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FAST REACTOR EXPERIMENTAL SHIELDING PROGRESS REPORT FOR JANUARY 1974

189a No. 10028, Activity No. HN 04 01 01 1

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[redacted]

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Breeder Reactors Physics

Contract No. W-7405-eng-26

Neutron Physics Division

FAST REACTOR EXPERIMENTAL SHIELDING PROGRESS REPORT

for

JANUARY 1974

189a No. 10028, Activity No. HN 04 01 01 1

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MAY 1974

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TABLE OF CONTENTS

	Page
LIST OF FIGURES	iv
LIST OF TABLES	v
ABSTRACT	vi
EXPERIMENTAL PROGRAM FOR FY 1974	vii
INTRODUCTION	1
PROGRAM PLAN	1
EXPERIMENTAL RESULTS	6

LIST OF FIGURES

Page

Fig. 1. FTR First-Fission Experiment, Shield Configuration 1A, Item II-A. 12

Fig. 2. FTR First-Fission Experiment, Shield Configuration 1B, Item II-B. 13

Fig. 3. FTR First-Fission Experiment, Shield Configuration 2A (2-in. SS preceding axial shield omitted), Item II-C. 14

Fig. 4. FTR First-Fission Experiment, Shield Configuration 2B (2-in. SS slab preceding axial shield omitted), Item II-D. 15

Fig. 5. FTR First-Fission Experiment, Shield Configuration 3A (2-in. SS slab preceding axial shield omitted), Item II-E. 16

Fig. 6. FTR First-Fission Experiment, Shield Configuration 3B (2-in. SS slab preceding axial shield omitted), Item II-F. 17

Fig. 7. FTR First-Fission Experiment, Shield Configuration 4A, Item II-G. 18

Fig. 8. FTR First-Fission Experiment, Shield Configuration 4B, Item II-H. 19

Fig. 9. Demo First-Fission Experiment, Shield Configuration 5A, Item III-A. 27

Fig. 10. Demo First-Fission Experiment, Shield Configuration 5B, Item III-B. 28

Fig. 11. BF_3 and ^{235}U Fission Counter Vertical Traverse Within the 3-1/2-in. Void for the Demo First-Fission Shield Configuration 5B, Item III-B. 33

Fig. 12. Demo External-Vessel Experiment, Shield Configuration 6, Item III-C. 34

LIST OF TABLES

Page

Table 1. ^{235}U Fission Counter Characteristics. 20

Table 2. ^{235}U Fission Counter Measurements in the Bare Beam at 196-in. from Concrete Interface, Item I. 21

Table 3. ^{235}U Fission Counter (TSF #16) Measurements on Centerline at 1-1/2-in. Behind FTR First-Fission Shield Configurations 22

Table 4. BF_3 (SP-32) Measurements on Centerline Behind FTR First-Fission Shield Configurations. 23

Table 5. 3-in. Bonner Ball Measurements on Centerline Behind FTR First-Fission Shield Configurations 24

Table 6. Cd-Covered (SP-32) Horizontal Traverse at 1-1/2-in. Behind Inconel for Shield Configuration 1A, Item II-A. 25

Table 7. Cd-Covered BF_3 (SP-32) Horizontal Traverse Through Beam Centerline at 2-in. Behind SS for FTR First-Fission Shield Configuration 2B (2-in. SS Omitted), Item II-C. . . 26

Table 8. ^{235}U Fission Counter Measurements on Centerline Behind Demo First-Fission Shield Configurations 5A and 5B, Items III-A and III-B. 29

Table 9. BF_3 (SP-32) Measurements on Centerline Behind Demo First-Fission Shield Configurations 5A and 5B, Items III-A and III-B. 30

Table 10. Bare BF_3 (SP-32) Vertical Traverses Within the 3-1/2-in. Void for the Demo First-Fission Shield Configuration 5B, Item III-B. 31

Table 11. Cd-Covered BF_3 (SP-32) and Fission Counter (TSF #16) Vertical Traverses Within the 3-1/2-in. Void for the Demo First-Fission Shield Configuration 5B, Item III-B. . . . 32

Table 12. ^{235}U Fission Counter (TSF #16) Measurements in the Concrete Cavity Beyond the Full Demo Plant Radial Shield, Shield Configuration 6, Item III-C. 35

Table 13. Composition of Boroplaster Used in the FTR Ex-Vessel Experiment. 36

ABSTRACT

This report describes the work performed by the ORNL Neutron Physics Division in the Fast Reactor Experimental Shielding Research during the month of January, 1974. Additional FTR and Demo-Plant first-fission measurements were made because of a significant disagreement between earlier measurements and calculated results. Measurements were taken with several ^{235}U fission counters, a bare and Cd-covered BF_3 counter, and the 3-in. Bonner ball. A more comprehensive set of shield configurations were analyzed with two of the configurations being duplicates of experiments conducted during August and September 1973. Care was taken to ensure that the effects of reflected low-energy neutrons from either the ground or the air in back of the shield were eliminated. The new results were found to agree to within about 10 percent for the two configurations run earlier.

LMFBR Shielding Experiments at the Tower Shielding Facility

FY 1974

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
1. FTR Inconel Experiment	CCCC											
2. FTR Preliminary Stored Fuel Experiment		CCCC										
3. Demo Preliminary Stored Fuel Experiment			CCCC	C								
4. Total Cross-Section Check				CCC	CCCV							
5. [1]Demo Rod Drop						CCCV						
6. [1]FTR Stored Fuel Experiment Repeat							CC					
7. [2]Total Cross-Section Check							CC	XX				
8. Demo AI Experiment								XX	XXXX	XX		
9. [3]Demo Stored Fuel 3-D Experiment										XX	XXXX	XXXX

[1]These experiments are repeats and have five weeks allocated to them beyond the previous schedule.

[2]This experiment was rescheduled with one week increase in time to allow for vacations.

[3]This experiment was decreased by six weeks in FY 1974.

V = Vacation
X = Scheduled
C = Completed

INTRODUCTION

This monthly report presents the progress of the Fast Reactor Shielding program which is being conducted under 189a No. 10028. The results obtained in the repeat of the FTR and the Demo preliminary stored fuel experiments are documented herein. These experiments were repeated because of a significant disagreement between the measured and calculated results for the two experiments conducted during the months of August and September. The new results agree to within approximately 10 percent for two of the configurations run earlier.

PROGRAM PLAN

The program plan as scheduled for this experiment was prepared by ORNL for implementation during January FY 1974. The following is a listing of the experimental configurations which were utilized in the measurements of the "repeat" FTR and Demo first-fission experiments.

I. Bare Beam

   A. ^{235}U fission chambers (bare)

   B. ^{235}U fission chambers (Cd-covered)

II. FTR First-Fission Experiment

   A. Shield configuration 1A

      Spectrum modifier (4-in. SS + 6-in. Na + 1-in. Boral) + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel.

      1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline at 1-1/2 in. behind Inconel.

      2. BF_3 (SP-32) Cd-covered.

         a. On centerline at 1-1/2-in. behind Inconel.

         b. Radial traverse in horizontal plane at 1-1/2 in. behind Inconel.

3. 3-in. Bonner ball on centerline at 1-1/2 in. behind Inconel.

B. Shield Configuration 1B (Shield Configuration 1A reflected)

Spectrum modifier + 2-1/2-in. Inconel + 1-in. SS +2-1/2-in. Inconel + 3-1/2-in. Void + 4-in. SS

1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline within void at 1-1/2 in. behind Inconel.
2. BF_3 (SP-32) Cd-covered
   a. On centerline at 1-1/2-in. behind Inconel.
3. 3-in. Bonner ball on centerline at 1-1/2 in. behind Inconel.
4. 3-in. Bonner ball on centerline at 1-1/2 in. behind Inconel, 4-in. iron replaces 4-in. SS reflector.

C. Shield Configuration 2A

Spectrum Modifier + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel + 24-in. Axial Shield.

1. ^{235}U fission counter TSF (Cd-covered) on centerline at 1-1/2 in. behind configuration.
2. BF_3 (SP-32) Cd-covered.
   a. On centerline at 1-1/2 in. behind configuration.
   b. Radial traverse on horizontal plane at 1-1/2 in. behind configuration.
3. 3-in. Bonner ball on centerline at 1-1/2 in. behind configuration.

D. Shield Configuration 2B (Shield Configuration 2A reflected)

Spectrum modifier + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel + 24-in. axial shield + 3-1/2-in. void + 12-in. Na + 2-in. SS + 12-in. Na.

1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline within void at 1-1/2 in. behind axial shield.
2. BF_3 (CP-32) Cd-covered on centerline within void at 1-1/2 in. behind axial shield.
3. 3-in. Bonner ball on centerline within void at 1-1/2 in. behind axial shield.

E. Shield Configuration 3A

Spectrum modifier + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel + 24-in. axial shield + 12-in. Na + 2-in. SS + 12-in. Na.

1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline at 1-1/2 in. behind configuration.
2. BF_3 (SP-32) Cd-covered on centerline at 1-1/2-in. behind configuration.

F. Shield Configuration 3B (Shield Configuration 3B reflected)

Spectrum modifier + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel + 24-in. axial shield + 12-in. Na + 2-in. SS + 12-in. Na + 3-1/2-in. void + 24-in. Na

1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline within void at 1-1/2 in. behind Na.
2. BF_3 (SP-32) Cd-covered on centerline within void at 1-1/2 in. behind Na.

3. 3-in. Bonner ball on centerline within void at 1-1/2 in. behind Na.

G. Shield Configuration 4A

Spectrum modifier + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel + 2-in. SS + 24-in. axial shield + 12-in. Na + 2-in. SS + 12-in. Na

1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline at 1-1/2 in. behind configuration.
2. BF_3 (SP-32) Cd-covered on centerline at 1-1/2 in. behind configuration.
3. 3-in. Bonner ball on centerline at 1-1/2 in. behind configuration.

