MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0148614 9

ORNL/TM-10306

ornl

OAK RIDGE
NATIONAL
LABORATORY

MARTIN MARIETTA

High Flux Isotope Reactor Quarterly Report July Through September 1986

B. L. Corbett
M. B. Farrar

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
CIRCULATION SECTION
4500N ROOM 175
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this report, send in name with report and the library will arrange a loan.

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

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ORNL/TM-10306

Operations Division

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
JULY THROUGH SEPTEMBER 1986

B. L. Corbett and M. B. Farrar

Manuscript Completed - November 1986
Date of Issue - December 1986

Sponsor: J. H. Swanks, Director
Operations Division

NOTICE: This document contains information of a preliminary nature. It is subject to revision or correction and, therefore, does not represent a final report.

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-AC05-84OR21400

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0148614 9

CONTENTS

	Page
SUMMARY	1
OPERATIONS	1
SHUTDOWNS	2
LOW-POWER OPERATIONS	4
PLANT MAINTENANCE	4
INSTRUMENTATION AND CONTROLS	4
SYSTEM SURVEILLANCE TESTS AND RESULTS	8
Vessel Head Studs	8
Stack Filters	8
Summary of Surveillance Tests	10
REVISIONS TO THE HFIR OPERATING MANUAL	10
UNUSUAL OCCURRENCES	10
REACTOR EXPERIMENTS	10
Experiment Facilities	10
HFIR Target Loading	10

LIST OF TABLES

Table		Page
1	HFIR basic operating data (July 1 - September 30, 1986) .	1
2	Cycles of operation	2
3	HFIR material inventories	2
4	Description of HFIR shutdowns	3
5	Process systems - maintenance and changes	4
6	Instrumentation - maintenance and changes	6
7	Vessel head stud-tensioning cycles	8
8	Particulate and iodine removal efficiencies	9
9	Summary of surveillance tests	11
10	Experiment facility assignments	12

LIST OF FIGURES

Figure		Page
1	HFIR target loading (Cycle 282)	13
2	HFIR target loading (Cycle 283)	14
3	HFIR target loading (Cycle 284)	15
4	HFIR target loading (Cycle 285)	16

HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT
JULY THROUGH SEPTEMBER 1986

SUMMARY

Four routine cycles of operation were completed during the second quarter. Four scheduled end-of-cycle shutdowns and four unscheduled shutdowns resulted in an on-stream time of 90.5%. The HIFI, Phase I, components were installed during the end-of-cycle 283 shutdown.

OPERATIONS

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

Table 1. HFIR basic operating data
(July 1 - September 30, 1986)

	This quarter	Last quarter	Year to date
Total energy, MWd	8317	8240	24,371
Time operated, h	1998.466	1980.734	5857.085
Average operating power, MW	99.9	99.8	99.9
Time operating, %	90.5	90.7	89.4
Reactor availability, %	93.8	91.9	91.2
Reactor water radioactivity, cpm/ml (av)	300,266	341,687	
Pool water radioactivity cpm/ml (av)	63	63	

The starting and ending dates for Cycles 282, 283, 284, and 285 are presented in Table 2.

Table 2. Cycles of operation

Cycle No.	Fuel assembly	Date started	Date ended	Accumulated power (MWd)
282	281	6/30/86	7/22/86	2117
283	282	7/23/86	8/12/86	2057
284	283	8/17/86	9/7/86	2105
285	284	9/8/86	9/29/86	2039

The status of the HFIR fuel and control-plate inventories on the last day of the quarter are indicated in Table 3. Only fuel assemblies 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	3	4
New fuel assemblies available for use at end of quarter (EOQ)	8	11
Spent fuel assemblies on hand at EOQ	12	10
Spent fuel assemblies shipped	1	3
New sets of control plates placed in service	0	0
New sets of control plates available for use at EOQ	3	3
New control cylinders placed in service	0	1
New control cylinders available for use at EOQ	0	0

