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OAK RIDGE NATIONAL LABORATORY

MARTIN MARIETTA

High Flux Isotope Reactor Quarterly Report January Through March 1986

B. L. Corbett
M. B. Farrar

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Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT JANUARY THROUGH MARCH 1986

B. L. Corbett and M. B. Farrar

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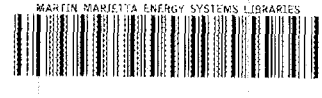

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JANUARY THROUGH MARCH 1986

SUMMARY

Four routine cycles of operation were completed during the first quarter. Four scheduled end-of-cycle shutdowns and two unscheduled shutdowns resulted in an on-stream time of 86.9%. An unscheduled control plate and control cylinder replacement was performed after tantalum contamination in the primary coolant system was traced to the inner cylinder.

OPERATIONS

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

Table 1. HFIR basic operating data
(January 1 - March 31, 1985)

	This quarter	Last quarter	Year to date
Total energy, MWd	7814	7534	7,814
Time operated, h	1877.885	1822.849	1877.885
Average operating power, MW	99.9	99.2	99.9
Time operating, %	86.9	82.6	86.9
Reactor availability, %	87.7	83.9	87.7
Reactor water radioactivity, cpm/ml (av)	276,054	233,395	
Pool water radioactivity cpm/ml (av)	92	76	

The starting and ending dates for Cycles 274, 275, 276, 277, and 278 are presented in Table 2.

Table 2. Cycles of operation

Cycle No.	Fuel assembly	Date started	Date ended	Accumulated power (MWd)
274	273	12/19/85	1/3/86	2121
275	274	1/14/86	2/5/86	2133
276	275	2/8/86	3/2/86	2184
277	276	3/3/86	3/25/86	2178
278	277	3/27/86	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	3
New fuel assemblies available for use at end of quarter (EOQ)	15	15
Spent fuel assemblies on hand (EOQ)	9	12
Spent fuel assemblies shipped (EOQ)	7	3
New sets of control plates placed in service	1	0
New sets of control plates available for use (EOQ)	3	4

SHUTDOWNS

There were four scheduled end-of-cycle shutdowns and two unscheduled shutdowns during the quarter. Total downtime for the quarter was 282.115 hours. Of this, 183.183 hours were scheduled and 98.932 were unscheduled. Approximately 16 hours of the unscheduled downtime was due to experiment trouble. Table 4 gives further details.

Table 4. Description of HFIR shutdowns

Date	Downtime, h	Remarks
		Scheduled
1/13	37.333	End of cycle 274. The total energy accumulated on fuel assembly 273 during this cycle was 2121 MWd.
2/5	51.800	End of cycle 275. The total energy accumulated on fuel assembly 274 during this cycle was 2133 MWd.
3/2	47.000	End of cycle 276. The total energy accumulated on fuel assembly 275 during this cycle was 2184 MWd.
3/25	47.050	End of cycle 277. The total energy accumulated on fuel assembly 276 during this cycle was 2178 MWd.
		Unscheduled
1/6	73.532	The reactor was shut down to determine the source of high Ta activity in the primary coolant system. The source was determined to be the inner control cylinder. The inner cylinder as well as the four shim plates were replaced prior to restart.
1/14	25.400	The reactor was shut down from 10 MW during the cycle 275 startup when the actual critical control element position was found to be out of administrative tolerance. The reactor was held down while critical control element position calculations could be made and a primary system leak was repaired. Following these actions, the reactor was held down an extra 8.0 hours at experimenter's request.

LOW-POWER OPERATIONS

There were no low-power runs (<90-MW) performed during the quarter.

