**High Flux Isotope Reactor Quarterly
Report January, February,
and March of 1976**

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MASTER

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HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
JANUARY, FEBRUARY, AND MARCH OF 1976

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JULY 1976

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SUMMARY

Routine reactor operation with only three end-of-cycle shutdowns this quarter resulted in an on-stream time of 95.0%. 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, 1976 through March 31, 1976)

	This Quarter	Last Quarter	Year To Date
Total energy, MWd	8,636	8,610	8,636
Average power, MW/operating hr	99.8	99.8	99.8
Time operating, %	95.0	93.7	95.0
Reactor availability, %	97.2	94.1	97.2
Reactor water radioactivity, <u>c/min</u> (av) <u>ml</u>	222,000	234,000	
Pool water radioactivity, <u>c/min</u> (av) <u>ml</u>	42	105	

The starting and ending dates for cycles 127, 128, and 129 are presented in Table 2. Cycle 130 was still in progress at the end of the quarter and 1724 MWd had been accumulated.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
127	12-31-75	1-23-76	2325
128	1-24-76	2-16-76	2318
129	2-19-76	3-13-76	2307
130	3-14-76	In progress	1724

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	47	45
Spent fuel elements on hand	12	9
Spent fuel elements shipped	0	8
New sets of shim plates placed in service	0	1
New sets of shim plates available for use	2	2

SHUTDOWNS

There were three end-of-cycle shutdowns this quarter for a total downtime of 108.216 hrs. Table 4 gives further details of the shutdowns.

Table 4. Description of HFIR Shutdowns

Date	Downtime (hr)	Remarks
1-23-76	13.000	Fuel cycle 127 was completed at 9:00 p.m. A total power generation of 2325 MWd was obtained on fuel elements 123-0 and 123-I.
2-16-76	64.583	Fuel cycle 128 was completed at 3:00 p.m. A total power generation of 2318 MWd was obtained on fuel elements 124-0 and 124-I. The shutdown was extended to inspect the reactor core components, insert experiments, perform maintenance, and complete semi-annual equipment checks.
3-13-76	30.633	Fuel cycle 129 was completed at 10:54 a.m. A total power generation of 2307 MWd was obtained on fuel elements 125-0 and 125-I. The shutdown was extended for some work on experiments.

OPERATIONAL NOTES AND SPECIAL TESTS

Control Plate Bearing Test

A test of four sleeve-type journal bearings was completed this quarter. These journal bearings were mounted on a control plate that was installed in the reactor at the start of fuel cycle 125. This plate was removed from the reactor at the end of cycle 128.

Based on a previous series of rod drops with journal bearings, it was expected that the time-of-flight of the plate with the experimental bearings would be 6-7% longer than a normal plate. Time-of-flight measurements made during the course of this test showed that the experimental plate was taking an average 12-15% longer than a normal plate. Although this was still well within the operating limits, the discrepancy between the initial test and the in-reactor run was disturbing.

When the journal bearings were removed from the plate for examination at the completion of the test, flat spots were found on the two bearings mounted at the top of the control plate. This indicated that these bearings were not turning as the plate moved in the reactor. There was no obvious explanation of this sticking phenomena on the top bearings since the bottom bearings appeared to have rolled and exhibited the expected amount of wear.

To continue the study of journal-bearing performance in the reactor, four more bearings will be fabricated to slightly different specifications. Clearances between the rotating parts of the bearing will be increased slightly, and the surface finish of mating components will be made smoother. Another in-reactor test will be conducted.

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 Charges

Date	Component	Remarks
Primary System		
1-2-76	Letdown valve	The misoperating letdown valve in cell 110 was replaced with a spare valve.
2-17-76	Drive rod	The drive rod assembly for the No. 4 safety plate was changed out as part of the preventive maintenance program.
2-17-76	Letdown valve	The letdown valve in cell 112 was found to be inoperative, and it was replaced with a spare valve.
Secondary System		
2-2-76	Circulating pump	The auxiliary secondary coolant circulating pump, PU-14, was returned to service. The impeller shaft coupling broke on this pump in June, 1975.
2-23-76	Cooling tower fan	Cooling tower fan assembly FN-4A2 was replaced with a rebuilt unit. The gearbox seals had developed oil leaks.
3-20-76	Cooling tower fan	Intermittent arcing and overheating occurred in the circuit breaker of fan FN-4A2. Damaged components were replaced, and all connections were tightened.
Miscellaneous		
1-21-76	Nitric acid pump	The north nitric acid pump in the primary pH control system was replaced because of leaking seals.
1-24-76	Battery charger	The battery charger for pony motor PU-1H tripped out of service. A fuse had blown in its control circuit.
3-13-76	Battery charger	The battery charger for pony motor PU-1H blew a control fuse when AC power was turned on following a reliability test. The charger failed again the next day during startup checks, and all three fuses were replaced.

