No. 3 FFED manual trip push button failed to trip the channel during safety tests. The trip comparator was replaced with a spare. When tested, the spare trip comparator push button caused the reactor to scram on two different occasions. The push button was replaced.
12-12-76	Voltage inverter	Safety channel No. 3 voltage inverter failed causing the channel to trip. A spare inverter was installed while repairs are being made.

SYSTEM SURVEILLANCE TESTS AND RESULTS

Vessel Head Studs

The accumulated number of tensioning cycles on the reactor vessel head studs is presented in Table 8. 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 8 represent the maximum cycles to which any new stud has been exposed.

Table 8. Vessel Head Stud-Tensioning Cycles

Type Cycle	This Quarter	Last Quarter	Total to Date
Head bolts tensioned	0	0	6
1500 psig			0
950 psig	0	0	7
650 psig	3	5	114

Stack Filters

Stack filtering systems in the special building hot exhaust (SBHE) and hot off-gas (HOG) systems were tested for iodine removal efficiency. Results of the most recent tests are tabulated in Table 9.

Table 9. 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	11-9-75	82.84	5-4-76	48	10-8-76	99.94	3-18-76	99.96	South	9-22-76	99.993	3-26-76	99.980
									North	9-22-76	99.996	3-26-76	99.000*
SBHE, center	11-17-76	87.14	5-11-76	80	10-21-76	99.98	3-30-76	99.98	South	9-22-76	99.992	3-26-76	99.988
									North	9-22-76	99.972	3-26-76	99.960
SBHE, east	11-12-76	48.24	5-6-76	47	10-14-76	99.93	3-23-76	99.97	South	9-22-76	99.971	3-26-76	99.956
									North	9-22-76	99.992	3-26-76	99.930*
HOG, west	11-16-76	99.17	5-13-76	73	10-26-76	99.99	4-6-76	99.99					
HOG, center	11-18-76	98.55	5-18-76	68	11-4-76	99.99	4-22-76	99.99					
HOG, east	11-10-76	92.22	5-20-76	98	10-12-76	99.96	4-14-76	99.90					

*Filters were replaced.

REACTOR DESIGN CHANGES

Instrumentation and controls design change memoranda which describe work completed this quarter are tabulated in Table 10.

Table 10. Instrumentation Change Memoranda

Memo No.	Subject	General Description
88	Electrical noise elimination	To reduce and/or eliminate electrical noise problems when operating in Modes 2 and 3, signal smoothing capacitors will be installed in the safety flux signal conditioners and the rate trip will be disabled in Modes 2 and 3.

REVISIONS TO THE HFIR OPERATING MANUAL

Revisions and additions to the HFIR operating manual which have been published this quarter are tabulated in Table 11.

Table 11. HFIR Manual Revisions

Date	Section No.	Subject	General Description
12-8-76	II-4.2y	Xenon production	A section on working the new xenon production facility was added.

REACTOR EXPERIMENTS

Experimental Facilities

Usage of the various HFIR experiment facilities is tabulated in Table 12.

Table 12. Experiment Facility Usage

Facility	Description	Division
RB-1	Isotope production	Operations
RB-2	Isotope production	Operations
RB-3	Isotope production	Operations
RB-4	HFIR tensile specimens	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	Californium production	Chemical Technology
CR-4	Californium production	Chemical Technology
CR-5	Isotope production	Operations
CR-6	Isotope production	Operations
CR-7	Isotope production	Operations
CR-8	Isotope production	Operations
VXF-1	HFIR corrosion specimen	Operations
VXF-7	Pneumatic tube	Analytical Chemistry
VXF-13	HTGR fuel irradiations	Engineering Technology
EF-2	Noise analysis studies	Instrumentation and Controls and Operations
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, and 4.

<u>TARGET TYPE</u>	<u>NUMBER</u>
PLUTONIUM (Pu)	<u>-</u>
CURIUM (Cm)	<u>27</u>
STAINLESS STEEL (SST)	<u>-</u>
GRAPHITE (C)	<u>1</u>
ALUMINUM (Al)	<u>2</u>
HYDRAULIC TUBE (HT)	<u>1</u>

Fig. 1. HFIR Target Loading for Cycle 138 - September 27, 1976

TARGET TYPENUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

2731

Fig. 2. HFIR Target Loading for Cycle 139 - October 21, 1976

ORNL DWG. 77-7856

<u>TARGET TYPE</u>	<u>NUMBER</u>
PLUTONIUM (Pu)	<u> </u>
CURIUM (Cm)	<u> 27 </u>
STAINLESS STEEL (SST)	<u> </u>
GRAPHITE (C)	<u> 1 </u>
ALUMINUM (AI)	<u> 2 </u>
HYDRAULIC TUBE (HT)	<u> 1 </u>

Fig. 3. HFIR Target Loading for Cycle 140 - November 15, 1976

TARGET TYPENUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

28111

Fig. 4. HFIR Target Loading for Cycle 141 - December 15, 1976

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

INTERNAL DISTRIBUTION

1. G. M. Adamson	33. R. W. Knight
2. J. L. Anderson	34. W. C. Koehler
3. D. S. Asquith	35. E. Lamb
4. K. S. Belitz	36. H. A. Levy
5. J. E. Bigelow	37. J. Lewin
6. D. S. Billington	38-43. R. V. McCord
7. F. T. Binford	44. J. R. McGuffey
8. G. H. Burger	45. H. A. McLain
9. C. D. Cagle	46. J. R. McWherter
10. W. R. Casto	47. J. M. Miller
11. R. D. Cheverton	48. L. C. Oakes
12. T. E. Cole	49. H. Postma
13. J. A. Conlin	50. K. H. Poteet
14-15. B. L. Corbett	51. M. E. Ramsey
16. J. A. Cox	52. R. L. Scott, Jr.
17. W. H. Culbert	53. W. H. Sides
18. F. L. Culler	54. T. M. Sims
19. S. J. Ditto	55. M. J. Skinner
20. G. J. Dixon	56. J. H. Swanks
21. K. Farrell	57. J. R. Thomas
22. A. P. Fraas	58. D. B. Trauger
23. E. D. Gupton	59. J. R. Weir
24. T. P. Hamrick	60. K. W. West
25. V. O. Haynes	61. F. W. Wiffen
26. C. H. Helton	62. M. K. Wilkinson
27. S. S. Hurt, III	63. J. W. Woods
28. E. B. Johnson	64-65. Central Research Library
29. S. I. Kaplan	66. Document Reference Section
30. O. L. Keller	67-68. Laboratory Records Department
31. E. M. King	69. Laboratory Records, ORNL R.C.
32. H. V. Klaus	

EXTERNAL DISTRIBUTION

- 70-96. Technical Information Center, Oak Ridge
- 97-98. M. B. Biles, ERDA Washington
- 99. K. J. Bobin, Belgium
- 100. J. L. Burnett, ERDA Washington
- 101. H. N. Culver, ERDA
- 102. M. Jacquemain, France
- 103. G. L. Rogosa, ERDA Washington
- 104. Research and Technical Support Division, ORO