SHUTDOWNS

There were four scheduled end-of-cycle shutdowns and four unscheduled shutdowns during the quarter. Total downtime for the quarter was 209.534 hours. Of this, 209.050 hours were scheduled and 0.484 were unscheduled. Approximately 72.550 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
7/22	28.966	End of cycle 282. The total energy accumulated on fuel assembly 281 during this cycle was 2117 MWd.
8/12	98.30	End of cycle 283. The total energy accumulated on fuel assembly 282 during this cycle was 2057 MWd. The HIFI, Phase I, core modifications were performed during this shutdown.
9/7	42.784	End of cycle 284. The total energy accumulated on fuel assembly 283 during this cycle was 2105 MWd.
9/29	39.000*	End of cycle 285. The total energy accumulated on fuel assembly 284 during this cycle was 2039 MWd.
		Unscheduled
7/8	0.117	Control plates Nos. 1 and 3 were dropped inadvertently during a routine channel No. 2 safety test due to an instrument noise burst.
8/20	0.117	All four control plates were dropped inadvertently during a routine channel No. 3 heat power safety test due to an instrument noise burst.
9/20	0.100	All four control plates were dropped inadvertently during a routine channel No. 3 heat power safety test due to an instrument noise burst.
9/18	0.150	Control plate No. 3 was dropped inadvertently during channel No. 3 at-power nuclear checks (procedure HFR-1203) due to an instrument noise burst.

*The end-of-cycle 285 shutdown was continued into the fourth quarter. Total downtime for the end-of-cycle 285 shutdown including downtime in the fourth quarter was 86.533 hours.

LOW-POWER OPERATIONS

Two low-power runs were performed during the quarter. These Mode 3 runs are summarized as follows:

Date	Time operated, h	Power level	Remarks
8/15	∿1.00	≤50 kW	A Mode 3 run was performed for reactivity measurements on the new HIFI core configuration.
8/16	0.417	≤50 kW	A Mode 3 run was performed for reactivity measurements on the new HIFI core configuration.

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
8/14	Radiation/pressure block valve	The solenoid on the valve in cell 110 was replaced.
8/15	HIFI modification	The new HIFI core components were installed in the reactor. The new hydraulic tube U-bend was removed for further modifications as a result of a misalignment problem. Cycle 284 was run without the hydraulic rabbit facility in service.
8/16	Target tower	An in-situ hydraulic flow test was conducted on the new HIFI target tower.

Table 5. (continued)

Date	Component	Remarks
9/8	HIFI modification	The new HIFI hydraulic-tube U-bend and in-pile section were installed.
9/8	Letdown valve	The cell 110 letdown valve was replaced with a rebuilt valve.
9/15	Primary heat exchanger, 1D	Leaking tube 3 in row 1 was plugged.
		Secondary system
7/22	Cooling tower fans	The alignment of fans FN-4C-1, FN-4C-2, FN-4D-1, and FN-4D-2 was checked and adjusted as necessary.
8/18	Cooling tower fan, FN-4C-2	A faulty vibration switch was repaired.
		Miscellaneous
7/9	Air compressor, C-1B	The air compressor developed a coolant-to-head leak and was shut down for repairs.
7/16	Eye wash	An eye wash was installed next to the cadmium nitrate tank.
7/21	Pony-motor batteries	The pony-motor battery racks were seismically restrained.
7/22	Air compressor, C-1A	Replaced the cooling water solenoid.
7/23	Plant intercom	A new master box is being installed in the reactor bay.
7/23	Demineralized water system	An integrator was installed in the feed line to TRU.
7/23	Low-pressure steam system	A leaking supply line to the deaerators was repaired.
7/26	Diesel No. 1 batteries	The batteries were seismically restrained.

