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CONSTRUCTION REPORT

GA17-7 (P13N) IRRADIATION CAPSULE

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INTRODUCTION

The PL3N (GAL7-7) capsule experiment is under irradiation in the Experimental Test Reactor (ETR) I-13-SW position. It is scheduled for an accumulated peak neutron exposure of 6×10^{21} n/cm² (peak fluence) ($E > 0.18$ Mev). The design temperatures are 1350° and 1500°C. The capsule began its irradiation in cycle 114E on January 27, 1972 and is due for discharge at the end of the calendar year.

This report presents a detailed description of the capsule, including fuel sample weights and dimensions, dimensions of capsule components, and piggyback (secondary) experiment locations. The report is intended as a guide for operational thermal analysis, as a reference for postirradiation examination, and as a reference for future capsule design.

DESCRIPTION OF CAPSULE EXPERIMENT

The capsule is described in detail in drawing 90-SK799B. The fuel samples are doubly contained in the capsule. The outer stainless steel tube provides the secondary containment and operates in contact with the reactor cooling water. Aluminum spacers separate the outer containment from the Inconel 600 primary containment. Slots are provided in the spacers for the vertical passage of thermocouples and gas lines from the cells up into the lead tube. There are five primary containments, one for each cell, which house the interlocking graphite crucibles that contain the samples.

The gaps between the Inconel cans and the aluminum spacers are used for temperature control. This area is common to all the cells; the gas in the gaps (and thus the thermal resistance of the gaps) can be changed from helium to argon. Additionally, the gas in the gaps between the graphite crucible and Inconel can, and all the other radial gaps in each cell, can be changed individually for temperature control. The capsule is designed to operate at peak specimen temperatures of 1350°C for Cells 2,3, and 5 and 1500°C for Cells 1 and 4 and contains 30 thermocouples for temperature monitoring.

SPECIMENS

The primary specimens in the experiment are fuel particles in bonded beds (fuel rods) and loose beds. Secondary specimens of various core materials and experimental carbons and pyrolytic carbons are contained in the remaining available space in the cells.

The detailed descriptions of the start-of-life conditions of all samples are given in the following tables:

1 through 7	Fuel rods
8 and 9	Fuel particle samples
10	Piggyback specimens

THERMOCOUPLES

Data pertinent to the thermocouples used in the experiment are given in Table 11.

DOSIMETRY

Flux wire dosimetry in the Pl3N capsule consists of three wires having the following composition:

Alloy	Wire Size	Use
Al-0.1% Co	0.020"	Thermal flux determination
V-0.45 Fe (Fe enriched to 85-86% with Fe ⁵⁴)	0.015"	Fast flux determination
Fe (99.99% pure)	0.015"	Fast flux determination

The dosimetry is housed in quartz (Supersil), vials which have been evacuated and back-filled with argon. The vials are placed in two grooves 180° apart in the aluminum thermal spacer. The location of the grooves is related to the capsule identification stamped on the bottom end cap as shown in Fig. 1. The orientation of the capsule in the ETR core and the arrangement of the core at the time of insertion are also shown in Fig. 1. The dosimetry lies ~ 40° off the true north-south location. Dosimetry lengths and locations are given in Table 12.

CAPSULE COMPONENT DIMENSIONS

Fuel rod dimensions are listed in Tables 1 through 5. Dimensions pertinent to heat transfer analysis of the remainder of the capsule components are presented in Tables 13, 14, and 15.

SPECIAL FEATURES OF CAPSULE DESIGN

The following three features are from a previous capsule and are incorporated in Pl3N:

1. Caps grooved to direct gas flow away from the thermocouples inside of the primary containment.
2. Oversheaths on the thermocouples in the secondary containment area.
3. Charcoal-filled void spaces to dampen vibrations and provide oxidation protection.