H. Shield Configuration 4B (Shield Configuration 4A reflected)

Spectrum modifier + 2-1/2-in. Inconel + 1-in. SS + 2-1/2-in. Inconel + 2-in. SS + 24-in. axial shield + 12-in. Na + 2-in. SS + 12-in. Na + 3-1/2-in. void + 24-in. Na.

1. ^{235}U fission counter TSF #16 (Cd-covered) on centerline within void at 1-1/2 in. behind Na.
2. BF_3 (SP-32) Cd-covered on centerline within void at 1-1/2 in. behind Na slab.
3. 3-in. Bonner ball on centerline within void at 1-1/2 in. behind Na slab.

III. Demo First-Fission Experiment

A. Shield Configuration 5A

Spectrum modifier + 10-in. blanket + 5-in. SS + 2-1/2-in. Inconel + 2-1/2-in. void + 2-1/2-in. Inconel + 2-in. SS +

4-in. Fe + 1-in. SS + 4-in. Fe + 1-in. SS + 2-in. Fe + 2-in. SS + 48-in. Na + 2-in. SS.

1. ^{235}U fission counter (bare and Cd-covered) on centerline at 1-1/2 in. (and 1-5/8 in.) behind configuration.

2. BF_3 (SP-32) bare and Cd-covered.

   a. Within 2-1/2-in. void between Inconel slots.

   b. On centerline at 1-1/2 in. behind configuration.

B. **Shield Configuration 5B (Shield Configuration 1A reflected)**

Spectrum modifier + 10-in. blanket + 5-in. SS + 2-1/2-in. Inconel + 2-1/2-in. void + 2-1/2-in. Inconel + 2-in. SS + 4-in. Fe + 1-in. SS + 4-in. Fe + 1-in. SS + 2-in. Fe + 2-in. SS + 48-in. Na + 2-in. SS + 3-1/2-in. void + 4-in. Fe.

1. BF_3 (SP-32) bare and Cd-covered within the void behind 2-in. SS.

   a. Vertical traverse, bare.

   b. Vertical traverse, Cd-covered.

2. Fission #16 vertical traverse, Cd-covered, within the void behind 2-in. SS.

C. Shield Configuration 6, followed by concrete cavity

Spectrum modifier + 10-in. blanket + 5-in. SS + 2-1/2-in. Inconel + 2-1/2-in. void + 2-1/2-in. Inconel + 2-in. SS + 4-in. Fe + 1-in. SS + 4-in. Fe + 1-in. SS + 2-in. Fe + 2-in. SS + 48-in. Na + 2-in. SS + 7-in. void + 1-in. SS + cavity with 3/8-in. Fe and 12-in. concrete around cavity.

1. ^{235}U fission counter (bare and Cd-covered) on centerline at 5/16 in. behind 1-in. SS in the cavity.

EXPERIMENTAL RESULTS

A series of measurements have been taken utilizing the ^{235}U fission counter, the bare and Cd-covered BF_3 counter, and the 3-in. Bonner ball behind a number of mockups of the FTR and the Demonstration Plant shield configurations. As a continuation of the FTR first-fission experiment, measurements were taken beyond a very thin shield (shield configuration 1A), which consisted of the spectral modifier followed by 5-in. Inconel and 1-in. stainless steel. Measurements were also taken for the same shield configuration with a 4-in. thick stainless steel reflector (shield configuration 1B). The reflector was intended to eliminate any background problems from low-energy neutrons. Shield configurations 2A and 2B correspond to a configuration which was run in an earlier experiment as the thinnest case. This shield contains no sodium but does contain the axial shield mockup. This configuration differs from the earlier one in that the 2-in. stainless steel slab forward to the axial shield was omitted. Measurements were also taken beyond an intermediate thickness shield (shield configuration 3A), which included the spectral modifier, the Inconel region, and the 24-in. axial shield followed by 24-in. sodium and 2-in. stainless steel. In this shield configuration, a 2-in.-thick piece of stainless steel, which should have been inserted prior to the 24-in.-thick axial shield, was inadvertently left out of the program plan. A complete set of measurements were obtained for this shield configuration, both unreflected and reflected, (shield configuration 2B) before it was determined that the 2-in. slab had been omitted. The 2-in. stainless steel slab was added to correct the intermediate thickness shield (now designated as shield configuration 4A) and a complete set of

measurements repeated for both unreflected and reflected (shield configuration 4B) conditions.

Measurements were also taken with the large cavity and the concrete reflector (shield configuration 6) and also with the Demo Plant full radial shield mockup (7-in. void and 1-in. steel guard vessel omitted). Measurements were taken in the latter case for unreflected and reflected conditions (shield configuration 5A and 5B, respectively).

Figure 1 shows configuration 1A in the FTR first fission repeat experiment. Figure 2 shows the same shield configuration with a 4-in. stainless steel reflector added beyond a 3-1/2-in. void into which the detectors were inserted for the measurements. Figure 3 shows shield configuration 2A and Fig. 4 shows the reflected case where the reflector is approximately 24-in. sodium. Figure 5 shows the configuration for the intermediate thickness shield where the stainless steel slab was omitted from the configuration. Figure 6 shows the intermediate thickness shield configuration with a 24-in. sodium reflector. Figures 7 and 8 show the intermediate thickness shield configuration (with the 2-in.-SS slab added before the axial shield) in the unreflected and reflected conditions respectively.

The characteristics of the various fission counter detectors used in this experiment are described in Table 1. TSF No. 16 is the TSF fission counter, the efficiency of which has been determined through a series of comparison measurements with a ^{239}Pu chamber of known efficiency. Measurements were taken with three other fission counters having various geometries and ^{235}U deposit thicknesses. The efficiency factors are closely related to the thickness of the ^{235}U deposits in the detector.

The efficiency factor was checked by placing the counter in the bare beam from the TSR and comparing the counting rate with a calculated counting rate. The results were reported in ORNL-TM-4420. The efficiency factors given in Table 1 were determined for the I&C detector and also the RS and the Y-12 detectors on the basis of the thickness of the ^{235}U deposit on the collecting electrodes. The data presented in Table 2 gives the fission rate in the various detectors per gram of uranium based on the efficiency factors given in Table 1. This fission rate should be about the same for all of the detectors because they were exposed to identical neutron fluxes. There is relatively good agreement between TSF No. 16 and the Y-12 chamber. Both of these detectors have a ^{235}U surface density of one milligram per square centimeter. It would appear that the efficiencies for the RSP 6 and the M-1037 chambers are not adequately known.

Table 3 presents the fission counter measurements obtained utilizing the TSF No. 16 counter beyond the various FTR shield configurations. Data are presented for both the Cd-covered and bare measurements. Table 4 presents the BF_3 detector measurements behind the various FTR shield configurations, again for both Cd-covered and bare detectors. Table 5 presents the 3-in. Bonner ball results taken beyond the various FTR shield configurations. Table 6 gives a Cd-covered BF_3 counter traverse taken behind the unreflected partial shield (shield configuration 1A). This data was taken to determine whether or not there were local streaming effects from the sides of the shield configuration which could contribute to the thermal flux at the center of the shield. The results given in Table 5 seem to indicate that no such streaming effects were present.

Table 7 gives a similar traverse beyond the somewhat thicker shield (shield configuration 2B), and again there is no indication of a streaming problem.

Figure 9 shows shield configuration 5A in the "repeat" Demo first-fission experiment and represents the full radial shield mockup with the exception of a 7-in. void and a 1-in.-thick steel guard vessel. Figure 10 shows a reflected version of that shown in Fig. 9 (shield configuration 5B). The reflector consists of 4-in. Fe beyond a 3-1/2-in. void. Table 8 presents ^{235}U fission counter measurement in both of the shield configurations shown in Figs. 9 and 10. Data are presented for two fission counters, the TSF counter #16 and the more sensitive I&C fission counter. Measurements were taken with both counters behind this configuration in order to get a direct comparison between counting rates for the two counters. The data were taken for the reflected configuration in order to eliminate the low energy neutron background caused by ground or air returns. Examination of the ratio of the bare to cadmium-covered detectors for the reflected and unreflected configurations indicates there is likely a considerable contamination of low energy flux in the unreflected configuration. Even for the reflected measurement there is a slight contamination due to thermal neutrons in-leakage from the edge of the system, as shown by the change in cadmium ratio for the cases where the cadmium was inserted on the sides and top and bottom of the inside surfaces of the cavity.

Table 9 gives the BF_3 measurements for the Demo first-fission shield configurations 5A and 5B. Measurements were taken in the 2-1/2-in. void in the forward region of the shield and also behind the full

shield configuration. Again, a change in cadmium ratio can be noted between the measurements internal to the shield and that external to the shield. As seen in the reflected configuration, even the lithium paraffin near the edge of the shield appears to increase the cadmium ratio for the BF_3 detector. Table 10 presents a series of bare BF_3 counter vertical traverses made in the 3-1/2-in. void. These measurements were taken to determine whether there were streaming problems from low energy neutrons from the sides edge of the shield to the centerline measurement position. Table 11 presents the cadmium-covered BF_3 vertical traverses within the 3-1/2-in. void and also the cadmium-covered fission counter vertical traverses taken in the 3-1/2-in. void beyond the Demo shield.

Figure 11 presents a plot of the radial traverses taken with both the BF_3 and the 235 fission counter in the 3-1/2-in. void beyond the Demo first fission shield configuration 5B. As can be seen by the upturn in the curves near the edges of the configuration, there are cases where there is a streaming component of neutrons into the cavity from the concrete at the bottom of the shield and from the region above the top of the shield. For the cadmium-covered measurements there appears to be no significant problem due to streaming into the center of the cavity for either the BF_3 counter or the cadmium-covered fission counter. It can be seen that cadmium on the bottom of the void has an effect clear to the center of the void in reducing the counting rate of the bare detector.