Table 5. (continued)

Date	Component	Remarks
7/31	Plant air system	A new plant air compressor was installed and tested.
8/1	Plant demineralizer system	A new canister-type plant demineralizer was installed in parallel with the existing plant demineralizer.
8/1	Sulfuric acid transfer pump	A new sulfuric acid transfer pump was permanently installed at the sulfuric acid tank.
8/13	Annunciator panels	Annunciator panels C and E-4 were refurbished.
9/22	Hot water injection system	Repacked steam control valve, TCV-1124.
7/1-9/30	Emergency pool fill system	Work progressed throughout the quarter on the installation of the new emergency pool fill line.
8/26-9/30	Air compressor, C-1A	Efforts to repair a coolant-to-air leak continued.

Table 6. Instrumentation - maintenance and changes

Date	Component	Remarks
7/1	Wide-range counting channel No. 1	A fission chamber drive shear pin was replaced in the gearbox.
7/3	Safety channel No. 2	Problems encountered during a flux/flow safety test were investigated by instrument technicians. The technicians determined that the operation of the flux/flow test valve will be checked out during shutdown maintenance.

Table 6. (continued)

Date	Component	Remarks
7/8	Safety channel No. 2	Calibration checks were performed.
7/9	Safety channel No. 2	Inlet temperature recorders were calibrated.
7/22	Safety channel annunciators	Capacitor-type noise suppressors were replaced with MOV-type noise suppressors.
7/22	Wide-range counting channel No. 3	A failed fission chamber assembly was replaced.
8/13	Wide-range counting channel No. 2	Corrosion products were cleaned from the fission chamber thimble internals.
8/13	Primary and pool storage tanks	The level indicators for the primary and pool storage tanks were calibrated.
8/13	Pneumatic transmitters	The following pneumatic transmitters were calibrated: LT-429, FT-425, FT-468, FT-441, FT-258, PDT-302, LT-428, FT-216, and FT-460.
8/19	Wide-range counting channel No. 1	A faulty fission chamber assembly was replaced.
8/20	Safety channel No. 2	A faulty flux/flow fast-trip comparator was replaced.
9/6	Stack inert gas monitor	An incrase in inert gas activity in the stack was traced to a contaminated probe. The probe was replaced.
9/8	Pool surge tank level indicator	The indicator was calibrated.
9/10	Safety channel No. 1	The inlet temperature probe was calibrated.
9/29	Multipoint recorders	All control room multipoint recorders were replaced with new recorders.

Table 6. (continued)

Date	Component	Remarks
9/29	Rustrak recorders	All Rustrak recorders in the control room were replaced with multipen recorders.
7/1-9/30	Artificial Intelligence Data Collection System	New AI sensors were tied into HFIR instrumentation. Work continued throughout the quarter.

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	6	213
4.5 MPa (650 psig)	0	0	117

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	9/22/86	99.99	3/31/86	99.99
					North	9/22/86	99.99	3/31/86	99.99
SBHE, center	4/18/86	99.975	11/14/85	99.867[a]	South	9/22/86	99.99	3/31/86	99.99
					North	9/22/86	99.98	3/31/86	99.94[a]
								4/15/86	99.987[b]
SBHE, east	4/24/86	99.964	11/12/85	99.906	South	9/22/86	99.99	3/31/86	99.99
					North	9/22/86	99.99	3/31/86	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.

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 were no unusual occurrence reports issued this quarter:

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 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	7/22/86	11/20/85	5/29/85
Poison injection system	8/14/86	8/16/85	10/29/84
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	9/30/86	11/18/85	10/4/84
Radiation block valve test	9/8/86	9/30/85	10/29/84
Reactor bay in-leakage test	9/8/86	9/30/85	10/28/84
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	9/29/86	5/11/85	12/11/85
Pony motor battery E	9/8/86	5/11/86	2/6/86
Pony motor battery F	6/28/86	3/25/86	12/7/85
Pony motor battery G	7/11/86	6/4/86	3/2/86
Pony motor battery H	8/13/86	4/18/86	1/13/86
Radiation monitoring equipment	9/11/86	7/16/86	5/7/86
Monthly tests			
Cadmium nitrate tests	9/27/86	8/30/86	7/26/86
Diesel run test, No. 1	9/30/86	8/26/86	7/29/86
Diesel run test, No. 2	9/30/86	8/26/86	7/29/86

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

Fig. 1.