TABLE 1

PREIRRADIATION FUEL ROD DIMENSIONS FOR CELL 1 OF CAPSULE PL3N

<u>Fuel Rod</u>	<u>(a)</u> <u>Measurement</u>	<u>Micrometer</u>			<u>Length</u> <u>(in.)</u>
		<u>A</u> <u>Diam.</u> <u>(in.)</u>	<u>B</u> <u>Diam.</u> <u>(in.)</u>	<u>C</u> <u>Diam.</u> <u>(in.)</u>	
1A-5	0°	0.4852	0.4864	0.4872	
	90°	0.4875	0.4886	0.4892	
	Center				0.7345
	0°				0.7354
	90°				0.7357
1B-8	0°	0.4842	0.4844	0.4853	
	90°	0.4845	0.4850	0.4852	
	Center				0.7300
	0°				0.7301
	90°				0.7304
1C-10	0°	0.4836	0.4842	0.4852	
	90°	0.4853	0.4863	0.4861	
	Center				0.7310
	0°				0.7313
	90°				0.7319
1D-1 (161-4)	0°	0.4902	0.4916	0.4905	
	90°	0.4907	0.4918	0.4905	
	Center				0.7350
	0°				0.7345
	90°				0.7342
1E-3	0°	0.4840	0.4841	0.4850	
	90°	0.4831	0.4834	0.4845	
	Center				0.7282
	0°				0.7282
	90°				0.7281

(a) Orientation per Fuels Development Div. photograph

TABLE 2

PREIRRADIATION FUEL ROD DIMENSIONS FOR CELL 2 OF CAPSULE P13N

<u>Fuel Rod</u>	<u>Measurement</u>	<u>Micrometer</u>			<u>Length</u> <u>(in.)</u>
		A Diam. (in.)	B Diam. (in.)	C Diam. (in.)	
2A-10	0°	0.4872	0.4872	0.4879	
	90°	0.4859	0.4859	0.4875	
	Center				0.7373
	0°				0.7368
	90°				0.7373
2B-15	0°	0.4849	0.4849	0.4854	
	90°	0.4847	0.4856	0.4861	
	Center				0.7310
	0°				0.7345
	90°				0.7341
2C-7	0°	0.4856	0.4868	0.4876	
	90°	0.4834	0.4857	0.4870	
	Center				0.7291
	0°				0.7321
	90°				0.7314
2D-16	0°	0.4840	0.4857	0.4856	
	90°	0.4853	0.4863	0.4859	
	Center				0.7348
	0°				0.7350
	90°				0.7350

(a) Orientation per Fuels Development Div. photograph

TABLE 3

PREIRRADIATION FUEL DIMENSIONS FOR CELL 3 OF CAPSULE P13N

<u>Fuel Rod</u>	<u>Measurement</u> (a)	<u>Micrometer</u>			<u>Length</u> (in.)
		<u>A</u> <u>Diam.</u> (in.)	<u>B</u> <u>Diam.</u> (in.)	<u>C</u> <u>Diam.</u> (in.)	
3A-1 (162-1)	0°	0.4904	0.4916	0.4909	
	90°	0.4897	0.4914	0.4904	
	Center				0.7350
	0°				0.7354
	90°				0.7344
3B-9	0°	0.4854	0.4855	0.4859	
	90°	0.4859	0.4863	0.4867	
	Center				0.7344
	0°				0.7348
	90°				0.7351
3C-13	0°	0.4841	0.4848	0.4848	
	90°	0.4844	0.4850	0.4853	
	Center				0.7309
	0°				0.7324
	90°				0.7319
3D-7	0°	0.4840	0.4851	0.4855	
	90°	0.4845	0.4854	0.4865	
	Center				0.7290
	0°				0.7290
	90°				0.7319

(a) Orientation per Fuels Development photograph

TABLE 4

PREIRRADIATION FUEL ROD DIMENSIONS FOR CELL 4 OF CAPSULE P13N

<u>Fuel Rod</u>	<u>Measurement^(a)</u>	<u>Micrometer</u>			<u>Length</u> <u>(in.)</u>
		<u>A</u> <u>Diam.</u> <u>(in.)</u>	<u>B</u> <u>Diam.</u> <u>(in.)</u>	<u>C</u> <u>Diam.</u> <u>(in.)</u>	
4A-13	0°	0.4832	0.4840	0.4847	
	90°	0.4826	0.4836	0.4842	
	Center				0.7297
	0°				0.7294
	90°				0.7304
4B-9	0°	0.4848	0.4858	0.4864	
	90°	0.4827	0.4841	0.4849	
	Center				0.7292
	0°				0.7302
	90°				0.7321
4C-9	0°	0.4853	0.4849	0.4846	
	90°	0.4830	0.4843	0.4841	
	Center				0.7334
	0°				0.7334
	90°				0.7331
4D-7	0°	0.4856	0.4878	0.4886	
	90°	0.4854	0.4865	0.4876	
	Center				0.7295
	0°				0.7317
	90°				0.7324

