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MARTIN MARIETTA

High Flux Isotope Reactor Quarterly Report October Through December 1985

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OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A03; Microfiche A01

ORNL/TM-9982

Operations Division

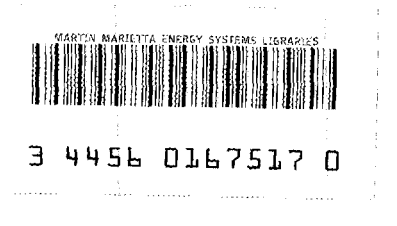
HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT OCTOBER THROUGH DECEMBER 1985

B. L. Corbett and M. B. Farrar

Manuscript Completed - February 1986
Date of Issue - March 1986

Sponsor: J. H. Swanks, Director
Operations Division

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
operated by
Martin Marietta Energy Systems, Inc.
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-840R21400



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HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
OCTOBER THROUGH DECEMBER 1985

SUMMARY

Three routine cycles of operation were completed during the third quarter. Eight scheduled shutdowns and three unscheduled shutdowns resulted in an on-stream percentage of 82.6%. The low-percentage on-stream time is attributed primarily to the replacement of the Cell 112 primary heat exchanger during the end-of-cycle 272 shutdown. Six low-power (<90-MW) runs were performed during the quarter.

OPERATIONS

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

Table 1. HFIR basic operating data
(October 1 - December 31, 1985)

	This quarter	Last quarter	Year to date
Total energy, MWd	7534	6447	30,173
Time operated, h	1822.849	1555.75	7275.918
Average operating power, MW	99.2	99.5	99.5
Time operating, %	82.6	70.5	83.1
Reactor availability, %	83.9	72.5	83.9
Reactor water radioactivity, cpm/ml (av)	233,395	251,686	
Pool water radioactivity cpm/ml (av)	76	198	

The starting and ending dates for Cycles 271, 272, 273, and 274 are presented in Table 2.

Table 2. Cycles of operation

Cycle No.	Fuel assembly	Date started	Date ended	Accumulated power (MWd)
271	269	9/30/85	10/22/85	2122
272	271	10/23/85	11/14/85	2114
273	272	11/24/85	12/17/85	2082
274	273	12/19/85	In progress	

The status of the HFIR fuel and control-plate inventories on the last day of the quarter are indicated in Table 3.

Table 3. HFIR material inventories

Item	This quarter	Last quarter
New fuel assemblies placed in service	3	4*
New fuel assemblies available for use at end of quarter (EOQ)	15	14*
Spent fuel assemblies on hand (EOQ)	12	12
Spent fuel assemblies shipped (EOQ)	3	3
New sets of control plates placed in service	0	0
New sets of control plates available for use (EOQ)	4	4

*The third quarter 1985 report erroneously stated that only three assemblies were placed in service during the third quarter. This did not include assembly No. 269 which was placed in service four hours prior to the end of the quarter.

SHUTDOWNS

There were three end-of-cycle shutdowns. In all, there was a total of eight scheduled shutdowns and three unscheduled shutdowns for a total downtime of 388.717 hours. Table 4 gives further details.

Table 4. Description of HFIR shutdowns

Date	Downtime, h	Remarks
		Scheduled
10/22	39.267	End of cycle 271. The total energy accumulated on fuel assembly 269 during this cycle was 2249 MWd.
10/23	0.817	A test run at 10 MW was performed so that adjustments to the HRB-17 and -18 experiments could be performed. Following this short run, the reactor was shut down to accommodate further adjustments to the experiment.
11/14	248.033	End of cycle 272. The total energy accumulated on fuel assembly 271 during this cycle was 2114 MWd. The installation of the second new primary heat exchanger was performed during this shutdown.
11/24	0.050	The reactor was shut down so that operators could complete reactor startup recertification tests.
11/24	0.033	The reactor was shut down so that operators could complete reactor startup recertification tests.
12/17	44.284	End of cycle 273. The total energy accumulated on fuel assembly 272 during this cycle was 2082 MWd.
12/18	3.500	The reactor was shut down following a low-power run to perform hydraulic tests on the new primary heat exchanger (see Table 5 for a description of low-power runs).
12/18	2.817	The reactor was shut down following a low-power run to continue hydraulic tests on the new primary heat exchanger (see Table 5 for a description of low-power runs).

