**High Flux Isotope Reactor
Quarterly Report July, August,
and September of 1977**

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MASTER

OAK RIDGE NATIONAL LABORATORY
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HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
JULY, AUGUST, AND SEPTEMBER OF 1977

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SUMMARY

Routine reactor operation with three end-of-cycle shutdowns and the completion of a fourth carried over from last quarter resulted in an on-stream time of 95.5%. The control plates were changed, and a new inner control cylinder was installed.

OPERATIONS

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

Table 1. HFIR Basic Operating Data
(July 1, 1977 through September 30, 1977)

	This Quarter	Last Quarter	Year To Date
Total energy, MWd	8,771	8,782	26,008
Average power, MW/operating hr	99.8	99.9	99.7
Time operating, %	95.5	96.6	95.5
Reactor availability, %	96.9	96.7	96.0
Reactor water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	281,000	286,000	
Pool water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	688*	49	

*Caused by an experiment leaking primary water into the pool system.

The starting and ending dates for cycles 149, 150, 151, and 152 are presented in Table 2.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
149	7-2-77	7-24-77	2280
150	7-25-77	8-17-77	2288
151	8-19-77	9-11-77	2281
152	9-11-77	In progress	1922

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	47	45
Spent fuel elements on hand	10	15
Spent fuel elements shipped	8	2
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, one of which was continued from last quarter, and one reactor control demonstration shutdown for a total downtime of 98.850 hours. There were no unscheduled shutdowns this quarter. Table 4 gives further details of the shutdowns.

Table 4. Description of HFIR Shutdowns

Date	Downtime (hr)	Remarks
7-1-77	25.617	This downtime was a continuation from last quarter of the end of fuel cycle 148 shutdown.
7-24-77	21.300	Fuel cycle 149 was completed at 9:30 p.m. A total power generation of 2280 MWd was obtained on fuel elements 145-0 and 145-1.
8-17-77	36.083	Fuel cycle 150 was completed at 4:00 p.m. A total power generation of 2288 MWd was obtained on fuel elements 148-0 and 148-1.
9-11-77	15.733	Fuel cycle 151 was completed at 2:27 a.m. A total power generation of 2281 MWd was obtained on fuel elements 149-0 and 149-1.
9-14-77	0.117	At the request of the Instrumentation and Controls Division, the reactor was shut down to demonstrate the performance of the HFIR control and safety systems.

OPERATIONAL NOTES AND SPECIAL TESTS

To comply with the surveillance requirements of the HFIR technical specifications, a number of special tests were completed this quarter. The nominal speed of the shim rod drives is 6 in./min. Measuring this parameter for each shim rod gave the following results:

<u>Shim Rod No.</u>	<u>Drive Speed, in./min.</u>
1	5.91
2	5.98
3	5.84
4	6.00
5	6.05

The servo controlled portion of the shim rod stroke is limited to a nominal 15 in./min. over a 1-in. span. When this movement was measured on a high speed recorder, the servo control was found to have a speed of 14.4 in./min. over an 0.815-in. span.

A "Case IV" shutdown margin measurement was also made. The Case IV conditions are the most severe combination of two independent control system failures considered in the HFIR safety analysis report. It consists of a failure of one safety rod to scram and a runaway of one safety rod (the same rod). The limiting condition is that the reactor be subcritical with the runaway rod at its withdraw limit, the control cylinder at the original symmetric critical position, and the remaining three safety rods completely inserted. The measurement showed that the reactor was subcritical with one safety rod at its withdraw limit, the control cylinder at its symmetric critical position, and the three remaining safety rods withdrawn less than 16.40 in.

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 Systems - Maintenance and Changes

Date	Component	Remarks
Primary System		
8-15-77	Demineralizer resin	The cation resin in the west primary demineralizer was replaced because of radiation damage.
9-17-77	Heat exchanger	A leaking tube in heat exchanger EX-1A was plugged. Two other tubes in locations most likely to develop leaks were plugged.
Miscellaneous		
8-8-77	Prefilters	The fiberglass prefilters in the SBHE center filter pit were replaced because of excessive pressure drop.
9-5-77	Electrical breaker	The electrical breaker for cooling tower fan 4D-2 caught fire and burned out forcing a power reduction to 90 MW until it could be replaced.

Table 6. Instrumentation - Maintenance and Changes

Date	Component	Remarks
8-22-77	Servo motor	The No. 1 servo motor was replaced because of a noisy bearing.
9-20-77	HV supply	The amplifier in the No. 1 channel Failed Fuel Element Detector was replaced because of a low output voltage on the HV supply. This was detected during a routine safety channel check procedure by I&C personnel.

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 8 represent the maximum cycles to which any new stud has been exposed.

Table 7. 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	5	3	10
650 psig	0	3	117

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 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	3-29-77	44	11-9-76	82.84	3-8-77	99.93	10-8-76	99.94	South	3-28-77	99.997	3-21-77	99.995
									North	3-28-77	99.995	3-21-77	99.996
SBHE, center	5-3-77	80	11-17-76	87	3-23-77	99.94	10-21-76	99.98	South	3-28-77	99.997	3-21-77	99.994
									North	3-28-77	99.953	3-30-77	99.996
SBHE, east	4-21-77	64	11-12-76	48	3-18-77	99.94	10-14-76	99.93	South	3-28-77	99.982	3-30-77	99.995
									North	3-28-77	99.994	3-21-77	99.990
HOG, west	5-19-77	98	11-16-76	99	3-16-77	99.99	10-26-76	99.99					
HOG, center	5-17-77	60	11-18-76	98	4-1-77	99.97	11-4-76	99.99					
HOG, east	5-20-77	88	11-10-76	92	3-8-77	99.93	10-12-76	99.96					

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
8-25-77	II-13	Technical specifications requirements	A complete chapter addition covering surveillance requirements of the HFIR technical specifications.

REACTOR EXPERIMENTS

Experimental Facilities

Usage of the various HFIR experiment 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	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 10. (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, and 4.

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

27

3

1

Fig. 1. HFIR Target Loading for Cycle 149 - July 2, 1977

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

27

1

2

1

Fig. 2. HFIR Target Loading for Cycle 150 - July 25, 1977

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

27

1

2

1

Fig. 3. HFIR Target Loading for Cycle 151 - August 19, 1977

TARGET TYPENUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

28111

Fig. 4. HFIR Target Loading for Cycle 152 - September 11, 1977

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