(a) Orientation per Fuels Development photograph

TABLE 5

PREIRRADIATION FUEL ROD DIMENSIONS FOR CELL 5 OF CAPSULE PL3N

<u>Fuel Rod</u>	<u>Measurement</u> ^(a)	<u>Micrometer</u>			<u>Length</u> <u>(in.)</u>
		A Diam. <u>(in.)</u>	B Diam. <u>(in.)</u>	C Diam. <u>(in.)</u>	
5X-7	0°	0.4844	0.4851	0.4860	
	90°	0.4837	0.4850	0.4858	
	Center				0.7289
	0°				0.7297
	90°				0.7295
5A-19	0°	0.4822	0.4836	0.4840	
	90°	0.4826	0.4836	0.4842	
	Center				0.7298
	0°				0.7353
	90°				0.7356
5B-6	0°	0.4812	0.4839	0.4866	
	90°	0.4825	0.4846	0.4857	
	Center				0.7300
	0°				0.7336
	90°				0.7334
5C-6	0°	0.4844	0.4848	0.4848	
	90°	0.4842	0.4842	0.4848	
	Center				0.7322
	0°				0.7322
	90°				0.7323
5D-25	0°	0.4848	0.4864	0.4870	
	90°	0.4833	0.4849	0.4863	
	Center				0.7283
	0°				0.7314
	90°				0.7317

(a) Orientation per Fuels Development Div. photograph

TABLE 6"

FUEL ROD COMPOSITION OF CAPSULE PL3N

<u>Capsule Location</u>		<u>Sample No.</u>	<u>Fissile Fuel Particles</u>		<u>Fertile Fuel Particles</u>		<u>Inert Particles</u>	
<u>Cell</u>	<u>Position</u>		<u>Batch No.</u>	<u>Type</u>	<u>Batch No.</u>	<u>Type</u>	<u>Batch No.</u>	<u>Type</u>
5	D	5D-25	E1319B1LSL	UC ₂ -TRISO	CT6A-2463	ThC ₂ -TRISO	3516-149	C-TRISO
5	C	5C-9	E1319B1LSL	UC ₂ -TRISO	T1353B1L	ThC ₂ -BISO	3516-149	C-TRISO
5	B	5B-7	U01344B1LSL-2	UO ₂ -TRISO	T01357B1L	ThO ₂ -BISO	---	---
5	A	5A-19	U01344B1LSL-2	UO ₂ -TRISO	T01357B1L	ThO ₂ -BISO	---	---
5	X	5X-7	5466-37E	(Th,U)O ₂ -TRISO	T01357B1L	ThO ₂ -BISO	3516-149	C-TRISO
4	D	4D-9	U01344B1LSL-2	UO ₂ -TRISO	T01372B1LSL-5	ThO ₂ -TRISO	3516-147	C-TRISO
4	C	4C-9	U01344B1LSL-2	UO ₂ -TRISO	T01357B1L	ThO ₂ -BISO	3516-147	C-TRISO
4	B	4B-9	U01344B1LSL-2	UO ₂ -TRISO	T01372B1LSL-5	ThO ₂ -TRISO	3516-149	C-TRISO
4	A	4A-13	U01344B1LSL-2	UO ₂ -TRISO	T01357B1L	ThO ₂ -BISO	---	---
3	D	3D-7	E1319B1LSL	UO ₂ -TRISO	CT6A-2463	ThC ₂ -TRISO	3516-147	C-TRISO
3	C	3C-13	E1319B1LSL	UC ₂ -TRISO	T1353B1L	ThC ₂ -BISO	3516-147	C-TRISO
3	B	3B-9	E1319B1LSL	UC ₂ -TRISO	T1353B1L	ThC ₂ -BISO	3516-147	C-TRISO
3	A	3A(162-1)	OR-1602	UCS-TRISO	OR1562	ThO ₂ -BISO	---	---
2	D	2D-16	U01344B1LSL-2	UO ₂ -TRISO	T01357B1L	ThO ₂ -BISO	3516-149	C-TRISO
2	C	2C-7	U01344B1LSL-2	UO ₂ -TRISO	T01372B1LSL-5	ThO ₂ -TRISO	3516-149	C-TRISO
2	B	2B-15	U01344B1LSL-2	UO ₂ -TRISO	T01357B1L	ThO ₂ -BISO	3516-149	C-TRISO
2	A	2A-10	U01344B1LSL-2	UO ₂ -TRISO	T01372B1LSL-5	ThO ₂ -TRISO	3516-149	C-TRISO
1	E	1E-3	5466-37E	(Th,U)O ₂ -TRISO	T01357B1L	ThO ₂ -BISO	3516-147	C-TRISO
1D	D	1D-(161-4)	OR-1602	UC ₂ -TRISO	OR-1562	ThO ₂ -BISO	---	---
1	C	1C-10	E1319B1LSL	UC ₂ -TRISO	T1353B1L	ThC ₂ -BISO	3516-147	C-TRISO
1	B	1B-8	E1319B1LSL	UC ₂ -TRISO	T1353B1L	ThC ₂ -BISO	3516-147	C-TRISO
1	A	1A-5	E1319B1LSL	UC ₂ -TRISO	CT6A-2463	ThC ₂ -TRISO	3516-147	C-TRISO

