ornl

OAK RIDGE
NATIONAL
LABORATORY

MARTIN MARIETTA

NUREG/CR-4031
ORNL/TM-9423

Neutron Spectral Characterization for the Fifth Heavy Section Steel Technology (HSST) Irradiation Series

C. A. Baldwin
F. B. K. Kam
F. W. Stallmann

Prepared for the U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
[u]nder Interagency Agreements DOE 40-551-75 and 40-552-75

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

NOTICE

Availability of Reference Materials Cited in NRC Publications

Most documents cited in NRC publications will be available from one of the following sources:

1. The NRC Public Document Room, 1717 H Street, N.W., Washington, DC 20555
2. The NRC/GPO Sales Program, U.S. Nuclear Regulatory Commission, Washington, DC 20555
3. The National Technical Information Service, Springfield, VA 22161

Although the listing that follows represents the majority of documents cited in NRC publications, it is not intended to be exhaustive.

Referenced documents available for inspection and copying for a fee from the NRC Public Document Room include NRC correspondence and internal NRC memoranda; NRC Office of Inspection and Enforcement bulletins, circulars, information notices, inspection and investigation notices; Licensee Event Reports; vendor reports and correspondence; Commission papers; and applicant and licensee documents and correspondence.

The following documents in the NUREG series are available for purchase from the NRC/GPO Sales Program: formal NRC staff and contractor reports, NRC-sponsored conference proceedings, and NRC booklets and brochures. Also available are Regulatory Guides, NRC regulations in the *Code of Federal Regulations*, and *Nuclear Regulatory Commission Issuances*.

Documents available from the National Technical Information Service include NUREG series reports and technical reports prepared by other federal agencies and reports prepared by the Atomic Energy Commission, forerunner agency to the Nuclear Regulatory Commission.

Documents available from public and special technical libraries include all open literature items, such as books, journal and periodical articles, and transactions. *Federal Register* notices, federal and state legislation, and congressional reports can usually be obtained from these libraries.

Documents such as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings are available for purchase from the organization sponsoring the publication cited.

Single copies of NRC draft reports are available free, to the extent of supply, upon written request to the Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at the NRC Library, 7920 Norfolk Avenue, Bethesda, Maryland, and are available there for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

NUREG/CR-4031
ORNL/TM-9423
Dist. Category-RL

Operations Division

NEUTRON SPECTRAL CHARACTERIZATION FOR THE FIFTH HEAVY SECTION STEEL TECHNOLOGY (HSST) IRRADIATION SERIES*

"Simulator Experiments"

C. A. Baldwin
F. B. K. Kam
F. W. Stallmann

Manuscript Completed - October 1984
Date Published - December 1984

*Prepared for the
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Washington, D.C. 20555
Under Interagency Agreements DOE 40-551-75 and 40-552-75

NRC FIN No. B0415

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

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to R. K. Nanstad of the Metals and Ceramics Division for his support of this work. The authors also wish to thank B. J. Taylor for the excellent job she has done in the preparation of this report.

This work was performed at the Oak Ridge National Laboratory which is operated by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES
(continued)

ABSTRACT

Three neutron dosimetry experiments were performed at the Oak Ridge Research Reactor Poolside Facility to study the feasibility of using the facility for the Fifth Nuclear Regulatory Commission Heavy Section Steel Technology Metallurgical Irradiations. The first two experiments revealed the original experimental configuration to be inadequate because the fluence rates estimated from the measured saturation activities were too low. In response to this, the core loading was changed and the entire experimental facility was moved closer to the core. A third experiment was performed and the resulting saturation activities and fluence rate estimates increased by approximately 40% at the points of interest. The latter fluence rate estimates were considered satisfactory, so no further changes were necessary.

This report describes the three characterization experiments in detail and gives all measurement results. An analysis of the results with regard to consistency and measurement uncertainty is also presented. It is shown that the experimental results are consistent within uncertainty bounds.

NEUTRON SPECTRAL CHARACTERIZATION FOR THE FIFTH HEAVY SECTION STEEL TECHNOLOGY (HSST) IRRADIATION SERIES

"Simulator Experiments"

C. A. Baldwin
F. B. K. Kam
F. W. Stallmann

INTRODUCTION

The Nuclear Regulatory Commission's (NRC) Heavy Section Steel Technology (HSST) Program[1] is concerned with the investigation of the behavior of cracklike flaws in reactor pressure vessel steels. In support of this goal, several irradiations will be carried out at the Oak Ridge Research Reactor Poolside Facility (ORR-PSF) over a period of approximately two years. Metallurgical specimens are to be irradiated and then tested to determine any change in properties due to radiation damage. The property changes will be correlated with the neutron damage exposure parameters fluence greater than 1 MeV, fluence greater than 0.1 MeV, and displacements per atom (dpa). The NRC's HSST program has been subcontracted to Oak Ridge National Laboratory (ORNL). The Operations Division Technical Department has the responsibility for the dosimetry portion of the experiments. The goals of dosimetry with respect to the experiments are twofold. First, the irradiation facility must be fully characterized in advance of the metallurgical irradiations. Results will be used to confirm as-built suitability of the facility and to estimate appropriate irradiation times. The second task is to determine dosimeters for each of 12 irradiation capsules which will provide detailed fluence and spectral information about each metallurgical specimen.

The ORR HSST facility is illustrated by an overhead view in Fig. 1. The core and surrounding aluminum support structure are stationary, while the thermal shields and experiment capsules are mounted on a cart and are free to move in the Y direction. This allows the water gap between the thermal shield addition and the aluminum window to vary in order to change the fluence rate received by the HSST capsules. This feature also allows the entire facility to be backed several feet away from the core during startup phases when power levels are below the nominal operating power of 30 MW. The thermal shield addition and permanent thermal shield are made of stainless steel and are 3.75 cm and 6.00 cm thick, respectively. There is a 0.50-cm water gap between the thermal shields and a 0.32-cm water gap between the permanent thermal shield and the HSST capsules. Three gradient-wire holders are located at the back of the permanent thermal shield to the north (MT1), center (MT2), and south (MT3) of the facility. Their purpose is to position dosimeters that can be removed and analyzed on a cycle-to-cycle basis, if necessary.

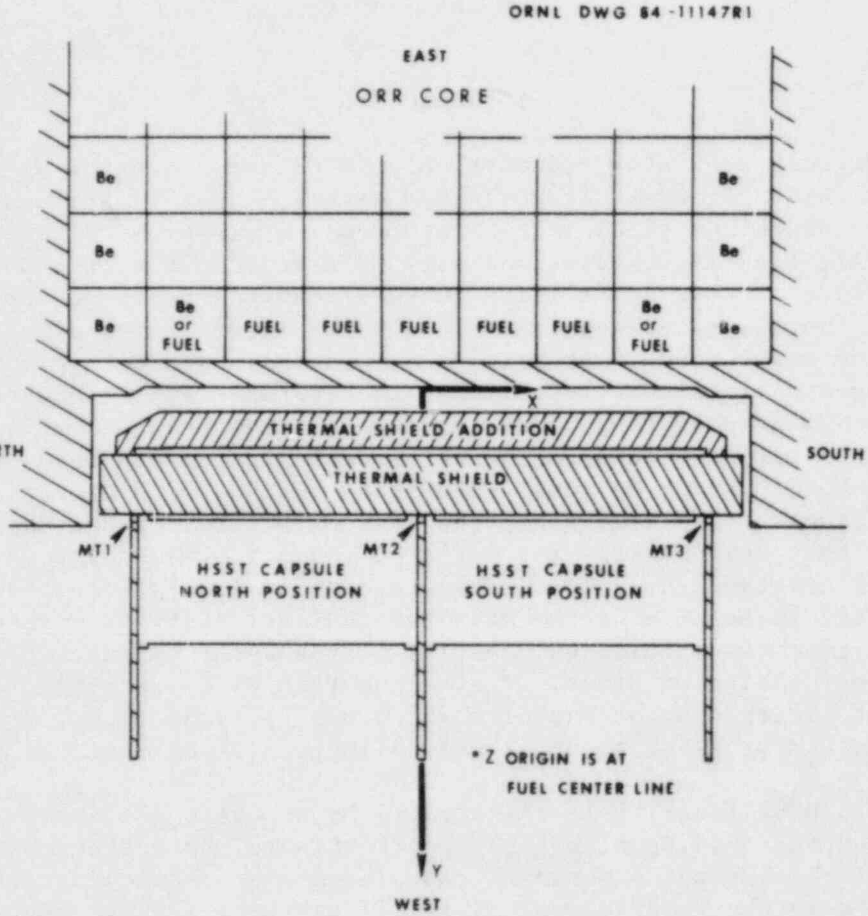


Fig. 1. ORR HSST Facility.

This report describes three irradiation experiments carried out to satisfy the first goal of the dosimetry task, i.e., characterize the HSST facility as-built. Other reports will describe the neutronic calculations and the least squares adjustment procedures[2] which provide the damage exposure parameters in each of the 12 metallurgical irradiation capsules.

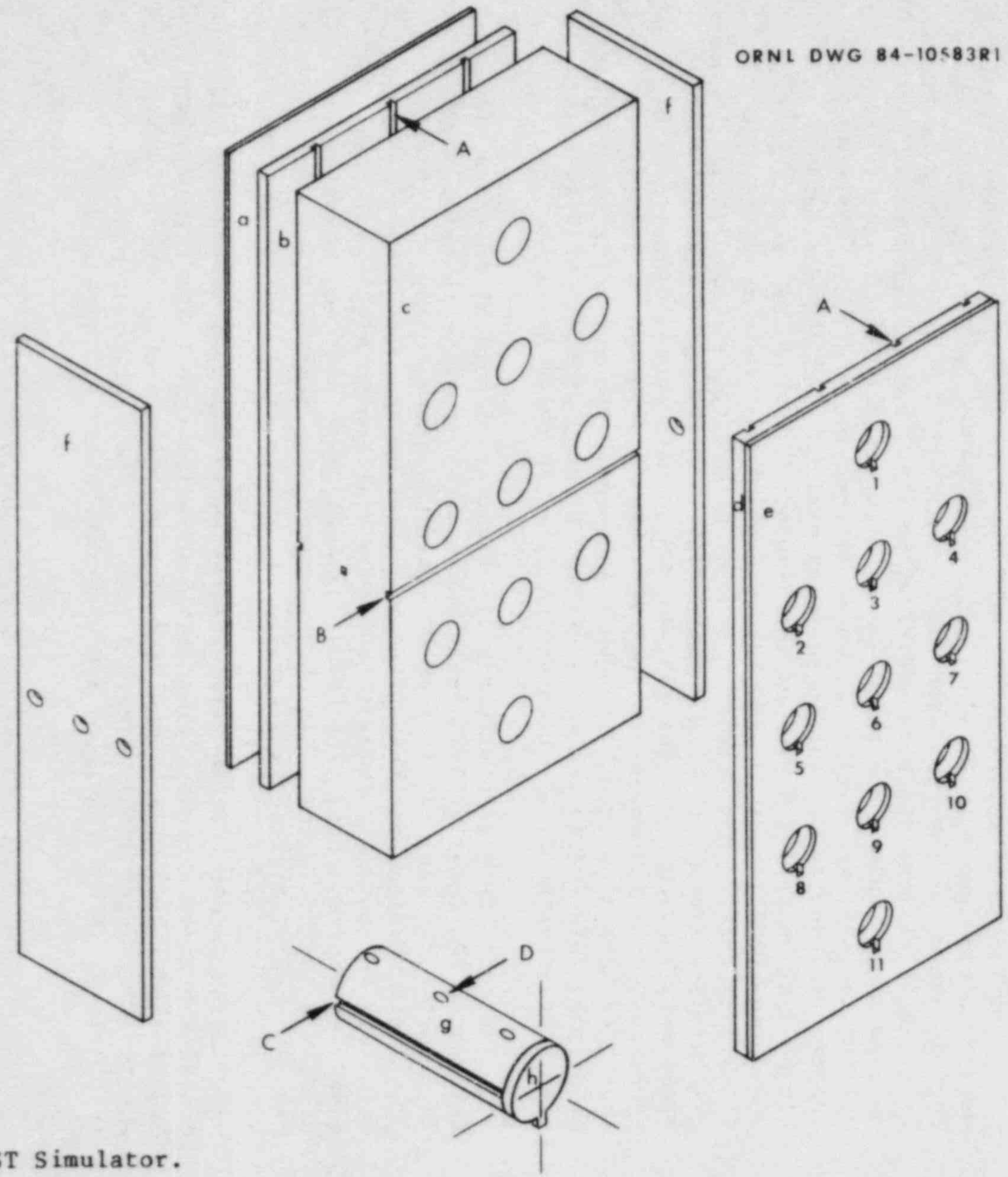
SIMULATOR AND DOSIMETRY DESCRIPTION

In order to characterize the HSST facility in advance of the actual metallurgical specimen irradiations, two mock-up capsules were built. One capsule, known as the prototype, is a replica of the real 4T-CT metallurgical capsules complete with gas flow, heaters, and thermocouples. Its purpose is to measure the thermal characteristics of the facility and capsule design. A second capsule, known as the simulator, is a less elaborate replica designed to accurately position various kinds of dosimeters. Figure 2 is an exploded view of the simulator showing the various parts and dosimeter locations. From the standpoint of neutronics, the primary difference between the simulator and the metallurgical capsules is the use of stainless steel rather than carbon steel in its construction. The 4T-CT metallurgical capsules contain two compact tension metallurgical specimens. The specimens are approximately 25.4 cm square and 10.2 cm thick and have a notch cut through the center. The notch tip location is of primary interest to the metallurgist, so most of the emphasis in the simulator experiments has been concentrated in these areas.

The dosimeters used with the simulator are identical to those planned for use in the metallurgical experiments. High-purity iron wire, 0.25 mm in diameter, is enclosed in 1-mm-OD stainless steel tubing and inserted into slots machined for this purpose. After irradiation, the wire is recovered and cut into segments and then analyzed by high-resolution gamma-ray spectroscopy. The resulting data, when plotted, reveal gradients in the X, Y, and Z directions, hence, the name gradient wire. Compact sets of dosimeters will also be used to study the neutron spectra at various locations. These sets contain an assortment of fission and non-fission detectors with different threshold energies. Figure A.1 in Appendix A illustrates a typical Fission/Radiometric Dosimeter Set (FRDS). FRDS monitors will also be analyzed by high-resolution gamma-ray spectroscopy after irradiation. A complete description of each FRDS and its location in the simulator are given in Tables A.1 through A.14.

