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High Flux Isotope Reactor Quarterly Report April Through June 1986

B. L. Corbett
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Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
APRIL THROUGH JUNE 1986

B. L. Corbett and M. B. Farrar

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HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
APRIL THROUGH JUNE 1986

SUMMARY

Four routine cycles of operation were completed during the second quarter. Four scheduled end-of-cycle shutdowns, three other scheduled shutdowns, and two unscheduled shutdowns resulted in an on-stream time of 90.7%. The control plates and cylinder were replaced during the end-of-cycle 281 shutdown. Control plate set 2 and previously unirradiated cylinder No. 9 were inserted into the reactor.

OPERATIONS

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

Table 1. HFIR basic operating data
(April 1 - June 30, 1986)

	This quarter	Last quarter	Year to date
Total energy, MWd	8240	7814	16,054
Time operated, h	1980.734	1877.885	3858.619
Average operating power, MW	99.8	99.9	99.9
Time operating, %	90.7	86.9	88.8
Reactor availability, %	91.9	87.7	89.8
Reactor water radioactivity, cpm/ml (av)	341,687	276,054	
Pool water radioactivity cpm/ml (av)	63	92	

The starting and ending dates for Cycles 278, 279, 280, 281, and 282 are presented in Table 2.

Table 2. Cycles of operation

Cycle No.	Fuel assembly	Date started	Date ended	Accumulated power (MWd)
278	277	3/27/86	4/18/86	2174
279	278	4/20/86	5/11/86	2168
280	279	5/13/86	6/4/86	2171
281	280	6/6/86	6/28/86	2154
282	281	6/30/86	In progress	

The status of the HFIR fuel and control-plate inventories on the last day of the quarter are indicated in Table 3. Only fuel elements which have undergone testing at the critical facility are included in this inventory.

Table 3. HFIR material inventories

Item	This quarter	Last quarter
New fuel assemblies placed in service	4	4
New fuel assemblies available for use at end of quarter (EOQ)	11	15
Spent fuel assemblies on hand at EOQ	10	9
Spent fuel assemblies shipped at EOQ	3	7
New sets of control plates placed in service	0	1
New sets of control plates available for use at EOQ	3	3

SHUTDOWNS

There were four scheduled end-of-cycle shutdowns, three other scheduled shutdowns, and two unscheduled shutdowns during the quarter. Total downtime for the quarter was 202.266 hours. Of this, 201.932 hours were scheduled and 0.334 were unscheduled. Approximately 25.867 hours of downtime were due to non-routine experiment work. Table 4 gives further details.

Table 4. Description of HFIR shutdowns

Date	Downtime, h	Remarks
		Scheduled
4/18	39.950	End of cycle 278. The total energy accumulated on fuel assembly 277 during this cycle was 2174 MWd.
5/11	49.783	End of cycle 279. The total energy accumulated on fuel assembly 278 during this cycle was 2168 MWd.
5/13	0.033	Rod drop recovery qualification test for a RO candidate.
5/13	0.167	Rod drop recovery qualification test for a RO candidate.
6/6	44.599	End of cycle 280. The total energy accumulated on fuel assembly 279 during this cycle was 2171 MWd.
6/7	17.867	The reactor was shut down following a 2.217-hour, 100-MW flux run to recover the flux wires from an SRB irradiation capsule.
6/28	49.533	End of cycle 281. The total energy accumulated on fuel assembly 280 was 2154 MWd.
		Unscheduled
6/9	0.217	Control plate No. 1 was dropped inadvertently during a routine channel No. 2 safety test due to an instrument noise burst.
6/11	0.117	Control plate No. 1 was dropped inadvertently during a routine channel No. 2 safety test due to an instrument noise burst.

LOW-POWER OPERATIONS

One low-power run was performed during the quarter. This Mode 3 run is summarized as follows:

Date	Time operated, h	Power level	Remarks
6/6	0.500	100 kW	A Mode 3, 100-kW run was performed to irradiate the fuel element for security purposes.