TABLE 7

CAPSULE P13N FUEL ROD LOADINGS

Sample No.	Volume (cm ³)	Particle	Fissile Fuel		Particle	Fertile Fuel		Inert Particles
			Volume (a) (cm ³)	U(93%enr.) (g)		Volume (a) (cm ³)	U, Th ²³² (g)	Volume (a) (cm ³)
5D	2.12	UC ₂ T	0.10	0.0373	ThC ₂ T	2.02	1.61	0.00
5C	2.17	UC ₂ T	0.15	0.053	ThC ₂ B	2.02	1.39	0.00
5B	2.17	UO ₂ T	0.36	0.121	ThO ₂ B	1.69	1.77	0.12
5A	2.17	UO ₂ T	0.31	0.106	ThO ₂ B	1.75	1.83	0.11
5X	2.12	ThUO ₂ T	0.72	0.112	ThO ₂ B	1.40	1.475	0.00
4D	2.12	UO ₂ T	0.21	0.0716	ThO ₂ T	1.85	1.91	0.06
4C	2.17	UO ₂ T	0.27	0.0900	ThO ₂ B	1.80	1.89	0.10
4B	2.17	UO ₂ T	0.22	0.0730	ThO ₂ T	1.90	1.95	0.05
4A	2.12	UO ₂ T	0.22	0.0743	ThO ₂ B	1.94	2.04	0.00
3D	2.12	UC ₂ T	0.14	0.050	ThC ₂ T	1.98	1.59	0.00
3C	2.17	UC ₂ T	0.15	0.054	ThC ₂ B	1.61	1.11	0.41
3B	2.17	UC ₂ T	0.15	0.053	ThC ₂ B	1.55	1.065	0.47
3A	2.12	UC ₂ TR	0.29	0.0510	ThC ₂ B	1.28	1.40	0.00 (b)
2D	2.12	UO ₂ T	0.21	0.0535	ThO ₂ B	1.06	1.11	0.85
2C	2.17	UO ₂ T	0.22	0.054	ThO ₂ T	1.54	1.59	0.41
2B	2.17	UO ₂ T	0.23	0.058	ThO ₂ B	0.95	0.997	0.99
2A	2.12	UO ₂ T	0.25	0.0635	ThO ₂ T	1.82	1.875	0.05
1E	2.12	ThUO ₂ T	0.73	0.1135	ThO ₂ B	1.39	1.46	0.00
1D	2.17	UC ₂ TR	0.37	0.0650	ThC ₂ B	1.22	1.34	0.00 (b)
1C	2.17	UC ₂ T	0.23	0.082	ThC ₂ B	1.94	1.34	0.00
1B	2.17	UC ₂ T	0.22	0.079	ThC ₂ B	1.95	1.345	0.00
1A	2.12	UC ₂ T	0.17	0.0615	ThC ₂ T	1.95	1.56	0.00