SIMULATOR EXPERIMENTS

Initial experiments with the prototype indicated that the thermal characteristics of the facility and capsule design were acceptable, so the go ahead was given to begin the neutron characterization experiments. The first irradiation experiment with the simulator was made with the prototype on the south side and the simulator on the north side of the facility (Run No. 1). A second run was made immediately after the first with the simulator and prototype reversed (Run No. 2). For both Run No. 1 and Run No. 2, the water gap between the aluminum window and the thermal shield addition was approximately 2.5 cm, and the ORR core was configured with five fuel elements in the row next to the aluminum window. Preliminary results from these two experiments revealed that the fluence rate at the



A. Slot for Gradient Wires (0.160 x 0.160 x 58.10)
B. Slot for Gradient Wires (0.160 x 0.160 x 26.98)
C. Slot for Gradient Wires (0.160 x 0.160 x 11.07)
D. Hole for Fission/Radiometric Dosimeter Sets (3.15 x 0.61 diam)

a. Front Plate (0.41 x 26.98 x 58.10, 6061-T6 Al)
b. Front Heater Plate Simulator (0.91 x 26.98 x 58.10, 304L SS)
c. 4T-CT Simulator (10.16 x 26.98 x 58.10, 304L SS)
d. Rear Heater Plate Simulator (0.91 x 26.98 x 58.10, 304L SS)
e. Rear Plate (0.41 x 26.98 x 58.10, 6061-T6 Al)
f. Side Plates (0.95 x 13.44 x 58.10, 6061-T6 Al)
g. Flux Monitor Holder Plug (11.07 x 3.78 diam, 304L SS)
h. Plug End Cap (0.41 x 3.78 diam, 6061-T6 Al)

All Dimensions in cm.

Fig. 2. ORR HSST Simulator.

notch tip location was below what had been anticipated, so two adjustments were made to increase the fluence rate. First, the core was reconfigured to have seven fuel elements adjacent to the experiment, and second, the water gap next to the aluminum window was reduced to approximately 1 cm. Several measurements were made to determine the new water-gap thickness. Measurements were made in pairs 2 cm to the north and south of the core centerline at several elevations. The results are summarized in Table 1.

Table 1. Aluminum Window to Thermal Shield Water Gap Measurements

Elevation relative to fuel centerline (mm)		Meas. 1[a] (mm)	Meas. 2[a] (mm)
241.3	north	11.56	11.52
241.3	south	11.50	12.10[b]
31.8	north		11.56
31.8	south		11.32
0.0	north	11.14	
0.0	south	11.30	
-196.9	north		12.58
-196.9	south		12.72
-254.0	north	13.24	
-254.0	south	13.10	

[a]Estimated uncertainty (+0.5 mm, -1.0 mm).

[b]Unreliable measurement.

The measurements indicate a slight 1- to 2-mm tilt in the thermal shield addition from top to bottom and an average water gap of approximately 12 mm. A third irradiation experiment (Run No. 3) was then made with the simulator and prototype positioned as they were in Run No. 1, but with the reduced water gap.

Irradiation data for the three runs are gathered in Appendix B. Tables B.1 through B.3 give power vs. time and control-rod position data, and Figs. B.1 through B.3 show the core loadings for Runs Nos. 1, 2, and 3. In the tables, two power levels are reported, instrument power and heat power. The heat power level is probably the more accurate, because it is based on actual core inlet and outlet temperature readings. The control-rod position quoted is for "ganged" rods in the B and D rows of the core;

rods in the F row are fully withdrawn. The control rods are made of a 77.5-cm cadmium section followed by a 5.72-cm water section followed by a 60.0-cm fuel section. The fuel follower section is the same length as a normal fuel element, and in the fully withdrawn position of 74.9 cm, it matches the top and bottom of the core. Referring to the core loadings, fuel elements with identifications starting with T are made with highly enriched uranium oxide (93 w/o). Fuel elements with identifications starting with CLE and NLE are experimental fuel elements made with low-enriched uranium oxide (20 w/o). Elements with identifications starting with BSI, CSI, and NSI are also experimental fuel elements made with low-enriched uranium silicide (20 w/o). Core positions marked with Be are solid beryllium, and those marked Al are solid aluminum. The remaining core positions are filled with various experiments or special isotope-production elements.

RESULTS

Gradient wires and FRDS capsules were recovered after each irradiation experiment and stored temporarily to allow short-lived isotopes time to decay. The most important monitors from each run were then counted and the reaction rates determined. Tables C.1, C.2, and C.3 in Appendix C give a complete listing of experimental results from each run. Referring to the tables, the first column gives the monitor identification, the second column gives the reaction of interest, the next three columns give the X-Y-Z coordinates of the monitor relative to the coordinate system of Fig. 1, the sixth column gives the measured activity at the end of irradiation, and the last column gives the saturated activity at 30 MW. The monitor identifications for gradient wires are of the form A-B-C, where A specifies the run number, B specifies the wire position (see Fig. C.1), and C indicates the particular segment of wire analyzed. For FRDS monitors, the identifications are of the form A-BCD, where A again specifies the run number, B is the FRDS number, C indicates the target element, and D is either T or B to indicate whether the monitor is from the top or bottom of the capsule. For Np, U, and Cu monitors, D is omitted, since no ambiguity exists.

Gradient wires oriented parallel to the X axis were cut into 2.54-cm segments for analysis and the results evaluated with a linear least squares cosine fitting algorithm. Only wires from the front location (MW1) were successfully fitted to cosine curves. Parameters for these fits are given in Table 2. Note that when the wires from Runs Nos. 1 and 2 were fitted separately, erroneous results were obtained due to the lack of any data on one side of the peak. This is obvious when one looks at the X_0 values, which show the peak value to be 6.1 cm to the south for Run No. 1 and 5.38 cm to the north for Run No. 2. When the two sets of data are evaluated simultaneously, the correct parameters are obtained and the X_0 value is near 0 cm, as it should be for a symmetrical distribution.

Table 2. Cosine Fits of Experimental Data for Gradient Wires Oriented Parallel to the X Axis

Run No.	Wire	Y (cm)	Z (cm)	A cos $B_x(X-X_o)$ A (Bq/atom @ 30 MW)	B_x (cm^{-1})	X_o (cm)	σ (%)	No. Exp. Data
1	MW1	14.47	-7.70	3.21 -13*	3.99-2	6.10	1.66	9
2	MW1	14.47	-7.70	3.24 -13	4.21-2	-5.38	2.27	9
1&2	MW1	14.47	-7.70	2.97 -13	5.04-2	-0.17	3.29	18
3	MW1	13.17	-7.70	3.97 -13	4.40-2	0.34	0.90	9

*Read as 3.21 x 10^{-13}, etc.

Fortunately, the problem of extrapolating past the peak was not encountered when evaluating data for Run No. 3. The values of σ indicate that all of the fits agree well with the experimental data. Here σ is defined as:

$$\sigma \equiv \sqrt{\frac{\sum_{i=1}^{N}\left[(M_i-C_i)/M_i\right]^2}{N-1}} \times 100 \quad , \tag{1}$$

where M_i = measured ^{54}Mn activities,
C_i = calculated data from fit parameters, and
N = number of experimental data.

It can be seen from the peak values, A, that the magnitude of the ^{54}Mn activity has increased from Runs Nos. 1 and 2 to Run No. 3 by 33% at X = 0 cm. This is primarily due to the decreased water gap between the core and the thermal shield addition. The difference becomes even larger as one moves away from the centerline due to the difference in buckling, B_x. Figure 3 shows a comparison between the experimental data and the last two fits in Table 2. The curves and experimental data are normalized to the appropriate peak value, A, to better illustrate the difference in buckling in the X direction. This difference in buckling is due, no doubt, to the addition of two fuel elements in the first row of the core.

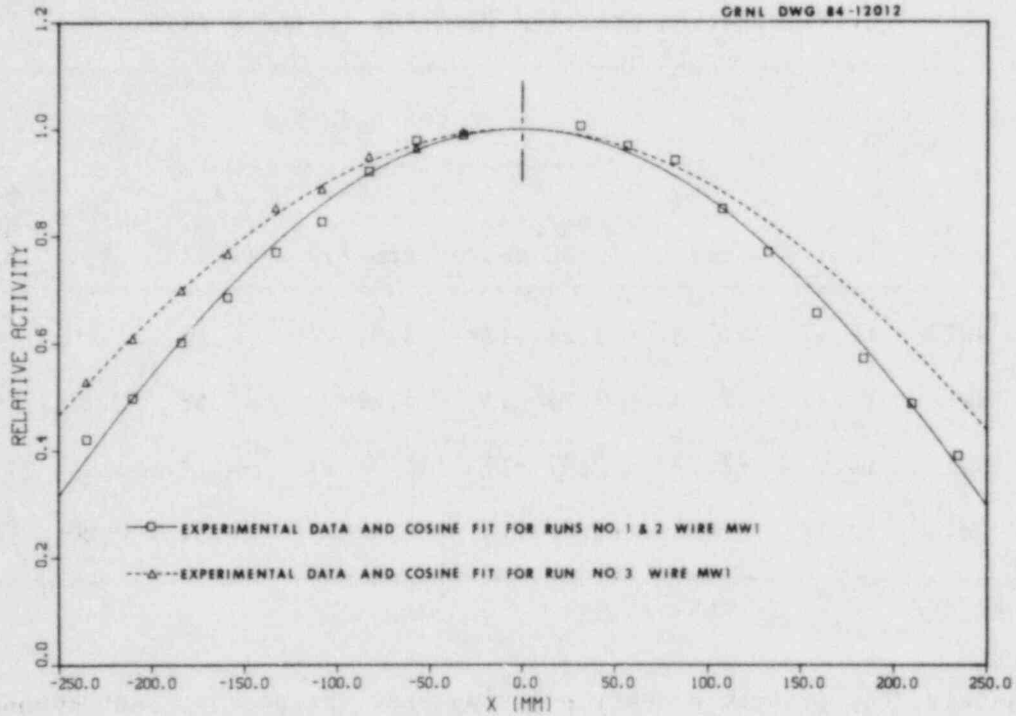


Fig. 3. Comparison of Data from Gradient Wires Oriented Parallel to the X Axis for Runs Nos. 1, 2, and 3.

Gradient wires oriented parallel to the Z axis were evaluated in the same manner as the MW1 gradient wires. The parameters obtained from the cosine fits of this data are listed in Table 3. It can be seen from Table 3 that the axial buckling, B_z, is almost constant for Runs Nos. 1, 2, and 3; however, the Z_0 values vary considerably from run to run. The probable explanation for this is the control-rod positioning for the three runs. For Run No. 1, the control-rod positions ranged from 51.36 to 62.33 cm withdrawn; for Run No. 2, from 56.52 to 74.93 cm withdrawn; and for Run No. 3, from 40.67 to 42.88 cm withdrawn. Fig. 4 illustrates typical sets of data and the associated cosine fits from Runs Nos. 1 and 3. Both sets of data have been normalized by the appropriate peak value, A, from Table 3. It is seen here that the experimental data from Run No. 1 agrees much better with the cosine fit than the data from Run No. 3. This is also demonstrated by the much lower values of σ in Table 3 for Run No. 1. Since the axial distributions were significantly different between Run No. 1 and Run No. 3, it will not be possible to compare data from one run to the other without considerable care. Comparisons made above $Z \sim 0$ cm will indicate too low a value for Run No. 3 data, while comparisons made below $Z \sim 0$ cm will indicate too high a value for Run No. 3 data. This is due primarily to the fact that Run No. 3 represents only the first 3 1/2 days of the fuel cycle, while Runs Nos. 1 and 2 represent the mid- and end-of-cycle distributions.

Table 3. Cosine Fits of Experimental Data for Gradient Wires Oriented Parallel to the Z Axis

Run No.	Wire	X (cm)	Y (cm)	A (Bq/atom @ 30 MW)	B_z (cm^{-1})	Z_o (cm)	σ (%)	No. Exp. Data
				A cos $B_z(Z-Z_o)$				
1	LW1	- 6.51	14.39	3.20 -13*	4.01-2	0.30	0.81	11
1	LW2	-14.76	14.39	2.46 -13	3.99-2	0.38	0.78	21
1	LW3	-23.02	14.39	1.46 -13	3.99-2	0.57	1.13	11
1	LW4	- 2.94	24.63	5.26 -14	4.03-2	-0.31	0.32	4
1	LW6	-18.89	24.63	2.63 -14	4.04-2	-0.47	1.05	5
1	LW7	-26.59	24.63	1.67 -14	3.98-2	0.20	0.82	5
2	LW2	14.76	14.39	2.41 -13	3.94-2	0.99	1.09	8
3	LW1	- 6.51	13.09	3.83 -13	4.11-2	-5.13	5.54	12
3	LW2	-14.76	13.09	3.19 -13	4.07-2	-5.00	4.15	21
3	LW3	-23.02	13.09	2.13 -13	4.04-2	-3.95	4.05	11
3	LW4	- 2.94	23.33	6.27 -14	3.94-2	-4.44	4.13	11
3	LW5	-10.64	23.33	4.51 -14	4.00-2	-4.63	3.59	11
3	LW6	-18.89	23.33	3.52 -14	4.04-2	-4.37	2.76	11
3	LW7	-26.59	23.33	2.36 -14	4.05-2	-3.40	2.45	11
3	MT1	-29.85	11.77	1.53 -13	3.93-2	-4.97	4.21	11
3	MT2	0.0	11.77	4.79 -13	4.08-2	-6.67	6.05	11
3	MT3	29.85	11.77	1.55 -13	3.92-2	-5.43	5.18	11

*Read as 3.20×10^{-13}, etc.

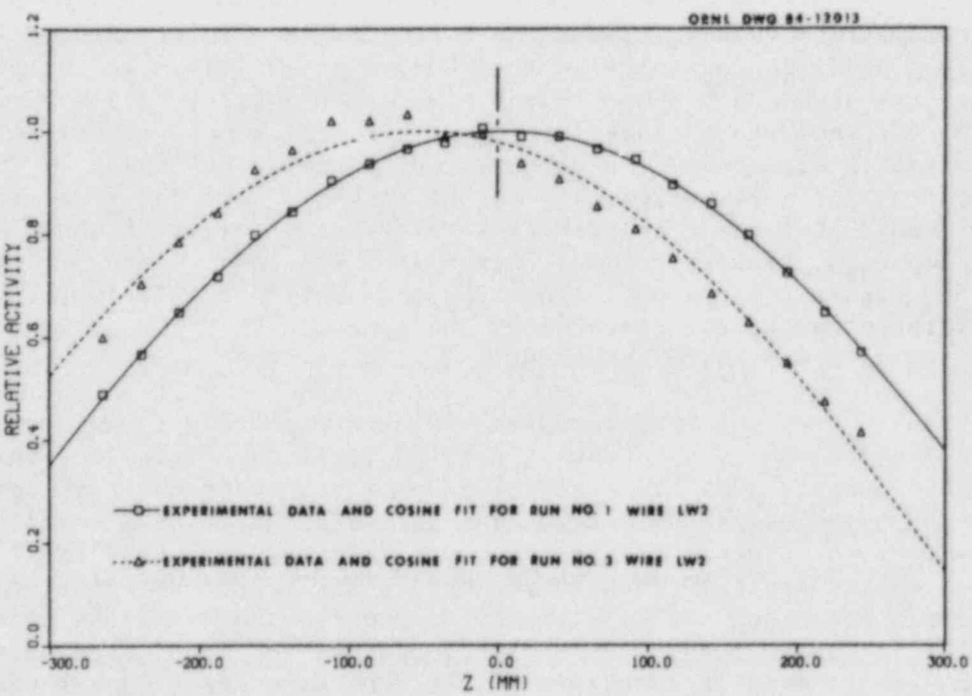


Fig. 4. Comparison of Data from Gradient Wires Oriented Parallel to the Z Axis for Runs Nos. 1 and 3.

