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**High Flux Isotope Reactor Quarterly Report
October, November, and December of 1977**

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OAK RIDGE NATIONAL LABORATORY
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Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
OCTOBER, NOVEMBER, AND DECEMBER OF 1977

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SUMMARY

Routine reactor operation with four end-of-cycle shutdowns and one scheduled cycle interruption shutdown resulted in an on-stream time of 90.3%. A new inner control cylinder and a set of outer control plates with remotely replaced bearing brackets were installed. The semiannual core component inspection was made.

OPERATIONS

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

Table 1. HFIR Basic Operating Data
(October 1, 1977 through December 31, 1977)

	This Quarter	Last Quarter	Year of 1977
Total energy, MWd	8,355	8,771	34,363
Average power, MW/operating hr	99.9	99.8	99.8
Time operating, %	90.8	95.5	94.4
Reactor availability, %	95.2	96.9	95.8
Reactor water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	365,000	281,000	
Pool water radioactivity, $\frac{\text{c/min}}{\text{ml}}$ (av)	70	688*	

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

The starting and ending dates for cycles 152, 153, 154, 155, and 156 are presented in Table 2.

Table 2. Cycles of Operation

Cycle No.	Date Started	Date Ended	Accumulated Power (MWd)
152	9-11-77	10-4-77	2270
153	10-6-77	10-29-77	2239
154	10-30-77	11-23-77	2112
155	11-24-77	12-16-77	2171
156	12-17-77	In progress	1485

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	44	47
Spent fuel elements on hand	14	10
Spent fuel elements shipped	0	8
New sets of shim plates placed in service	0	0
New sets of shim plates available for use	3	2

SHUTDOWNS

There were four end-of-cycle shutdowns and one mid-cycle shutdown for experiment installation for a total downtime of 202.433 hrs. There were no unscheduled shutdowns this quarter. Table 4 gives further details of the shutdowns.

Table 4. Description of HFIR Shutdowns

Date	Downtime (hrs)	Remarks
10-4-77	54.600	Fuel cycle 152 was completed at 11:35 a.m. A total power generation of 2270 MWd was obtained on fuel elements 150-0 and 150-I.
10-29-77	38.617	Fuel cycle 153 was completed at 4:00 a.m. A total power generation of 2239 MWd was obtained on fuel elements 152-0 and 152-I. Startup was delayed ~24 hrs while a new iridium irradiation was prepared for installation.
11-7-77	55.333	The reactor was shut down prior to the end of fuel cycle 154 for removal of iridium samples. Startup was further delayed while awaiting Xenon decay.
11-23-77	30.833	Fuel cycle 154 was terminated at 4:00 a.m. A total power generation of 2112 MWd was obtained on fuel elements 153-0 and 153-I. The shutdown was extended for installation of another iridium irradiation facility.
12-16-77	23.050	Fuel cycle 155 was terminated at 4:00 a.m. A total power generation of 2171 MWd was obtained on fuel elements 154-0 and 154-I.

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		
10-15-77	Speed controller	The newly overhauled pressurizer pump PU-4B speed controller failed after ~30 hrs operation because of bearing failure.
11-11-77	Speed controller	The PU-4B speed controller failed again and will be replaced with a spare.
11-14-77	Heat exchanger	A leaking tube in heat exchanger EX-1B was plugged.
11-21-77	Heat exchanger	A leaking tube in heat exchanger EX-1A was plugged.
Pool Coolant System		
11-3-77	Coolant pump	The shaft in pool coolant pump PU-9A was replaced because of excessive wear.
Miscellaneous		
11-20-77	Diesel generator	The No. 2 diesel generator failed to start for its weekly test run. A defective coil in its starting circuit SR relay was replaced.
12-7-77	Acid pump	The secondary system west acid addition pump. PU-1A, failed and was overhauled.

Table 6. Instrumentation - Maintenance and Changes

Date	Component	Remarks
10-5-77	Servo demand	The Channel 1 servo demand drive unit became defective and was replaced.
11-9-77	Pressure control	Pressure recorder controller PRC-127 became inoperative. Its trouble was traced to faulty O-ring seals in the letdown valve positioners which were allowing supply pressure to leak back into the signal line. New O-rings were installed in all four positioners.
12-2-77	Signal converter	A dual signal converter in Channel 1 wide-range counting channel failed and was replaced.
12-25-77	Operational amplifier	A failure occurred within the servo amplifier in Channel 2 wide-range counting channel. After repairs, it was replaced.

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

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	5	15
650 psig	0	3	117

Semiannual Reactor-Component Inspection

At the end of fuel cycle 152, 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. The pressure vessel top head holddown nuts and studs were inspected ultrasonically by Quality Assurance and Inspection Department personnel. The condition of these components has not deteriorated since their installation.