Table 4. (Continued)

Date	Downtime, h	Remarks
		Unscheduled
9/30	2.566	The reactor was shut down from 10 MW during the cycle 271 startup when bad contacts on relay K-402 prohibited the insertion of control plate No. 2. (Note: This shutdown was erroneously omitted from the third quarter 1985 report and will be considered as a fourth quarter event.)
10/7	0.150	The reactor was shut down when control plate No. 3 dropped due to noise when checking the saturation curve on the channel No. 2 ion chamber.
11/29	47.200	The reactor was manually shut down when a hydraulic oil leak in the inner control cylinder pressure balance system was discovered.

LOW-POWER OPERATIONS

Six low-power runs (<90-MW) runs were performed during the quarter. All low-power runs were performed in operation Mode 1. A summary of low-power operation during this quarter is given in Table 5.

PLANT MAINTENANCE

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

INSTRUMENTATION AND CONTROLS

Maintenance and changes in the various instrumentation systems are listed in Table 7.

Table 5. Summary of low-power (<90 MW) operations

Date	Time operated, h	Power level	Remarks
10/23	1.833	10 MW	The reactor was brought to 10 MW to allow experimenters to complete the maintenance and calibration of the HRB-17 and HRB-18 equipment.
11/24	0.433	10 MW	The reactor was brought to 10 MW and scrammed as part of the reactor operator recertification examinations.
11/24	0.200	10 MW	The reactor was brought to 10 MW and scrammed as part of the reactor operator recertification examinations.
12/19	3.583	10 to 35 MW	The reactor was operated at low power to warm the secondary system water in preparation for the hydraulic performance evaluation of the new cell 112 primary heat exchanger.
12/19	1.300	10 to 30 MW	The reactor was again operated at low power to warm the secondary system water in preparation for the continuation of the hydraulic performance evaluation of the new cell 112 primary heat exchanger.
12/19	2.050	10 to 80 MW	The reactor was operated at different low-power levels as part of a thermal analysis of the new cell 112 primary heat exchanger. The reactor was brought directly to 100 MW following the test.

Table 6. Process systems - maintenance and changes

Date	Component	Remarks
		Primary system
7/23	Primary pressurizer pump, PU-4B	The magnetic clutch was replaced with a spare.
10/3	Primary heat exchanger, 1D	Leaking tube 1 of row 1 was plugged.
10/11	Primary heat exchanger, 1B	Leaking tube 3 of row 1 was plugged.
10/22	Letdown valves	The letdown valves in cells 112 and 113 were replaced with rebuilt spares.
10/23	Control plate magnet assembly	The plate No. 3 magnet assembly was replaced with a rebuilt spare.
11/12	Primary pressurizer pump, PU-4A	The motor was removed and sent to the motor shop for overhaul.
11/14-24	Letdown valves	The letdown valves in cells 110 and 111 were replaced with rebuilt spares.
11/14-24	Control plate magnet assemblies	The magnet assemblies for plates Nos. 3 and 4 were replaced with rebuilt spares.
11/14-24	Primary relief valves	The primary relief valves were replaced with calibrated spares.
11/14-24	Primary pony motor	All four pony motors were removed and sent to the motor shop for rebuilding.
11/14-24	Servo motor	The channel No. 1 servo motor was replaced with a new motor.
11/14-24	Primary heat exchanger, 1A	Leaking tube 6 of row 1 was plugged.
11/14-24	3/4-in. equalizing valve	The operating solenoid for the cell 110 3/4-in. equalizing valve was replaced.

