**High Flux Isotope Reactor Quarterly Report
January, February, and March of 1977**

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

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Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
JANUARY, FEBRUARY, AND MARCH OF 1977

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SUMMARY

Routine reactor operation with four end-of-cycle shutdowns this quarter resulted in an on-stream time of 94.5%. The semiannual reactor-component inspection was completed, and the control plates were changed.

OPERATIONS

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

Table 1. HFIR Basic Operating Data
(January 1, 1977 through March 31, 1977)

	This Quarter	Last Quarter	Year To Date
Total energy, MWd	8,455	8,323	8,455
Average power, MW/operating hr	99.4	99.0	99.4
Time operating, %	94.5	96.5	94.5
Reactor availability, %	95.1	96.8	95.1
Reactor water radioactivity, c/min (av) ml	356,000	313,000	
Pool water radioactivity, c/min (av) ml	49	52	

The starting and ending dates for cycles 141, 142, 143, and 144 are presented in Table 2. Cycle 145 was still in progress at the end of the quarter and 404 MWd had been accumulated.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
141	12-15-76	1-10-77	2368
142	1-10-77	2-3-77	2398
143	2-5-77	3-1-77	2448
144	3-2-77	3-26-77	2345
145	3-27-77	In progress	404

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	3
New fuel elements available for use	45	49
Spent fuel elements on hand	13	9
Spent fuel elements shipped	1	7
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	4	118.784
Unscheduled		
Controller error	1	0.133

Table 5. Description of HFIR Shutdowns

Date	Downtime (hr)	Remarks
Scheduled		
1-10-77	18.917	Fuel cycle 141 was completed at 1:15 a.m. A total power generation of 2368 MWd was obtained on fuel elements 138-0 and 138-I. The shutdown was extended ~4 hours to complete experiment removal.
2-3-77	34.5	Fuel cycle 142 was completed at 8:10 p.m. A total power generation of 2398 MWd was obtained on fuel elements 139-0 and 139-I. Outer control plate 9-3, which was fitted with test journal bearings, was removed from position No. 3. Plate 10-3, also fitted with test journal bearings, was installed in its place.
3-1-77	22.95	Fuel cycle 143 was completed at 6:09 p.m. A total power generation of 2448 MWd was obtained on fuel elements 164-0 and 164-I. Normal primary system operating pressure was raised to 750 psig. The low pressure trip setpoint was raised to 600 psig, and the high inlet temperature trip setpoint was lowered to 130°F.
3-26-77	42.417	Fuel cycle 144 was terminated at 4:00 a.m. A total power generation of 2345 MWd was obtained on fuel elements 140-0 and 140-I. The shutdown was extended to complete the semiannual component inspection and to change the control plates.
Unscheduled		
3-27-77	0.133	The reactor scrammed at 10 MW power level during startup due to high inlet temperature from lack of secondary coolant flow.

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		
1-2-77	Pressurizer pump	The magnetic clutch on pressurizer pump PU-4B was replaced because of bearing failure.
3-7-77	Pressurizer pump	The magnetic clutch on pressurizer pump PU-4B was replaced, again, because of bearing failure.
3-25-77	Heat exchanger	A leak of ~0.1 gpm developed in the Cell 110 heat exchanger. The defective tube was located and plugs welded in both ends.
3-28-77	Heat exchanger	A leak of ~5 gpm developed in the Cell 111 heat exchanger. The defective tube was located and plugs welded in both ends.
3-29-77	Pressurizer pump	The suction seal on pressurizer pump PU-4B was replaced because of excessive leakage.
Miscellaneous		
1-10-77	Acid pump	The sulfuric acid pump motor was replaced after acid leaked through a faulty valve onto the motor causing its windings to short out.
1-11-77	Air compressor	The motor on instrument air compressor C-1B was overhauled with new bearings.

Table 7. Instrumentation - Maintenance and Changes

Date	Component	Remarks
Safety System		
1-3-77	Signal converter	The dual signal converter for safety channel No. 3 flux recorder failed. It was replaced with a spare.