The remaining gradient wires were oriented parallel to the Y axis and extend from the front to the back of the simulator capsule. These wires were cut into 1.27-cm segments and evaluated with a linear least squares exponential fitting algorithm. The results of these fits are given in Table 4 for wires from Runs Nos. 1 and 3. At first glance, it might appear

Table 4. Exponential Fits of Experimental Data for Gradient Wires Oriented Parallel to the Y Axis

Run No.	Wire	X (cm)	Z (cm)	A exp(λY): A (Bq/atom @ 30 MW)	A exp(λY): λ (cm^{-1})	σ (%)	No. Exp. Data
1[a]	SW06	-16.588	7.554	3.47-12*	-0.197	2.08	7
1	SW11	-12.937	-3.815	4.57-12	-0.197	0.98	7
1	SW17	-12.937	-15.187	4.13-12	-0.201	0.74	7
3[b]	SW11	-12.937	-3.815	4.72-12	-0.199	1.14	7

[a]For Runs No. 1 and 2 valid values for Y are 13.48 cm $\leq$ Y $\leq$ 25.47 cm.
[b]For Run No. 3 valid values for Y are 12.18 cm $\leq$ Y $\leq$ 24.17 cm.
*Read as 3.47 x 10^{-12}, etc.

that the maximum values, A, for the SW11 wires are in error because there is only a 3% difference between Runs Nos. 1 and 3. This is not the case, however, because the maximum values are extrapolations to Y = 0 cm. Indeed, one would have cause for concern if the values were not close to each other in magnitude. This brings out an important point -- the X and Z coordinates for a given location on the simulator are the same for Runs Nos. 1 and 3, but the Y coordinate is different. Figure 5 shows an absolute comparison between the SW11 wires from Runs Nos. 1 and 3. It is seen from the figure and the table that the attenuation coefficients, λ, for the different wires are essentially the same and that the fits are in excellent agreement with the experimental data.

Results from the FRDS capsules are used primarily to uncover details of the neutron energy spectrum at a given location. This is accomplished through a process known as spectral adjustment, where one combines calculated and experimental data to derive parameters such as fluence greater than 1.0 MeV or fluence greater than 0.1 MeV. For the results of this process with respect to these experiments, the reader is referred to Ref. 2; here, only checks of the consistency of the FRDS data will be presented. The fits in Tables 3 and 4 were used to calculate the ^{54}Mn saturated activity at the Fe monitor locations in the FRDS capsules. When these values were compared with the actual measured ^{54}Mn activities, the agreement was found to be ±2% or better, thus demonstrating consistency between the FRDS and gradient wire results at least for the Fe data. Ratios of one activity to another for each capsule were then computed using the Fe data as

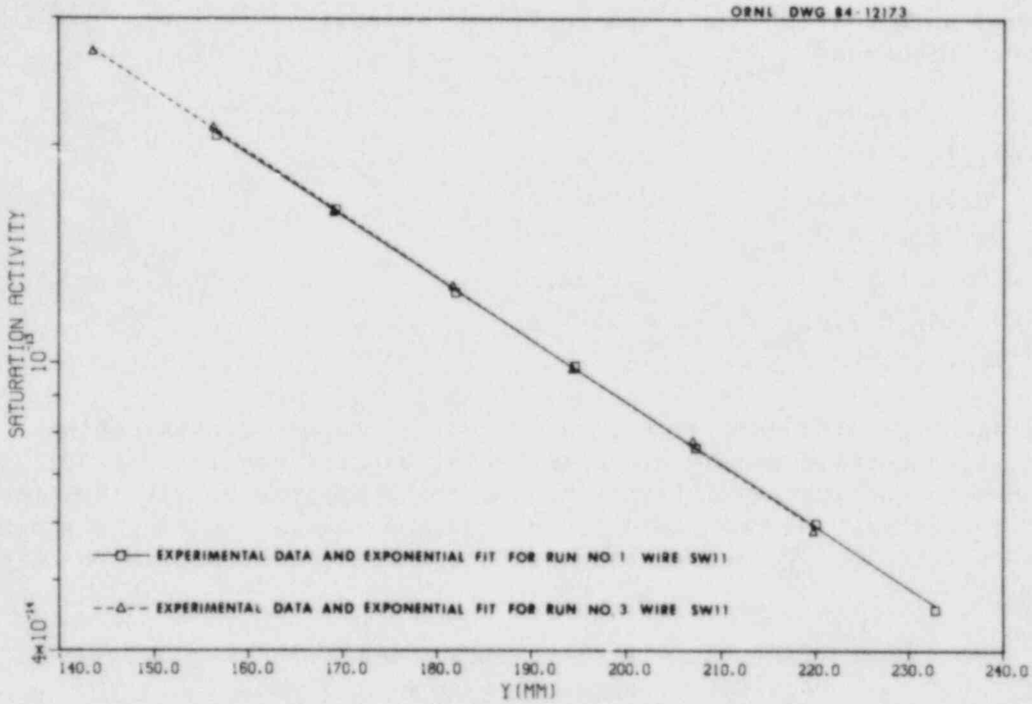


Fig. 5. Comparison of Data from Gradient Wires Oriented Parallel to the Y Axis for Runs Nos. 1 and 3.

the reference activity. This effectively removes any bias associated with the magnitude of the fluence and isolates spectral effects so that data from one capsule can be directly compared to another. These results are shown in Table 5. The ratios in the table have been ordered left to right according to the threshold energy of the reaction in the numerator.

Table 5. Activity Ratios for FRDS Monitors from Runs Nos. 1, 2, and 3

Run No.	FRDS No.	X (cm)	Y (cm)	Z (cm)	Cu/Fe	Ti/Fe	Fe/Fe	Ni/Fe	U/Fe	Np/Fe	Co/Fe
1	106	-14.76	14.86	7.54	6.15-3*	0.128	1.0	1.38	6.34	59.2	380.3
1	108	-14.76	23.89	7.54	5.94-3	0.121	1.0	1.40	7.12	105.2	619.2
1	109	-14.76	14.86	-15.20	5.96-3	0.127	1.0	1.34	6.17	61.7	
1	111	-14.76	23.89	-15.20	5.01-3	0.125	1.0	1.43	7.22	112.5	635.8
2	115	14.76	14.86	-15.20	6.04-3	0.127	1.0	1.37	6.04	64.8	
3	119	-14.76	13.56	-3.83	5.87-3	0.126	1.0	1.40	6.22	72.7	395.1
3	118	-14.76	22.59	-3.83	5.72-3	0.118	1.0	1.40	7.90	118.1	644.0

*Read as 6.15 x 10^{-3}, etc.

The threshold energies have the following approximate values for an MTR-type spectrum[3]:

$^{63}Cu(n,\alpha)^{60}Co$	6.7 MeV,
$^{46}Ti(n,p)^{46}Sc$	4.4 MeV,
$^{54}Fe(n,p)^{54}Mn$	2.9 MeV,
$^{58}Ni(n,p)^{58}Co$	2.7 MeV,
$^{238}U(n,f)F.P.$	1.5 MeV,
$^{237}Np(n,f)F.P.$	0.58 MeV,
$^{59}Co(n,\gamma)^{60}Co$	132 eV.

It is seen that the data at a given Y coordinate are consistent with each other, if a certain amount of experimental uncertainty is allowed. To obtain some qualitative information about the spectral shift from the front to the back of the capsule, one can compute ratios of the ratios as shown in Table 6. These results indicate a small decrease in the high-

Table 6. Front-to-Back Compar ıon of Activity Ratios for Runs Nos. ı and 3

Run No.	FRDS ratio	Cu/Fe	Ti/Fe	Fe/Fe	Ni/Fe	U/Fe	Np/Fe	Co/Fe
1	106/108	1.03	1.06	1.0	0.98	0.89	0.56	0.61
1	109/111	0.99	1.02	1.0	0.94	0.85	0.55	
3	119/118	1.03	1.07	1.0	1.00	0.79	0.61	0.61

energy part of the spectrum above ~2 MeV and a larger increase in the intermediate- and low-energy end of the spectrum as one moves from the front to the back of the capsule.

UNCERTAINTIES

The uncertainty in the activities at end of irradiation (EOI) and the derived saturation activities arises from several sources. For the activities at EOI listed in Appendix C, excluding gradient wires from the MT1, MT2, and MT3 locations, there are three primary sources of uncertainty. The largest of these is an overall counting uncertainty which takes into account absolute detector calibration, source-to-detector geometric perturbations, correction for decay while counting, and correction of the measured activity to EOI. This uncertainty has been assessed by the Analytical Chemistry Division and is quoted as ±5%. The determination of the monitor mass also has an associated uncertainty and is conservatively estimated to be ±1%. The third uncertainty is due primarily to the water gap between the ORR aluminum window and the thermal shield addition and will be referred to here as a position uncertainty. The uncertainty in this water gap was shown to be on the order of ±1 mm which would translate to approximately ±2% in the measured activities. For the saturation activities, additional uncertainties due to the power vs. time history and nuclear data must be taken into account. A list of the uncertainties considered is given below. Combining the appropriate uncertainties by taking

Overall counting uncertainty	±5%
Target mass	±1%
Position uncertainty	±2%
Reactor power level	±3%
Irradiation time	negligible
Target atomic weight	negligible
Target impurities	negligible
Target isotopic abundance	negligible
Target alloy weight percent (Co/Al only)	±2%
Product half-life	negligible
Product fission yield (Np and U only)	±4%

the square root of the sum of the squares, one arrives at the following overall uncertainties for monitors in the simulator block.

Activities at EOI	±5.5%
Saturation activities for Fe, Ni, Ti, and Cu monitors	±6.2%
Saturation activities for Co/Al monitors	±6.6%
Saturation activities for Np and U monitors	±7.4%

For the gradient wires in the MT1, MT2, and MT3 locations, an additional uncertainty of ±5% must be included due to the crude method of positioning the monitors. This yields overall uncertainties for these monitors of ±7.5% and ±8.0% for activities at EOI and saturation activities, respectively.

CONCLUSIONS

Three experiments were planned and carried out at the ORR-PSF to characterize the neutronic environment of the HSST facility as-built. Two initial experiments performed on the north and south sides of the facility showed the ^{54}Mn saturation activity distribution to be symmetrical about the Y-Z plane, but the fluence rates estimated from the saturated activities were deemed too low and would necessitate unacceptably long irradiation times. To improve the situation, changes were made in the core loading and in the experiment geometry. Adding two fuel elements to the core face next to the experiment decreased the horizontal buckling, B_x, for ^{54}Mn from 5.04×10^{-2} cm^{-1} to 4.40×10^{-2} cm^{-1} which has the effect of increasing the saturation activities at the metallurgical specimen crack tip locations by approximately 15%. Moving the entire HSST facility 13 mm closer to the core reduced the attenuation of the fast neutrons and resulted in a uniform increase of the ^{54}Mn saturation activities by 25%. Overall, the ^{54}Mn saturation activities increased by approximately 40% at the crack tip locations for the third experiment. Results of all three experiments reveal the axial buckling, B_z, to be almost constant at 4.00 x 10^{-2} cm^{-1} for ^{54}Mn; however, the axial offset, Z_o, is strongly dependent on the position of the "ganged" control rods. Attenuation through the simulator block itself was found to be exponential for ^{54}Mn with an attenuation coefficient of 0.199 cm^{-1}. Results from the FRDS capsules were found to be consistent with the gradient wire results for ^{54}Mn, and the other reactions were shown to be consistent within uncertainty bounds. Data contained in this report should be adequate to provide a basis for spectral unfolding techniques used to derive the neutron damage exposure parameters fluence rate greater than 1 MeV, fluence rate greater than 0.1 MeV, and dpa.

REFERENCES

1. G. D. Whitman and R. H. Bryan, Heavy Section Steel Technology Program Quarterly Progress Report for January-March 1981, NUREG/CR-2141/VI, ORNL/TM-7822, U.S. Nuclear Regulatory Commission, Washington, DC, June 1981.

2. F. W. Stallmann and Igor Remec, Neutron Spectral Characterization for the Fifth Heavy Section Steel Technology (HSST) Irradiation Series, "Neutronic Calculations," (to be published).

3. W. L. Zijp and J. H. Baard, Nuclear Data Guide for Reactor Neutron Metrology, Parts I and II, EUR 7167, Inergieonderzoek Centrum Nederland, Petten, Netherlands, August 1979.