Table 6. (continued)

Date	Component	Remarks
11/14-24	Primary inlet valve, FCV-550	The cell 110 inlet block valve (FCV-550) control transformer was replaced.
11/14	Primary pump, PU-1A	The pump shaft and seal assembly are to be replaced. This operation is still in progress at the end of the quarter.
11/14-24	Primary heat exchanger, 1B	The heat exchanger was replaced with a new unit.
11/28	Primary pump, PU-1C	A faulty closing coil resistor was replaced in the motor starter circuit.
		Secondary system
10/8	Backflow preventer	A new chemical-addition station backflow preventer was installed in the softener building.
11/14-24	Cooling tower fan	Fan FN-4A-1 was replaced with a rebuilt spare.
11/14-24	Cooling tower	Wooden catwalks were installed below all fans.
		Miscellaneous
10/22	HOG charcoal filters	The east bank of HOG charcoal filters was replaced.
11/14-24	Horizontal beam tubes	The beam tube cavities were purged and filled with helium.
11/14-24	13.8-kV bus duct	The bus duct was cleaned, and all connections were checked.
11/14-24	Secondary relief valves	The secondary relief valves on the primary heat exchanger shells in cells 110, 111, and 112 were replaced. The valve in cell 113 was inaccessible.

Table 6. (continued)

Date	Component	Remarks
11/14-24	Cell coolers (Cell 110)	One cell cooler was replaced with a new cooler.
11/14-24	Cell coolers (Cell 111)	One cell cooler was replaced with a new cooler.
11/14-24	Cell coolers (Cell 112)	The fan motors in two of the cell coolers were replaced with rebuilt motors.
11/14-24	Cell coolers (Cell 113)	The fan motor in one of the cell coolers was replaced with a rebuilt motor.
11/14-24	Chiller	The energy conservation bypass valve was removed and replaced with a spool piece.
11/14-24	480-V normal emergency system No. 2	A 480-V feeder breaker was replaced.
11/29	Pressure balance system	The top seal was replaced on the No. 5 control plate pressure balance cylinder.
12/16	PWD sump	The conduit from the building to the PWD sump which carries the sump level signals collapsed and was replaced with a temporary conduit.

Table 7. Instrumentation - maintenance and changes

Date	Component	Remarks
10/1	Inlet strainer ΔP indication, PDR-103	An air leak on the control room recorder was repaired.
10/8	Ion chambers	The saturation curves of all ion chambers were checked.
10/22	Fission chamber	The WRCC No. 1 fission chamber was replaced.

Table 7. (continued)

Date	Component	Remarks
10/23	Primary pH controller, ApHC-1200	The controller was replaced with a new digital controller.
10/28	Pony motor current alarms	The PU-1E and PU-1F high- and low-current alarms were calibrated.
11/14-24	RR-1000	The existing 24-point recorder was replaced with a 12-point recorder
11/14-24	Blowdown controller, FT-325	A new controller was installed.
11/14-24	Safety channels	The heat-power systems on all three safety channels were calibrated.
11/14-24	Primary heat exchanger 1B dp indication	Differential pressure cells were installed across both the primary and secondary sides of the exchanger.
11/14-24	Tower basin level controller, LC-310	The tower basin level system was calibrated.
11/14-24	Control room recorders	The following recorders and indicators were calibrated: Tdr-100-4, -5, -6; Pdr-103, -106; PRC-127; FR-216, -258; TR-310-1, -2; PI-309; and FR-215, -407.
12/2	Fission chamber	The WRCC No. 1 fission chamber drive was repaired.
12/9	Fission chamber	The WRCC No. 3 fission chamber high-voltage supply was replaced.
12/18	Pool radiation sensors	The following radiation detectors were repaired and calibrated: RE-423, RE-497, and RE-498.

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

Table 8. 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)	5	15	194
4.5 MPa (650 psig)	0	0	117

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 9.

SUMMARY OF SURVEILLANCE TESTS

Table 10 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.

Table 9. 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	11/7/85	99.977	7/10/85	99.681[a]	South	9/25/85	99.99	3/26/85	99.99
			7/27/85	99.512[a,b]	North	9/25/85	99.99	3/26/85	99.99
			8/9/85	99.926					
SBHE, center	11/14/85	99.867[a]	7/11/85	99.935	South	9/25/85	99.99	3/26/85	99.99
					North	9/25/85	99.99	3/26/85	99.99
SBHE, east	11/12/85	99.906	7/25/85	98.87[a,b]	South	9/25/85	99.99	3/26/85	99.99
			7/26/85	98.88[a,b]	North	9/25/85	99.99	3/26/85	99.93[a,c]
			8/6/85	99.77[a,b]				4/19/85	99.99
			9/10/85	99.94					
HOG, west	11/19/85	99.987	8/9/85	99.926					
HOG, center	11/21/85	99.991	9/17/85	99.99					
HOG, east	10/31/85	99.996	9/24/85	99.88[a]					

[a]Below minimum acceptable efficiency. Note: See Table 6 for details of filter maintenance.