(a) For reference only

(b) Matrix diluted

TABLE 8

COMPOSITION OF CAPSULE P13N LOOSE FUEL PARTICLE BEDS

Capsule Position		Fuel Particle			Fuel Particle Loading				Reference Microradiograph
Cell	Position	Sample No.	Type	Sieve Size (μm)	Density (g/cm^3)	Required (g)	Actual (g)	Loading Decrease (%)	
4	4	(U-44)1344	UO ₂ -TRISO	>380<417	2.345	0.3285	0.3285	0.0	U100
4	3	(U-33)1344	UO ₂ -TRISO	>417	2.580	0.0292	0.0292	0.0	U99
4	2	5466-37	(Th,U)O ₂ - TRISO	>420<840	2.37	0.2877	0.2632	8.52	U127
4	1	(U-90)1344	UO ₂ -TRISO	>417<460	>2.28<2.35	0.0696	0.0502	27.87	U126
4	4	(U-78)1357	ThO ₂ -BISO	>701<740	3.27	1.0479	0.9613	8.26	U130
4	3	(U-83)1357	ThO ₂ -BISO	>740<790	3.080	1.1242	0.9392	16.46	U129
4	2	(U-81)1357	ThO ₂ -BISO	>701<740	3.147	1.0692	0.9395	12.13	U128
4	1	T01372B1LSL-5	ThO ₂ -TRISO	>595<840	3.65	1.0269	1.0269	0.0	U115
3	4	(U-48)1319	UC ₂ -TRISO	>351<380	2.515	0.0686	0.0686	0.0	U104
3	3	(U-50b)1319	UC ₂ -TRISO	>380<417	2.708	0.0496	0.0496	0.0	U117
3	2	(U-49)1319	UC ₂ -TRISO	<351	2.515	0.0703	0.0703	0.0	U102
3	1	(U-50a)1319	UC ₂ -TRISO	>380<417	2.708	0.0500	0.0500	0.0	U116
3	4	(U-69)1353	ThC ₂ -BISO	>701<740	2.708	0.8723	0.6466	25.87	U125
3	3	(U-77)1353	ThC ₂ -BISO	>650<701	>2.955<3.08	0.7852	0.6298	19.79	U124
3	2	(U-73)1353	ThC ₂ -BISO	>650<701	2.955	0.8303	0.6731	18.93	U123
3	1	CT6A-2463	ThC ₂ -TRISO	>420<840	3.05	0.9415	0.7310	22.36	U122
2	4	(U-33)1344	UO ₂ -TRISO	>417	2.580	0.0558	0.0558	0.0	U94
2	3	(U-90)1344	UO ₂ -TRISO	>417<460	>2.28<2.35	0.0730	0.0730	0.0	U93
2	2	5466-37	(Th,U)O ₂ -TRISO	>420<840	2.37	0.1589	0.1641	3.27 ⁽²⁾	U121
2	1	(U-44)1344	UO ₂ -TRISO	>380<417	2.345	0.0978	0.0978	0.0	U92
2	4	(U-81)1357	ThO ₂ -BISO	>701<740	3.147	0.8961	0.7135	20.38	U118
2	3	(U-83)1357	ThO ₂ -BISO	>740<790	3.080	0.9251	0.6547	29.23	U119
2	2	(U-78)1357	ThO ₂ -BISO	>701<740	3.27	0.6786	0.5460	19.54	U120
2	1	T01372B1LSL-5	ThO ₂ -TRISO	>595<840	3.65	0.8614	0.8614	0.0	U114

(a) Percent increase (rather than decrease) in loading due to error in chemistry (12.25% U was used instead of 12.65% U)