Figure 12 shows the configuration for fission counter measurements taken beyond the full Demo radial shield, shield configuration 6. The bare response was within 10 percent of the value measured in the earlier

experiments. Table 12 presents fission counter measurements in the concrete cavity beyond the full shield configuration.

The composition of the boroplaster used in the FTR ex-vessel experiment reported in the August & September Progress Report is presented in Table 13. The material was obtained from Reactor Experiments, San Carlos, California.

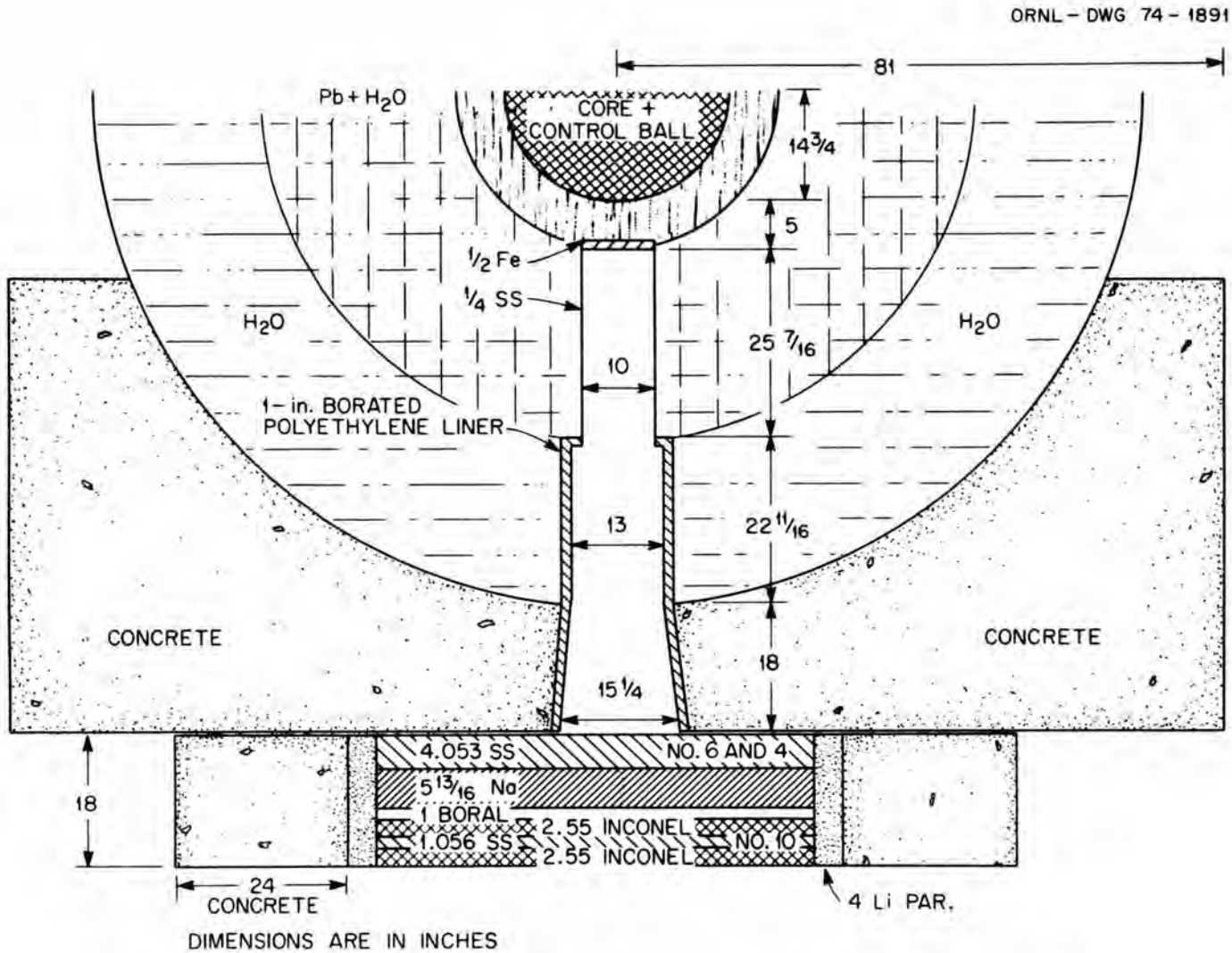

Fig. 1. FTR First-Fission Experiment, Shield Configuration 1A, Item II-A.

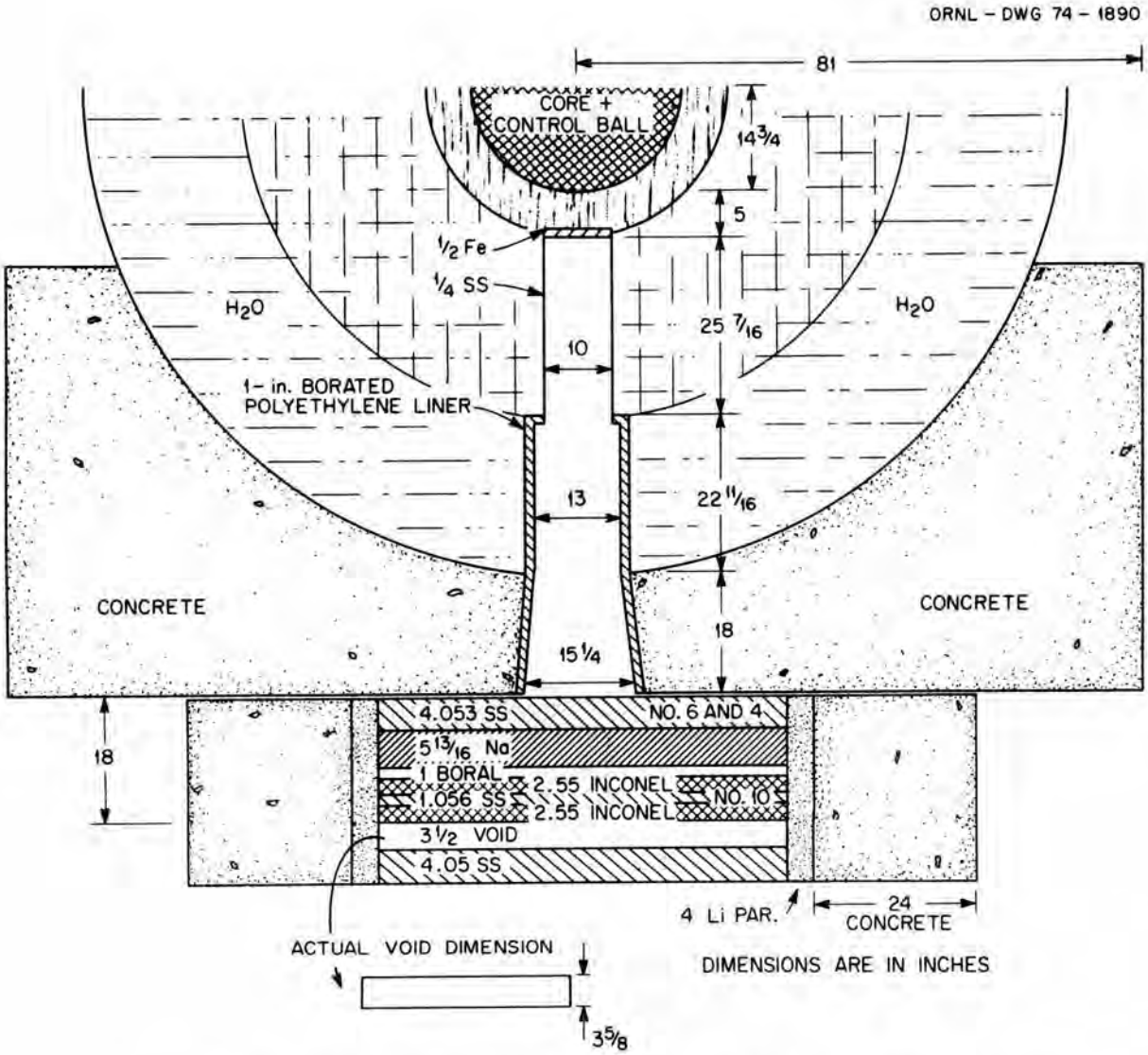

Fig. 2. FTR First-Fission Experiment, Shield Configuration 1B, Item II-B.