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	10-13-77	17	3-22-77	44	9-22-77	99.93	3-8-77	99.93	South	9-28-77	99.997	3-21-77	99.995
									North	9-28-77	99.995	3-21-77	99.996
SBHE, center	10-20-77	92	5-3-77	80	10-6-77	99.96	3-23-77	99.94	South	9-28-77	99.997	3-21-77	99.994
									North	9-28-77	99.953	3-30-77	99.996
SBHE, east	10-18-77	38	4-21-77	64	10-4-77	99.90	3-18-77	99.94	South	9-28-77	99.982	3-30-77	99.995
									North	9-28-77	99.994	3-21-77	99.990
HOG, west	10-19-77	99	5-19-77	98	10-5-77	99.99	3-16-77	99.99					
HOG, center	10-26-77	93	5-17-77	60	11-1-77	99.99	4-1-77	99.97					
HOG, east	10-27-77	56	5-20-77	88	9-21-77	99.99	3-8-77	99.93					

Summary of Surveillance Tests

Table 9 is a tabulation of the completion dates of the surveillance tests required by the Technical Specifications. This table contains all the surveillance tests scheduled for frequencies of one month or longer. Other surveillance requirements which will not be reported are satisfied by the routine completion of daily and weekly check sheets, startup check lists, hourly data sheets, the operating log books, and miscellaneous quality assurance tests.

Table 9. Summary of Surveillance Tests

Test	Most Recent Test	Previous Test	Previous Test
Annual Tests			
Count rate channel A calibration	10-11-77		
Count rate channel B calibration	12-16-77		
Count rate channel C calibration	8-11-77		
Normal-emergency systems	8-18-77		
Poison injection system	3-27-77		
Pressurizer pump high pressure cutoff	10-6-77		
Pressure relief valves	10-5-77		
Pressure vessel head studs	10 5 77		
Radiation block valve test	3-27-77		
Reactor bay in-leakage	7-25-77		
Reactor components	10-5-77		
Safety channel A calibration	9-20-77		
Safety channel B calibration	12-8-77		
Safety channel C calibration	8-3-77		
Servo channel A calibration	9-27-77		
Servo channel B calibration	11-14-77		
Servo channel C calibration	7-14-77		
Speed of shim and regulating drives	10-6-77		
Switchgear battery load test	6-6-77		

Table 9. (continued)

Test	Most Recent Test	Previous Test	Previous Test
Semiannual Tests			
Main pump low pressure cutoff	10-6-77	2-4-77	
Pony motor battery E	12-16-77	5-13-77	
Pony motor battery F	11-23-77	9-11-77	
Pony motor battery G	10-4-77	6-6-77	
Pony motor battery H	10-29-77	7-24-77	
Radiation monitoring equipment	11-10-77	9-12-77	7-7-77
SBHE filter efficiency	9-28-77	3-21-77	
Monthly Tests			
Cadmium nitrate tests	12-10-77	11-12-77	10-8-77
Diesel run test, No. 1	12-13-77	11-15-77	10-11-77
Diesel run test, No. 2	12-13-77	11-15-77	10-11-77

REVISIONS TO THE HFIR OPERATING MANUAL

Revisions and additions to the HFIR operating manual which have been published this quarter are tabulated in Table 10.

Table 10. HFIR Manual Revisions

Date	Section No.	Subject	General Description
11-28-77	I--3, 4, 6, 8, & 10	General updating	Sections revised to reflect changes made by requirements of the Technical Specifications.
12-8-77	II--2 & 7	General updating	Miscellaneous changes to bring manual up to date.
12-12-77	I	Table of contents	Completely revised table of contents and lists of tables, figures, and examples.

REACTOR EXPERIMENTS

Experimental Facilities

Usage of the various HFIR experiment facilities is tabulated in Table 11.

Table 11. 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
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	Isotope production	Operations

Table 11. (continued)

Facility	Description	Division
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.

HFIR TARGET LOADING

CYCLE NO. 152DATE 9-11-77

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

28111

FIGURE 1

HFIR TARGET LOADING

CYCLE NO. 153DATE 10-6-77

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

28111UCN-12912
(3 1-78)

FIGURE 2

HFIR TARGET LOADING

CYCLE NO. 154DATE 10-30-77

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

281111UCN-12912
(3 1-78)

FIGURE 3

HFIR TARGET LOADING

CYCLE NO. 155DATE 11-24-77

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

2731UCN-12912
(3 1-78)

FIGURE 4

HFIR TARGET LOADING

CYCLE NO. 156DATE 12-17-77

TARGET TYPE

NUMBER

PLUTONIUM (Pu)

CURIUM (Cm)

STAINLESS STEEL (SST)

GRAPHITE (C)

ALUMINUM (Al)

HYDRAULIC TUBE (HT)

2821UCN-12912
(3 1-78)

FIGURE 5

INTERNAL DISTRIBUTION

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