Table 6. Instrumentation - Maintenance and Changes

Date	Component	Remarks
Safety System		
2-19-76	Signal converter	The dual signal converter in channel No. 1 was replaced because the reset flux readout was too high.
Servo System		
2-20-76	Signal converter	Misoperation of the regulating rod position recorder was corrected by the repair of its dual signal converter.
3-26-76	Motor	A new type servo motor was installed in the No. 1 channel. The motor in this position developed intermittent sticking problems, and no more motors of the original type are available.
Miscellaneous		
1-2-76	Relays	At least two of the three relays in the main flow sensing matrix of the hydraulic tube control system failed. They were replaced.
1-7-76	Power indicator	A new servo motor was installed in the long-scale digital-log power indicating instrument.

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	3	4	101

Semiannual Reactor-Component Inspection

At the end of fuel cycle 128, 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 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	10-23-75	75	4-15-75	88	9-8-75	99.90	3-18-75	99.93	South	3-26-76	99.980	9-26-75	99.996
									North	3-26-76	99.000*	9-26-75	99.997
SBHE, center	10-29-75	88	4-24-75	90	9-11-75	99.97	3-20-75	99.99	South	3-26-76	99.988	9-26-75	99.995
									North	3-26-76	99.960	9-26-75	99.958
SBHE, east	10-28-75	59	4-17-75	42	10-9-75	99.91	3-19-75	99.93	South	3-26-76	99.956	9-26-75	99.992
									North	3-26-76	99.930*	9-26-75	99.960
HOG, west	10-30-75	90	4-8-75	77	10-20-75	99.98	3-26-75	99.97					
HOG, center	11-5-75	44	4-10-75	99.52	10-14-75	99.99	3-26-75	99.99					
HOG, east	11-4-75	92	4-2-75	49	10-15-75	99.99	3-26-75	99.94					

*Filters were replaced.

REACTOR DESIGN CHANGES

Mechanical design change memoranda which describe work completed this quarter are tabulated in Table 9.

Table 9. Mechanical Design Change Memoranda

Memo No.	Subject	General Description
50	Control plate bearings	The ball bearings used on the HFIR control plates have been discontinued as a standard production item. Specially ordered replacement bearings will incorporate two improvements: (1) the race diameter has been increased to eliminate the installation of the "tire" presently required; and (2) a split race which holds the balls more securely has been incorporated.
51	Pool bypass filter drain line rerouting	Chemicals used to clean the pool bypass filter are flushed into an ILW drain line. Occasionally these chemicals are forced into the primary head tank through an overflow line. To prevent this happening, the pool bypass filter drain line will be rerouted from the ILW to the PWD system.

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	Reactor
RB-6	Isotope production	Operations
RB-7	HTGR fuel irradiations	Reactor
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
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)	-
CURIUM (Cm)	<u>30</u>
STAINLESS STEEL (SST)	-
GRAPHITE (C)	-
ALUMINUM (Al)	-
HYDRAULIC TUBE (HT)	<u>1</u>

Fig. 1. HFIR Target Loading for Cycle 127 - December 31, 1975

TARGET TYPENUMBER

PLUTONIUM (Pu)

-

CURIUM (Cm)

30

STAINLESS STEEL (SST)

-

GRAPHITE (C)

-

ALUMINUM (Al)

-

HYDRAULIC TUBE (HT)

1

Fig. 2. HFIR Target Loading for Cycle 128 - January 24, 1976

ORNL DWG 76-11556

TARGET TYPENUMBER

PLUTONIUM (Pu)

 -

CURIUM (Cm)

 30

STAINLESS STEEL (SST)

 -

GRAPHITE (C)

 -

ALUMINUM (Al)

 -

HYDRAULIC TUBE (HT)

 1

Fig. 3. HFIR Target Loading for Cycle 129 - February 19, 1976

ORNL DWG 76-11557

<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. 4. HFIR Target Loading for Cycle 130 - March 14, 1976

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