TABLE 9

CAPSULE P13N LOOSE FUEL PARTICLE BED LOADINGS						
<u>Fissile</u>		<u>Fuel</u>		<u>Fertile</u>		<u>Fuel</u>
Sample		Volume ^(a)	U(93% enr.)		Volume ^(a)	Th ²³²
No.	Particle	(cm ³)	(g)	Particle	(cm ³)	(g)
4-4	UO ₂ T	0.174	0.0588	ThO ₂ B	0.50	0.525
4-3	UO ₂ T	0.020	0.0068	ThO ₂ B	0.50	0.525
4-2	ThUO ₂ T	0.233	0.0364	ThO ₂ B	0.50	0.525
4-1	UO ₂ T	0.0304	0.0103	ThO ₂ T	0.50	0.515
3-4	UC ₂ T	0.0368	0.0133	ThC ₂ B	0.525	0.362
3-3	UC ₂ T	0.0368	0.0133	ThC ₂ B	0.525	0.362
3-2	UC ₂ T	0.0372	0.0135	ThC ₂ B	0.525	0.362
3-1	UC ₂ T	0.0370	0.0134	ThC ₂ T	0.525	0.420
2-4	UO ₂ T	0.0385	0.0130	ThO ₂ B	0.420	0.440
2-3	UO ₂ T	0.0319	0.0108	ThO ₂ B	0.420	0.432
2-2	ThUO ₂ T	0.129	0.0201	ThO ₂ B	0.324	0.340
2-1	UO ₂ T	0.052	0.0175	ThO ₂ T	0.420	0.432

(a) For reference only

TABLE 10

CAPSULE P13N PIGGYBACK SAMPLE IDENTIFICATION AND LOCATION

CELL 1

<u>Hole No.</u>	<u>POSITION</u>				
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
1	3-6	10-5	none	31-1	4-7
2	14-2	9-5	none	32-1	3-4
3	13-2	23-2	none	6-4	14-6
4	18-3	25-2	none	5-4	13-1
5	17-2	27-2	none	22-2	35-4
6	4-10	10-6	none	36-3	17-1
7	3-7	9-6	none	33-3	4-8
8	22-3	29-2	none	34-4	3-5
9	16-5	31-2	none	21-1	22-1
10	4-9	12-4	none	39-1	2-4
11		14-3	none	40-1	2-5

CELL 2

1	2-18	5-3	none	4-4	none
2	1-3	6-3	none	3-1	none
3	7-5	No. 1 KAAE	none	7-3	none
4	8-6	No. 2 KAAE	none	8-3	none
5	18-6	36-2	none	18-5	none
6	2-19	35-3	none	14-4	none
7	3-3	34-3	none	4-5	none
8	7-6	33-2	none	3-2	none
9	8-7	4-6	none	7-4	none
10	14-5	No. 3 KAAE	none	8-4	none
11		No. 4 KAAE	none	8-5	none
12			none	14-7	none

CELL 3

<u>Hole No.</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
1	KAAE	2-6	none	23-1	none
2	KAAE	2-7	none	24-1	none
3	KAAE	2-8	none	25-1	none
4	16-6	2-9	none	26-1	none
5	6-2	2-10	none	27-1	none
6	5-2	2-11	none	28-1	none
7	KAAE	2-12	none	29-1	none
8	2-17	2-13	none	30-1	none
9	12-5	2-14	none	4-11	none
10	18-4	2-15	none	2-16	none
11	KAAE	2-1	none		none
12	KAAE		none		none

CELL 4

1	PRICE 1	16-4	none	---
2	4-3	18-2	none	9-3
3	2	KAAE	none	---
4	3	12-3	none	8-1
5	4	14-1	none	7-1
6	5	KAAE	none	10-4
7	6	16-3	none	9-4
8	4-2	KAAE	none	8-2
9	7	KAAE	none	7-2
10	8	KAAE	none	18-1
11	9	KAAE	none	10-3
12	10		none	

CELL 5

<u>Hole No.</u>	<u>X</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
1	No. 1 EC	5-1	none	12-6	none
2	No. 2 EC	6-1	none	12-7	none
3	No. 6 KAAE	19-1	none	11-1	none
4	11-2	20-1	none	12-1	none
5	12-2	35-1	none	15-1	none
6	No. 7 KAAE	36-1	none	16-1	none
7	15-2	33-1	none	10-1	none
8	16-2	34-1	none	12-8	none
9	No. 8 KAAE	9-2	none	16-7	none
10	No. 10-2	2-3	none	18-7	none
11	No. 5 KAAE	4-1	none	15-3	none

Note: Piggyback positions in the split thimbles are arbitrarily numbered from 1 through 10,11, or 12 clockwise, depending on the number of holes available in a given crucible for piggyback samples. Hole No. 1 is one position counterclockwise from the notched split as viewed from the loading end.