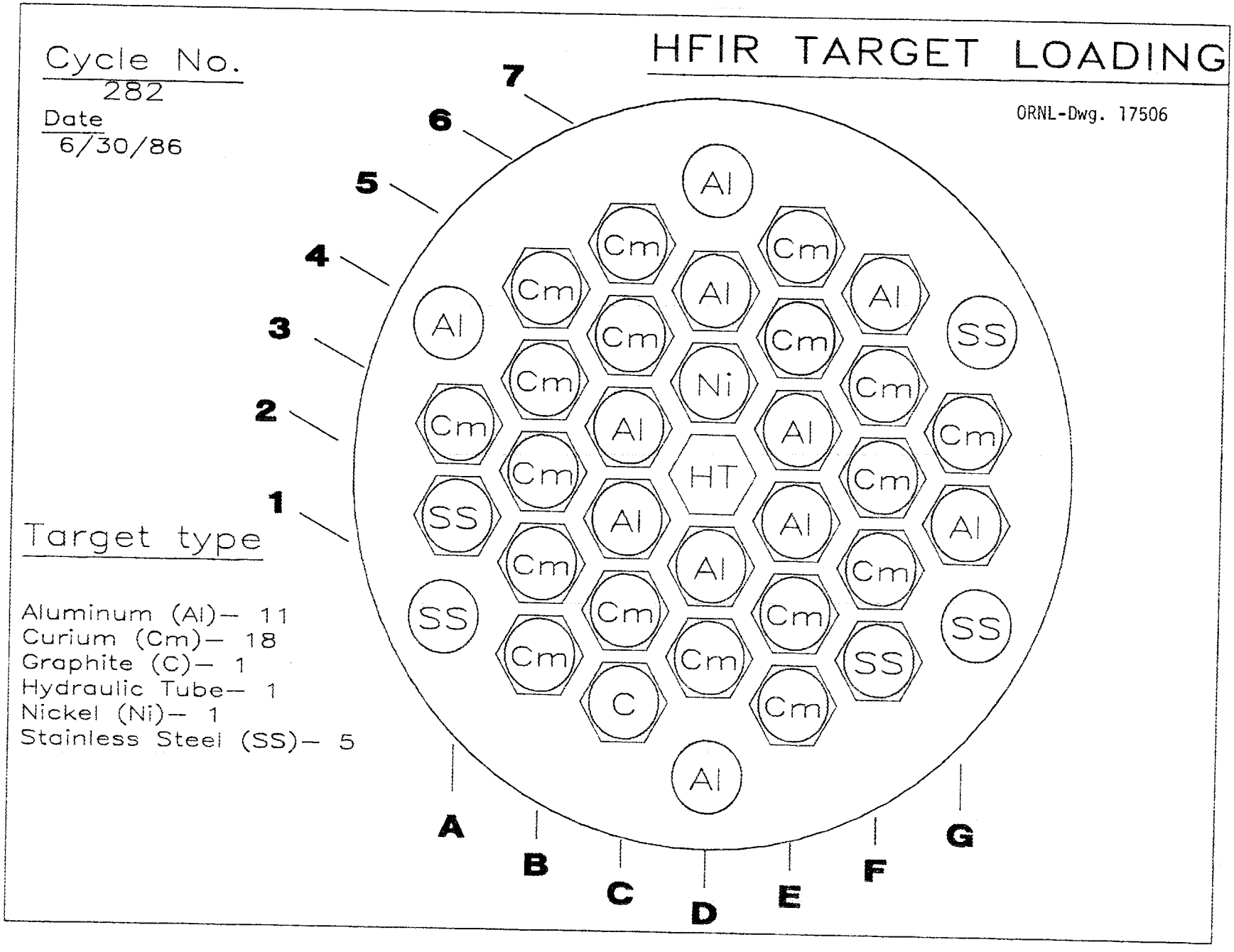

HFIR TARGET LOADING
ORNL-Dwg. 17506
Cycle No.
282
Date
6/30/86
Target type
Aluminum (Al)— 11
Curium (Cm)— 18
Graphite (C)— 1
Hydraulic Tube— 1
Nickel (Ni)— 1
Stainless Steel (SS)— 5
1
2
3
4
5
6
7
A
B
C
D
E
F
G
Al
Cm
Ni
HT
SS
C

Fig. 2.