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
4/14	Primary heat exchanger, 1D	Leaking tube 10 in row 1 was repaired.
5/12	Primary pressure relief system	A pressure monitoring system for the cavity between the relief valves and rupture disks was installed.
5/12	Control rod drive	Drive rod No. 4 was replaced with a rebuilt spare.
5/13	Control rod drive	The magnet actuator on drive rod No. 3 was replaced with a rebuilt spare.
6/30	Reactor vessel	A guide pin was installed on the reactor vessel head in preparation for the HIFI installation.
6/30	Control rod drive	The magnet actuator on drive rod No. 3 was replaced with a rebuilt spare.

Table 5. (continued)

Date	Component	Remarks
6/30	Letdown valve	The air-supply solenoid was replaced on the cell 112 letdown valve.
		Secondary system
4/30	Cooling tower fan, FN 4-D1	A faulty vibration switch was replaced.
4/30	Cooling tower fans	All original design vibration switches were replaced with new switches.
5/16	Cooling tower fan, FN 4-D2	A faulty high-speed relay contact was replaced.
6/5	Cooling tower	Damaged cooling tower fill was replaced.
6/8	Cooling tower fan, FN 4-A1	A faulty vibration switch was readjusted.
6/29	Cooling tower fan, FN 4D-2	The fan motor was replaced with a spare.
6/29	Cooling tower	Damaged cooling tower fill was replaced.
		Miscellaneous
4/14	SBHE filters	New HEPA filters were installed in the center SBHE bank.
4/29	Emergency air compressor, C-3	A faulty solenoid was replaced.
4/29	Instrument battery charger, B-1	A faulty control transformer and a current regulator were replaced.
5/1	Instrument air receiver	Air receiver AR-1 was cleaned internally.
5/14	Evacuation air horn	The experiment room evacuation air horn was relocated per MCM HFIR-66.
6/6	Wide-range counting channel	A shear pin in the channel No. 1 fission chamber drive was replaced, and the chamber was returned to service.

Table 5. (continued)

Date	Component	Remarks
6/5	Annunciator panel	Annunciator panel B was refurbished and artificial intelligence tie-ins were completed.
6/23	Plant demineralizer	Work began on the installation of the new plant demineralizer system.
6/29	Instrument power transformers	Instrument power transformers 6 and 7 were replaced with new transformers because of PCB pollution concerns.

Table 6. Instrumentation - maintenance and changes

Date	Component	Remarks
4/1	ApHC-331 controller	The secondary system pH controller was repaired.
4/2	Level indicator	A "bubbler" type level indicator was installed on the corrosion inhibitor storage tank.
4/18	Intercom system	A new intercom master station was installed in the control room.
4/18	Motion detector	Wiring to the heat exchanger cell motion detectors was replaced.
4/21	Wide-range counting channel	The channel No. 2 0.1-hp servo amplifier was replaced.
4/24	Hydraulic tube facility	Flow transmitters FT-4 and FT-5 were calibrated.
5/12	Laboratory Emergency Response/ Control Center	Reactor status signals were routed to the new Laboratory Emergency Response/Control Center.
5/13	EF-2 flow transmitter	The transmitter was calibrated.

Table 6. (continued)

Date	Component	Remarks
6/5	Motion detector	The pipe tunnel motion detector was repaired.
6/23	Primary make-up flow transmitter	The FE-215 flow transmitter was calibrated.
6/29	Control switches	The following control switches were calibrated: PDS-103-A, PDS-106-A, PDS-106-B, LS-214-A1, LS-214-A2, LS-214-A, LS-214-B, PS-127-A, PS-127-C, LS-605-A, LS-605-B, LS-454-A, LS-454-B, LS-454, PS-201, PS-400, PS-614, TSS-100-4A, TSS-100-4B, TS-100-5A, TS-100-5B, TSS-100-6A, TSS-100-6B, FS-917, APHS-334B, and LSS-704.
6/30	Pressure balance system	The pressure balance system dp gauges were calibrated.