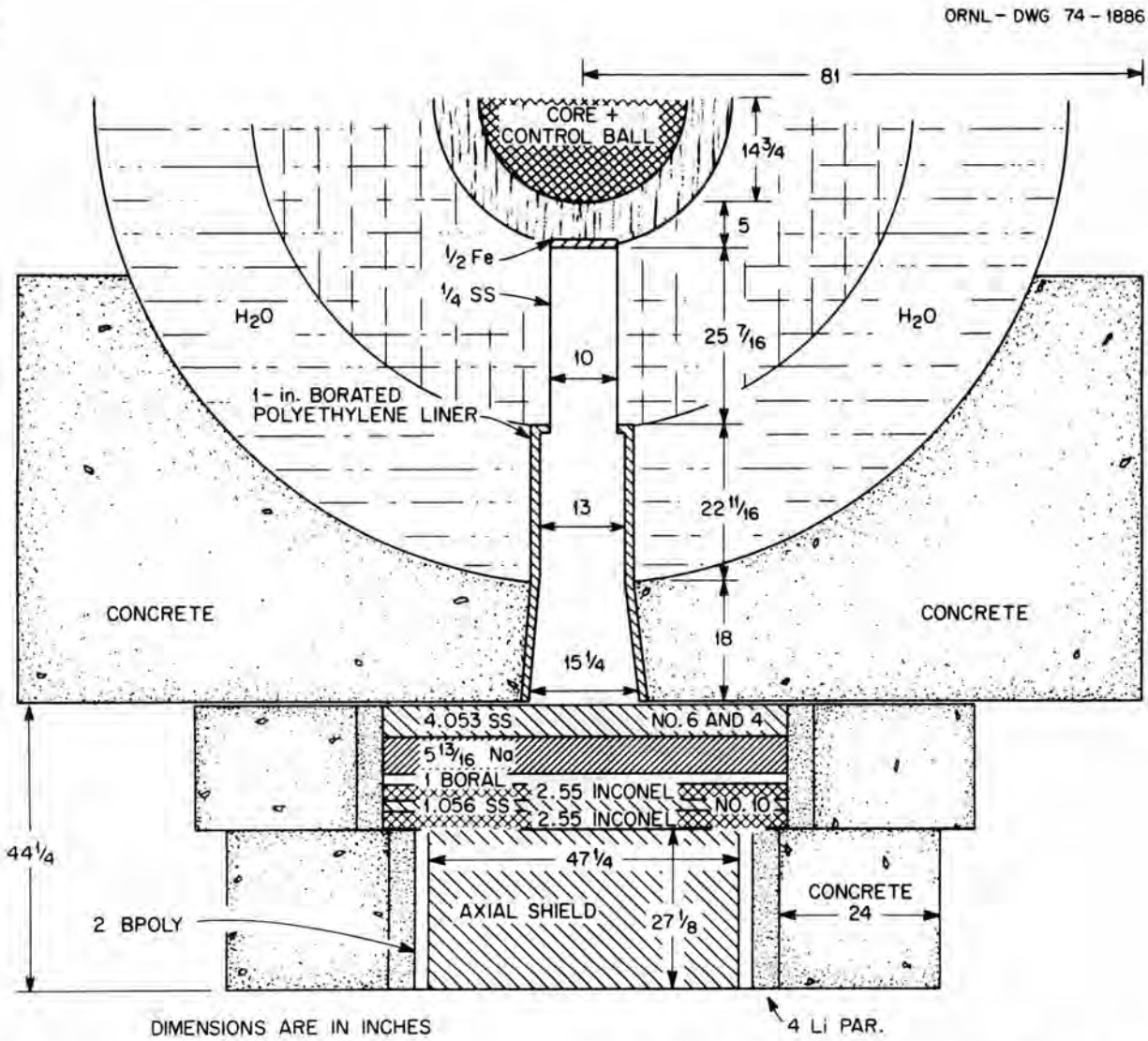

Fig. 3. FTR First-Fission Experiment, Shield Configuration 2A (2-in. SS preceding axial shield omitted), Item II-C.

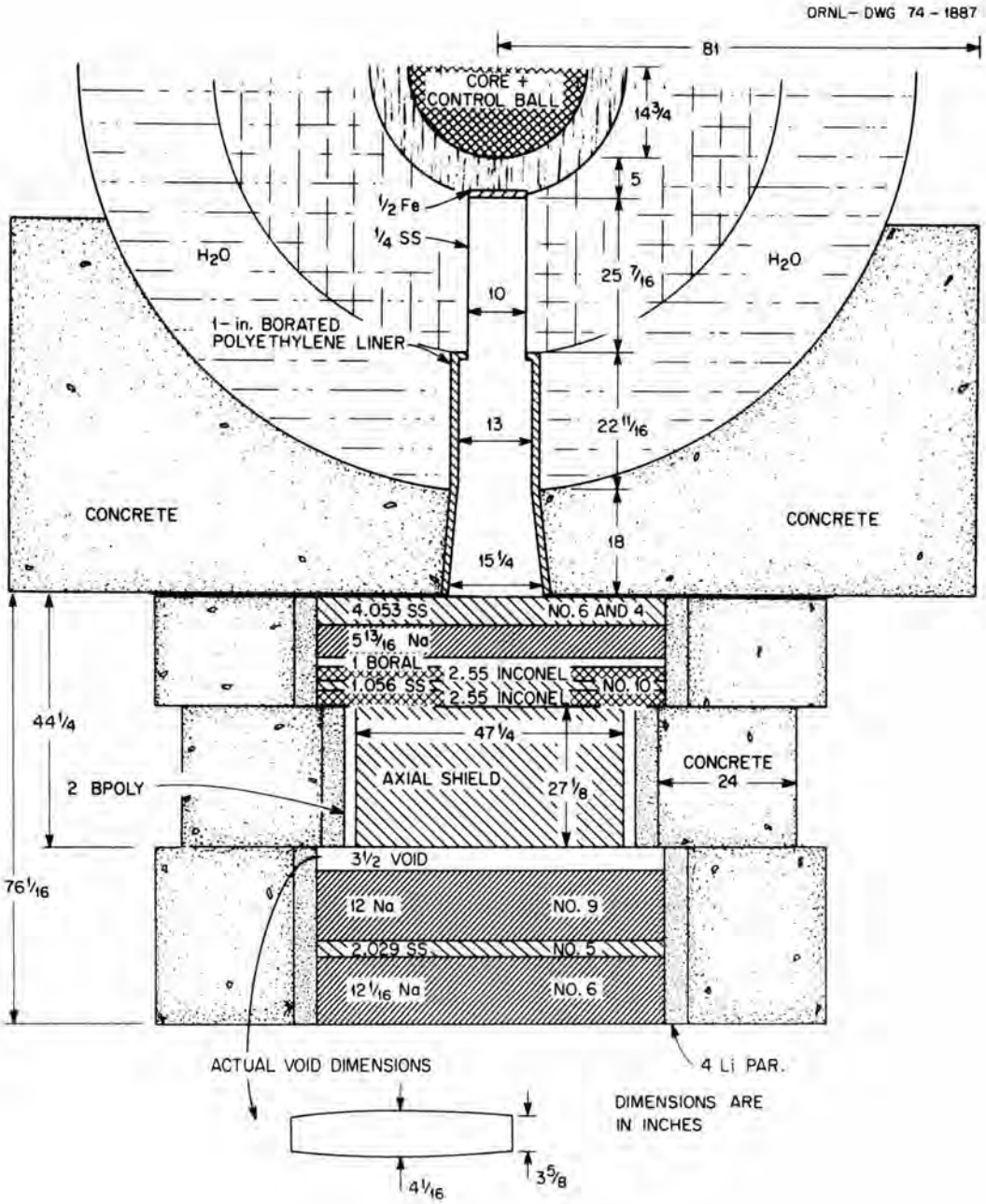

Fig. 4. FTR First-Fission Experiment, Shield Configuration 2B (2-in. SS slab preceding axial shield omitted), Item II-D.

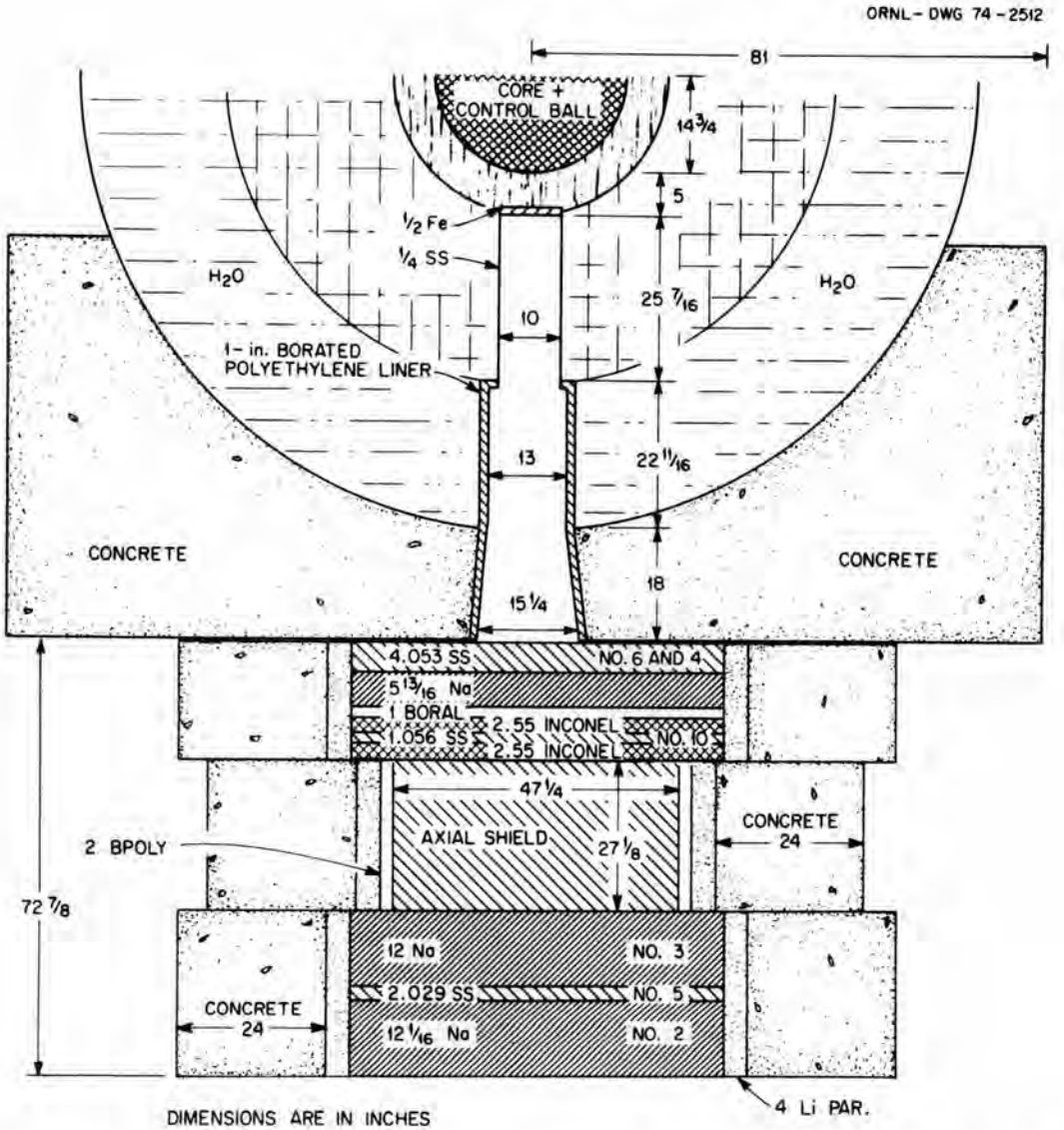

Fig. 5. FTR First-Fission Experiment, Shield Configuration 3A (2-in. SS slab preceding axial shield omitted), Item II-E.