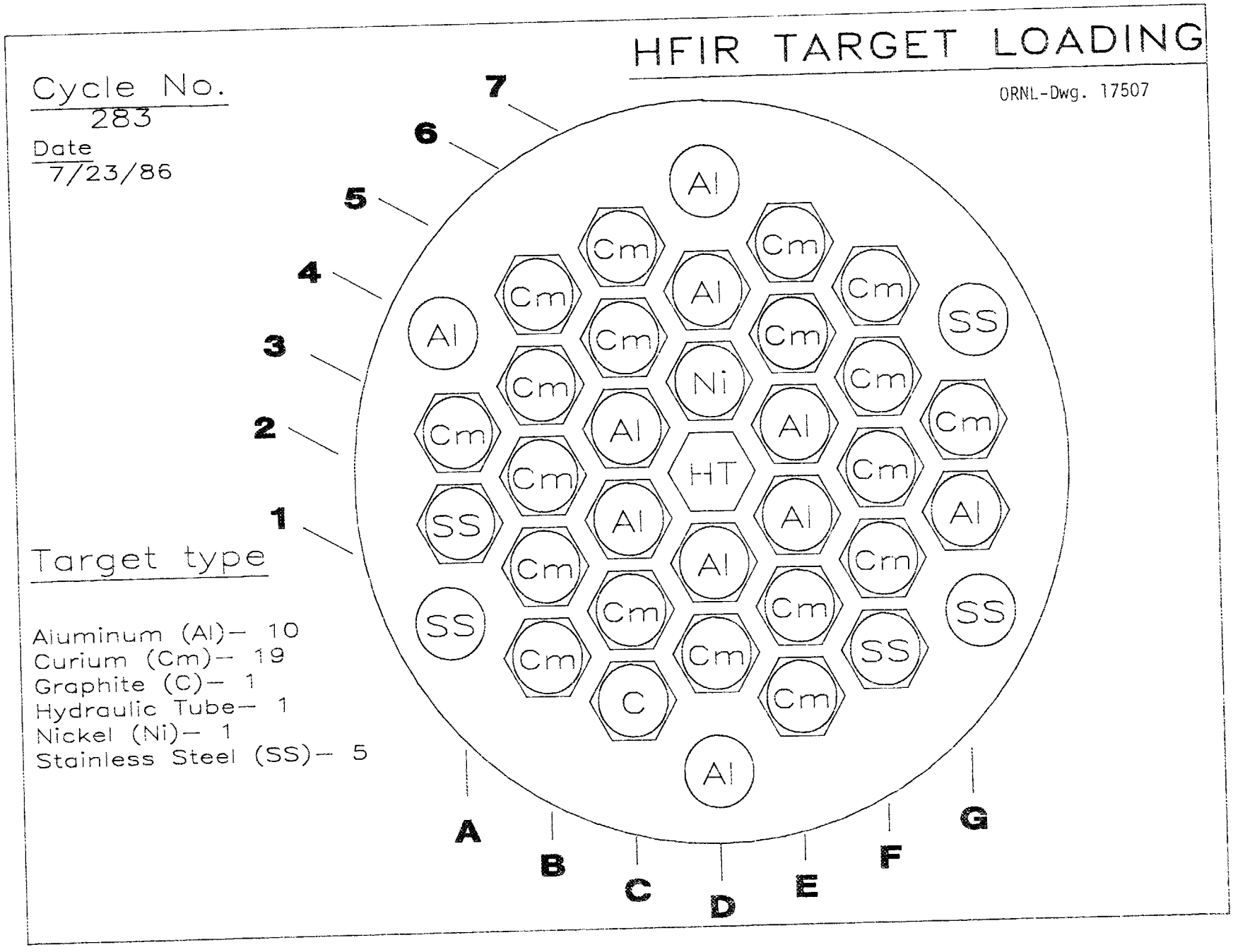

HFIR TARGET LOADING
ORNL-Dwg. 17507
Cycle No.
283
Date
7/23/86
Target type
Aluminum (Al)— 10
Curium (Cm)— 19
Graphite (C)— 1
Hydraulic Tube— 1
Nickel (Ni)— 1
Stainless Steel (SS)— 5
7
6
5
4
3
2
1
A
B
C
D
E
F
G
Al
Cm
SS
Ni
HT
C

Fig. 3.