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
1/8	Control cylinder and control plates	The damaged inner cylinder No. 8 was replaced with inner cylinder No. 7. Control plate set No. 3 was removed from the reactor for inspection. Control plate set No. 12 was installed.
1/13	HRB-17 and HRB-18 experiments	The HRB experiments were installed in core positions RB-5 and RB-7 respectively.
1/14	Hydraulic tube U-bend O-rings	The worn O-rings were replaced to repair a primary-to-pool leak.
1/24	East deminer-alizer columns	The resin was replaced in both the anion and cation columns.
2/5	Primary pump PU-1C	The shaft replacement operation, begun last quarter, was completed.
2/6	HRB-17 and HRB-18 experiments	The HRB experiments were removed from the core.
2/6	Vessel vent valve HCV-102	The position indicator switches on HCV-102 were repaired.

Table 5. (continued)

Date	Component	Remarks
2/12	Hydraulic-tube flow transducer	A primary-to-pool leak at the H-tube flow transducer was repaired and the transducers were replaced.
3/3	Letdown valves	Letdown valves were replaced with rebuilt spares in Cells 112 and 113.
3/6	Primary heat exchanger, 1A	Leaking tube 5 in row 2 was plugged.
3/26	Drive rod gearbox.	The No. 1 drive rod gearbox was replaced.
		Secondary system
1/16	Cooling tower fan, FN-4A-1	A defective vibration switch was replaced with a new model.
1/17	SBHE charcoal filters	The charcoal in the center SBHE filter bank was replaced. The filter bank frames were cleaned and painted prior to filter installation.
1/29	Cooling tower fan, FN-4A-1	The bent drive shaft was replaced.
2/3	Pool coolant pump, PU-9B	The pump inlet valve diaphragm was replaced.
2/22	Cooling tower fan, FN-4A-1	The fan motor was replaced due to a bad bearing.
		Miscellaneous
1/2	PWD diversion valves	The PWD pond No. 1 to pond No. 2 diversion valves were repaired.
1/13	PU-11 cooling system	The cooling water stream drain for PU-11 was changed from the PWD system to the storm drain.
2/6	Cell cooler	A cell cooler in heat exchanger cell 113 was replaced.

Table 5. (continued)

Date	Component	Remarks
2/7	Annunciator panel	Control room annunciator panel E-1 shorted out. The panel was replaced with a spare. A generic modification on all panels has been initiated to prevent further failures.
2/7	Cell cooler	A cell cooler in heat exchanger cell 110 was replaced.
3/4	Pool coolant pump, PU-9B	A glove was removed from pool coolant pump, PU-9B.
3/14	Cell cooler	A cell cooler in heat exchanger cell 113 was replaced.
3/26	Annunciator panels	Annunciator panels "A" and "H/I" were modified.

Table 6. Instrumentation - maintenance and changes

Date	Component	Remarks
1/6	Pool deaerator off-gas temperature sensor	TE-476 was repaired.
1/7	Accelerograph	The new seismic detection/annunciator system was placed in service.
1/13	Calibration program	The following equipment was calibrated: (1) tower blowdown flow transmitter and recorder, (2) PWD flow indication, (3) manual control rod timers, and (4) RE-200 cladding failure detector.
1/13	Wide-range counting channel	The annual shutdown checks were performed per procedure HFR-1203.
1/14	PSS-128 A, B, and C	The pressure scram set points were readjusted.

Table 6. (continued)

Date	Component	Remarks
1/21	Counting channel	A faulty preamp was replaced.
1/22	RE-252	A faulty probe was replaced.
1/31	Calibration program	The following equipment was calibrated: (1) primary make-up indicator, (2) pool make-up indicator, and (3) tower blowdown flow transmitter.
2/5	Pony motors	All pony motor alarm switches were calibrated.
2/6	Calibration program	The following equipment was calibrated: (1) hydraulic tube instrumentation, (2) pressurizer pump high-pressure cut-off switch, (3) pool surge tank level indicator, (4) safety system temperature indicators, (5) pool surge tank make-up flow transmitter, (6) primary head tank make-up flow transmitter, and (7) Hyscan pressure transmitters.
2/7	Calibration program	The following equipment was calibrated: (1) primary deaerator level switches LS-202-A and LS-202-B, (2) servo system pressure-to-current converters, (3) FCV-464 limit switches, (4) primary head tank make-up flow sensor FE-215, and (5) pool surge tank make-up flow sensor, FE-407.
2/8	Safety channel No. 1	A faulty heat-power multiplier was replaced.
2/8	Calibration program	Safety channel temperature transmitters TT-100-2B, TT-100-3A, and TT-100-3B were calibrated.
2/10	Safety channels	Nuclear checks were performed on all three channels per procedure HFR-1201.
2/18	RE-253	A faulty probe was replaced.