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 6.9-MPa (1000-psig) cycles. Installation of new reactor vessel head studs was completed in June 1972. In November 1983, stud 72-1 was replaced by stud 73-9 because of a small anomaly discovered during previous ultrasonic inspections. The numbers in Table 7 represent the maximum cycles to which any stud has been exposed.

STACK FILTERS

Stack filtering systems in the special building hot exhaust (SBHE) and hot off-gas (HOG) systems were tested for particulate and iodine removal efficiencies. Results of the most recent tests are tabulated in Table 8.

Table 7. Vessel head stud-tensioning cycles

	This quarter	Last quarter	Total to date
Head bolts tensioned	0	0	8
10.3 MPa (1500 psig)	0	0	0
6.5 MPa (950 psig)	0	0	11
5.2 MPa (750 psig)	6	7	207
4.5 MPa (650 psig)	0	0	117

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 are not reported, are satisfied by the routine completion of daily and weekly check sheets, startup checklists, hourly data sheets, the operating logbooks, and miscellaneous quality assurance tests.

REVISIONS TO THE HFIR OPERATING MANUAL

There were no revisions to the HFIR Operating Manual during the quarter.

UNUSUAL OCCURRENCES

There was one unusual occurrence report issued this quarter:

ORNL-86-11-HFIR-86-2 Operation of untested containment filters

REACTOR EXPERIMENTS

EXPERIMENT FACILITIES

Assignments of the various HFIR experiment facilities are tabulated in Table 10.

HFIR TARGET LOADING

A description of the HFIR target loading for each of the operating cycles this quarter is presented in Figs. 1, 2, 3, and 4.

Table 8. Particulate and iodine removal efficiencies

Filter bank	Elemental iodine				Filter position	Particulate retention			
	Last test		Previous test			Last test		Previous test	
	Date	Eff.,%	Date	Eff.,%		Date	Eff.,%	Date	Eff.,%
SBHE, west	4/22/86	99.981	11/7/85	99.977	South	3/31/86	99.99	9/25/85	99.99
					North	3/31/86	99.99	9/25/85	99.99
SBHE, center	4/18/86	99.975	11/14/85	99.867[a]	South	3/31/86	99.99	9/25/85	99.99
					North	3/31/86	99.94[a]	9/25/85	99.99
						4/15/86	99.987[b]		
SBHE, east	4/24/86	99.964	11/12/85	99.906	South	3/31/86	99.99	9/25/85	99.99
					North	3/31/86	99.99	9/25/85	99.99
CHOG, west	4/15/86	99.992	11/19/85	99.987					
HOG, center	4/30/86	99.799[a]	11/21/85	99.991					
OHOG, east	4/16/86	99.954	10/31/85	99.996					

[a]Below minimum acceptable efficiency.

[b]The HEPA filter was replaced and the efficiency test was repeated satisfactorily.

Table 9. Summary of surveillance tests

Test	Most recent test	Previous test	Previous test
Decennial tests			
Pressure boundary components	11/83	7/75	NA
Annual tests			
Count rate channel A calibration	3/11/86	2/6/85	3/20/84
Count rate channel B calibration	3/12/86	2/8/85	3/22/84
Count rate channel C calibration	3/13/86	2/19/85	3/27/84
Normal emergency systems	11/20/85	5/29/85	10/4/84
Poison injection system	8/6/85	10/29/84	12/8/83
Pressurizer pump high-pressure cutoff	2/6/86	2/22/85	3/6/84
Pressure relief valves	11/15/85	10/3/84	1/6/84
Reactor vessel head studs	11/18/85	10/4/84	10/1/83
Radiation block valve test	9/30/85	10/29/84	12/12/83
Reactor bay in-leakage test	9/30/85	10/28/84	12/12/83
Reactor components	9/28/85	10/4/84	12/12/83
Safety channel A calibration	2/10/86	2/28/85	3/11/84
Safety channel B calibration	2/10/86	3/1/85	3/11/84
Safety channel C calibration	2/10/86	3/4 85	3/11/84
Servo channel A calibration	2/19/86	2/5/85	2/9/84
Servo channel B calibration	2/19/86	2/5/85	2/9/84
Servo channel C calibration	2/19/86	2/5/85	2/9/84
Speed of shim and regulating drives	11/20/85	11/19/84	12/20/83
Switchgear battery load test	5/12/86	5/8/85	4/30/84
Semiannual tests			
Main pump low-pressure cutoff	5/11/86	12/11/85	6/30/85
Pony motor battery E	5/11/86	2/6/86	10/22/85
Pony motor battery F	6/28/86	3/25/86	12/7/85
Pony motor battery G	6/4/86	3/2/86	9/26/85
Pony motor battery H	4/18/86	1/13/86	11/14/85
Radiation monitoring equipment	5/7/86	3/13/86	1/13/86
Monthly tests			
Cadmium nitrate tests	6/29/86	5/25/86	4/25/86
Diesel run test, No. 1	6/25/86	5/22/86	4/29/86
Diesel run test, No. 2	6/25/86	5/22/86	4/29/86