[b]The East and West banks of filters were retested following the failure of both banks. The reactor was already shutdown for the replacement of the primary heat exchanger. The west bank charcoal filters were replaced and were tested satisfactorily prior to the completion of the shutdown.

[c]The East bank of SBHE filters was removed from service for the replacement of HEPA filters. The North bank of HEPA filters was replaced and tested on 4/19/85.

Table 10. 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	2/6/85	3/20/84	9/20/83
Count rate channel B calibration	2/8/85	3/22/84	9/20/83
Count rate channel C calibration	2/19/85	3/27/84	9/20/83
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	2/22/85	3/6/84	8/9/83
Pressure relief valves	11/15/85	10/3/84	1/6/84
Pressure-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	2/28/85	3/11/84	7/19/83
Safety channel B calibration	3/1/85	3/11/84	7/20/83
Safety channel C calibration	3/4 85	3/11/84	7/21/83
Servo channel A calibration	2/5/85	2/9/84	6/8/83
Servo channel B calibration	2/5/85	2/9/84	6/8/83
Servo channel C calibration	2/5/85	2/9/84	6/8/83
Speed of shim and regulating drives	11/20/85	11/19/84	12/20/83
Switchgear battery load test	5/8/85	4/30/84	5/5/83
Semiannual tests			
Main pump low-pressure cutoff	12/11/85	6/30/85	2/24/85
Pony motor battery E	10/22/85	5/28/85	2/1/85
Pony motor battery F	12/7/85	8/13/85	6/17/85
Pony motor battery G	9/26/85	6/30/85	12/28/84
Pony motor battery H	11/14/85	9/4/85	6/30/85
Radiation monitoring equipment	11/12/85	9/11/85	7/16/85
Monthly tests			
Cadmium nitrate tests	12/29/85	11/30/85	10/26/85
Diesel run test, No. 1	12/31/85	11/26/85	10/29/85
Diesel run test, No. 2	12/31/85	11/26/85	10/29/85

REVISIONS TO THE HFIR OPERATING MANUAL

There were no HFIR Operating Manual revisions this quarter.

UNUSUAL OCCURRENCES

There was one unusual occurrence report issued this quarter:

ORNL-85-26-HFIR-85-10 Unscheduled reactor shutdown

REACTOR EXPERIMENTS

EXPERIMENT FACILITIES

Assignments of the various HFIR experiment facilities are tablulated in Table 11.

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 11. Experiment facility assignments