Table 6. (continued)

Date	Component	Remarks
2/19	Servo channels	Nuclear checks were performed on all three channels per procedure HFR-1202.
3/3	Shim drive position indicator	The shim drive No. 3 position indicator potentiometer was replaced.
3/3	Primary pressure switches PSS-127 and PSS-128 A, B, and C	The pressure switches were calibrated.
3/13	Wide-range counting channels	Nuclear checks were performed on all three wide-range counting channels per procedure HFR-1203.
3/19	Secondary temperature controller, TC-310	The set point controller was replaced.
3/24	Secondary temperature controller, TC-310	The FN-4D2 temperature module was replaced.
3/26	Flow totalizers	New flow totalizers were installed for the primary head tank and pool surge tank.

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.

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)	7	5	201
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 8.

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

The following changes were made to ORNL/TM-1168/R2, effective on January 24, 1986.

1. Page 2-3, change +0.25 in. to $\pm$0.25 in.
2. Page 14-3-a, addition of new annunciator procedure A-14
3. Page 14-3-b, addition of blank page to maintain organization of manual
4. Page 14-35, change point 16 to point 12
5. Page 14-84, change point 8 to point 7
6. Page 14-108, change 90 mR/h to 9 mR/h
7. Page 14-122, change points 1 or 15 to point 1
8. Page 14-124, change points 6 or 20 to point 6
9. Page 14-125, change points 3 or 21 to point 3

(continued on page 12)

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	11/7/85	99.977	7/10/85	99.681[a]	South	3/31/86	99.99	9/25/85	99.99
			7/27/85	99.512[a,b]	North	3/31/86	99.99	9/25/85	99.99
			8/9/85	99.926					
SBHE, center	11/14/85	99.867[a]	7/11/85	99.935	South	3/31/86	99.99	9/25/85	99.99
					North	3/31/86	99.94[a]	9/25/85	99.99
SBHE, east	11/12/85	99.906	7/25/85	98.87[a,b]	South	3/31/86	99.99	9/25/85	99.99
			7/26/85	98.88[a,b]	North	3/31/86	99.99	9/25/85	99.99
			8/6/85	99.77[a,b]					
			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.

[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.

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	5/8/85	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	2/6/86	10/22/85	5/28/85
Pony motor battery F	3/25/86	12/7/85	8/13/85
Pony motor battery G	3/2/86	9/26/85	6/30/85
Pony motor battery H	1/13/86	11/14/85	9/4/85
Radiation monitoring equipment	3/13/86	1/13/86	11/12/85
Monthly tests			
Cadmium nitrate tests	3/30/86	2/28/86	1/31/86
Diesel run test, No. 1	3/26/86	2/26/86	1/28/86
Diesel run test, No. 2	3/26/86	2/26/86	1/28/86

10. Page 14-126, change points 2 and 12 to point 2
11. Page 14-127, change point 1 or 15 to point 1
12. Page 14-129, change point 8 or 22 to point 7
13. Page 14-130, change point 9 or 23 to point 8
14. Page 14-131, change point 9 or 23 to point 8
15. Page 14-133, change point 10 or 24 to point 9
16. Page 14-134, change point 10 or 24 to point 9
17. Page 14-167, inserted annunciator procedure HI-20 that was inadvertently dropped during the last revision
18. Page 14-168 through 14-170, renumbered pages 168 to 171 to account for insertion of annunciator procedure HI-20

The following changes were made to ORNL/TM-1168/R2, effective on March 3, 1986.