Table 10. Experiment facility assignments

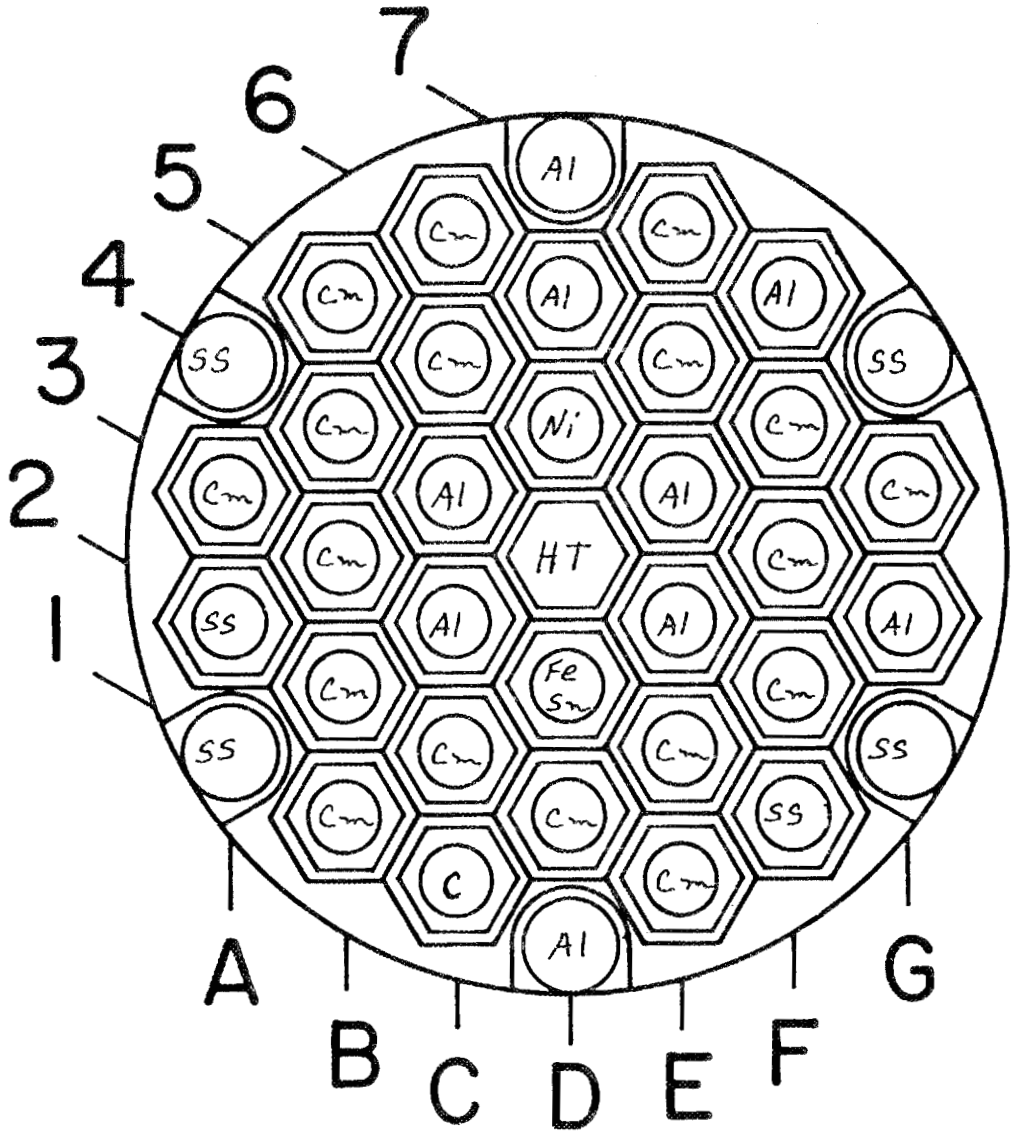
Facility	Description	Sponsor
PTP-A1	Materials studies	Fusion Energy
PTP-A4	Materials studies	Fusion Energy
PTP-D1	Materials studies	Fusion Energy
PTP-D7	Materials studies	Fusion Energy
PTP-G4	Materials studies	Fusion Energy
PTP-G7	Materials studies	Fusion Energy
RB-1	Isotope production	Operations
RB-2	Isotope production	Operations
RB-3	Isotope production	Operations
RB-4	Isotope production	Operations
RB-5	Fuel studies	Engineering Technology
RB-6	Fuel studies	Engineering Technology
RB-7	Isotope production	Operations
RB-8	Isotope production	Operations
CR-1	Isotope production	Operations
CR-2	Isotope production	Operations
CR-3	Isotope production	Operations
CR-4	Isotope production	Operations
CR-5	Isotope production	Operations
CR-6	Isotope production	Operations
CR-7	Isotope production	Operations
CR-8	Isotope production	Operations
VXF-1	Isotope production	Operations
VXF-2	Isotope production	Operations
VXF-3	Isotope production	Operations