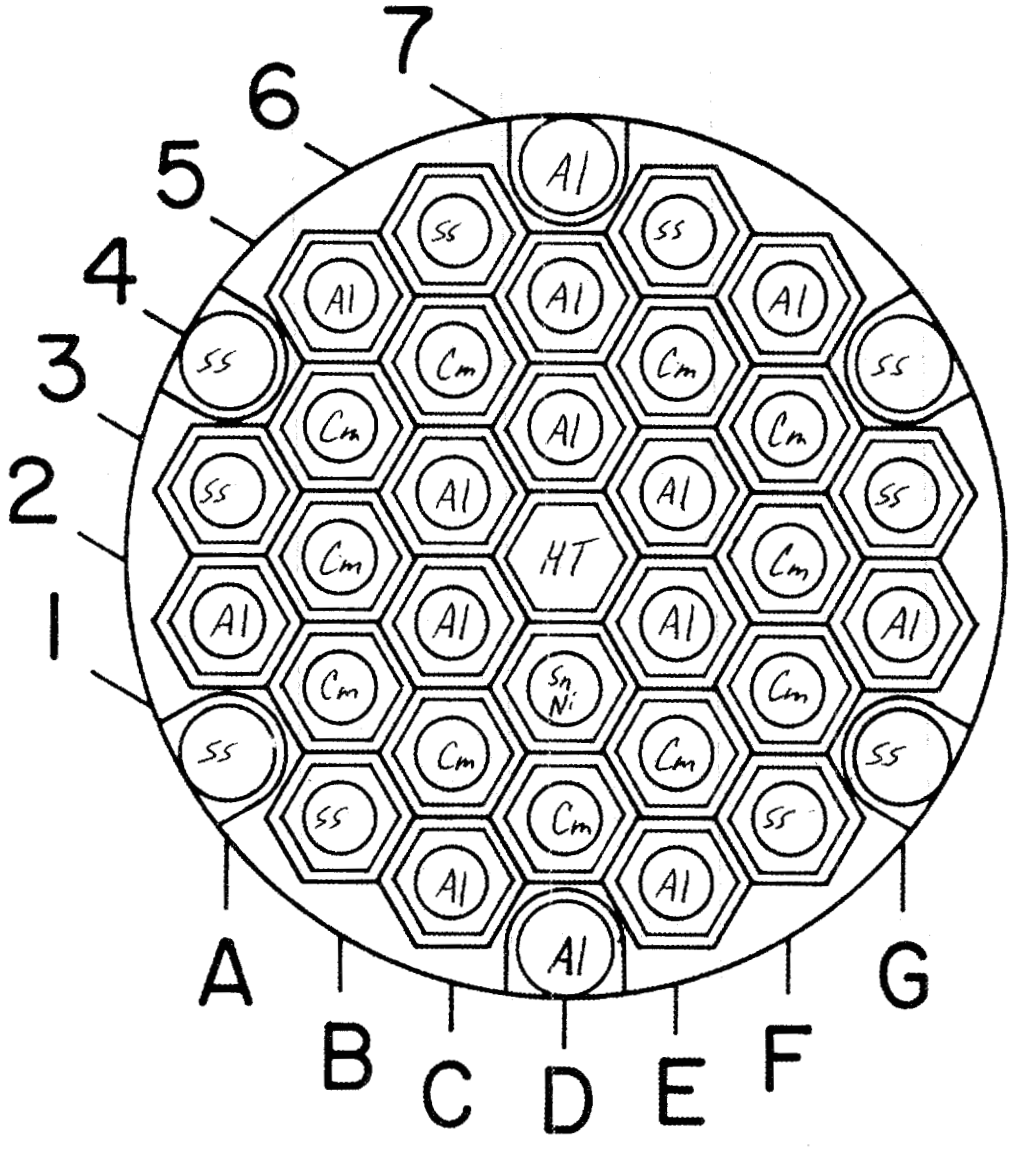
Facility	Description	Sponsor
PTP-A1	Materials studies	Fusion Energy
PTP-A4	Materials studies	Fusion Energy
PTP-D1	Materials studies	Fusion Energy
PTP-D7	Materials studies	Fusion Energy
PTP-G4	Materials studies	Fusion Energy
PTP-G7	Materials studies	Fusion Energy
RB-1	Isotope production	Operations
RB-2	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	HFIR corrosion specimen	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. 271

Date 9/30/85

ORNL Dwg. 86-8381



Target type	Number	Target type	Number
Curium (Cm)	11	Stainless steel (SS)	6
Graphite (C)		Aluminum (Al)	12
Hydraulic tube (HT)	1	Tin/Nickel	1

