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**High Flux Isotope Reactor Quarterly Report
July, August, and September of 1976**

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OAK RIDGE NATIONAL LABORATORY

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

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Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
JULY, AUGUST, AND SEPTEMBER OF 1976

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SUMMARY

An extended shutdown to replace part of the beryllium reflector reduced the operating time this quarter to 88% and the operating time for the year to 92.9%. 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
(July 1, 1976 through September 30, 1976)

	This Quarter	Last Quarter	Year To Date
Total energy, MWd	8,085	8,612	25,333
Average power, MW/operating hr	99.9	99.0	99.6
Time operating, %	88.0	95.6	92.9
Reactor availability, %	88.3	96.3	93.9
Reactor water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	459,000	344,000	
Pool water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	116	54	

The starting and ending dates for cycles 134, 135, 136, and 137 are presented in Table 2. Cycle 138 was still in progress at the end of the quarter and 375 MWd had been accumulated.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
134	6-17-76	7-9-76	2225
135	7-10-76	8-1-76	2279
136	8-2-76	8-25-76	2248
137	9-2-76	9-25-76	2350
138	9-29-76	In progress	375

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	47	48
Spent fuel elements on hand	13	11
Spent fuel elements shipped	2	5
New sets of shim plates placed in service	0	0
New sets of shim plates available for use	2	2

SHUTDOWNS

There were four end-of-cycle shutdowns this quarter for a total downtime of 265.303 hours. Table 4 gives further details of the shutdowns.

Table 4. Description of HFIR Shutdowns

Date	Downtime (hr)	Remarks
7-9-76	19.916	Fuel cycle 134 was terminated at 8:00 a.m. A total power generation of 2225 MWd was obtained on fuel elements 131-0 and 131-I. The shutdown was extended approximately six hours to complete a number of small maintenance items.
8-1-76	16.470	Fuel cycle 135 was completed at 11:50 p.m. A total power generation of 2279 MWd was obtained on fuel elements 132-0 and 132-I.
8-25-76	199.500	Fuel cycle 136 was terminated at 4:00 a.m. A total power generation of 2248 MWd was obtained on fuel elements 133-0 and 133-I. The shutdown was extended to replace the removable and semipermanent beryllium, change control plates, replace guide track bearings, install new extension tubes, and complete the semiannual component inspection.
9-26-76	29.417	Fuel cycle 137 was terminated at midnight. A total power generation of 2350 MWd was obtained on fuel elements 134-0 and 134-I. The shutdown was extended to complete some reactor maintenance and experiment work.

OPERATIONAL NOTES AND SPECIAL TESTS

Beryllium Replacement

The HFIR beryllium reflector consists of five concentric rings with a total beryllium thickness of ~ 1 ft. The three innermost rings, which are fastened together in one assembly called the removable beryllium, are subject to the highest neutron flux and must be replaced routinely about every 2 1/2 years because of radiation damage. The next ring, called the semipermanent beryllium is subject to less neutron damage and is replaced each 5-6 years. The outermost ring, the permanent beryllium, lasts 8-10 years.

In the past the removable beryllium was replaced when it became difficult to insert or remove experimental assemblies located in it. Although the removable beryllium assembly in the reactor had reached its nominal end-of-life in February, 1976, no difficulty was experienced

during experiment interchange; so it was decided to permit it to stay in the reactor another six months. During the HFIR shutdown at the end of fuel cycle 136 in August, the removable beryllium assembly was removed from the reactor, but only after a great deal of difficulty. Special removal tools had to be fabricated, and the entire operation took ~3 days. It was also found that the semipermanent beryllium was cracked although it had only been in the reactor ~4 years. A thorough inspection of the reactor revealed no other abnormalities, and the reassembly proceeded uneventfully. It is not known whether the semipermanent beryllium cracked first and wedged the removable assembly in place or whether the difficult extraction of the removable beryllium cracked the semipermanent beryllium.

PLANT MAINTENANCE

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

INSTRUMENTATION AND CONTROLS

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

Table 5. Process System - Maintenance and Changes

Date	Component	Remarks
Primary System		
8-26-76	Removable and semi-permanent beryllium	The removable and semipermanent beryllium assemblies were replaced. The removable beryllium was very difficult to remove from the reactor, and all four pieces of the semipermanent beryllium were cracked.
8-26-76	Control rod tracks	New bearings were installed on the upper and lower control rod guide tracks.
8-26-76	Seal housing	The seal housing for control rod No. 2 was replaced because of high pressure leaks through the O-ring seals.
Secondary System		
7-9-76	Cooling tower fan	Cooling tower fan 4C-2 was replaced for refurbishing.
7-14-76	Acid pump	A burned out motor was replaced on the west sulfuric acid injection pump.
8-2-76	Control valve	A locking pin was installed in the secondary flow control valve 377-A stem-to-actuator coupling to prevent separation.
Miscellaneous		
8-23-76	Air compressor	Inlet and exhaust valves were replaced in air compressor C-1B.
8-31-76	Control valve	Primary deaerator level control valve 202 was refurbished.