APPENDIX A

DESCRIPTION OF FISSION/RADIOMETRIC DOSIMETER SETS

ORNL DWG. 83-16449R1

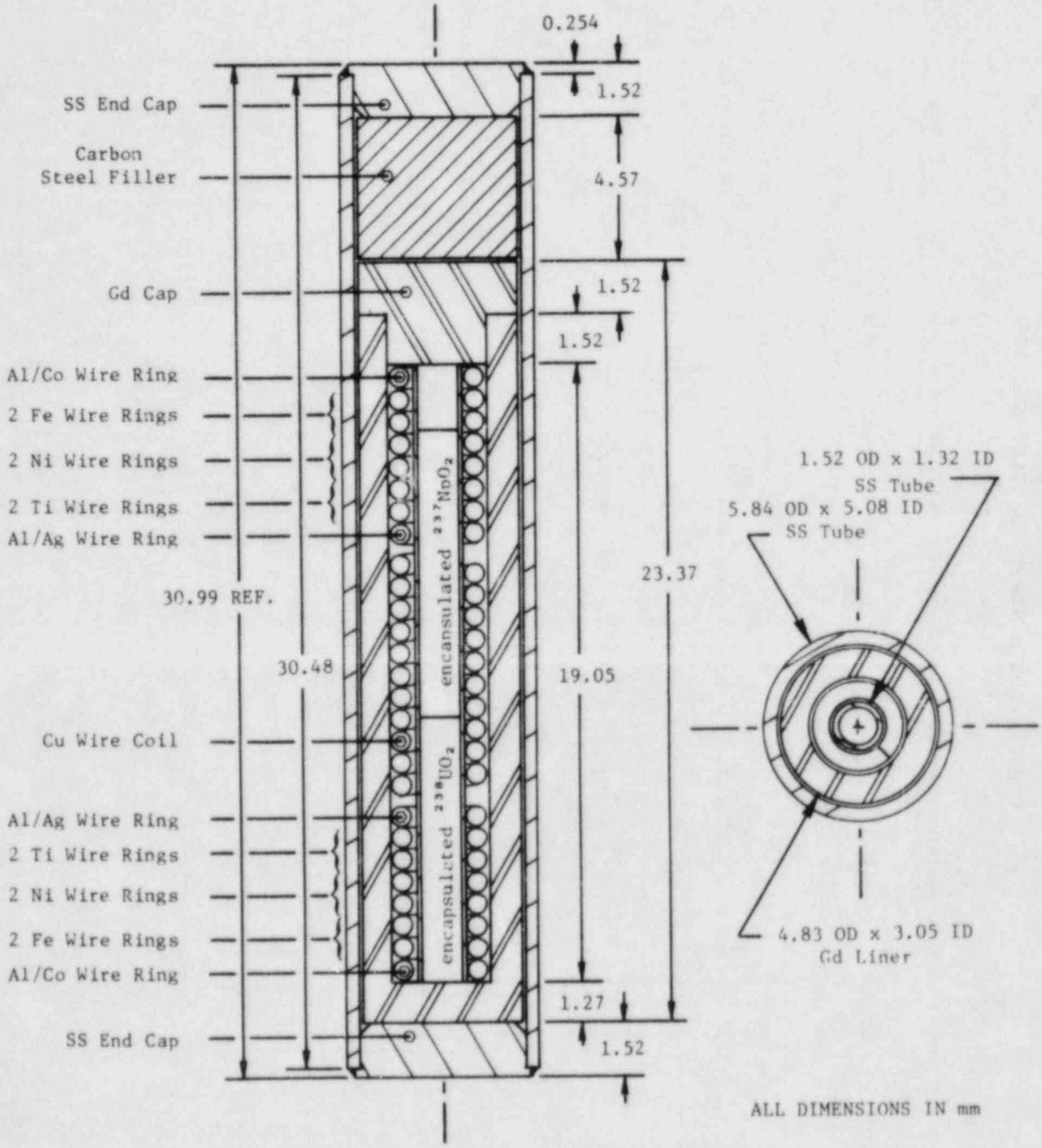


Fig. A.1. Typical Fission/Radiometric Dosimeter Set.

Table A.1. Data Sheet for FRDS No. 106

TEST K_{Ic} HSST Neutron Spectral Characterization Experiments, Run No. 1, North Side   Page 1 of 14

LOCATION K_{Ic} HSST Simulator Hole 3, Slot 1 (Front)

CONTAINER IDENTIFICATION T83-106   SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd   LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.25 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	211.3	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.25 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.815	V	1.27 mm	.79 mm	8.76 mm	#72	
					^{237}Np 6.904						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 9.119	V	1.27 mm	.79 mm	8.00 mm	#22	
					^{238}U 8.040						

Table A.2. Data Sheet for FRDS No. 107

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 1, North Side — Page 2 of 14

LOCATION K_{IC} HSST Simulator Hole 3, Slot 2 (Middle)

CONTAINER IDENTIFICATION 83-107T — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.25 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	211.3	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.25 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.990	V	1.27 mm	.79 mm	8.76 mm	#71	
					^{237}Np 7.058						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.823	V	1.27 mm	.79 mm	8.00 mm	#21	
					^{238}U 7.779						

Table A.3. Data Sheet for FRDS No. 108

TEST: K_{Ic} HSST Neutron Spectral Characterization Experiments, Run No. 1, North Side — Page 3 of 14

LOCATION: K_{Ic} HSST Simulator Hole 3, Slot 3 (Back)

CONTAINER IDENTIFICATION: 83-108T — SET IDENTIFICATION: ORNL-V3

LINER MATERIAL: Gd — LINER DIMENSIONS: 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description: In	Outside diam	Inside diam	Length	Ident.	Comments
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	205.1	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.897	V	1.27 mm	.79 mm	8.76 mm	#70	
					^{237}Np 6.976						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.538	V	1.27 mm	.79 mm	8.00 mm	#20	
					^{238}U 7.528						

Table A.4. Data Sheet for FRDS No. 109

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 1, North Side — Page 4 of 14

LOCATION K_{IC} HSST Simulator Hole 9, Slot 1 (Front)

CONTAINER IDENTIFICATION T83-109 — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	207.8	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 8.315	V	1.27 mm	.79 mm	8.76 mm	#69	
					^{237}Np 7.345						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.289	V	1.27 mm	.79 mm	8.00 mm	#19	
					^{238}U 7.308						

Table A.5. Data Sheet for FRDS No. 110

TEST K_{Ic} HSST Neutron Spectral Characterization Experiments, Run No. 1, North Side — Page 5 of 14

LOCATION K_{Ic} HSST Simulator Hole 9, Slot 2 (Middle)

CONTAINER IDENTIFICATION T83-110 — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description: In	Outside diam	Inside diam	Length	Ident.	Comments
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	213.2	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 8.227	V	1.27 mm	.79 mm	8.7[illegible] mm	#68	
					^{237}Np 7.268						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.844	V	1.27 mm	.79 mm	8.00 mm	#18	
					^{238}U 7.798						

Table A.6. Data Sheet for FRDS No. 111

TEST K_{1C} HSST Neutron Spectral Characterization Experiments, Run No. 1, North Side — Page 6 of 14

LOCATION K_{1C} HSST Simulator Hole 9, Slot 3 (Back)

CONTAINER IDENTIFICATION 83-111T — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				T	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	212.6	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 8.433	V	1.27 mm	.79 mm	8.76 mm	#67	
					^{237}Np 7.450						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 9.117	V	1.27 mm	.79 mm	8.00 mm	#17	
					^{238}U 8.038						

Table A.7. Data Sheet for FRDS No. 112

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 2, South Side — Page 7 of 14

LOCATION K_{IC} HSST Simulator Hole 3, Slot 1 (Front)

CONTAINER IDENTIFICATION T83-112 — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description: In	Outside diam	Inside diam	Length	Ident.	Comments
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	212.0	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.85 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.73 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.338	V	1.27 mm	.79 mm	8.76 mm	#66	
					^{237}Np 6.482						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 9.428	V	1.27 mm	.79 mm	8.00 mm	#16	
					^{238}U 8.313						

Table A.8. Data Sheet for FRDS No. 113

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 2, South Side

LOCATION K_{IC} HSST Simulator Hole 3, Slot 2 (Middle)

CONTAINER IDENTIFICATION 83-113T SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	213.9	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.120	V	1.27 mm	.79 mm	8.76 mm	#65	
					^{237}Np 6.290						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 9.515	V	1.27 mm	.79 mm	8.00 mm	#15	
					^{238}U 8.389						

Table A.9. Data Sheet for FRDS No. 114

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 2, South Side   Page 9 of 14

LOCATION K_{IC} HSST Simulator Hole 3, Slot 3 (Back)

CONTAINER IDENTIFICATION 83-114T   SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd   LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description: In	Outside diam	Inside diam	Length	Ident.	Comments
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				T	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25685	.508 mm diam wire, 2.79 mm OD coil	211.9	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.337	V	1.27 mm	.79 mm	8.76 mm	#64	
					^{237}Np 6.481						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 9.213	V	1.27 mm	.79 mm	8.00 mm	#14	
					^{238}U 8.123						

Table A.10. Data Sheet for FRDS No. 115

TEST: K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 2, South Side — Page 10 of 14

LOCATION: K_{IC} HSST Simulator Hole 9, Slot 1 (Front)

CONTAINER IDENTIFICATION: 83-115T — SET IDENTIFICATION: ORNL-V3

LINER MATERIAL: Gd — LINER DIMENSIONS: 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	209.2	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.262	V	1.27 mm	.79 mm	8.76 mm	#63	
					^{237}Np 6.415						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.933	V	1.27 mm	.79 mm	8.00 mm	#13	
					^{238}U 7.876						

Table A.11. Data Sheet for FRDS No. 116

TEST K_{IC} HSST Neutron Spectral Characterization Experiment, Run No. 2, South Side

LOCATION K_{IC} HSST Simulator Hole 9, Slot 2 (Middle)

CONTAINER IDENTIFICATION 83-116T SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				T	[illegible]ings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	205.8	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.694	V	1.27 mm	.79 mm	8.76 mm	#62	
					^{237}Np 6.797						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 9.338	V	1.27 mm	.79 mm	8.00 mm	#12	
					^{238}U 8.233						

Table A.12. Data Sheet for FRDS No. 117

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 2, South Side — Page 12 of 14

LOCATION K_{IC} HSST Simulator Hole 9, Slot 3 (Back)

CONTAINER IDENTIFICATION T83-117 — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	214.1	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.575	V	1.27 mm	.79 mm	8.76 mm	#61	
					^{237}Np 6.692						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.978	V	1.27 mm	.79 mm	8.00 mm	#11	
					^{238}U 7.916						

Table A.13. Data Sheet for FRDS No. 118

TEST K_{Ic} HSST Neutron Spectral Characterization Experiments, Run No. 3, North Side Page 13 of 14

LOCATION K_{Ic} HSST Simulator Hole 6, Slot 3 (Back)

CONTAINER IDENTIFICATION 83-118T SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	214.9	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.286	V	1.27 mm	.79 mm	8.76 mm	#60	
					^{237}Np 6.436						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.283	V	1.27 mm	.79 mm	8.00 mm	#10	
					^{238}U 7.303						

Table A.14. Data Sheet for FRDS No. 119

TEST K_{IC} HSST Neutron Spectral Characterization Experiments, Run No. 3, North Side — Page 14 of 14

LOCATION $K_{I}C$ HSST Simulator Hole 6, Slot 1 (Front)

CONTAINER IDENTIFICATION 83-119T — SET IDENTIFICATION ORNL-V3

LINER MATERIAL Gd — LINER DIMENSIONS 0.48 cm OD x 0.30 cm ID x 2.34 cm

Material	Purchase order number	Supplier	Batch number	Description	Material mass (mg)	Encapsulated monitor description					Comments
						In	Outside diam	Inside diam	Length	Ident.	
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01	NA				T	1 ring
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				T	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				T	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				T	2 rings
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				T	2 rings
Cu		MRC	29/25689	.508 mm diam wire, 2.79 mm OD coil	218.1	NA					
0.173 wt% Ag/Al		Rx. Exp.	620	.508 mm diam wire, 2.79 mm OD ring	3.67 ± .02 ea.	NA				B	2 rings
Ti		MRC	22/2777	.508 mm diam wire, 2.79 mm OD ring	7.15 ± .05 ea.	NA				B	2 rings
Ni		MRC	28/1779	.508 mm diam wire, 2.79 mm OD ring	12.70 ± .1 ea.	NA				B	2 rings
Fe		MRC	26/7392	.508 mm diam wire, 2.79 mm OD ring	10.95 ± .05 ea.	NA				B	2 rings
0.100 wt% Co/Al		Sig. Cohn	Bar 16	.508 mm diam wire, 2.79 mm OD ring	3.71 ± .01 ea.	NA				B	2 rings
$^{237}NpO_2$	36-0516-B	ORNL	83-1	.457 mm diam oxide wire	NpO_2 7.618	V	1.27 mm	.79 mm	8.76 mm	#59	
					^{237}Np 6.730						
$^{238}UO_2$	36-0516-A	ORNL	82-D-238	.457 mm diam oxide wire	UO_2 8.937	V	1.27 mm	.79 mm	8.00 mm	#9	
					^{238}U 7.880						

APPENDIX B

IRRADIATION DATA

ORR CORE

Cycle 165-F

Start October 13, 1983

End October 27, 1983

Core location —>	A-3
Element identification —>	T-365
Initial ^{235}U mass (g) —>	285
^{235}U mass (g) at start of cycle —>	221

POOL
W

S

A-1 Be	A-2 Be	A-3 T-382 285 220	A-4 T-405 285 266	A-5 T-414 285 285	A-6 T-417 285 285	A-7 T-369 285 220	A-8 Be	A-9 Be
B-1 Be	B-2 CLE-202 336 239	B-3 CLE-203 326 140	B-4* U-021 167 50	B-5 T-376 285 201	B-6* U-022 167 52	B-7 T-304 285 176	B-8 Be	B-9 NLE-201 340 265
C-1 Be	C-2 T-415 285 285	C-3 IR	C-4 T-216 265 155	C-5 IR	C-6 T-221 265 154	C-7 IR	C-8 T-416 285 285	C-9 Be
D-1 Be	D-2 T-372 285 214	D-3 T-380 285 217	D-4* U-028 167 109	D-5 T-409 285 266	D-6* U-029 167 108	D-7 T-400 285 242	D-8 T-383 285 218	D-9 Be
E-1 Be	E-2 T-363 285 217	E-3 MFE 4A	E-4 T-390 285 226	E-5 IR	E-6 T-391 285 221	E-7 MFE 4B	E-8 T-407 285 266	E-9 Be
F-1 Be	F-2 Be	F-3 T-251 265 164	F-4* U-019 167 25	F-5 T-389 285 222	F-6* U-020 167 27	F-7 T-222 265 167	F-8 Be	F-9 TRIGA LEU
G-1 Be	G-2 Be	G-3 Be	G-4 Be	G-5 Be	G-6 Be	G-7 Be	G-8 Be	G-9 Be

N

*Control rod location.

E

Fig. B.1. Core Loading for Simulator Run No. 1.