1. Page 2-3, improved clarity of CAUTION note
2. Page 14-2, added Annunciator A-14 to index list
3. Page 14-3a, renumbered page for Annunciator Procedure A-14
4. Page 14-4a, renumbered blank page
5. Page 14-30, changed sensor point from IC-28 to IC-39
6. Page 14-52, changed sensor point from IC-41 to IC-52
7. Page 14-170, added page 14-170 (Annunciator Procedure HI-24) to back of page 14-169.

UNUSUAL OCCURRENCES

There was one unusual occurrence report issued this quarter:

ORNL-86-2-HFIR-86-1 Excessive radioactivity in primary coolant

REACTOR EXPERIMENTS

EXPERIMENT FACILITIES

Assignments of the various HFIR experiment facilities are tablulated 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, 4, and 5.

Table 10. Experiment facility assignments

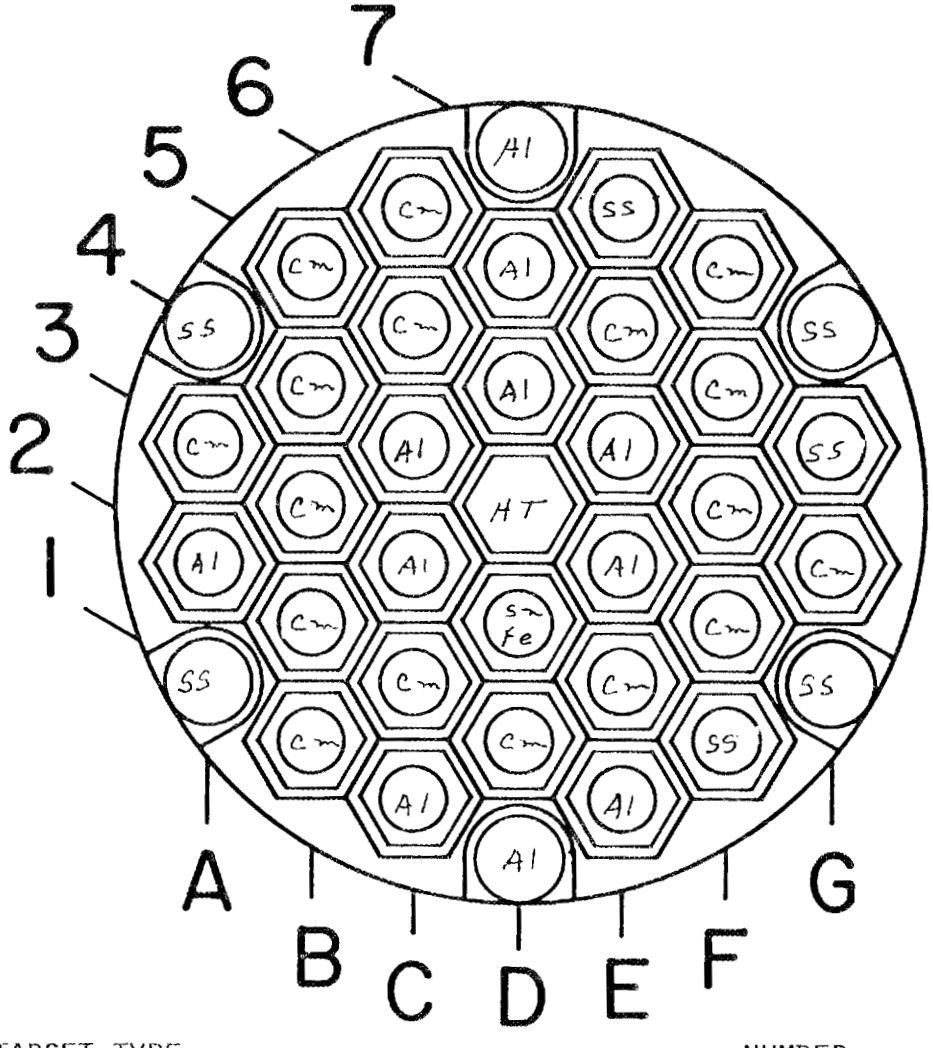
Facility	Description	Sponsor
PTP-A1	Materials studies	Fusion Energy
PTP-A4	Materials studies	Fusion Energy
PTP-D1	Materials studies	Fusion Energy
PTP-D7	Materials studies	Fusion Energy
PTP-G4	Materials studies	Fusion Energy
PTP-G7	Materials studies	Fusion Energy
RB-1	Isotope production	Operations
RB-2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