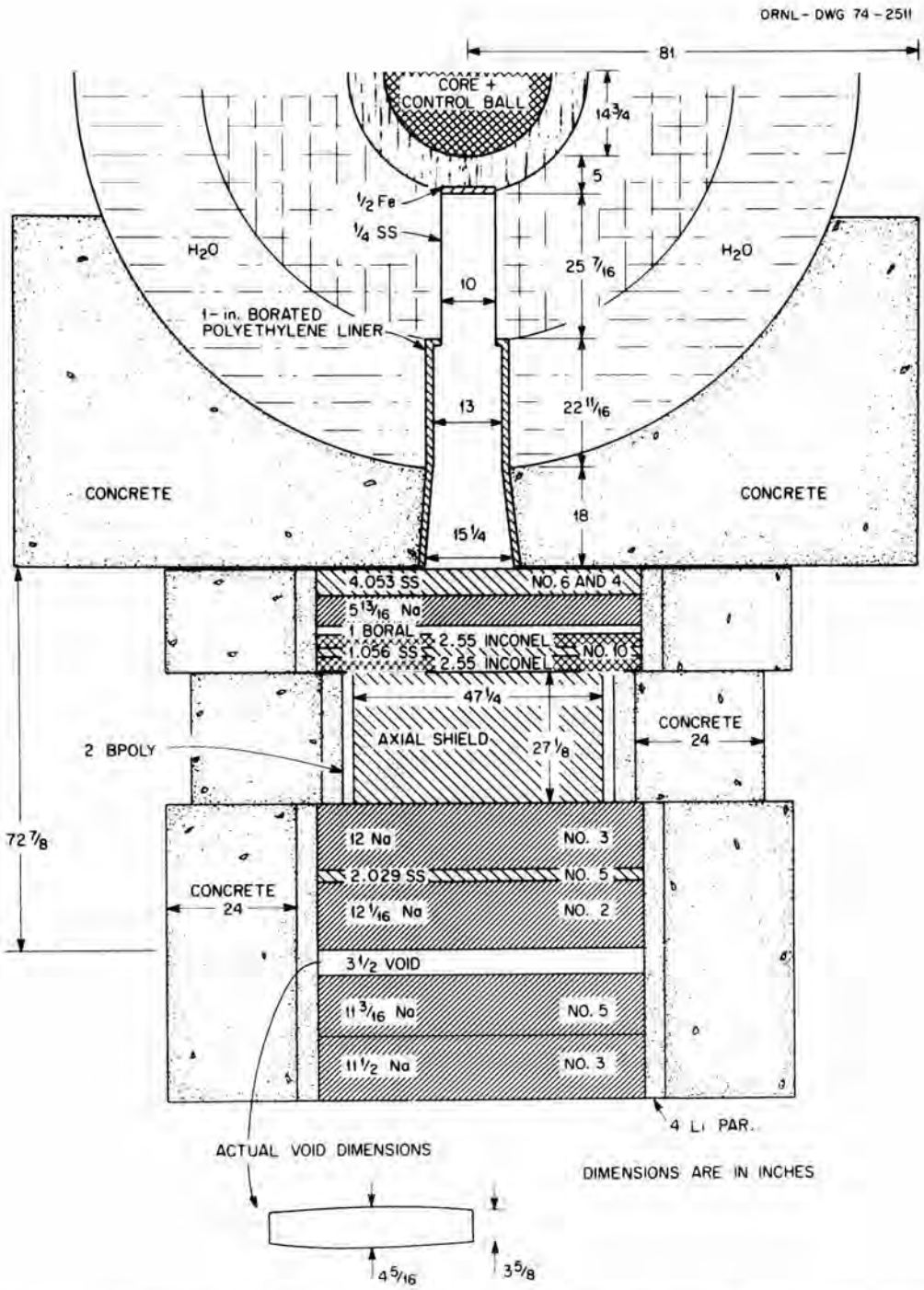

Fig. 6. FTR First-Fission Experiment, Shield Configuration 3B (2-in. SS slab preceding axial shield omitted), Item II-F.

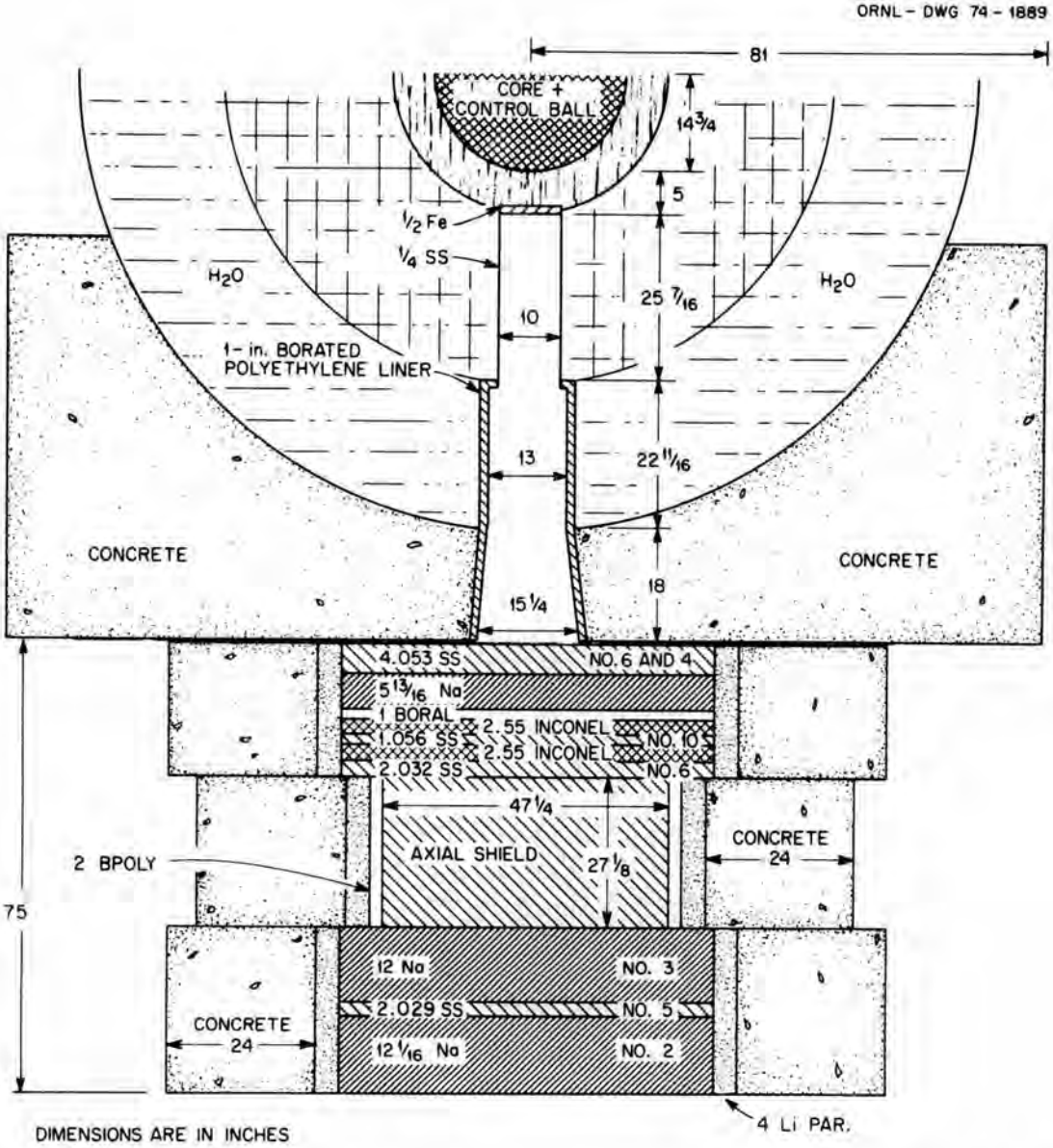

Fig. 7. FTR First-Fission Experiment, Shield Configuration 4A, Item II-G.