VXF-4	Isotope production	Operations
VXF-5	Isotope production	Operations
VXF-7	Pneumatic tube	Analytical Chemistry
VXF-8	Isotope production	Operations
VXF-9	Isotope production	Operations
VXF-10	Isotope production	Operations
VXF-11	Isotope production	Operations
VXF-12	Isotope production	Operations
VXF-13	Isotope production	Operations
VXF-14	Isotope production	Operations
VXF-15	Isotope production	Operations
VXF-16	Isotope production	Operations
VXF-17	Isotope production	Operations
VXF-18	Isotope production	Operations
VXF-19	Isotope production	Operations
VXF-20	Isotope production	Operations
VXF-21	Isotope production	Operations
VXF-22	Isotope production	Operations
HB-1	Neutron diffractometer	Solid State
HB-2	Neutron diffractometer	Chemistry
HB-3	Neutron diffractometer	Solid State
HB-4	Neutron diffractometer, SANS Facility	Solid State

HFIR TARGET LOADING

Cycle No. 279

Date 4/19/86

ORNL Dwg. 96-13824



Target type	Number	Target type	Number
Curium (Cm)	18	Stainless steel (SS)	2
Graphite (C)	1	Aluminum (Al)	7
Hydraulic tube (HT)	1	Ni	1
Fe-Sn	1		