REVISED

HFIR TARGET LOADING

CYCLE NO. 274 DATE 12/19/85

ORNL Dwg. 86-11579



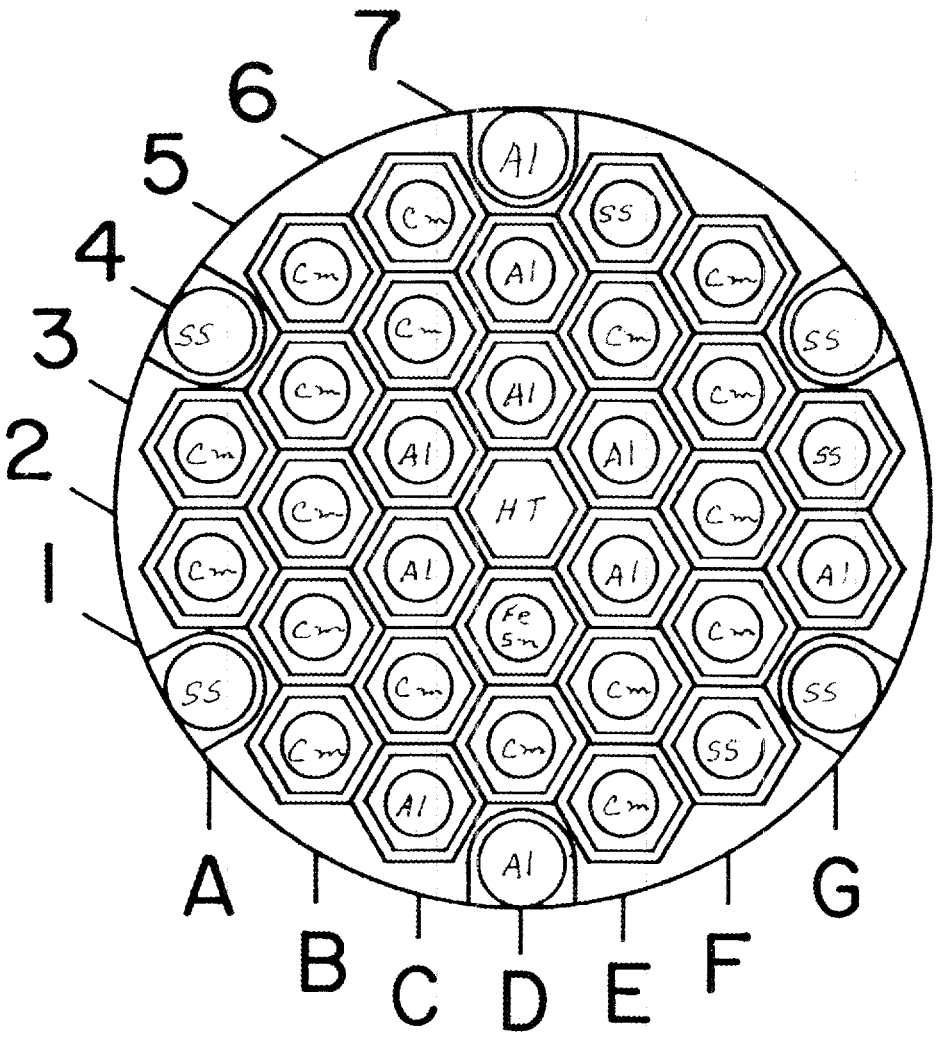
TARGET TYPE	NUMBER
PLUTONIUM (Pu)	
CURIUM (Cm)	17
COBALT (Co)	
TIN (Sn)	1
NICKEL (Ni)	
STAINLESS STEEL (SS)	3
GRAPHITE (C)	
ALUMINUM (Al)	9
HYDRAULIC TUBE (HT)	1

Fig. 1.