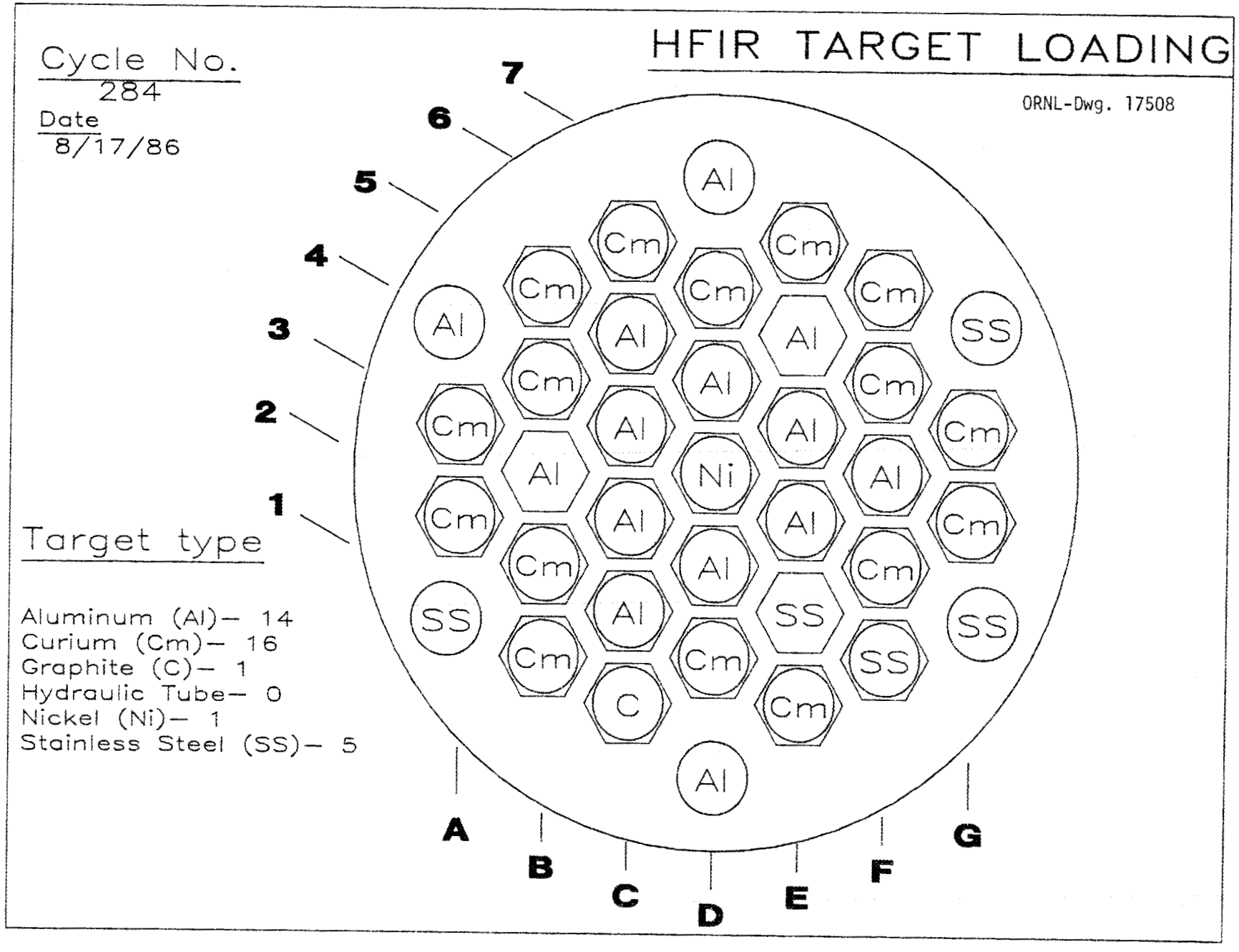