ORR CORE

Cycle 165-G

Start October 28, 1983

End November 9, 1983

Core location —>	A-3
Element identification —>	T-365
Initial ^{235}U mass (g) —>	285
^{235}U mass (g) at start of cycle —>	221

POOL
W

	A-1 Be	A-2 Be	A-3 T-387 285 220	A-4 T-408 285 266	A-5 T-418 285 285	A-6 T-419 285 285	A-7 T-370 285 219	A-8 Be	A-9 Be	
	B-1 Be	B-2 NLE-201 340 258	B-3 CLE-203 326 130	B-4* U-021 167 46	B-5 T-358 285 203	B-6* U-022 167 48	B-7 T-337 285 180	B-8 <u>ISO</u>	B-9 CLE-202 336 222	
	C-1 Be	C-2 T-420 285 285	C-3 <u>IR</u>	C-4 CSI-202 339 148	C-5 <u>IR</u>	C-6 NSI-202 340 149	C-7 <u>IR</u>	C-8 T-421 285 285	C-9 Be	
S	D-1 Be	D-2 T-362 285 217	D-3 T-360 285 218	D-4* U-028 167 100	D-5 T-406 285 267	D-6* U-029 167 99	D-7 T-401 285 241	D-8 T-373 285 218	D-9 Be	N
	E-1 Be	E-2 T-392 285 218	E-3 MFE 4A	E-4 T-402 285 228	E-5 <u>IR</u>	E-6 T-379 285 221	E-7 MFE 4B	E-8 T-410 285 266	E-9 Be	
	F-1 Be	F-2 Be	F-3 T-271 265 172	F-4* U-019 167 22	F-5 T-374 285 222	F-6* U-020 167 24	F-7 T-321 285 171	F-8 Be	F-9 TRIGA LEU	
	G-1 Be	G-2 Be	G-3 Be	G-4 Be	G-5 Be	G-6 Be	G-7 Be	G-8 Be	G-9 Be	

*Control rod location.

E

Fig. B.2. Core Loading for Simulator Run No. 2.

ORR CORE

Cycle 167-B

Start March 2, 1984

End March 7, 1984

Core location —>	A-3
Element identification —>	T-365
Initial ^{235}U mass (g) —>	285
^{235}U mass (g) at start of cycle —>	221

POOL
W

S (left) / N (right)

A-1 Be	A-2 T-345 285 194	A-3 T-398 285 196	A-4 T-426 285 262	A-5 T-448 285 285	A-6 T-437 285 268	A-7 T-389 285 196	A-8 T-367 285 194	A-9 Be
B-1 Be	B-2 Be	B-3 BSI-201 340 207	B-4* U-026 167 94	B-5 T-321 285 154	B-6* U-027 167 94	B-7 BSI-202 340 215	B-8 Be	B-9 Be
C-1 Be	C-2 T-449 285 285	C-3 AL	C-4 T-244 265 149	C-5 T-231 265 155	C-6 T-195 265 157	C-7 AL	C-8 T-450 285 285	C-9 Be
D-1 Be	D-[illegible] T-424 285 232	D-3 T-381 285 194	D-4* U-030 167 150	D-5 T-438 285 268	D-6* U-031 167 150	D-7 T-399 285 203	D-8 T-444 285 263	D-9 Be
E-1 Be	E-2 T-397 285 195	E-3 MFE 4A	E-4 T-442 285 267	E-5 AL	E-6 T-415 285 231	E-7 MFE 4B	E-8 T-443 285 267	E-9 Be
F-1 Be	F-2 Be	F-3 T-343 285 195	F-4* U-028 167 49	F-5 T-440 285 264	F-6* U-029 167 51	F-7 T-378 285 196	F-8 Be	F-9 Be
G-1 Be	G-2 Be	G-3 Be	G-4 Be	G-5 Be	G-6 Be	G-7 Be	G-8 Be	G-9 Be

*Control rod elements.

E

Fig. B.3. Core Loading for Simulator Run No. 3.

Table B.1. Irradiation Data for Simulator Run No. 1

Date	Time	Hours	MWh inst.	MWh heat	Control[a] rod position
Oct. 17, 1983	8:00 - 12:00	16	480.0	478.60	51.36
Oct. 18, 1983	12:00 - 12:00	24	720.0	716.28	51.54
Oct. 19, 1983	12:00 - 12:00	24	720.0	712.68	52.76
Oct. 20, 1983	12:00 - 12:00	24	720.0	711.52	53.82
Oct. 21, 1983	12:00 - 12:00	24	720.0	714.28	54.94
Oct. 22, 1983	12:00 - 12:00	24	720.0	717.32	55.91
Oct. 23, 1983	12:00 - 12:00	24	720.0	715.00	57.28
Oct. 24, 1983	12:00 - 12:00	24	720.0	715.04	58.42
Oct. 25, 1983	12:00 - 12:00	24	720.0	715.76	59.72
Oct. 26, 1983	12:00 - 12:00	24	720.0	714.12	61.00
Oct. 27, 1983	12:00 - 4:00	4	120.0	117.44	62.32

[a]Centimeters withdrawn at midnight on given date for "ganged" control rods in B and D rows, control rods in F row fully withdrawn (see text, page 5).

Average Inst. Power 30 MW
Average Heat Power 29.78 MW

Core Cycle 165-F

Simulator Inserted October 17, 1983, 10:54 a.m.
Reactor Scrammed with Simulator Inserted October 27, 1983, 4:00 a.m.
Duration of Irradiation 839,160 seconds.

Table B.2. Irradiation Data for Simulator Run No. 2

Date	Time	Hours	MWh inst.	MWh heat	Control[a] rod position
Oct. 31, 1983	8:00 - 12:00	16	480.0	472.88	56.52
Nov. 1, 1983	12:00 - 12:00	24	720.0	714.12	57.86
Nov. 2, 1983	12:00 - 12:00	24	720.0	714.76	59.14
Nov. 3, 1983	12:00 - 12:00	24	720.0	717.28	60.68
Nov. 4, 1983	12:00 - 12:00	24	719.2[b]	717.54	62.00
Nov. 5, 1983	12:00 - 12:00	24	720.0	719.72	63.72
Nov. 6, 1983	12:00 - 12:00	24	720.0	718.96	66.65
Nov. 7, 1983	12:00 - 12:00	24	720.0	719.28	71.25
Nov. 8, 1983	12:00 - 12:00	24	720.0	723.08	74.93

[a]Centimeters withdrawn at midnight on given date for "ganged" control rods in B and D rows, control rods in F row fully withdrawn (see text, page 5).

[b]Set back to 19 MW, back to 30 MW in six minutes.

Average Inst. Power 30 MW
Average Heat Power 29.89 MW

Core Cycle 165-G

Simulator Inserted October 31, 1983, 9:03 a.m.
Reactor Scrammed with Experiment Inserted November 8, 1983, 12:00 midnight.
Duration of Irradiation 745,020 seconds.

Table B.3. Irradiation Data for Simulator Run No. 3

Date	Time	Hours	MWh inst.	MWh heat	Control[a] rod position
March 3, 1984	4:00 - 12:00	8	240.0	240.35	40.66
March 4, 1984	12:00 - 12:00	24	720.0	718.72	41.38
March 5, 1984	12:00 - 12:00	24	720.0	714.12	41.78
March 6, 1984	12:00 - 12:00	24	720.0	715.24	42.32
March 7, 1984	12:00 - 8:00	8	240.0	239.76	42.87

[a]Centimeters withdrawn at midnight on given date for "ganged" control rods in B and D rows, control rods in F row fully withdrawn (see text, page 5).

Average Inst. Power 30 MW
Average Heat Power 29.86 MW

Core Cycle 167-B

Simulator Inserted March 3, 1984, 4:25 p.m.
Simulator Retracted March 7, 1984, 8:26 a.m.
Duration of Irradiation 316,860 seconds.

APPENDIX C

EXPERIMENTAL RESULTS

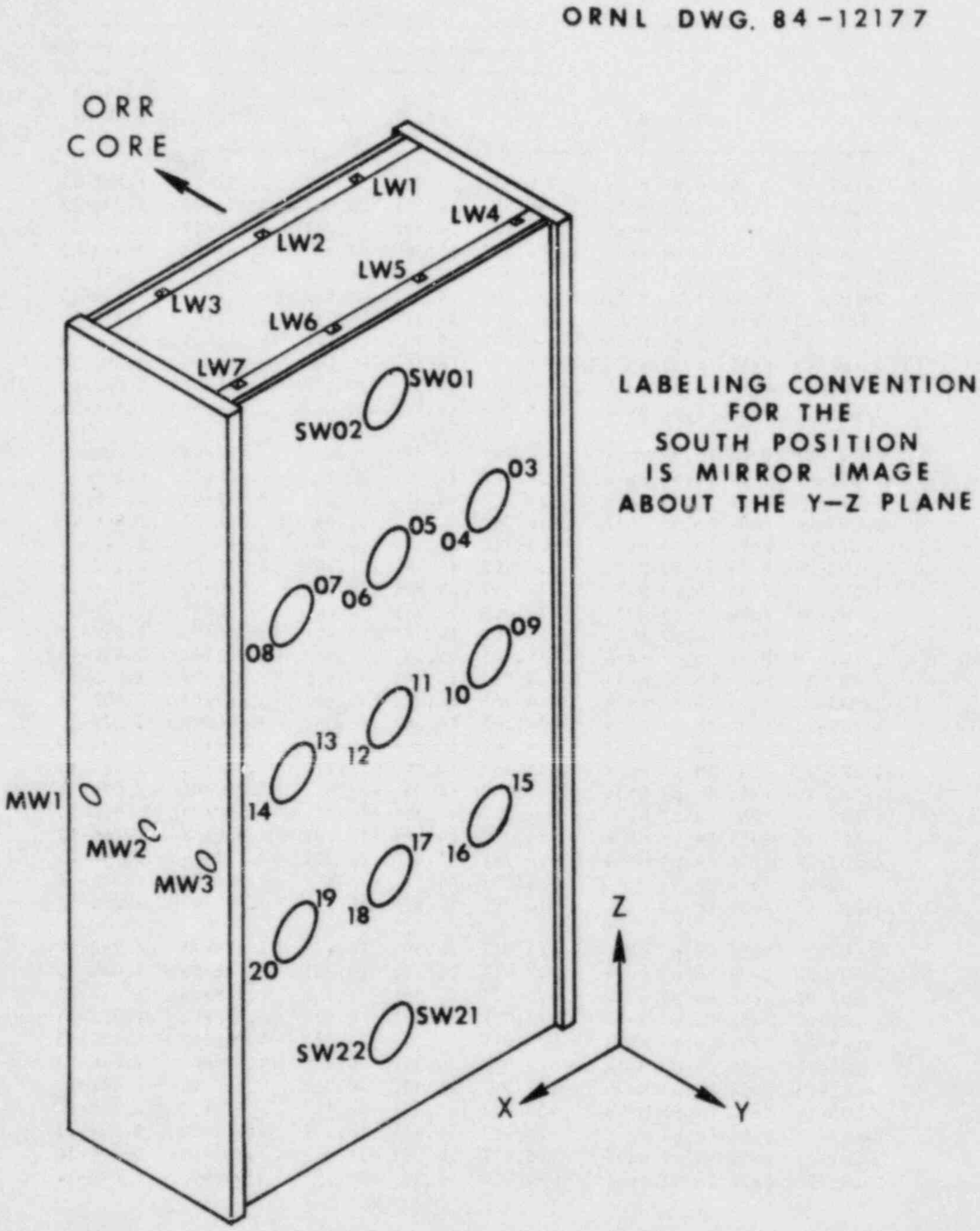


Fig. C.1. Gradient Wire Labeling Convention for Simulator in the North Position.

Table C.1. Experimental Results from Run No. 1

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
1-LW1-01	Fe54 (n,p) Mn54	-6.507	14.391	24.448	2.42E+03	1.83E-13
1-LW1-03	Fe54 (n,p) Mn54	-6.507	14.391	19.367	3.03E+03	2.29E-13
1-LW1-05	Fe54 (n,p) Mn54	-6.507	14.391	14.287	3.59E+03	2.71E-13
1-LW1-07	Fe54 (n,p) Mn54	-6.507	14.391	9.207	3.96E+03	2.99E-13
1-LW1-09	Fe54 (n,p) Mn54	-6.507	14.391	4.127	4.20E+03	3.17E-13
1-LW1-11	Fe54 (n,p) Mn54	-6.507	14.391	-0.952	4.20E+03	3.17E-13
1-LW1-13	Fe54 (n,p) Mn54	-6.507	14.391	-6.032	4.12E+03	3.11E-13
1-LW1-15	Fe54 (n,p) Mn54	-6.507	14.391	-11.112	3.81E+03	2.88E-13
1-LW1-17	Fe54 (n,p) Mn54	-6.507	14.391	-16.192	3.39E+03	2.56E-13
1-LW1-19	Fe54 (n,p) Mn54	-6.507	14.391	-21.272	2.70E+03	2.04E-13
1-LW1-21	Fe54 (n,p) Mn54	-6.507	14.391	-26.352	2.04E+03	1.54E-13
1-LW2-01	Fe54 (n,p) Mn54	-14.762	14.391	24.448	1.85E+03	1.40E-13
1-LW2-02	Fe54 (n,p) Mn54	-14.762	14.391	21.907	2.10E+03	1.59E-13
1-LW2-03	Fe54 (n,p) Mn54	-14.762	14.391	19.367	2.36E+03	1.78E-13
1-LW2-04	Fe54 (n,p) Mn54	-14.762	14.391	16.827	2.59E+03	1.96E-13
1-LW2-05	Fe54 (n,p) Mn54	-14.762	14.391	14.287	2.79E+03	2.11E-13
1-LW2-06	Fe54 (n,p) Mn54	-14.762	14.391	11.747	2.91E+03	2.20E-13
1-LW2-07	Fe54 (n,p) Mn54	-14.762	14.391	9.207	3.07E+03	2.32E-13
1-LW2-08	Fe54 (n,p) Mn54	-14.762	14.391	6.667	3.13E+03	2.37E-13
1-LW2-09	Fe54 (n,p) Mn54	-14.762	14.391	4.127	3.21E+03	2.43E-13
1-LW2-10	Fe54 (n,p) Mn54	-14.762	14.391	1.587	3.22E+03	2.43E-13
1-LW2-11	Fe54 (n,p) Mn54	-14.762	14.391	-0.952	3.27E+03	2.47E-13
1-LW2-12	Fe54 (n,p) Mn54	-14.762	14.391	-3.492	3.18E+03	2.40E-13
1-LW2-13	Fe54 (n,p) Mn54	-14.762	14.391	-6.032	3.14E+03	2.37E-13
1-LW2-14	Fe54 (n,p) Mn54	-14.762	14.391	-8.572	3.05E+03	2.30E-13
1-LW2-15	Fe54 (n,p) Mn54	-14.762	14.391	-11.112	2.94E+03	2.22E-13
1-LW2-16	Fe54 (n,p) Mn54	-14.762	14.391	-13.652	2.74E+03	2.07E-13
1-LW2-17	Fe54 (n,p) Mn54	-14.762	14.391	-16.192	2.59E+03	1.96E-13
1-LW2-18	Fe54 (n,p) Mn54	-14.762	14.391	-18.732	2.33E+03	1.76E-13
1-LW2-19	Fe54 (n,p) Mn54	-14.762	14.391	-21.272	2.11E+03	1.59E-13
1-LW2-20	Fe54 (n,p) Mn54	-14.762	14.391	-23.812	1.84E+03	1.39E-13
1-LW2-21	Fe54 (n,p) Mn54	-14.762	14.391	-26.352	1.59E+03	1.20E-13
1-LW3-01	Fe54 (n,p) Mn54	-23.017	14.391	24.448	1.11E+03	8.39E-14
1-LW3-03	Fe54 (n,p) Mn54	-23.017	14.391	19.367	1.43E+03	1.08E-13
1-LW3-05	Fe54 (n,p) Mn54	-23.017	14.391	14.287	1.64E+03	1.24E-13
1-LW3-07	Fe54 (n,p) Mn54	-23.017	14.391	9.207	1.83E+03	1.38E-13
1-LW3-09	Fe54 (n,p) Mn54	-23.017	14.391	4.127	1.96E+03	1.48E-13
1-LW3-11	Fe54 (n,p) Mn54	-23.017	14.391	-0.952	1.90E+03	1.44E-13
1-LW3-13	Fe54 (n,p) Mn54	-23.017	14.391	-6.032	1.86E+03	1.41E-13
1-LW3-15	Fe54 (n,p) Mn54	-23.017	14.391	-11.112	1.72E+03	1.30E-13
1-LW3-17	Fe54 (n,p) Mn54	-23.017	14.391	-16.192	1.51E+03	1.14E-13
1-LW3-19	Fe54 (n,p) Mn54	-23.017	14.391	-21.272	1.26E+03	9.52E-14
1-LW3-21	Fe54 (n,p) Mn54	-23.017	14.391	-26.352	9.26E+02	7.00E-14