HFIR TARGET LOADING

CYCLE NO. 275 DATE 1/15/86

ORNL Dwg. 86-11580



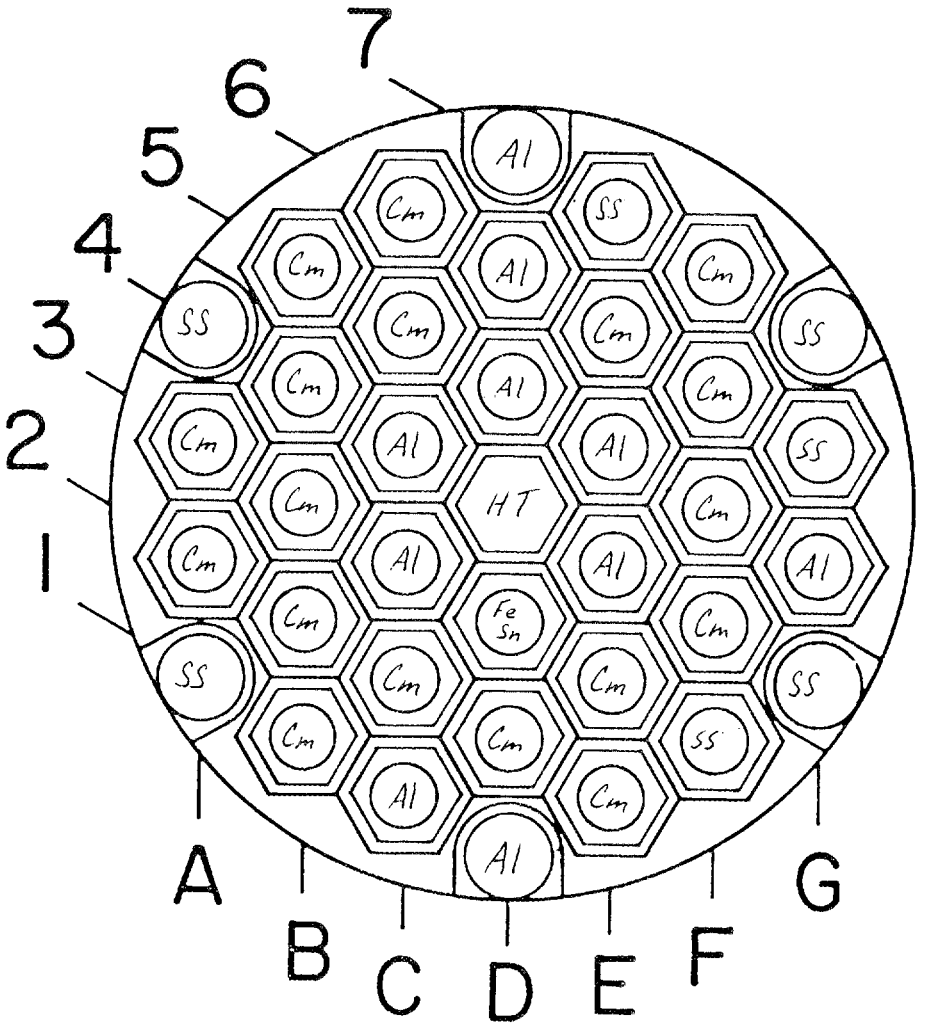
TARGET TYPE	NUMBER
PLUTONIUM (Pu)	
CURIUM (Cm)	18
COBALT (Co)	
TIN (Sn)	1
NICKEL (Ni)	
STAINLESS STEEL (SS)	3
GRAPHITE (C)	
ALUMINUM (Al)	8
HYDRAULIC TUBE (HT)	1

Fig. 2.