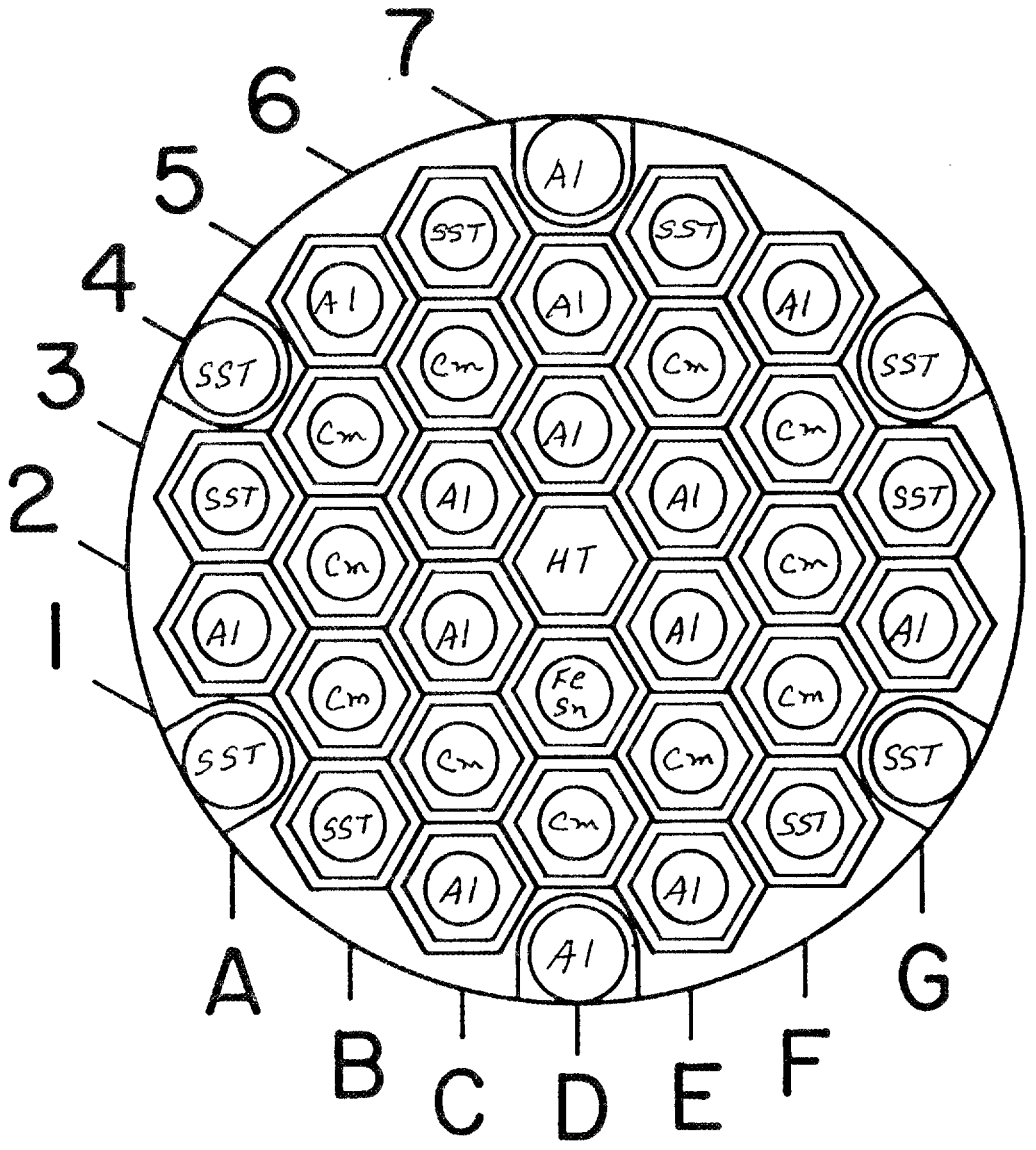
Fig. 1.