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
750 psig	2	0	2
650 psig	3	3	117

Semiannual Reactor-Component Inspection

At the end of fuel cycle 144, the semiannual reactor-component inspection was made. The shroud flange, fuel grid, and control plates were

removed from the vessel. The components which remained in the vessel--upper and lower tracks, beryllium, beam tubes, and support pedestals--were inspected. No component abnormalities were detected.

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	11-9-76	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	99.938
									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	95.93	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	58	11-4-76	99.99	4-22-76	99.99					
HOG, east	11-10-76	92.22	5-20-76	98	10-12-75	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																		
89	Technical specification conformance	<p>To assure conformance with the technical specifications for the HFIR, the set-points for the indicated safety and control switches will be adjusted as follows:</p> <p>a. <u>Primary System Pressure</u></p> <table><tr><td>Operating pressure</td><td>750 psig</td></tr><tr><td>Scram setpoint</td><td>600 psig</td></tr><tr><td>Primary pump cutoff</td><td>400 psig</td></tr><tr><td>Block valve closure</td><td>675 psig</td></tr><tr><td>Start-standby pressurizer pump</td><td>700 psig</td></tr><tr><td>Low pressure alarm</td><td>700 psig</td></tr><tr><td>High pressure alarm</td><td>800 psig</td></tr><tr><td>Pressurizer pump cutoff</td><td>850 psig</td></tr></table> <p>b. <u>Reactor Inlet Temperature</u></p> <table><tr><td>Scram</td><td>130°F</td></tr></table>	Operating pressure	750 psig	Scram setpoint	600 psig	Primary pump cutoff	400 psig	Block valve closure	675 psig	Start-standby pressurizer pump	700 psig	Low pressure alarm	700 psig	High pressure alarm	800 psig	Pressurizer pump cutoff	850 psig	Scram	130°F
Operating pressure	750 psig																			
Scram setpoint	600 psig																			
Primary pump cutoff	400 psig																			
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Start-standby pressurizer pump	700 psig																			
Low pressure alarm	700 psig																			
High pressure alarm	800 psig																			
Pressurizer pump cutoff	850 psig																			
Scram	130°F																			

Mechanical design change memoranda which describe work completed this quarter are tabulated in Table 11.

Table 11. Mechanical Change Memoranda

Memo No.	Subject	General Description
52	Control plate bracket attachment screws	To increase the strength of the control plate bracket-to-the-control-plate attaching mechanism, stainless steel screws will be used on all remotely replaced brackets.

REVISIONS TO THE HFIR OPERATING MANUAL

Revisions and additions to the HFIR operating manual which have been published this quarter are tabulated in Table 12.

Table 12. HFIR Manual Revisions

Date	Section No.	Subject	General Description
3-22-77	II-2.1 thru 3.1f	Technical specification compliance	Miscellaneous additions and updating to conform with the HFIR technical specifications and setpoint changes.

REACTOR EXPERIMENTS

Experimental Facilities

Usage of the various HFIR experiment facilities is tabulated in Table 13.

Table 13. Experiment Facility Usage

Facility	Description	Division
PTP-A1	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	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

Table 13. (continued)

Facility	Description	Division
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, 4, and 5.

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

28

1

1

1

Fig. 1. HFIR Target Loading for Cycle 141 - December 15, 1976

TARGET TYPENUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

27121

Fig. 2. HFIR Target Loading for Cycle 142 - January 10, 1977

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

Fig. 3. HFIR Target Loading for Cycle 143 - February 5, 1977

TARGET TYPENUMBER

PLUTONIUM (Pu)

-

CURIUM (Cm)

27

STAINLESS STEEL (SST)

-

GRAPHITE (C)

-

ALUMINUM (Al)

3

HYDRAULIC TUBE (HT)

1

Fig. 4. HFIR Target Loading for Cycle 144 - March 2, 1977

TARGET TYPENUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (AI)

HYDRAULIC TUBE (HT)

2731

Fig. 5. HFIR Target Loading for Cycle 145 - March 27, 1977

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3. D. S. Asquith	34. H. A. Levy
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