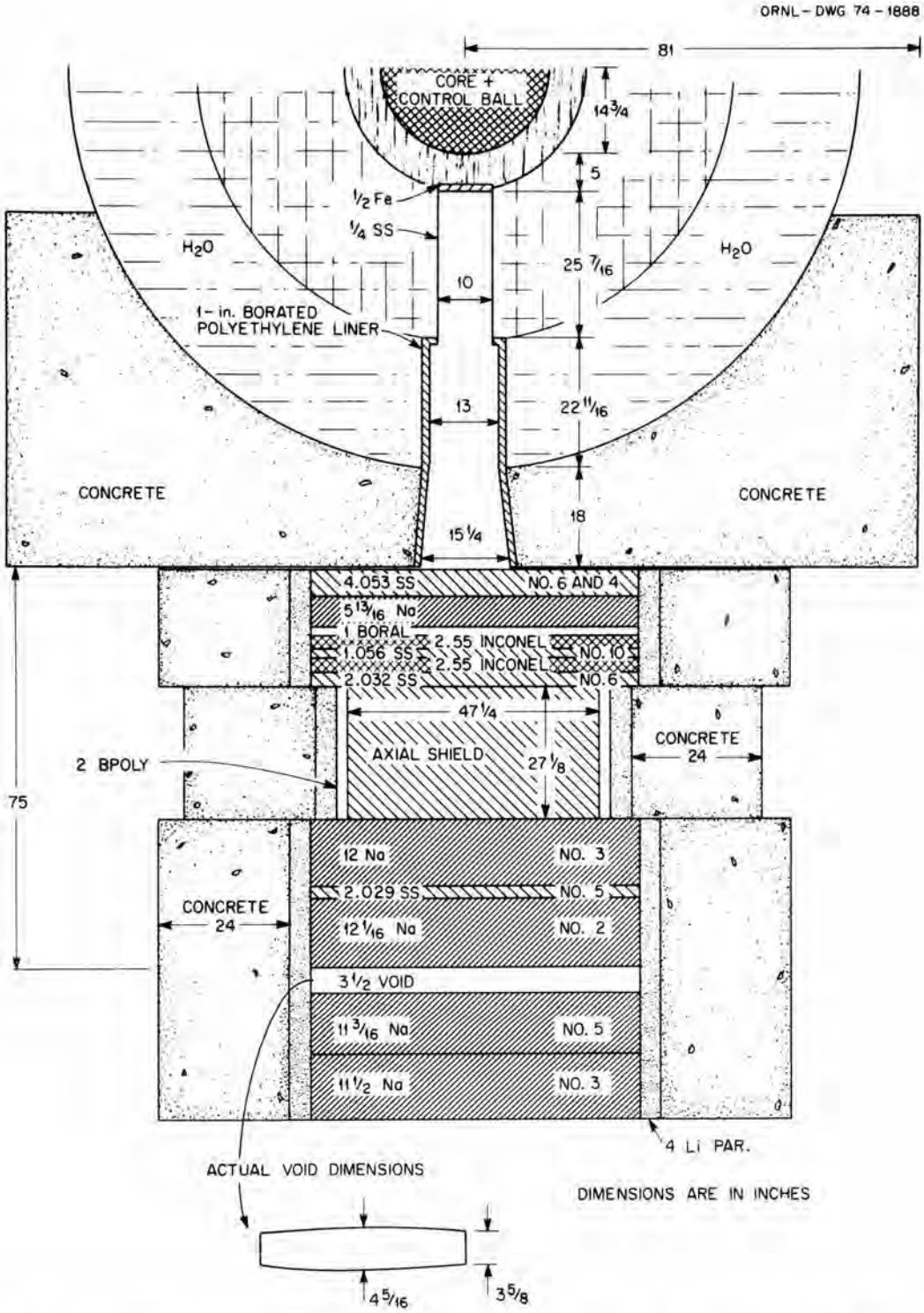

Fig. 8. FTR First-Fission Experiment, Shield Configuration 4B, Item II-H.

Table 1. ^{235}U Fission Counter Characteristics

Detector Designation	^{235}U Content		Efficiency Factor
	Total (mg)	mg/cm^2	
TSF #16	31.36	1.0	.70
M-1037 (I&C)	1700	2.0	.50
RS-P6-0807-101	89.0		.83
Y-12	5.2	1.0	.69

Table 2. ^{235}U Fission Counter Measurements in the Bare Beam at 196-in. from Concrete Interface, Item I.

Detector Designation	Bare or Cd-Covered	Detector Angle with Beam CL	Detector Response Fissions per Sec/kW/gr ^{235}U
TSF #16	Bare	0°	7.890(4)
	Bare	0°	7.990(4)
	Bare	90°	7.930(4)
	Cd-Covered	0°	3.038(3)
	Cd-Covered	0°	2.986(3)
	Cd-Covered	90°	3.023(3)
RS-P6-0807-101	Bare	0°	7.095(4)
	Bare	0°	7.044(4)
	Cd-Covered	0°	2.673(3)
	Cd-Covered	0°	2.671(3)
M-1037 (I&C)	Bare	0°	8.794(4)
	Bare	0°	8.511(4)
	Cd-Covered	0°	3.386(3)
	Cd-Covered	0°	3.314(3)
Y-12	Bare	0°	8.397(4)
	Bare	0°	8.145(4)
	Bare	0°	8.538(4)
	Cd-Covered	0°	3.121(3)
	Cd-Covered	0°	3.042(3)

Table 3. ^{235}U Fission Counter (TSF #16) Measurements on Centerline at 1-1/2-in. Behind FTR First-Fission Shield Configurations

Shield Configuration	Item	Cd-Covered ^{235}U Fission Counter Response (cpm/MW)
#1A	II-A	1.06 (6)
#1B	II-B	3.75 (6)
#2A	II-C	2.97 (4)
#2B	II-D	1.11 (5)
#3A	II-E	6.13 (3)
#3B	II-F	1.62 (4)
#4A	II-G	4.27 (3)
#4B	II-H	No Measurement with TSF #16
		Bare ^{235}U Fission Counter Response (cpm/MW)
#1B	II-B	4.64 (6)
#4A	II-G	5.07 (3)

Table 4. BF_3 (SP-32) Measurements on Centerline Behind FTR First-Fission Shield Configurations

Shield Configuration	Item	Detector Location (in. behind shield config.)	Cd-Covered* BF_3 Response (cpm/MW)
#1A	II-A	2-in.	1.79 (7)
#1B	II-B	Within 3-1/2-in. Void	8.10 (7)
#2A	II-C	1-1/2 in.	6.85 (5)
		2-in.	6.66 (5)
#2B	II-D	Within 3-1/2-in. Void	2.80 (6)
#3A	II-E	1-1/2 in.	1.67 (5)
#3B	II-F	Within 3-1/2-in. Void	4.80 (5)
#4A	II-G	1-1/2-in., Cd on Concrete	1.196 (5)
			1.704 (5) bare
		4-in., Cd on Concrete	1.06 (5)
			1.555 (5) bare
		4-in., Cd on back, top, sides, and bottom of detector.	1.43 (5) bare
#4B	II-H	Within 3-1/2-in. Void	3.54 (5)

*Except as noted for the bare detector.

Table 5. 3-in. Bonner Ball Measurements on Centerline Behind FTR First-Fission Shield Configurations

Shield Configuration	Item	Detector Location (in. behind Shield Configuration)	3-in. Bonner Ball Response (cpm/MW)
#1A	II-A	1-1/2 in.	9.51 (8)
#1B Reflected (4-in. SS)	II-B	1-1/2 in.	3.19 (9)
#1B Reflected (4-in. Fe)	II-B	1-1/2 in.	3.10 (9)
#2A	II-C	1-1/2 in.	2.27 (7)
#2B	II-D	Within 3-1/2 in. Void Following Axial Shield	7.16 (7)
#3A	II-E	1-1/2 in.	2.94 (6)
#3B	II-F	Within 3-1/2 in. Void Following Na	7.97 (6)
#4A	II-G	1-1/2 in. 4-in.	2.20 (6) 1.87 (6)
#4B	II-H	Within 3-1/2-in. Void Following Na	5.55 (6)

Table 6. Cd-Covered BF_3 (SP-32) Horizontal Traverse at 1-1/2-in. Behind Inconel for Shield Configuration 1A, Item II-A.

Detector Location (in. from Beam Centerline)	BF_3 Detector Response (cpm/1 MW)
28" S	4,160,000
27	4,168,000
24	4,716,000
21	5,878,000
18	7,284,000
15	9,131,000
12	11,343,000
9	13,637,000
6	15,746,000
3	17,356,000
CL	17,843,000
CL	17,994,000
3" N	17,713,000
6	16,272,000
9	14,270,000
12	11,957,000
15	9,879,000
18	8,098,000
21	6,630,000
24	5,642,000
27	5,065,000
29	5,127,000

Table 7. Cd-Covered BF_3 (SP-32) Horizontal Traverse Through Beam Centerline at 2-in. Behind SS for FTR First-Fission Shield Configuration 2B (2-in. SS Omitted), Item II-C

Detector Location (in. from Beam Centerline)	BF_3 Detector Response (cpm/1 MW)
21" S	272,870
18	344,540
15	411,030
12	494,360
9	565,000
6	612,900
3	645,370
CL	653,620
3" N	644,270
6	607,080
9	549,040
12	482,780
15	394,800
18	311,710
21	227,410
22 1/2	195,160