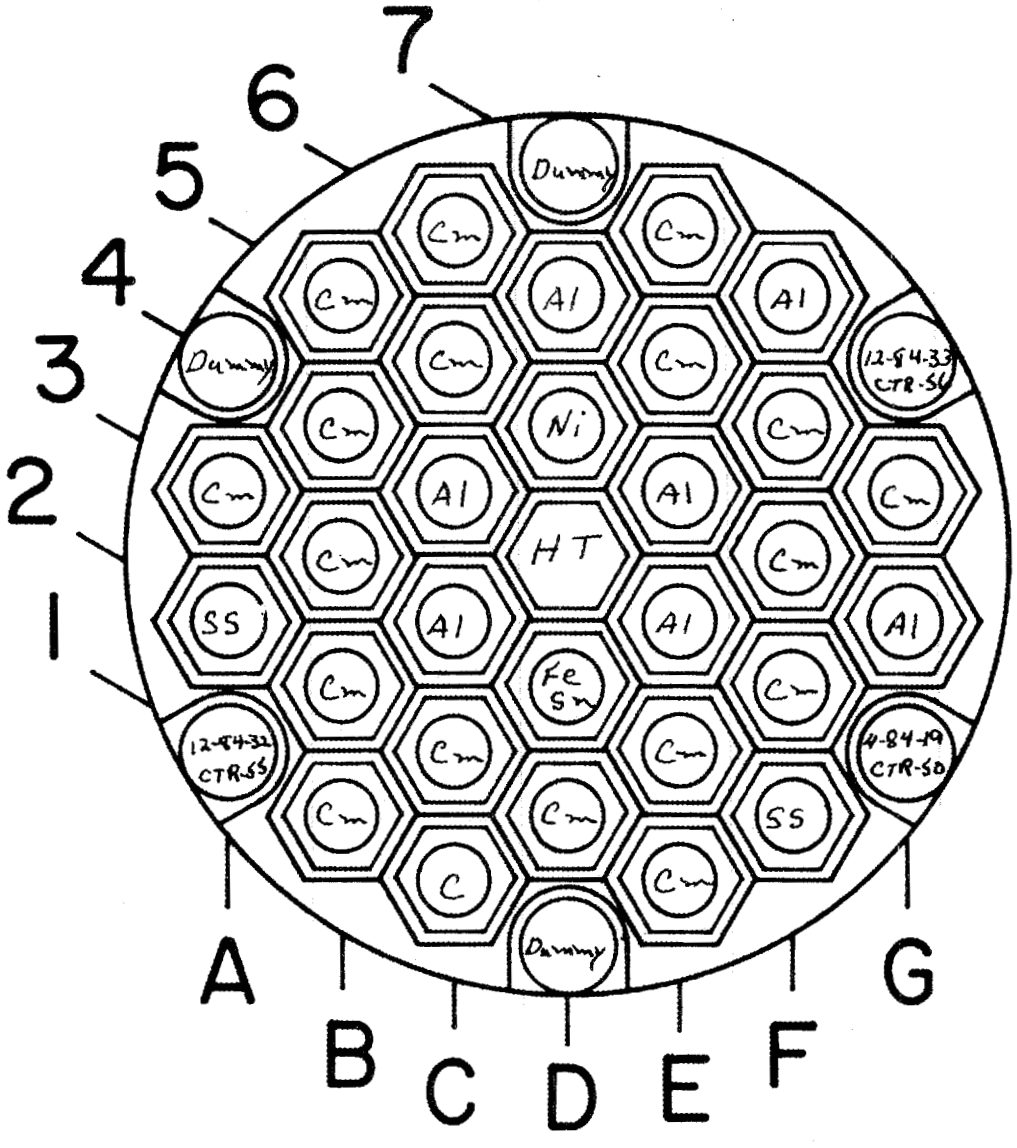
Fig. 1.

HFIR TARGET LOADING

Cycle No. 280

Date 5/13/86

ORNL Dwg. 86-13825



Target type	Number	Target type	Number
Curium (Cm)	18	Stainless steel (SS)	2
Graphite (C)	1	Aluminum (Al)	7
Hydraulic tube (HT)	1	Fe-Sn	1
		Ni	1