HFIR TARGET LOADING

CYCLE NO. 272

DATE 10/23/85

ORNL Dwg. 86-8382



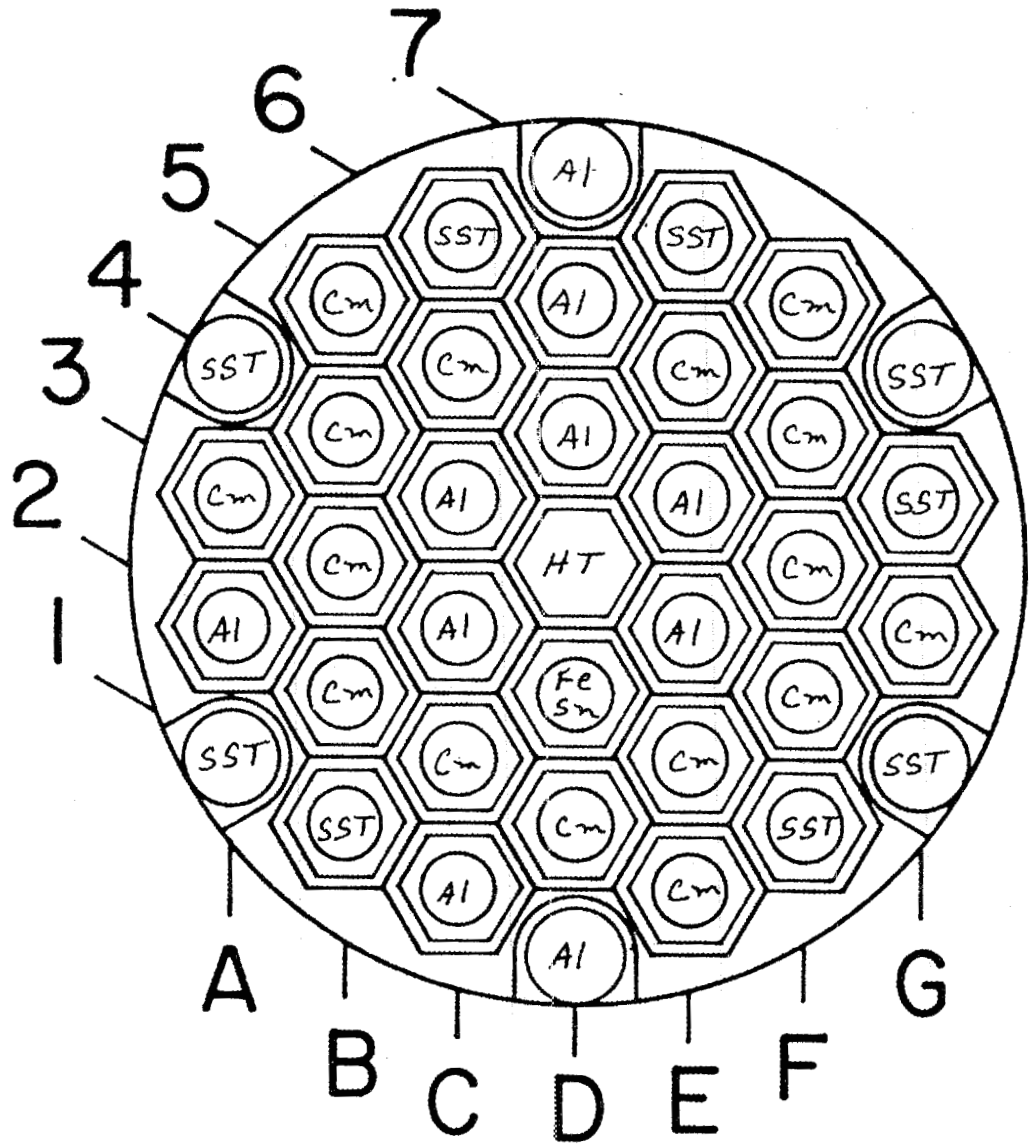
TARGET TYPE	NUMBER
PLUTONIUM (Pu)	
CURIUM (Cm)	11
COBALT (Co)	
TIN (Sn)	1
NICKEL (Ni)	
STAINLESS STEEL (SST)	6
GRAPHITE (C)	
ALUMINUM (Al)	12
HYDRAULIC TUBE (HT)	1

Fig. 2.