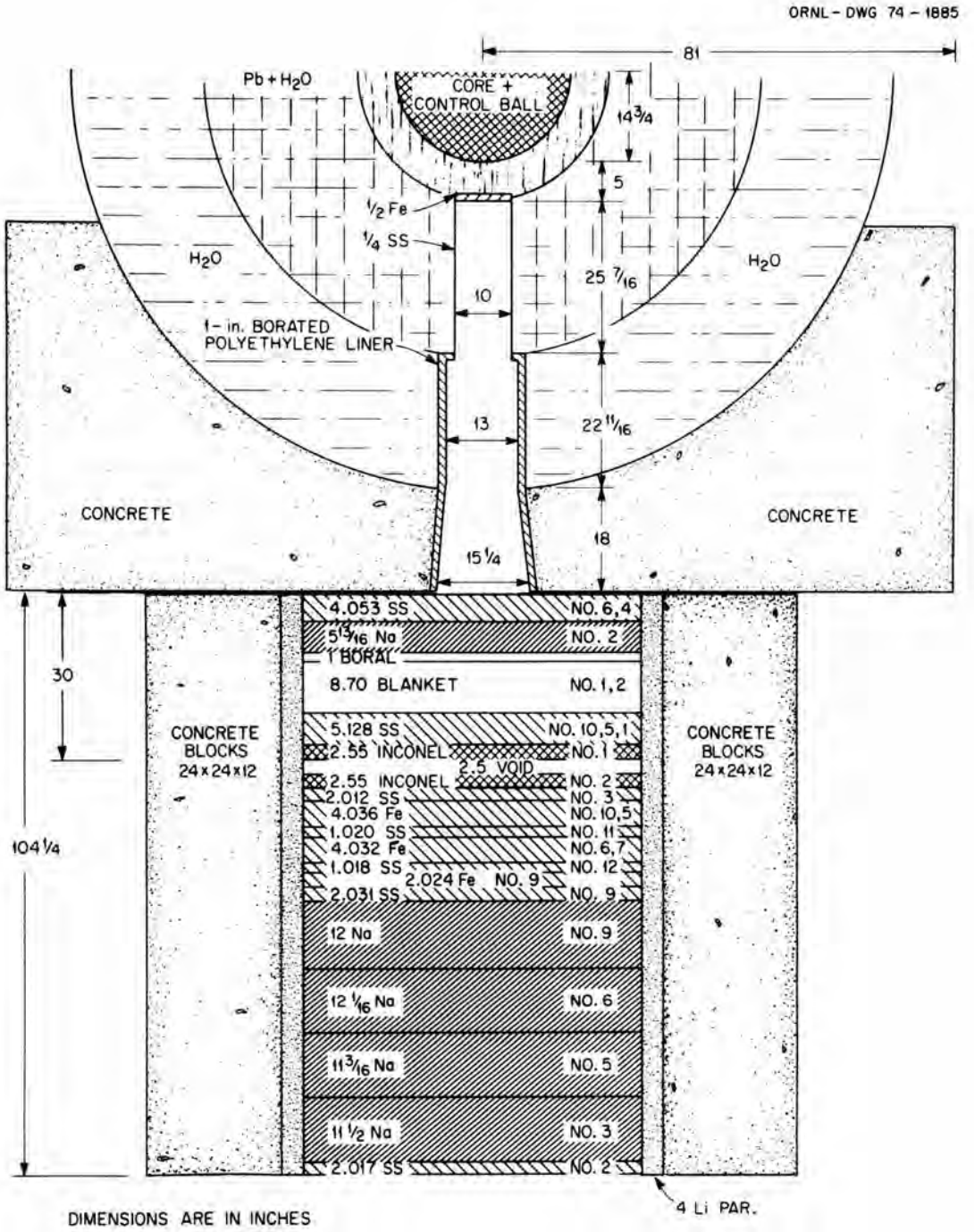

Fig. 9. Demo First-Fission Experiment, Shield Configuration 5A, Item III-A.

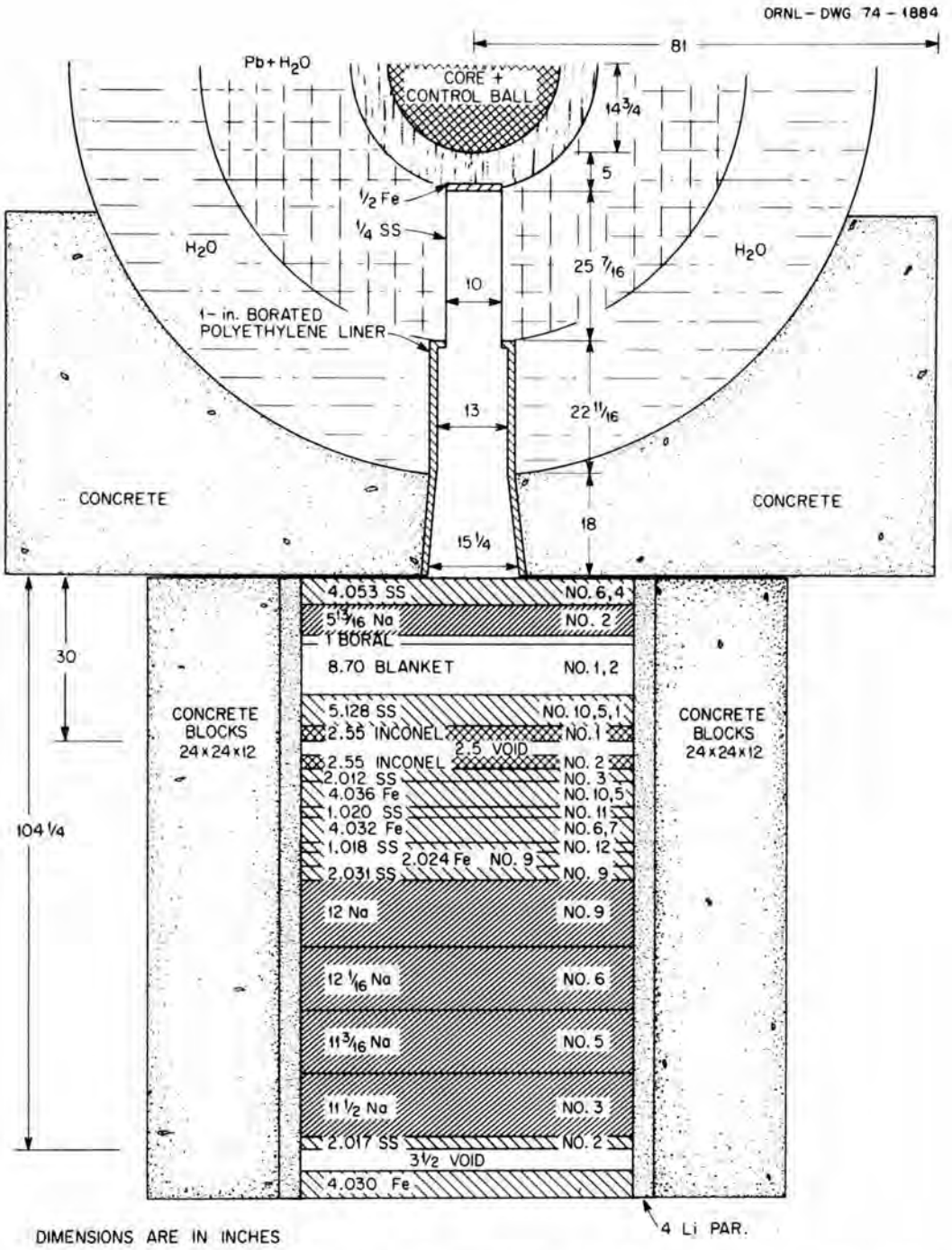

Fig. 10. Demo First-Fission Experiment, Shield Configuration 5B, Item III-B.

Table 8. ^{235}U Fission Counter Measurements on Centerline Behind Demo First-Fission Shield Configurations 5A and 5B Items III-A and III-B.

Detector Description	Detector Orientation	Detector Location (in. behind SS Slab)	Bare or Cd-Covered	Detector Response (cpm/1 MW)	Ratio Bare/ Cd-Covered
		Shield Configuration 5A			
TSF #16	Vertical	1 5/8"	Cd-Covered	472	
	Vertical	1 5/8"	Bare	726	
	Horizontal	1 1/2"	Cd-Covered	473	
	Horizontal	1 1/2"	Bare	773	1.63
M-1037 (I&C)	Vertical	1 1/2"	Cd-Covered	20,630	
	Vertical	1 1/2"	Bare	30,900	1.50

Detector Description	Detector Location	Condition in Void	Bare or Cd-Covered	Detector Response (cpm/1 MW)	Ratio Bare/ Cd-Covered
		Shield Configuration 5B (Reflected)			
TSF #16	*	No Cd	Cd-Covered	1,554	
TSF #16	*	No Cd	Bare	1,993	1.28
TSF #16	*	**	Cd-Covered	1,485	
TSF #16	*	**	Bare	1,662	1.12

*Vertical in 3-1/2" Void on Beam Centerline.

**Cd on both sides, top, bottom, and over Fe surface.

Table 9. BF_3 (SP-32) Measurements on Centerline Behind Demo First Fission Shield Configurations 5A and 5B Items III-A and III-B.

Shield Configuration 5A

Detector Location	Bare or Cd-Covered	BF_3 Detector Response (cpm/1 MW)	Ratio Bare/ Cd-Covered
2-1/2" Void	Cd-Covered	38,076,000	1.23
2-1/2" Void	Bare	46,772,000	-
1-1/2" behind 2" SS	Cd-Covered	15,360	-
1-1/2" behind 2" SS	Bare	27,850	1.81

Shield Configuration 5B (Reflected)

Detector Location in 3-1/2-in. Void	Bare or Cd-Covered	Condition in Void	BF_3 Detector Response (cpm/1 MW)	Ratio Bare/ Cd-Covered
Centerline	Bare	Cd on bottom, sides, top & over Fe surface	55,980	
30" North of CL against Li Par	Cd-Covered	No Cd	18,150	
30" North of CL against Li Par	Bare	No Cd	44,040	2.43

Table 10. Bare BF_3 (SP-32) Vertical Traverses Within the 3-1/2-in. Void for the Demo First-Fission Shield Configuration 5B, Item III-B.

No Cd in 3-1/2-in. Void		Cd Cover on Bottom of Void		Cd Cover on Bottom and Sides of Void	
Detector Location (in. from Beam CL)	BF_3 Response (cpm/MW)	Detector Location (in. from Beam CL)	BF_3 Response (cpm/MW)	Detector Location (in. from Beam CL)	BF_3 Response (cpm/MW)
33-in. above	207,710	38-in. above	50,100	38-in. above	51,720
30	85,280	35	98,290	35	108,640
27	63,230	32	95,710	32	98,910
24	59,900	29	69,380	29	72,790
21	61,100	26	55,860	26	58,390
18	63,640	23	54,040	23	55,120
15	66,510	20	56,160	20	57,150
12	70,330	17	59,890	17	59,950
9	72,760	14	62,570	14	62,980
6	74,610	11	65,360	11	65,980
4	75,060	8	68,000	8	68,130
2	74,890	5	69,830	5	69,760
1	74,590	2	71,410	2	70,480
1	75,030	CL	70,380	CL	71,010
CL	75,110	2-in. below	69,910	2-in. below	70,600
CL	75,070	5	69,110	5	69,110
1-in. below	74,780	8	65,720	8	65,470
2	74,870	11	62,790	11	62,250
4	74,470	14	58,480	14	57,670
6	73,040	17	53,870	17	53,810
9	71,210	20	49,990	20	47,750
12	68,780	23	44,620	23	43,580
15	66,960	26	39,430	26	38,880
18	65,230	29	33,920	27.8	36,630
21	65,090				
23	67,600				
24	70,080				
26	79,760				
27	88,770				
29.2	125,220				

Table 11. Cd-Covered BF_3 (SP-32) and Fission Counter (TSF #16) Vertical Traverses Within the 3-1/2-in. Void for the Demo First-Fission Shield Configuration 5B, Item III-B.