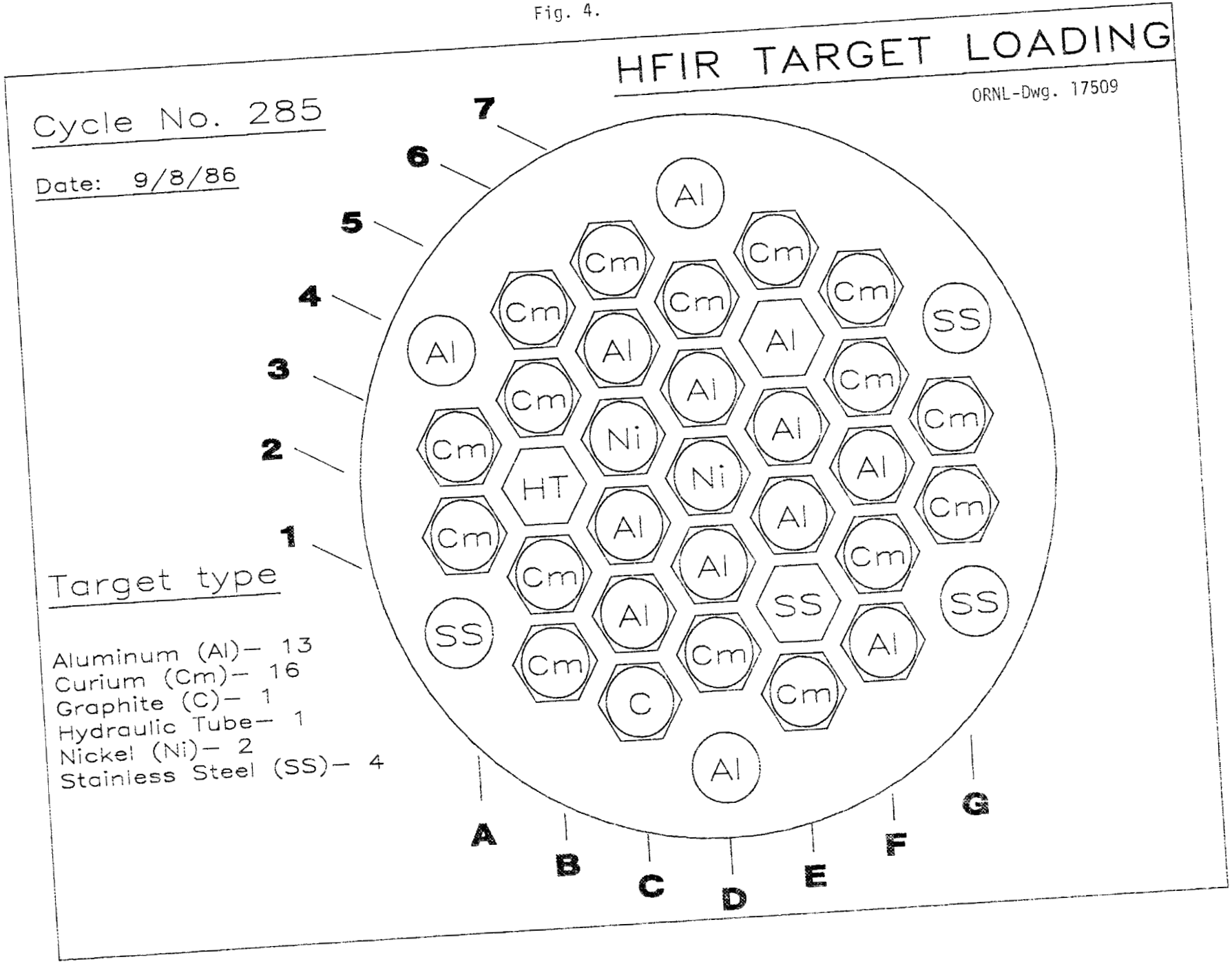