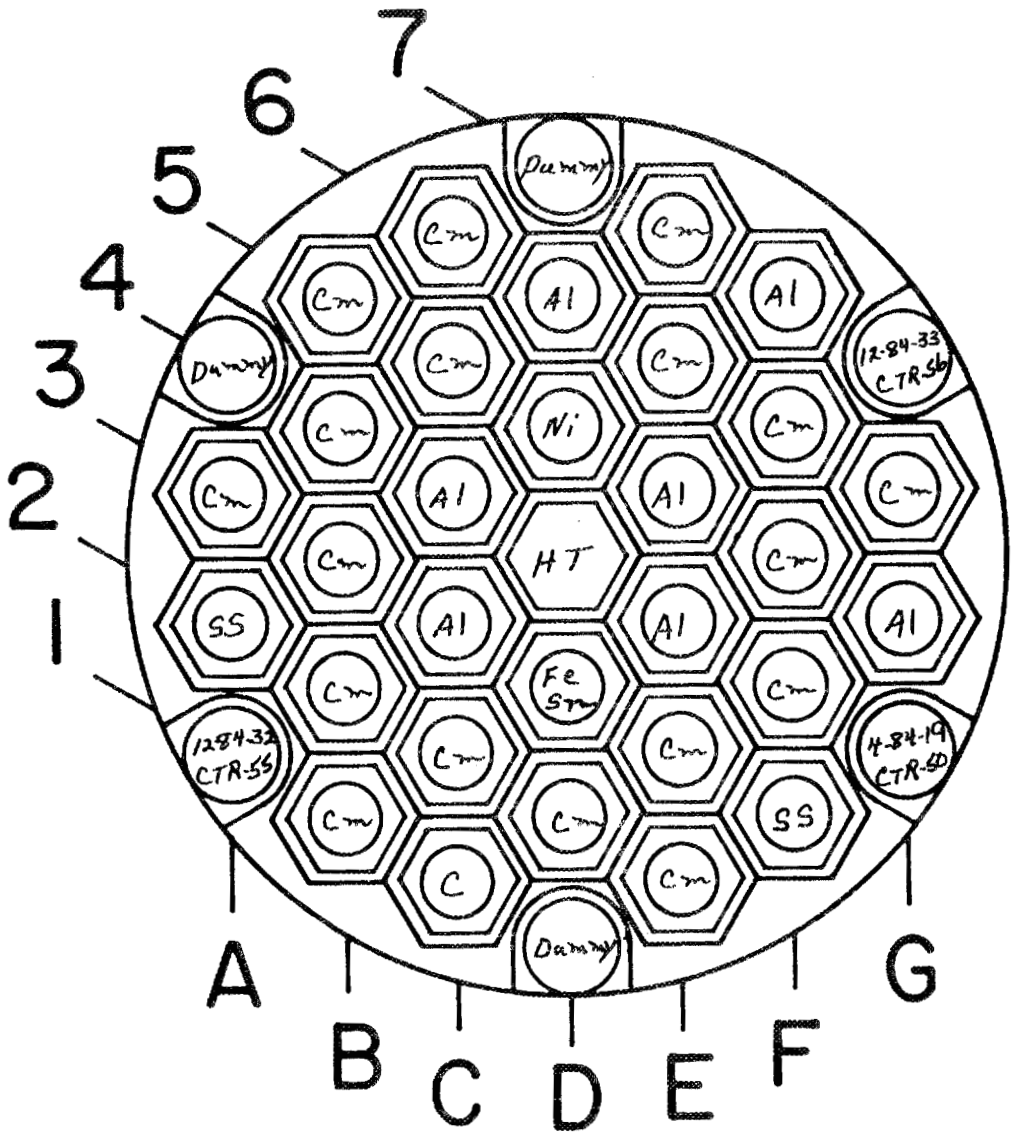
Fig. 2.