Table C.1. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
1-LW4-15	Fe54 (n,p) Mn54	-2.936	24.631	6.667	6.68E+02	5.05E-14
1-LW4-11	Fe54 (n,p) Mn54	-2.936	24.631	-3.492	6.93E+02	5.24E-14
1-LW4-07	Fe54 (n,p) Mn54	-2.936	24.631	-13.652	5.95E+02	4.50E-14
1-LW4-03	Fe54 (n,p) Mn54	-2.936	24.631	-23.812	4.07E+02	3.08E-14
1-LW6-04	Fe54 (n,p) Mn54	-18.890	24.631	16.827	2.66E+02	2.01E-14
1-LW6-08	Fe54 (n,p) Mn54	-18.890	24.631	6.667	3.34E+02	2.52E-14
1-LW6-12	Fe54 (n,p) Mn54	-18.890	24.631	-3.492	3.50E+02	2.64E-14
1-LW6-16	Fe54 (n,p) Mn54	-18.890	24.631	-13.652	2.95E+02	2.23E-14
1-LW6-20	Fe54 (n,p) Mn54	-18.890	24.631	-23.812	2.06E+02	1.56E-14
1-LW7-04	Fe54 (n,p) Mn54	-26.589	24.631	16.827	1.75E+02	1.32E-14
1-LW7-08	Fe54 (n,p) Mn54	-26.589	24.631	6.667	2.14E+02	1.62E-14
1-LW7-12	Fe54 (n,p) Mn54	-26.589	24.631	-3.492	2.17E+02	1.64E-14
1-LW7-16	Fe54 (n,p) Mn54	-26.589	24.631	-13.652	1.90E+02	1.44E-14
1-LW7-20	Fe54 (n,p) Mn54	-26.589	24.631	-23.812	1.27E+02	9.60E-15
1-MW1-01	Fe54 (n,p) Mn54	-3.175	14.470	-7.700	3.96E+03	2.99E-13
1-MW1-02	Fe54 (n,p) Mn54	-5.715	14.470	-7.700	3.81E+03	2.88E-13
1-MW1-03	Fe54 (n,p) Mn54	-8.255	14.470	-7.700	3.70E+03	2.80E-13
1-MW1-04	Fe54 (n,p) Mn54	-10.795	14.470	-7.700	3.35E+03	2.53E-13
1-MW1-05	Fe54 (n,p) Mn54	-13.335	14.470	-7.700	3.03E+03	2.29E-13
1-MW1-06	Fe54 (n,p) Mn54	-15.875	14.470	-7.700	2.58E+03	1.95E-13
1-MW1-07	Fe54 (n,p) Mn54	-18.415	14.470	-7.700	2.25E+03	1.70E-13
1-MW1-08	Fe54 (n,p) Mn54	-20.955	14.470	-7.700	1.92E+03	1.45E-13
1-MW1-09	Fe54 (n,p) Mn54	-23.495	14.470	-7.700	1.54E+03	1.16E-13
1-SW06-1	Fe54 (n,p) Mn54	-16.588	15.661	7.554	2.07E+03	1.56E-13
1-SW06-2	Fe54 (n,p) Mn54	-16.588	16.931	7.554	1.63E+03	1.23E-13
1-SW06-3	Fe54 (n,p) Mn54	-16.588	18.201	7.554	1.26E+03	9.52E-14
1-SW06-4	Fe54 (n,p) Mn54	-16.588	19.471	7.554	9.82E+02	7.42E-14
1-SW06-5	Fe54 (n,p) Mn54	-16.588	20.741	7.554	7.74E+02	5.85E-14
1-SW06-6	Fe54 (n,p) Mn54	-16.588	22.011	7.554	6.16E+02	4.65E-14
1-SW06-7	Fe54 (n,p) Mn54	-16.588	23.281	7.554	4.47E+02	3.38E-14
1-SW11-1	Fe54 (n,p) Mn54	-12.937	15.661	-3.815	2.72E+03	2.06E-13
1-SW11-2	Fe54 (n,p) Mn54	-12.937	16.931	-3.815	2.16E+03	1.63E-13
1-SW11-3	Fe54 (n,p) Mn54	-12.937	18.201	-3.815	1.66E+03	1.25E-13
1-SW11-4	Fe54 (n,p) Mn54	-12.937	19.471	-3.815	1.31E+03	9.90E-14
1-SW11-5	Fe54 (n,p) Mn54	-12.937	20.741	-3.815	1.01E+03	7.63E-14
1-SW11-6	Fe54 (n,p) Mn54	-12.937	22.011	-3.815	7.94E+02	6.00E-14
1-SW11-7	Fe54 (n,p) Mn54	-12.937	23.281	-3.815	6.03E+02	4.56E-14
1-SW17-1	Fe54 (n,p) Mn54	-12.937	15.661	-15.187	2.34E+03	1.77E-13
1-SW17-2	Fe54 (n,p) Mn54	-12.937	16.931	-15.187	1.79E+03	1.35E-13
1-SW17-3	Fe54 (n,p) Mn54	-12.937	18.201	-15.187	1.41E+03	1.07E-13
1-SW17-4	Fe54 (n,p) Mn54	-12.937	19.471	-15.187	1.08E+03	8.16E-14
1-SW17-5	Fe54 (n,p) Mn54	-12.937	20.741	-15.187	8.41E+02	6.36E-14
1-SW17-6	Fe54 (n,p) Mn54	-12.937	22.011	-15.187	6.52E+02	4.93E-14
1-SW17-7	Fe54 (n,p) Mn54	-12.937	23.281	-15.187	5.01E+02	3.79E-14

Table C.1. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
1-106COT	Co59 (n,γ) Co60	-14.762	14.856	8.443	2.78E+03	7.85E-11
1-106FET	Fe54 (n,p) Mn54	-14.762	14.856	8.341	2.75E+03	2.08E-13
1-106NIT	Ni58 (n,p) Co58	-14.762	14.856	8.240	1.78E+05	2.82E-13
1-106TIT	Ti46 (n,p) Sc46	-14.762	14.856	8.138	2.10E+03	2.69E-14
1-106NP	Np237(n,f) Zr95	-14.762	14.856	7.833	1.88E+05	1.31E-11
1-106NP	Np237(n,f) Ru103	-14.762	14.856	7.833	3.16E+05	1.40E-11
1-106NP	Np237(n,f) Cs137	-14.762	14.856	7.833	1.29E+03	1.32E-11
1-106NP	Np237(n,f) Ba140	-14.762	14.856	7.833	5.74E+05	1.01E-11
1-106CU	Cu63 (n,α) Co60	-14.762	14.856	7.541	2.97E+01	1.31E-15
1-106U	U238 (n,f) Zr95	-14.762	14.856	6.995	1.67E+04	1.29E-12
1-106U	U238 (n,f) Ru103	-14.762	14.856	6.995	3.40E+04	1.36E-12
1-106U	U238 (n,f) Cs137	-14.762	14.856	6.995	1.27E+02	1.38E-12
1-106U	U238 (n,f) Ba140	-14.762	14.856	6.995	8.40E+04	1.37E-12
1-106TIB	Ti46 (n,p) Sc46	-14.762	14.856	6.944	2.13E+03	2.73E-14
1-106NIB	Ni58 (n,p) Co58	-14.762	14.856	6.843	1.86E+05	2.95E-13
1-106FEB	Fe54 (n,p) Mn54	-14.762	14.856	6.741	2.82E+03	2.13E-13
1-106COB	Co59 (n,γ) Co60	-14.762	14.856	6.640	2.87E+03	8.10E-11
1-108NP	Np237(n,f) Zr95	-14.762	23.891	7.833	5.48E+04	3.81E-12
1-108NP	Np237(n,f) Ru103	-14.762	23.891	7.833	9.17E+04	4.06E-12
1-108NP	Np237(n,f) Cs137	-14.762	23.891	7.833	4.07E+02	4.18E-12
1-108NP	Np237(n,f) Ba140	-14.762	23.891	7.833	1.89E+05	3.31E-12
1-108CU	Cu63 (n,α) Co60	-14.762	23.891	7.541	4.93E+00	2.17E-16
1-108U	U238 (n,f) Zr95	-14.762	23.891	6.995	3.28E+03	2.53E-13
1-108U	U238 (n,f) Ru103	-14.762	23.891	6.995	6.80E+03	2.71E-13
1-108U	U238 (n,f) Cs137	-14.762	23.891	6.995	2.45E+01	2.66E-13
1-108U	U238 (n,f) Ba140	-14.762	23.891	6.995	1.52E+04	2.48E-13
1-108TIB	Ti46 (n,p) Sc46	-14.762	23.891	6.944	3.44E+02	4.41E-15
1-108NIB	Ni58 (n,p) Co58	-14.762	23.891	6.843	3.23E+04	5.12E-14
1-108FEB	Fe54 (n,p) Mn54	-14.762	23.891	6.741	4.83E+02	3.65E-14
1-108COB	Co59 (n,γ) Co60	-14.762	23.891	6.640	8.02E+02	2.26E-11
1-109FET	Fe54 (n,p) Mn54	-14.762	14.856	-14.399	2.49E+03	1.88E-13
1-109NIT	Ni58 (n,p) Co58	-14.762	14.856	-14.501	1.59E+05	2.52E-13
1-109TIT	Ti46 (n,p) Sc46	-14.762	14.856	-14.602	1.86E+03	2.38E-14
1-109NP	Np237(n,f) Zr95	-14.762	14.856	-14.907	1.64E+05	1.14E-11
1-109NP	Np237(n,f) Ru103	-14.762	14.856	-14.907	2.69E+05	1.19E-11
1-109NP	Np237(n,f) Cs137	-14.762	14.856	-14.907	1.18E+03	1.21E-11
1-109NP	Np237(n,f) Ba140	-14.762	14.856	-14.907	6.[illegible]5E+05	1.10E-11
1-109CU	Cu63 (n,α) Co60	-14.762	14.856	-15.199	2.55E+01	1.12E-15
1-109U	U238 (n,f) Zr95	-14.762	14.856	-15.745	1.40E+04	1.08E-12
1-109U	U238 (n,f) Ru103	-14.762	14.856	-15.745	2.85E+04	1.14E-12
1-109U	U238 (n,f) Cs137	-14.762	14.856	-15.745	1.07E+02	1.16E-12
1-109U	U238 (n,f) Ba140	-14.762	14.856	-15.745	7.58E+04	1.24E-12

Table C.1. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
1-111COT	Co59 (n,γ) Co60	-14.762	23.891	-14.298	7.05E+02	1.99E-11
1-111FET	Fe54 (n,p) Mn54	-14.762	23.891	-14.399	4.14E+02	3.13E-14
1-111NIT	Ni58 (n,p) Co58	-14.762	23.891	-14.501	2.83E+04	4.49E-14
1-111TIT	Ti46 (n,p) Sc46	-14.762	23.891	-14.602	3.06E+02	3.92E-15
1-111NP	Np237(n,f) Zr95	-14.762	23.891	-14.907	4.73E+04	3.29E-12
1-111NP	Np237(n,f) Ru103	-14.762	23.891	-14.907	7.92E+04	3.50E-12
1-111NP	Np237(n,f) Cs137	-14.762	23.891	-14.907	3.36E+02	3.45E-12
1-111NP	Np237(n,f) Ba140	-14.762	23.891	-14.907	2.19E+05	3.84E-12
1-111CU	Cu63 (n,α) Co60	-14.762	23.891	-15.199	4.28E+00	1.88E-16
1-111U	U238 (n,f) Zr95	-14.762	23.891	-15.745	2.75E+03	2.12E-13
1-111U	U238 (n,f) Ru103	-14.762	23.891	-15.745	5.69E+03	2.27E-13
1-111U	U238 (n,f) Cs137	-14.762	23.891	-15.745	2.32E+01	2.52E-13
1-111U	U238 (n,f) Ba140	-14.762	23.891	-15.745	1.29E+04	2.11E-13