Cd-Covered BF_3 (SP-32)		Cd-Covered Fission Counter (TSF #16)	
Detector Location (in. from Beam CL)	Response (cpm/MW)	Detector Location (in. from Beam CL)	Response (cpm/MW)
36-in. above	16,680	30-in. above	471
33	20,690	27	608
30	20,580	24	795
27	25,900	21	980
24	32,050	18	1092
18	41,860	15	1227
12	49,540	12	1259
6	54,444	9	1408
3	55,240	6	1425
CL	54,690	3	1456
3-in. below	54,610	CL	1454
6	52,690	2-1/2-in. below	1468
12	47,180	5-1/2	1435
18	37,750	8-1/2	1379
21	33,340	11-1/2	1269
24	30,910	14-1/2	1137
28	30,810	17-1/2	1051
		20-1/2	892
		23-1/2	773
		26-1/2	577

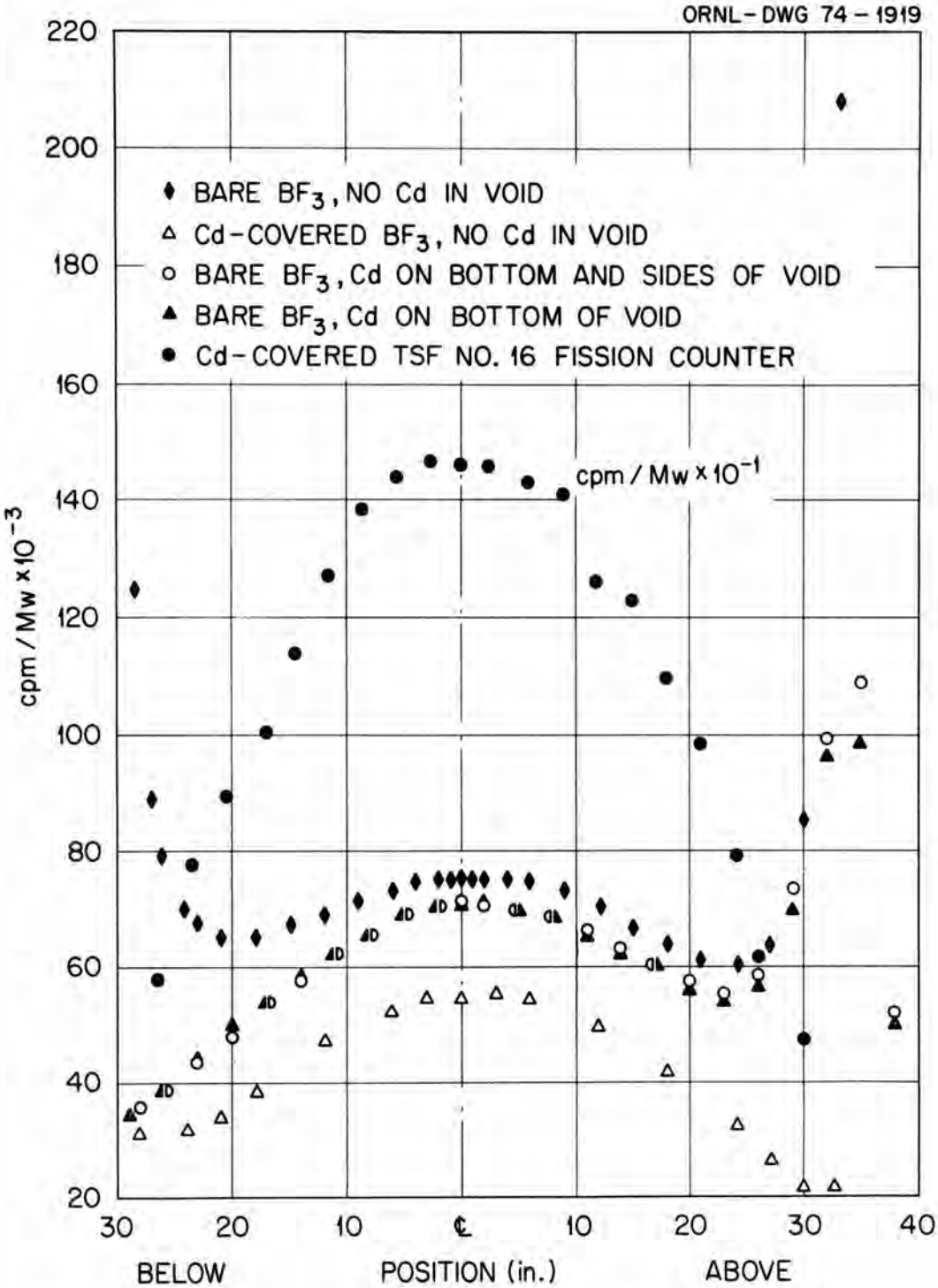

Fig. 11. BF_3 and ^{235}U Fission Counter Vertical Traverse Within the 3-1/2-in. Void for the Demo First-Fission Shield Configuration 5B, Item III-B.

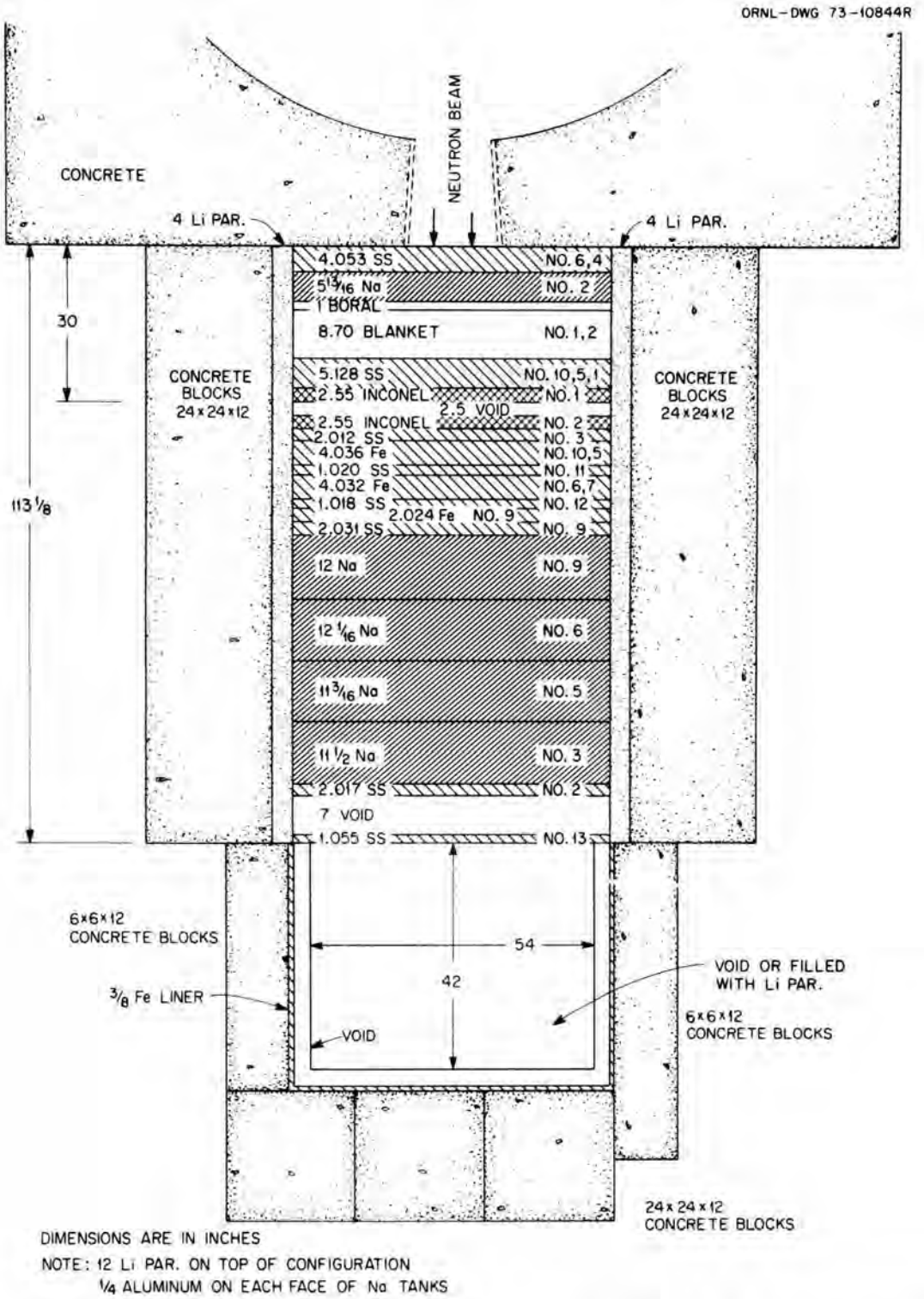

Fig. 12. Demo External-Vessel Experiment, Shield Configuration 6, Item III-C.

Table 12. ^{235}U Fission Counter (TSF #16) Measurements in the Concrete Cavity Beyond the Full Demo Plant Radial Shield, Shield Configuration 6, Item III-C.

Bare or Cd-Covered	Detector Location (in. behind slab configuration)	^{235}U Fission Counter Response (cpm/MW)
Bare	5/16 in.	554
Cd-Covered	5/16 in.	287

Table 13. Composition of Boroplaster Used in the FTR Ex-Vessel Experiment

Item	Wt %
Boron	5.55 or 17.86% B_2O_3
Calcium	14.85
Sulphate	36.51 or 12.19% S
Oxygen	60.7
Carbon	0.36
Water	28.99
Silicon	0.16
Carbonate	0.23
Bulk Density	1.319 g/cc

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