Fig. 1 Location and orientation of Pl3N capsule in ETR core

TABLE 11

CAPSULE PL3N THERMOCOUPLES

<u>TC</u> <u>No.</u>	<u>Cell No.</u> <u>and Location</u>	<u>Manufacturer</u> (a)	<u>Junction</u>	<u>Serial No.</u>
W1	1, Crucible	AR	Grounded, BC	890
W2	1, Crucible	SEMCO	Grounded, BC	894
W3	1, Crucible	SEMCO	Grounded, BC	886
W4	2, Crucible	AR	Grounded, BC	883
W5	2, Crucible	AR	Grounded, BC	895
W6	2, Crucible	SEMCO	Grounded, BC	884
W7	2, Crucible	SEMCO	Grounded, BC	888
W8	3, Crucible	SEMCO	Grounded, BC	889
W9	3, Crucible	AR	Grounded, BC	903
W10	3, Crucible	AR	Grounded, BC	901
W11	3, Crucible	AR	Grounded, BC	902
W12	4, Crucible	SEMCO	Grounded, BC	904
W13	4, Crucible	SEMCO	Grounded, BC	905
W14	4, Crucible	SEMCO	Grounded, BC	906
W15	4, Crucible	SEMCO	Grounded, BC	907
W16	4, Crucible	SEMCO	Grounded, BC	908
W17	5, Crucible	SEMCO	Grounded, BC	909
W18	5, Crucible	AR	Grounded, BC	910
W19	5, Crucible	SEMCO	Grounded, BC	911
K1	1, Crucible	CSG	Isolated, BC	849
K2	1, Crucible	CSG	Isolated, BC	847
K3	2, Crucible	CSG	Isolated, BC	848
K4	3, Crucible	CSG	Isolated, BC	846
K5	5, Crucible	CSG	Grounded, BC	850
K6	5, Crucible	CSG	Grounded, BC	851
K7	1, Inconel Can	CSG	Grounded, BC	852
K8	2, Inconel Can	CSG	Isolated, BC	845
K9	3, Inconel Can	CSG	Isolated, BC	842
K10	4, Inconel Can	CSG	Isolated, BC	843
K11	5, Inconel Can	CSG	Isolated, BC	844

(a) AR - Aero Research

SEMCO - Scientific Engineering and Manufacturing Co. Inc.

CSG - Claud S. Gordon Co.

TABLE 12

CAPSULE P13N DOSIMETRY LOCATION

<u>Location</u>	<u>Distance From Top of Core to Center Line</u>	<u>Flux Wire Length (In.)</u>
Cell 1	32.16	1.00
Cell 2	25.50	1.12
Cell 3	18.84	1.25
Cell 4	12.19	1.38
Cell 5	5.25	1.50
Above Cell 5	2.50	0.50

TABLE 13

CAPSULE P13N PRIMARY CONTAINMENT DIMENSIONS

	<u>Cell 1</u>	<u>Cell 2</u>	<u>Cell 3</u>	<u>Cell 4</u>	<u>Cell 5</u>
Number of Tungsten Radiation Shield Layers	none	none	2 opposite Loose Bed	2 opposite Loose Bed and Position D	2 opposite position D
Inconel Primary Containment .					
i.d.	0.9509/ 0.9524	0.9514/ 0.9532	0.9509/ 0.9536	0.9514/ 0.9538	0.9538/ 0.9528
o.d.	1.0038/ 1.0048	1.0030/ 1.0040	1.0034/ 1.0043	1.0031/ 1.0040	1.0010/ 1.0029
step o.d.	-----	0.9773/ 0.9791	0.9768/ 0.9785	0.9762/ 0.9783	-----
Aluminum Thermal Bond					
i.d.	1.0094	1.0090/ 1.0100	1.0096	1.0095	1.0093
o.d.	1.1770	1.1780	1.1773	1.1773	1.1782
Stainless Steel Outer Containment					
i.d.	1.1866/ 1.1872	1.1866/ 1.1872	1.866/ 1.1872	1.1866/ 1.1872	1.1866/ 1.1872
o.d.	1.2520	1.2520	1.2520	1.2520	1.2520
Insulation Layers					
Top of Cell					
Grafoil	0	0	0	0	0
Graphite Cloth	8	8	8	8	8
Bottom of Cell					
Grafoil	1	1	1	1	1
Graphite Cloth	7	7	7	7	7