HFIR TARGET LOADING
ORNL-Dwg. 17508
Cycle No.
284
Date
8/17/86
Target type
Aluminum (Al)— 14
Curium (Cm)— 16
Graphite (C)— 1
Hydraulic Tube— 0
Nickel (Ni)— 1
Stainless Steel (SS)— 5
7
6
5
4
3
2
1
A
B
C
D
E
F
G
Al
Cm
SS
Ni
C

Fig. 4.


HFIR TARGET LOADING
ORNL-Dwg. 17509
Cycle No. 285
Date: 9/8/86
Target type
Aluminum (Al)— 13
Curium (Cm)— 16
Graphite (C)— 1
Hydraulic Tube— 1
Nickel (Ni)— 2
Stainless Steel (SS)— 4
7
6
5
4
3
2
1
A
B
C
D
E
F
G
Al
Cm
SS
Ni
HT
C

INTERNAL DISTRIBUTION

1. D. S. Asquith
2. S. J. Ball
3. K. S. Belitz
4. J. E. Bigelow
5. G. H. Burger
6. H. D. Cochran
7. B. L. Corbett
8. J. L. Cotter
9. W. H. Culbert
10. M. B. Farrar
11. T. P. Hamrick
12. C. H. Helton
13. E. E. Hill
14. S. S. Hurt
15. O. L. Keller
16. G. L. Kickendahl
17. R. W. Knight
18. M. W. Kohring
19. R. A. Lorenz
20-24. R. V. McCord
25. D. M. McGinty
26. P. E. Melroy
27. E. Newman
28. J. A. Setaro
29. R. L. Senn
30. E. M. Shirley
31. R. M. Stinnett
32. J. H. Swanks
33. K. R. Thoms
34. D. B. Trauger
35. K. W. West
36. F. W. Wiffen
37. M. W. Wilkinson
38. R. S. Wiltshire
39. A. Zucker
40. Central Research Library
41. Document Reference Section
42. Laboratory Records Department
43. Laboratory Records, ORNL RC
44. ORNL Patent Office

EXTERNAL DISTRIBUTION

45-74. Technical Information Center, Oak Ridge, TN 37831
75. J. A. Lenhard, Office of Assistant Manager for Energy Research and Development, DOE, Oak Ridge, TN 37831
76. J. L. Burnett, Division of Chemical Sciences, Office of Basic Energy Sciences, ER-142, GTN, Department of Energy, Washington, DC 20545
77. John N. Maddox, Office of Health & Environmental Research, Office of Energy Research, ER-73, Mail Stop G 226, GTN, Department of Energy, Washington, DC 20545
78. L. E. Temple, Construction Management, Office of Energy Research, Department of Energy, Washington, DC 20545
79. Neal Goldenberg, Safety, QA, and Safeguards, Office of Support Programs, Department of Energy, Germantown, MD 20545
80. M. Jacquemain, Head, Technical Department ILL, Institute Max von Laue-Paul Langevin, CEDEX 156, 38 Grenoble-Gare, France
81. T. M. Jelinek, Branch Chief, Nuclear Safety Branch, Safety & Health Division, DOE, Oak Ridge, TN 37831
82. D. K. Stevens, 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. K. R. O'Kula, Savannah River Laboratory, Building 773-41a, Aiken, SC 29808