HFIR TARGET LOADING

Cycle No. 281

Date 6/7/86

ORNL Dwg. 86-13826



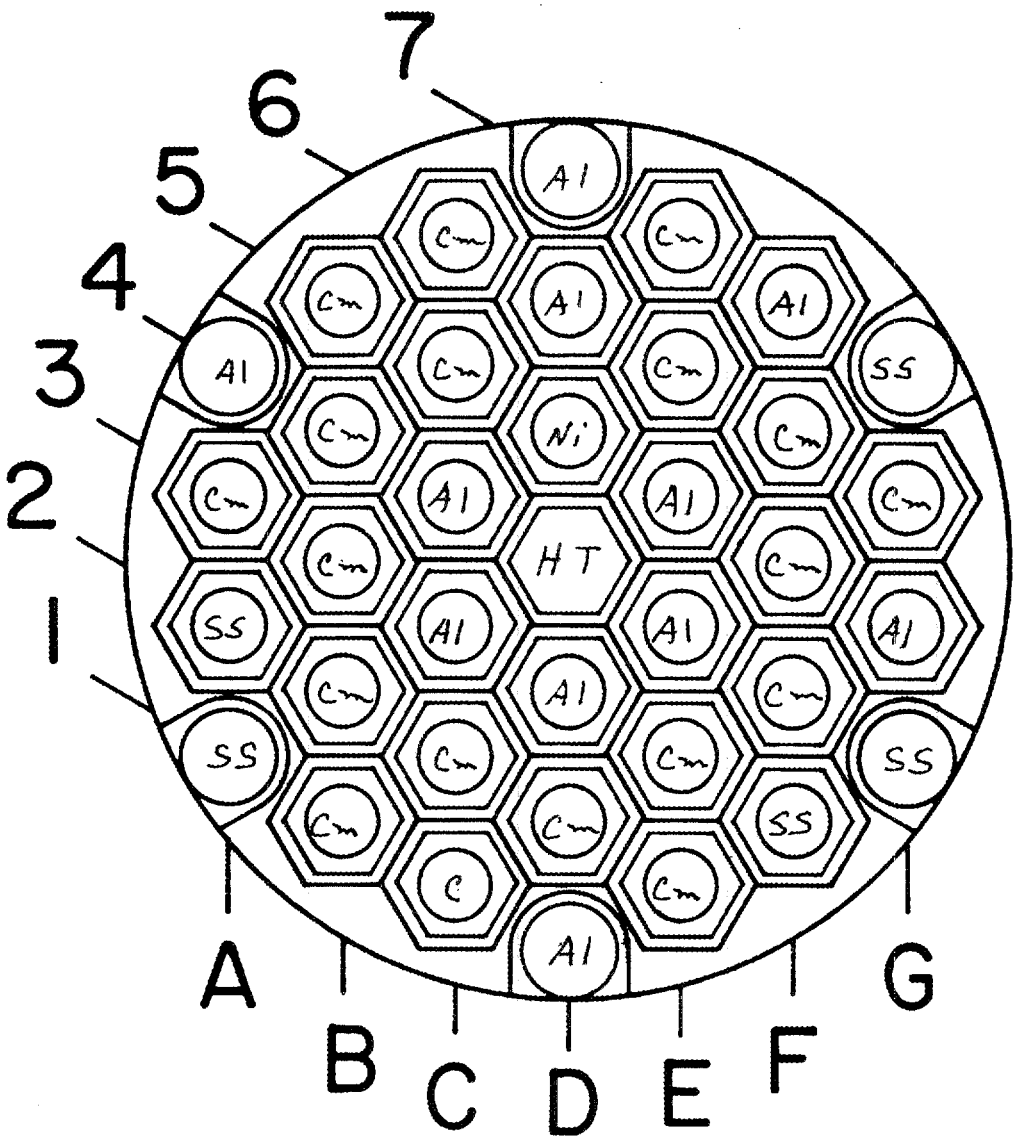
Target type	Number	Target type	Number
Curium (Cm)	18	Stainless steel (SS)	2
Graphite (C)	1	Aluminum (Al)	7
Hydraulic tube (HT)	1	Fe-Sn	1
Ni	1		

Fig. 3.

HFIR TARGET LOADING

Cycle No. 282 Date 6/30/86

ORNL Dwg. 86-13827



Target type	Number	Target type	Number
Curium (Cm)	18	Stainless steel (SS)	2
Graphite (C)	1	Aluminum (Al)	8
Hydraulic tube (HT)	1	Nickel (Ni)	1

Fig. 4.

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