HFIR TARGET LOADING

CYCLE NO. 276 DATE 2/8/86

ORNL Dwg. 86-11581



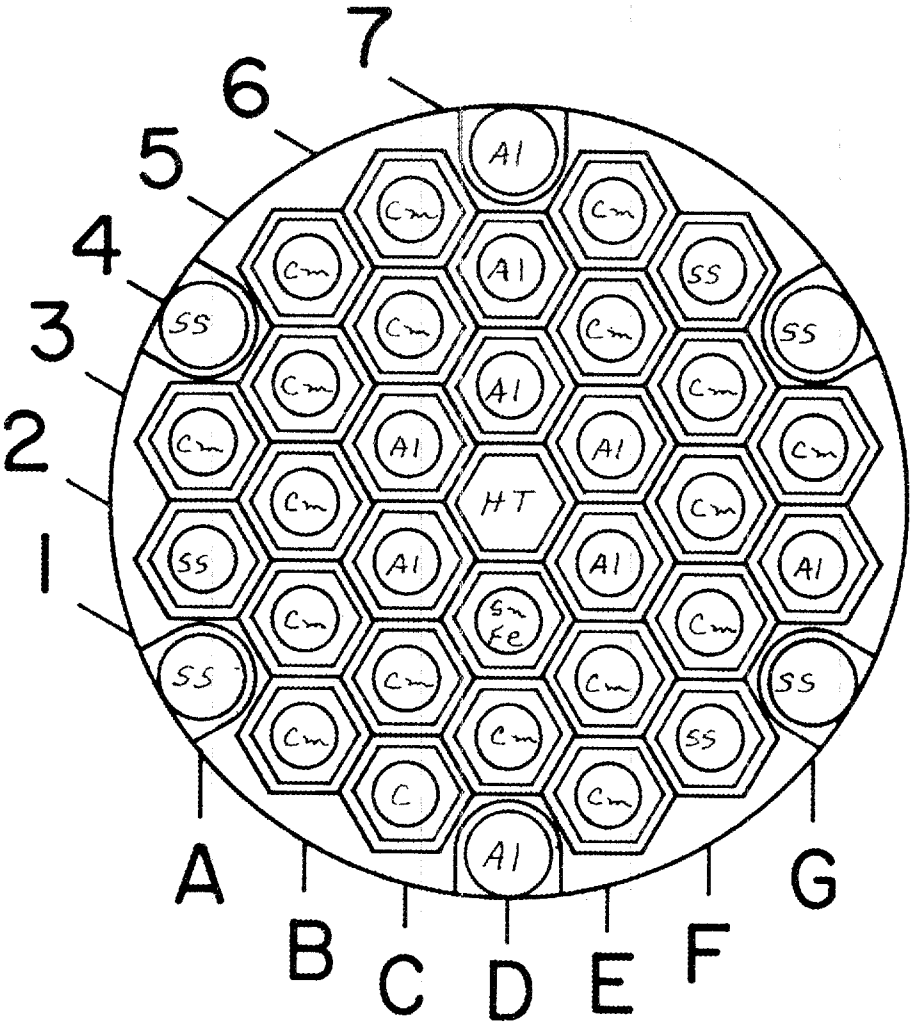
TARGET TYPE	NUMBER
PLUTONIUM (Pu)	
CURIUM (Cm)	18
COBALT (Co)	
TIN (Sn)	1
NICKEL (Ni)	
STAINLESS STEEL (SS)	3
GRAPHITE (C)	
ALUMINUM (Al)	8
HYDRAULIC TUBE (HT)	1

Fig. 3.