TABLE 14

CAPSULE P13N GRAPHITE CRUCIBLE DIMENSIONS

	<u>Position</u>				
<u>Cell 1</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
Body Outside Diam.	0.9160	0.9420	0.9410	0.9490	0.9490
Inside Diam.	0.5028	0.4888	0.4873	0.5120	0.4878
Length W/Cap (a)	0.9600				1.1140
Length W/O Cap	0.8800	0.8670	0.7345	0.866	1.0320
Cap Thickness (a)	0.2610				0.2615
Cap Diam. (a)	0.9150				0.9491
<u>Cell 2</u>					
Body Outside Diam.	0.9493	0.9496	0.9490	0.9491	(b)
Inside Diam.	0.4910	0.4891	0.4890	0.4872	
Length W/Cap (a)	0.9720			1.1020	
Length W/O Cap	0.8800	0.8660	0.7350	1.0190	
Cap Thickness (a)	0.2615			0.2600	
Cap Diam. (a)	0.9491			0.9494	
<u>Cell 3</u>					
Body Outside Diam.	0.9370	0.9504	0.9490	0.9490	(b)
Inside Diam.	0.4946	0.4894	0.4884	0.4990	
Length W/Cap (a)	0.9585			1.1000	
Length W/O Cap	0.8790	0.8665	0.7340	1.0180	
Cap Thickness (a)	0.2615			0.2610	
Cap Diam. (a)	0.9370			0.9490	
<u>Cell 4</u>					
Body Outside Diam.	0.9460	0.9256	0.9490	0.8740	(b)
Inside Diam.	0.4878	0.5922	0.4890	0.5056	
Length W/Cap (a)	0.9610			1.1005	
Length W/O Cap	0.8790	0.8675	0.7340	1.0190	
Cap Thickness (a)	0.2610			0.2610	
Cap Diam.	0.9460			0.8733	

Cell 5

	X	A	B	C	D
Body Outside Diam.	0.9333	0.9430	0.9493	0.8740	0.8735
Inside Diam.	0.4884	0.4876	0.4870	0.5184	0.5030
Length W/Cap (a)	0.9810				1.1130
Length W/O Cap	0.8790	0.8640	0.7350	0.8675	1.0320
Cap Thickness (a)	0.2610				0.2610
Cap Diam.	0.9335				0.9000

(a) Where Applicable

(b) Dimensions For Positions 1,2,3, and 4 Given in Table 15.

TABLE 15

CAPSULE P13N LOOSE BED CRUCIBLE DIMENSIONS

	<u>Cell 2</u>	<u>Cell 3</u>	<u>Cell 4</u>
Stem Base-Diameter	0.8770	0.8730	0.8717
Stem Base and Stem-Length	0.7620	0.7627	0.7620
Crucible-Position No. 1- Diameter	0.8781	0.8740	0.8735
- Thickness	0.1460	0.1485	0.0920
Crucible-Position No. 2-Diameter	0.8780	0.8740	0.8736
-Thickness	0.1460	0.1487	0.2522
Crucible-Position No. 3-Diameter	0.8780	0.8742	0.8738
-Thickness	0.1466	0.1484	0.2523
Crucible Position No. 4-Diameter	0.8783	0.8742	-----
-Thickness	0.1463/ 0.1467	0.1485	-----
Cap			
-Diameter	0.9540	0.8730	0.8737
-Thickness	0.1033	0.1032	0.1002