Table C.2. Experimental Results from Run No. 2

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
2-LW2-01	Fe54 (n,p) Mn54	14.762	14.391	24.448	1.72E+03	1.46E-13
2-LW2-04	Fe54 (n,p) Mn54	14.762	14.391	16.827	2.31E+03	1.96E-13
2-LW2-07	Fe54 (n,p) Mn54	14.762	14.391	9.207	2.68E+03	2.27E-13
2-LW2-10	Fe54 (n,p) Mn54	14.762	14.391	1.587	2.85E+03	2.41E-13
2-LW2-13	Fe54 (n,p) Mn54	14.762	14.391	-6.032	2.72E+03	2.30E-13
2-LW2-16	Fe54 (n,p) Mn54	14.762	14.391	-13.652	2.44E+03	2.07E-13
2-LW2-19	Fe54 (n,p) Mn54	14.762	14.391	-21.272	1.81E+03	1.53E-13
2-LW2-21	Fe54 (n,p) Mn54	14.762	14.391	-26.352	1.34E+03	1.13E-13
2-MW1-01	Fe54 (n,p) Mn54	3.175	14.470	-7.700	3.47E+03	2.94E-13
2-MW1-02	Fe54 (n,p) Mn54	5.715	14.470	-7.700	3.44E+03	2.91E-13
2-MW1-03	Fe54 (n,p) Mn54	8.255	14.470	-7.700	3.23E+03	2.74E-13
2-MW1-04	Fe54 (n,p) Mn54	10.795	14.470	-7.700	2.91E+03	2.46E-13
2-MW1-05	Fe54 (n,p) Mn54	13.335	14.470	-7.700	2.70E+03	2.29E-13
2-MW1-06	Fe54 (n,p) Mn54	15.875	14.470	-7.700	2.41E+03	2.04E-13
2-MW1-07	Fe54 (n,p) Mn54	18.415	14.470	-7.700	2.11E+03	1.79E-13
2-MW1-08	Fe54 (n,p) Mn54	20.955	14.470	-7.700	1.75E+03	1.48E-13
2-MW1-09	Fe54 (n,p) Mn54	23.495	14.470	-7.700	1.47E+03	1.25E-13
2-115FET	Fe54 (n,p) Mn54	14.762	14.856	-14.399	2.15E+03	1.82E-13
2-115NIT	Ni58 (n,p) Co58	14.762	14.856	-14.501	1.41E+05	2.50E-13
2-115TIT	Ti46 (n,p) Sc46	14.762	14.856	-14.602	1.61E+03	2.31E-14
2-115NP	Np237(n,f) Zr95	14.762	14.856	-14.907	1.44E+05	1.12E-11
2-115NP	Np237(n,f) Ru103	14.762	14.856	-14.907	2.37E+05	1.17E-11
2-115NP	Np237(n,f) Cs137	14.762	14.856	-14.907	1.09E+03	1.25E-11
2-115NP	Np237(n,f) Ba140	14.762	14.856	-14.907	6.09E+05	1.17E-11
2-115CU	Cu63 (n,α) Co60	14.762	14.856	-15.199	2.22E+01	1.10E-15
2-115U	U238 (n,f) Zr95	14.762	14.856	-15.745	1.22E+04	1.05E-12
2-115U	U238 (n,f) Ru103	14.762	14.856	-15.745	2.53E+04	1.12E-12
2-115U	U238 (n,f) Cs137	14.762	14.856	-15.745	8.94E+01	1.09E-12
2-115U	U238 (n,f) Ba140	14.762	14.856	-15.745	6.42E+04	1.15E-12

Table C.3. Experimental Results from Run No. 3

Monitor ID	Reaction	Coordinates X (cm)	Coordinates Y (cm)	Coordinates Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
3-LW1-01	Fe54 (n,p) Mn54	-6.507	13.091	24.448	7.80E+02	1.55E-13
3-LW1-03	Fe54 (n,p) Mn54	-6.507	13.091	19.367	1.02E+03	2.02E-13
3-LW1-05	Fe54 (n,p) Mn54	-6.507	13.091	14.287	1.31E+03	2.60E-13
3-LW1-07	Fe54 (n,p) Mn54	-6.507	13.091	9.207	1.51E+03	2.99E-13
3-LW1-09	Fe54 (n,p) Mn54	-6.507	13.091	4.127	1.76E+03	3.49E-13
3-LW1-11	Fe54 (n,p) Mn54	-6.507	13.091	-0.952	1.87E+03	3.71E-13
3-LW1-13	Fe54 (n,p) Mn54	-6.507	13.091	-6.032	1.99E+03	3.95E-13
3-LW1-15	Fe54 (n,p) Mn54	-6.507	13.091	-11.112	1.95E+03	3.87E-13
3-LW1-17	Fe54 (n,p) Mn54	-6.507	13.091	-16.192	1.82E+03	3.61E-13
3-LW1-18	Fe54 (n,p) Mn54	-6.507	13.091	-18.732	1.66E+03	3.29E-13
3-LW1-20	Fe54 (n,p) Mn54	-6.507	13.091	-23.812	1.36E+03	2.70E-13
3-LW1-21	Fe54 (n,p) Mn54	-6.507	13.091	-26.352	1.16E+03	2.30E-13
3-LW2-01	Fe54 (n,p) Mn54	-14.762	13.091	24.448	6.68E+02	1.32E-13
3-LW2-02	Fe54 (n,p) Mn54	-14.762	13.091	21.907	7.60E+02	1.51E-13
3-LW2-03	Fe54 (n,p) Mn54	-14.762	13.091	19.367	8.85E+02	1.75E-13
3-LW2-04	Fe54 (n,p) Mn54	-14.762	13.091	16.827	1.01E+03	2.00E-13
3-LW2-05	Fe54 (n,p) Mn54	-14.762	13.091	14.287	1.10E+03	2.18E-13
3-LW2-06	Fe54 (n,p) Mn54	-14.762	13.091	11.747	1.21E+03	2.40E-13
3-LW2-07	Fe54 (n,p) Mn54	-14.762	13.091	9.207	1.30E+03	2.58E-13
3-LW2-08	Fe54 (n,p) Mn54	-14.762	13.091	6.667	1.37E+03	2.72E-13
3-LW2-09	Fe54 (n,p) Mn54	-14.762	13.091	4.127	1.46E+03	2.89E-13
3-LW2-10	Fe54 (n,p) Mn54	-14.762	13.091	1.587	1.51E+03	2.99E-13
3-LW2-11	Fe54 (n,p) Mn54	-14.762	13.091	-0.952	1.60E+03	3.17E-13
3-LW2-12	Fe54 (n,p) Mn54	-14.762	13.091	-3.492	1.59E+03	3.15E-13
3-LW2-13	Fe54 (n,p) Mn54	-14.762	13.091	-6.032	1.66E+03	3.29E-13
3-LW2-14	Fe54 (n,p) Mn54	-14.762	13.091	-8.572	1.64E+03	3.25E-13
3-LW2-15	Fe54 (n,p) Mn54	-14.762	13.091	-11.112	1.64E+03	3.25E-13
3-LW2-16	Fe54 (n,p) Mn54	-14.762	13.091	-13.652	1.55E+03	3.07E-13
3-LW2-17	Fe54 (n,p) Mn54	-14.762	13.091	-16.192	1.49E+03	2.95E-13
3-LW2-18	Fe54 (n,p) Mn54	-14.762	13.091	-18.732	1.35E+03	2.68E-13
3-LW2-19	Fe54 (n,p) Mn54	-14.762	13.091	-21.272	1.26E+03	2.50E-13
3-LW2-20	Fe54 (n,p) Mn54	-14.762	13.091	-23.812	1.13E+03	2.24E-13
3-LW2-21	Fe54 (n,p) Mn54	-14.762	13.091	-26.352	9.64E+02	1.91E-13
3-LW3-01	Fe54 (n,p) Mn54	-23.017	13.091	24.448	4.82E+02	9.56E-14
3-LW3-03	Fe54 (n,p) Mn54	-23.017	13.091	19.367	6.29E+02	1.25E-13
3-LW3-05	Fe54 (n,p) Mn54	-23.017	13.091	14.287	7.74E+02	1.53E-13
3-LW3-07	Fe54 (n,p) Mn54	-23.017	13.091	9.207	8.95E+02	1.77E-13
3-LW3-09	Fe54 (n,p) Mn54	-23.017	13.091	4.127	1.00E+03	1.98E-13
3-LW3-11	Fe54 (n,p) Mn54	-23.017	13.091	-0.952	1.07E+03	2.12E-13
3-LW3-13	Fe54 (n,p) Mn54	-23.017	13.091	-6.032	1.08E+03	2.14E-13
3-LW3-15	Fe54 (n,p) Mn54	-23.017	13.091	-11.112	1.07E+03	2.12E-13
3-LW3-17	Fe54 (n,p) Mn54	-23.017	13.091	-16.192	9.81E+02	1.94E-13
3-LW3-19	Fe54 (n,p) Mn54	-23.017	13.091	-21.272	8.26E+02	1.64E-13
3-LW3-21	Fe54 (n,p) Mn54	-23.017	13.091	-26.352	6.22E+02	1.23E-13

Table C.3. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
3-LW4-01	Fe54 (n,p) Mn54	-2.936	23.331	24.448	1.46E+02	2.89E-14
3-LW4-03	Fe54 (n,p) Mn54	-2.936	23.331	19.367	1.88E+02	3.73E-14
3-LW4-05	Fe54 (n,p) Mn54	-2.936	23.331	14.287	2.20E+02	4.36E-14
3-LW4-07	Fe54 (n,p) Mn54	-2.936	23.331	9.207	2.59E+02	5.14E-14
3-LW4-09	Fe54 (n,p) Mn54	-2.936	23.331	4.127	2.98E+02	5.91E-14
3-LW4-11	Fe54 (n,p) Mn54	-2.936	23.331	-0.952	3.20E+02	6.34E-14
3-LW4-13	Fe54 (n,p) Mn54	-2.936	23.331	-6.032	3.18E+02	6.30E-14
3-LW4-15	Fe54 (n,p) Mn54	-2.936	23.331	-11.112	3.11E+02	6.17E-14
3-LW4-17	Fe54 (n,p) Mn54	-2.936	23.331	-16.192	2.91E+02	5.77E-14
3-LW4-19	Fe54 (n,p) Mn54	-2.936	23.331	-21.272	2.47E+02	4.90E-14
3-LW4-21	Fe54 (n,p) Mn54	-2.936	23.331	-26.352	1.97E+02	3.91E-14
3-LW5-01	Fe54 (n,p) Mn54	-10.635	23.331	24.448	9.40E+01	1.86E-14
3-LW5-03	Fe54 (n,p) Mn54	-10.635	23.331	19.367	1.35E+02	2.68E-14
3-LW5-05	Fe54 (n,p) Mn54	-10.635	23.331	14.287	1.61E+02	3.19E-14
3-LW5-07	Fe54 (n,p) Mn54	-10.635	23.331	9.207	1.90E+02	3.77E-14
3-LW5-09	Fe54 (n,p) Mn54	-10.635	23.331	4.127	2.07E+02	4.10E-14
3-LW5-11	Fe54 (n,p) Mn54	-10.635	23.331	-0.952	2.26E+02	4.48E-14
3-LW5-13	Fe54 (n,p) Mn54	-10.635	23.331	-6.032	2.23E+02	4.42E-14
3-LW5-15	Fe54 (n,p) Mn54	-10.635	23.331	-11.112	2.34E+02	4.64E-14
3-LW5-17	Fe54 (n,p) Mn54	-10.635	23.331	-16.192	2.05E+02	4.06E-14
3-LW5-19	Fe54 (n,p) Mn54	-10.635	23.331	-21.272	1.83E+02	3.63E-14
3-LW5-21	Fe54 (n,p) Mn54	-10.635	23.331	-26.352	1.38E+02	2.74E-14
3-LW6-01	Fe54 (n,p) Mn54	-18.890	23.331	24.448	7.50E+01	1.49E-14
3-LW6-03	Fe54 (n,p) Mn54	-18.890	23.331	19.367	9.90E+01	1.96E-14
3-LW6-05	Fe54 (n,p) Mn54	-18.890	23.331	14.287	1.31E+02	2.60E-14
3-LW6-07	Fe54 (n,p) Mn54	-18.890	23.331	9.207	1.47E+02	2.91E-14
3-LW6-09	Fe54 (n,p) Mn54	-18.890	23.331	4.127	1.65E+02	3.27E-14
3-LW6-11	Fe54 (n,p) Mn54	-18.890	23.331	-0.952	1.75E+02	3.47E-14
3-LW6-13	Fe54 (n,p) Mn54	-18.890	23.331	-6.032	1.82E+02	3.61E-14
3-LW6-15	Fe54 (n,p) Mn54	-18.890	23.331	-11.112	1.74E+02	3.45E-14
3-LW6-17	Fe54 (n,p) Mn54	-18.890	23.331	-16.192	1.60E+02	3.17E-14
3-LW6-19	Fe54 (n,p) Mn54	-18.890	23.331	-21.272	1.36E+02	2.70E-14
3-LW6-21	Fe54 (n,p) Mn54	-18.890	23.331	-26.352	1.10E+02	2.18E-14
3-LW7-01	Fe54 (n,p) Mn54	-26.589	23.331	24.448	5.20E+01	1.03E-14
3-LW7-03	Fe54 (n,p) Mn54	-26.589	23.331	19.367	7.40E+01	1.47E-14
3-LW7-05	Fe54 (n,p) Mn54	-26.589	23.331	14.287	8.90E+01	1.76E-14
3-LW7-07	Fe54 (n,p) Mn54	-26.589	23.331	9.207	1.01E+02	2.00E-14
3-LW7-09	Fe54 (n,p) Mn54	-26.589	23.331	4.127	1.10E+02	2.18E-14
3-LW7-11	Fe54 (n,p) Mn54	-26.589	23.331	-0.952	1.23E+02	2.44E-14
3-LW7-13	Fe54 (n,p) Mn54	-26.589	23.331	-6.032	1.17E+02	2.32E-14
3-LW7-15	Fe54 (n,p) Mn54	-26.589	23.331	-11.112	1.15E+02	2.28E-14
3-LW7-17	Fe54 (n,p) Mn54	-26.589	23.331	-16.192	1.05E+02	2.08E-14
3-LW7-19	Fe54 (n,p) Mn54	-26.589	23.331	-21.272	9.00E+01	1.78E-14
3-LW7-21	Fe54 (n,p) Mn54	-26.589	23.331	-26.352	6.90E+01	1.37E-14