HFIR TARGET LOADING

Cycle No. 277 Date 3/3/86

ORNL Dwg. 86-11582



Target type	Number	Target type	Number
Curium (Cm)	18	Stainless steel (SS)	3
Graphite (C)	1	Aluminum (Al)	7
Hydraulic tube (HT)	1	Tin (Sn)	1

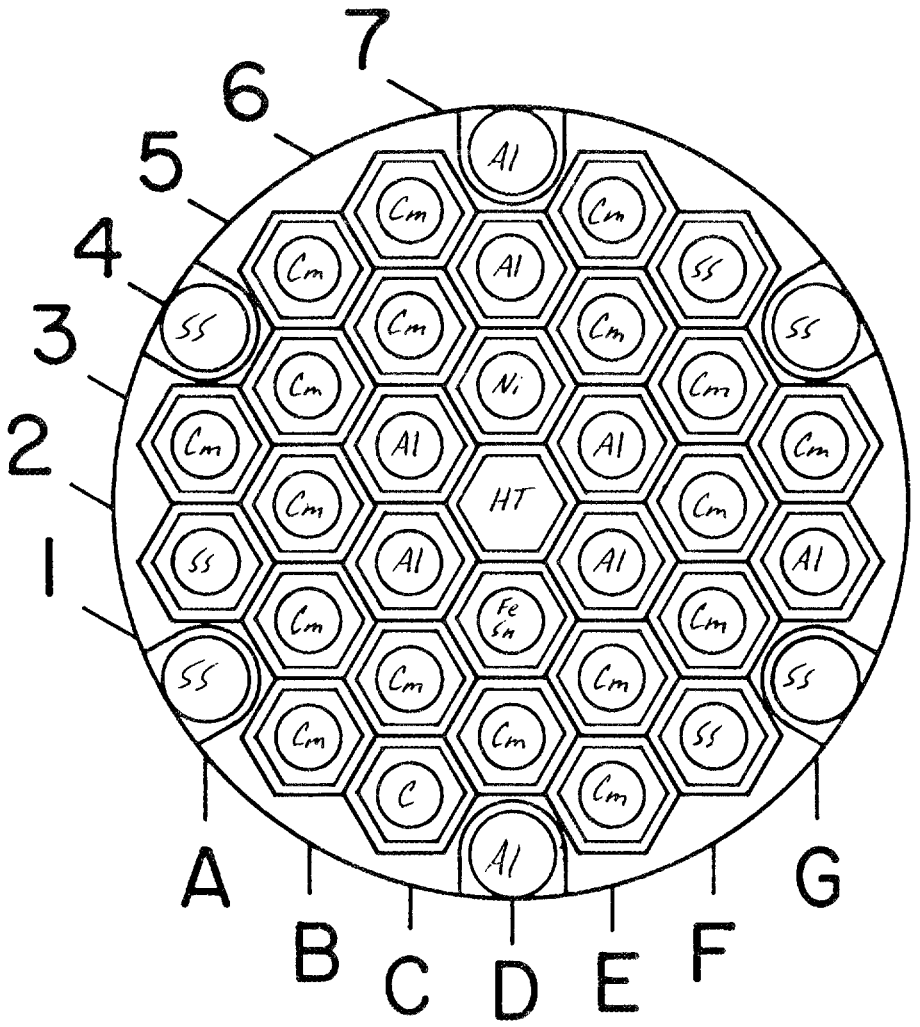
Fig. 4.

HFIR TARGET LOADING

Cycle No. 278

Date 3/27/86

ORNL Dwg. 86-11583



Target type	Number	Target type	Number
Curium (Cm)	18	Stainless steel (SS)	3
Graphite (C)	1	Aluminum (Al)	6
Hydraulic tube (HT)	1	Ni	1
Fe-Sn	1		

Fig. 5.

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80. M. Jacquemain, Head, Technical Department ILL, Institute Max von Laue-Paul Langevin, CEDEX 156, 38 Grenoble-Gare, France
81. W. A. Johnson, Branch Chief, Facilities and System Safety Branch, Safety Division, DOE, Oak Ridge, TN 37831
82. R. H. Kropschot, Associate Director, Office of Basic Energy Sciences, ER-10, GTN, U.S. Department of Energy, Washington, DC 20545
83. A. C. Wood, Australian AEC, Nuclear Science and Technology Branch, Private Mail Bag, Sutherland 2232, New South Wales, Australia
84. Dr. K. R. O'Kula, Savannah River Laboratory, Building 773-41a, Aiken, SC 29808