HFIR TARGET LOADING

CYCLE NO. 273 DATE 11/24/85

ORNL Dwg. 86-8383



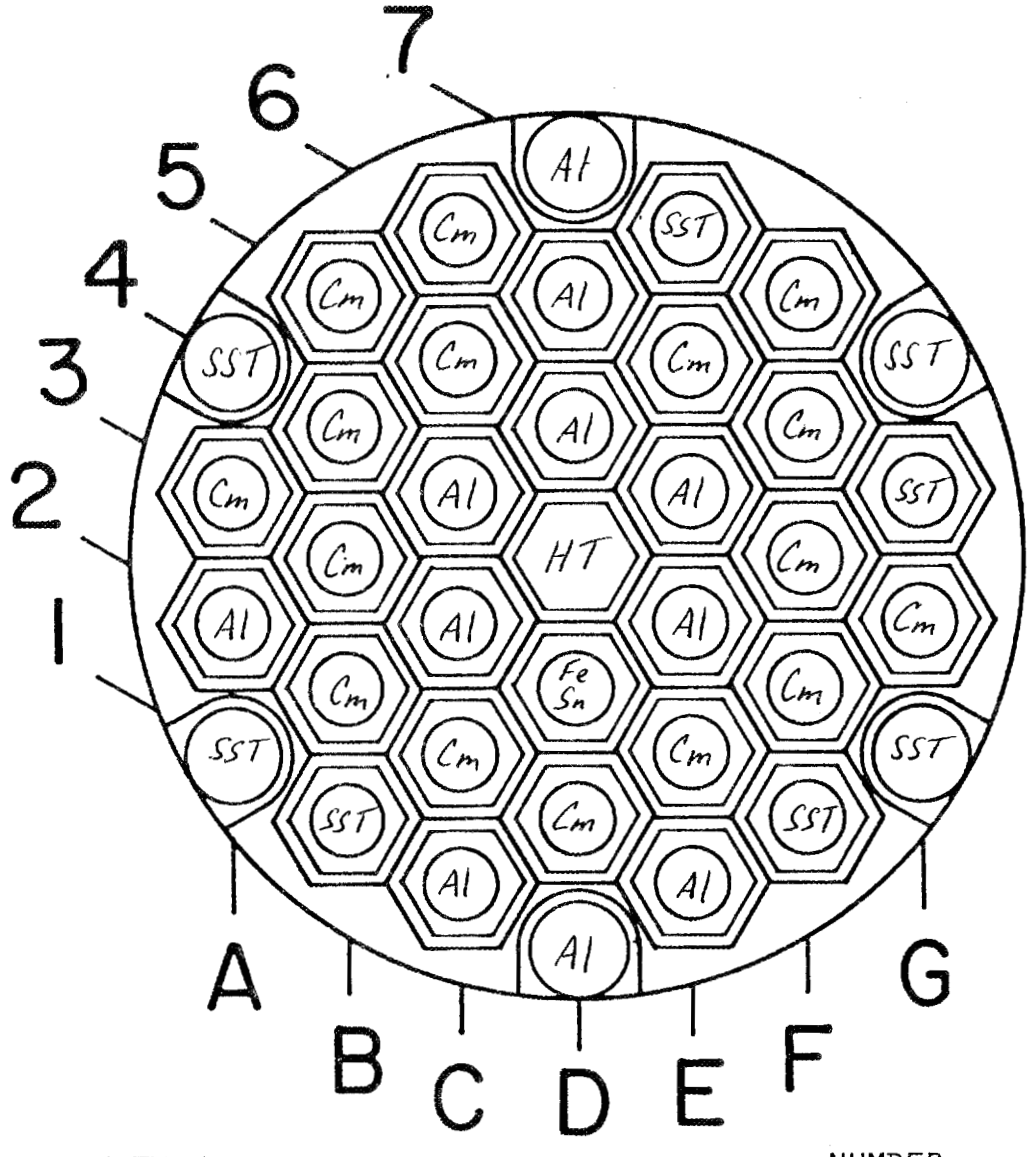
TARGET TYPE	NUMBER
PLUTONIUM (Pu)	
CURIUM (Cm) -	16
COBALT (Co)	
TIN (Sn)	1
NICKEL (Ni)	
STAINLESS STEEL (SST)	5
GRAPHITE (C)	
ALUMINUM (Al)	8
HYDRAULIC TUBE (HT)	1

Fig. 3.

HFIR TARGET LOADING

CYCLE NO. 274 DATE 12/19/85

ORNL Dwg. 86-8384



TARGET TYPE	NUMBER
PLUTONIUM (Pu)	
CURIUM (Cm)	16
COBALT (Co)	
TIN (Sn)	1
NICKEL (Ni)	
STAINLESS STEEL (SST)	4
GRAPHITE (C)	
ALUMINUM (Al)	9
HYDRAULIC TUBE (HT)	1

Fig. 4.

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