Table C.3. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
3-MW1-01	Fe54 (n,p) Mn54	-3.175	13.170	-7.700	1.99E+03	3.95E-13
3-MW1-02	Fe54 (n,p) Mn54	-5.715	13.170	-7.700	1.93E+03	3.83E-13
3-MW1-03	Fe54 (n,p) Mn54	-8.255	13.170	-7.700	1.90E+03	3.77E-13
3-MW1-04	Fe54 (n,p) Mn54	-10.795	13.170	-7.700	1.78E+03	3.53E-13
3-MW1-05	Fe54 (n,p) Mn54	-13.335	13.170	-7.700	1.71E+03	3.39E-13
3-MW1-06	Fe54 (n,p) Mn54	-15.875	13.170	-7.700	1.54E+03	3.05E-13
3-MW1-07	Fe54 (n,p) Mn54	-18.415	13.170	-7.700	1.40E+03	2.78E-13
3-MW1-08	Fe54 (n,p) Mn54	-20.955	13.170	-7.700	1.22E+03	2.42E-13
3-MW1-09	Fe54 (n,p) Mn54	-23.495	13.170	-7.700	1.06E+03	2.10E-13
3-MW2-01	Fe54 (n,p) Mn54	-3.175	18.171	-7.700	8.22E+02	1.63E-13
3-MW2-02	Fe54 (n,p) Mn54	-5.715	18.171	-7.700	7.58E+02	1.50E-13
3-MW2-03	Fe54 (n,p) Mn54	-8.255	18.171	-7.700	6.97E+02	1.38E-13
3-MW2-04	Fe54 (n,p) Mn54	-10.795	18.171	-7.700	6.49E+02	1.29E-13
3-MW2-05	Fe54 (n,p) Mn54	-13.335	18.171	-7.700	6.17E+02	1.22E-13
3-MW2-06	Fe54 (n,p) Mn54	-15.875	18.171	-7.700	5.52E+02	1.09E-13
3-MW2-07	Fe54 (n,p) Mn54	-18.415	18.171	-7.700	4.89E+02	9.70E-14
3-MW2-08	Fe54 (n,p) Mn54	-20.955	18.171	-7.700	4.51E+02	8.94E-14
3-MW2-09	Fe54 (n,p) Mn54	-23.495	18.171	-7.700	4.01E+02	7.95E-14
3-MW3-01	Co59 (n,γ) Co60	-3.175	23.172	-7.700	1.87E+03	1.39E-10
3-MW3-02	Co59 (n,γ) Co60	-5.715	23.172	-7.700	1.58E+03	1.18E-10
3-MW3-03	Co59 (n,γ) Co60	-8.255	23.172	-7.700	1.40E+03	1.04E-10
3-MW3-04	Co59 (n,γ) Co60	-10.795	23.172	-7.700	1.32E+03	9.83E-11
3-MW3-05	Co59 (n,γ) Co60	-13.335	23.172	-7.700	1.18E+03	8.79E-11
3-MW3-06	Co59 (n,γ) Co60	-15.875	23.172	-7.700	1.11E+03	8.27E-11
3-MW3-07	Co59 (n,γ) Co60	-18.415	23.172	-7.700	9.96E+02	7.42E-11
3-MW3-08	Co59 (n,γ) Co60	-20.955	23.172	-7.700	9.08E+02	6.76E-11
3-MW3-09	Co59 (n,γ) Co60	-23.495	23.172	-7.700	8.08E+02	6.02E-11
3-SW11-1	Fe54 (n,p) Mn54	-12.937	14.361	-3.815	1.36E+03	2.70E-13
3-SW11-2	Fe54 (n,p) Mn54	-12.937	15.631	-3.815	1.07E+03	2.12E-13
3-SW11-3	Fe54 (n,p) Mn54	-12.937	16.901	-3.815	8.15E+02	1.62E-13
3-SW11-4	Fe54 (n,p) Mn54	-12.937	18.171	-3.815	6.44E+02	1.28E-13
3-SW11-5	Fe54 (n,p) Mn54	-12.937	19.441	-3.815	4.96E+02	9.83E-14
3-SW11-6	Fe54 (n,p) Mn54	-12.937	20.711	-3.815	3.94E+02	7.81E-14
3-SW11-7	Fe54 (n,p) Mn54	-12.937	21.981	-3.815	2.96E+02	5.87E-14
3-SW12-1	Co59 (n,γ) Co60	-16.588	14.361	-3.815	1.55E+03	1.15E-10
3-SW12-2	Co59 (n,γ) Co60	-16.588	15.631	-3.815	1.21E+03	9.01E-11
3-SW12-3	Co59 (n,γ) Co60	-16.588	16.901	-3.815	9.92E+02	7.39E-11
3-SW12-4	Co59 (n,γ) Co60	-16.588	18.171	-3.815	8.40E+02	6.26E-11
3-SW12-5	Co59 (n,γ) Co60	-16.588	19.441	-3.815	7.34E+02	5.47E-11
3-SW12-6	Co59 (n,γ) Co60	-16.588	20.711	-3.815	7.11E+02	5.30E-11
3-SW12-7	Co59 (n,γ) Co60	-16.588	21.981	-3.815	7.76E+02	5.78E-11

Table C.3. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
3-119COT	Co59 (n,γ) Co60	-14.762	13.556	-2.926	1.49E+03	1.11E-10
3-119FET	Fe54 (n,p) Mn54	-14.762	13.556	-3.028	1.43E+03	2.84E-13
3-119NIT	Ni58 (n,p) Co58	-14.762	13.556	-3.129	9.78E+04	3.98E-13
3-119TIT	Ti46 (n,p) Sc46	-14.762	13.556	-3.312	1.09E+03	3.60E-14
3-119NP	Np237(n,f) Zr95	-14.762	13.556	-3.536	1.11E+05	1.98E-11
3-119NP	Np237(n,f) Ru103	-14.762	13.556	-3.536	1.84E+05	2.04E-11
3-119NP	Np237(n,f) Ba140	-14.762	13.556	-3.536	5.50E+05	2.21E-11
3-119CU	Cu63 (n,α) Co60	-14.762	13.556	-3.828	1.45E+01	1.68E-15
3-119U	U238 (n,f) Zr95	-14.762	13.556	-4.374	8.66E+03	1.71E-12
3-119U	U238 (n,f) Ru103	-14.762	13.556	-4.374	1.75E+04	1.75E-12
3-119U	U238 (n,f) Ba140	-14.762	13.556	-4.374	5.08E+04	1.88E-12
3-119TIB	Ti46 (n,p) Sc46	-14.762	13.556	-4.425	1.08E+03	3.57E-14
3-119NIB	Ni58 (n,p) Co58	-14.762	13.556	-4.526	9.88E+04	4.02E-13
3-119FEB	Fe54 (n,p) Mn54	-14.762	13.556	-4.628	1.45E+03	2.87E-13
3-119COB	Co59 (n,γ) Co60	-14.762	13.556	-4.729	1.55E+03	1.15E-10
3-118COT	Co59 (n,γ) Co60	-14.762	22.591	-2.926	4.14E+02	3.08E-11
3-118FET	Fe54 (n,p) Mn54	-14.762	22.591	-3.028	2.43E+02	4.82E-14
3-118NIT	Ni58 (n,p) Co58	-14.762	22.591	-3.129	1.67E+04	6.79E-14
3-118TIT	Ti46 (n,p) Sc46	-14.762	22.591	-3.312	1.73E+02	5.71E-15
3-118NP	Np237(n,f) Zr95	-14.762	22.591	-3.536	3.08E+04	5.48E-12
3-118NP	Np237(n,f) Ru103	-14.762	22.591	-3.536	5.12E+04	5.68E-12
3-118NP	Np237(n,f) Ba140	-14.762	22.591	-3.536	1.53E+05	6.07E-12
3-118CU	Cu63 (n,α) Co60	-14.762	22.591	-3.828	2.39E+00	2.78E-16
3-118U	U238 (n,f) Zr95	-14.762	22.591	-4.374	1.95E+03	3.85E-13
3-118U	U238 (n,f) Ru103	-14.762	22.591	-4.374	3.72E+03	3.72E-13
3-118U	U238 (n,f) Ba140	-14.762	22.591	-4.374	1.07E+04	3.96E-13
3-118TIB	Ti46 (n,p) Sc46	-14.762	22.591	-4.425	1.75E+02	5.78E-15
3-118NIB	Ni58 (n,p) Co58	-14.762	22.591	-4.526	1.67E+04	6.79E-14
3-118FEB	Fe54 (n,p) Mn54	-14.762	22.591	-4.628	2.47E+02	4.90E-14
3-118COB	Co59 (n,γ) Co60	-14.762	22.591	-4.729	4.26E+02	3.17E-11

Table C.3. (continued)

Monitor ID	Reaction	Coordinates X (cm)	Y (cm)	Z (cm)	Activity Bq/mg @ EOI	Saturation activity Bq/atom @ 30 MW
3-MT1-01	Fe54 (n,p) Mn54	-29.845	11.770	23.813	3.58E+02	7.10E-14
3-MT1-03	Fe54 (n,p) Mn54	-29.845	11.770	18.733	4.61E+02	9.14E-14
3-MT1-05	Fe54 (n,p) Mn54	-29.845	11.770	13.653	5.62E+02	1.11E-13
3-MT1-07	Fe54 (n,p) Mn54	-29.845	11.770	8.573	6.39E+02	1.27E-13
3-MT1-09	Fe54 (n,p) Mn54	-29.845	11.770	3.493	6.97E+02	1.38E-13
3-MT1-11	Fe54 (n,p) Mn54	-29.845	11.770	-1.588	7.66E+02	1.52E-13
3-MT1-13	Fe54 (n,p) Mn54	-29.845	11.770	-6.668	7.92E+02	1.57E-13
3-MT1-15	Fe54 (n,p) Mn54	-29.845	11.770	-11.748	7.78E+02	1.54E-13
3-MT1-17	Fe54 (n,p) Mn54	-29.845	11.770	-16.828	7.01E+02	1.39E-13
3-MT1-19	Fe54 (n,p) Mn54	-29.845	11.770	-21.908	6.08E+02	1.21E-13
3-MT1-21	Fe54 (n,p) Mn54	-29.845	11.770	-26.988	4.70E+02	9.32E-14
3-MT2-01	Fe54 (n,p) Mn54	0.000	11.770	23.813	9.09E+02	1.80E-13
3-MT2-03	Fe54 (n,p) Mn54	0.000	11.770	18.733	1.21E+03	2.40E-13
3-MT2-05	Fe54 (n,p) Mn54	0.000	11.770	13.653	1.58E+03	3.13E-13
3-MT2-07	Fe54 (n,p) Mn54	0.000	11.770	8.573	1.84E+03	3.65E-13
3-MT2-09	Fe54 (n,p) Mn54	0.000	11.770	3.493	2.14E+03	4.24E-13
3-MT2-11	Fe54 (n,p) Mn54	0.000	11.770	-1.588	2.36E+03	4.68E-13
3-MT2-13	Fe54 (n,p) Mn54	0.000	11.770	-6.668	2.49E+03	4.94E-13
3-MT2-15	Fe54 (n,p) Mn54	0.000	11.770	-11.748	2.50E+03	4.96E-13
3-MT2-17	Fe54 (n,p) Mn54	0.000	11.770	-16.828	2.27E+03	4.50E-13
3-MT2-19	Fe54 (n,p) Mn54	0.000	11.770	-21.908	1.94E+03	3.85E-13
3-MT2-21	Fe54 (n,p) Mn54	0.000	11.770	-26.988	1.54E+03	3.05E-13
3-MT3-01	Fe54 (n,p) Mn54	29.845	11.770	23.813	3.60E+02	7.14E-14
3-MT3-03	Fe54 (n,p) Mn54	29.845	11.770	18.733	4.46E+02	8.84E-14
3-MT3-05	Fe54 (n,p) Mn54	29.845	11.770	13.653	5.60E+02	1.11E-13
3-MT3-07	Fe54 (n,p) Mn54	29.845	11.770	8.573	6.51E+02	1.29E-13
3-MT3-09	Fe54 (n,p) Mn54	29.845	11.770	3.493	6.95E+02	1.38E-13
3-MT3-11	Fe54 (n,[illegible]) Mn54	29.845	11.770	[illegible].588	7.57E+02	1.50E-13
3-MT3-13	Fe54 (n,p) Mn54	29.845	11.770	-6.668	8.03E+02	1.59E-13
3-MT3-15	Fe54 (n,p) Mn54	29.845	11.770	-11.748	8.16E+02	1.62E-13
3-MT3-17	Fe54 (n,p) Mn54	29.845	11.770	-16.828	7.18E+02	1.42E-13
3-MT3-19	Fe54 (n,p) Mn54	29.845	11.770	-21.908	6.21E+02	1.23E-13
3-MT3-21	Fe54 (n,p) Mn54	29.845	11.770	-26.988	4.86E+02	9.64E-14

NUREG/CR-4031
ORNL/TM-9423
Dist. Category RL

INTERNAL DISTRIBUTION

1-5. C. A. Baldwin
6. R. G. Berggren
7. C. D. Cagle
8. J. A. Conlin
9. R. W. Hobbs
10. F. B. K. Kam
11. R. E. Maerker
12. L. F. Miller
13. R. K. Nanstad
14. C. E. Pugh
15. I. Remec
16. J. A. Setaro
17. F. W. Stallmann
18. J. H. Swanks
19. B. J. Taylor
20. K. Thoms
21. C. D. West
22. M. L. Williams
23. Document Reference Section
24-25. Central Research Library
26-27. Laboratory Records Department
28. Laboratory Records - ORNL R.C.
29. ORNL Patent Office

EXTERNAL DISTRIBUTION

30. Assistant Manager for Energy Research and Development, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN 37830
31-32. Technical Information Center, U.S. Department of Energy, Oak Ridge, TN 37830
33-242. Given distribution under category RL (10 copies - NTIS)

NRC FORM 335 (2-84) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

SEE INSTRUCTIONS ON THE REVERSE

1. REPORT NUMBER (Assigned by TIDC, add Vol. No., if any)

NUREG/CR-4031, ORNL/TM-9423

2. TITLE AND SUBTITLE

NEUTRON SPECTRAL CHARACTERIZATION FOR THE FIFTH HEAVY SECTION STEEL TECHNOLOGY (HSST) IRRADIATION SERIES "Simulator Experiments"

3. LEAVE BLANK

4. DATE REPORT COMPLETED

MONTH	YEAR
October	1984

5. AUTHOR(S)

C. A. Baldwin, F. B. K. Kam, and F. W. Stallmann

6. DATE REPORT ISSUED

MONTH	YEAR

7. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)

Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tennessee 37831

8. PROJECT/TASK/WORK UNIT NUMBER

NRC B&R No. 60 19 01 01

9. FIN OR GRANT NUMBER

B0415

10. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)

Division of Engineering Technology
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

11a. TYPE OF REPORT

Topical

b. PERIOD COVERED (Inclusive dates)

October 1984

12. SUPPLEMENTARY NOTES

13. ABSTRACT (200 words or less)

Three neutron dosimetry experiments were performed at the Oak Ridge Research Reactor Poolside Facility to study the feasibility of using the facility for the Fifth Nuclear Regulatory Commission Heavy Section Steel Technology Metallurgical Irradiations. The first two experiments revealed the original experimental configuration to be inadequate because the fluence rates estimated from the measured saturation activities were too low. In response to this, the core loading was changed and the entire experimental facility was moved closer to the core. A third experiment was performed and the resulting saturation activities and fluence rate estimates increased by approximately 40% at the points of interest. The latter fluence rate estimates were considered satisfactory, so no further changes were necessary.

This report describes the three characterization experiments in detail and gives all measurement results. An analysis of the results with regard to consistency and measurement uncertainty is also presented. It is shown that the experimental results are consistent within uncertainty bounds.

14. DOCUMENT ANALYSIS – a. KEYWORDS/DESCRIPTORS

Neutron Dosimetry

b. IDENTIFIERS/OPEN ENDED TERMS

15. AVAILABILITY STATEMENT

Unlimited

16. SECURITY CLASSIFICATION

(This page) Unclassified

(This report) Unclassified

17. NUMBER OF PAGES

18. PRICE