Table 6. Instrumentation - Maintenance and Changes

Date	Component	Remarks
Servo System		
9-14-76	Signal conditioner	A faulty zener diode was replaced in the No. 3 servo flux signal conditioner because of sluggish reset gain action.
Wide-Range Counting Channel		
7-28-76	Chamber	Wide-range counting channel No. 3 failed. The trouble was traced to the chamber and snake assembly which was replaced.
9-26-76	Drive motor	At shutdown the No. 2 channel fission chamber would not move. A new fission-chamber-drive motor was installed.
Miscellaneous		
8-31-76	Seat switch	The push rod for the No. 2 control rod seat switch jammed. The push rod and the rod drive seal were replaced and the seat switch was adjusted.

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
650 psig	5	5	111

Semiannual Reactor-Component Inspection

At the end of fuel cycle 136, the semiannual reactor-component inspection was made. The shroud flange, fuel grid, control plates, extension tubes, upper and lower tracks, and the removable and semipermanent beryllium were removed from the vessel. The components which remained in the vessel--permanent beryllium, beam tubes, and support pedestals--were inspected. No component abnormalities were detected, but new removable and semipermanent beryllium assemblies were installed because the ones removed had suffered radiation damage.

Stack Filters

Stack filtering systems in the special building hot exhaust (SBHE) and hot off-gas (HOG) systems were tested for particulate 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	5-4-76	48	10-23-75	75	3-13-76	99.96	9-8-75	99.90	South	9-22-76	99.993	3-26-76	99.980
									North	9-22-76	99.996	3-26-76	99.000*
SBHE, center	5-11-76	30	10-29-75	88	3-30-76	99.98	9-11-75	99.97	South	9-22-76	99.992	3-26-76	99.988
									North	9-22-76	99.972	3-26-76	99.960
SBHE, east	5-6-76	47	10-28-75	59	3-23-76	99.97	10-9-75	99.91	South	9-22-76	99.971	3-26-76	99.956
									North	9-22-76	99.992	3-26-76	99.930*
HOG, west	5-13-76	73	10-30-75	90	4-6-76	99.99	10-20-75	99.98					
HOG, center	5-13-76	68	11-5-75	44	4-22-76	99.99	10-14-75	99.99					
HOG, east	5-20-76	58	11-4-75	92	4-14-76	99.90	10-15-75	99.99					

*Filters were replaced.

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REVISIONS TO THE HFIR OPERATING MANUAL

Revisions and additions to the HFIR operating manual which have been published this quarter are tabulated in Table 9.

Table 9. HFIR Manual Revisions

Date	Section No.	Subject	General Description
7-17-76	II-2.1	Reactor startup	A section on reactor safety was added to emphasize the need for conservative decisions during reactor operation.

REACTOR EXPERIMENTS

Experimental Facilities

Usage of the various HFIR experiment facilities is tabulated in Table 10.

Table 10. 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

Table 10. (continued)

Facility	Description	Division
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.

<u>TARGET TYPE</u>	<u>NUMBER</u>
PLUTONIUM (Pu)	-
CURIUM (Cm)	29
STAINLESS STEEL (SST)	-
GRAPHITE (C)	1
ALUMINUM (Al)	-
HYDRAULIC TUBE (HT)	1

Fig. 1. HFIR Target Loading for Cycle 134 - June 17, 1976

TARGET TYPENUMBER

PLUTONIUM (Pu)

-

CURIUM (Cm)

29

STAINLESS STEEL (SST)

-

GRAPHITE (C)

1

ALUMINUM (Al)

-

HYDRAULIC TUBE (HT)

1

Fig. 2. HFIR Target Loading for Cycle 135 - July 10, 1976

TARGET TYPENUMBER

PLUTONIUM (Pu)

-

CURIUM (Cm)

29

STAINLESS STEEL (SST)

-

GRAPHITE (C)

1

ALUMINUM (Al)

-

HYDRAULIC TUBE (HT)

1

Fig. 3. HFIR Target Loading for Cycle 136 - August 2, 1976

TARGET TYPENUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

 29

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

Fig. 4. HFIR Target Loading for Cycle 137 - September 2, 1976

<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. 5. HFIR Target Loading for Cycle 138 - September 27, 1976

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