Reactor Core Physics Design and Operating Data for Cycles 1 and 2 of TMI Unit 1 Power Plant

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Prepared by
The Babcock & Wilcox Company
Lynchburg, Virginia

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ELECTRIC POWER RESEARCH INSTITUTE

Reactor Core Physics Design and Operating Data for Cycles 1 and 2 of TMI Unit 1 PWR Power Plant
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NP-1410, Volume 1
Research Project 519-4

Final Report, August 1980
Work Completed, August 1979

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NOTICE

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EPRI PERSPECTIVE

PROJECT DESCRIPTION

This report is one of several recently published documents intended to provide reference information on power reactor design and operating data. It is contained in two volumes. Volume 1 is being given the same breadth of distribution as was given to the Quad Cities 1, EPRI NP-240; Peach Bottom 2, EPRI NP-563; and Zion 2, EPRI NP-1232, reports. Volume 2, however, which contains only operating state-point data, is available only upon request to the Research Reports Center.*
Samples of these state-point data are given in Appendices A and B of Volume 1.

PROJECT OBJECTIVE

The purpose of RP519 has been to provide reference information on power reactor design and operating data for prototypical BWR and PWR designs. The project was begun because there was a lack of information in the open literature which was sufficiently complete to allow the testing of nuclear fuel management computer codes.

PROJECT RESULTS

This report contains information from a prototypical Babcock & Wilcox Co. reactor design. The following can be considered as companion reports:

- EPRI Topical Report NP-240 (Quad Cities 1)
- EPRI Final Report NP-472 (Monticello)
- EPRI Topical Report NP-563 (Peach Bottom 2)
- EPRI Final Report NP-827 (Turkey Point 3)
- EPRI Final Report NP-79-2-LD (Surry 1)
- EPRI Final Report NP-79-4-LD (Millstone 1)
- EPRI Final Report NP-1232 (Zion 2)

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Similar information from a CE reactor (ANO-2) will be published later this year as an account of work performed under RP1385.

This report will likely be most useful to nuclear fuel engineers who wish to exercise fuel management calculational methods; others, however, may have need for its fuel bundle design details, etc.

R. N. Whitesel, Project Manager
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ABSTRACT

This report contains design and operating data for the first two fuel cycles at Three Mile Island Unit 1. These data are provided for use in benchmark testing of the Advanced Recycle Methodology Package and qualification of other reactor analysis and fuel management codes.

The design data include descriptions of the fuel pins, guide tubes, control elements, spacer grids, instrumentation, and core loading plans. The operating data supplied contain the plant primary and secondary side flows and temperatures, the operating rod pattern, and an incore detector signal map for each statepoint measurement. In addition, representative startup test results are provided for both cycles.

ACKNOWLEDGMENT

The collection of the data presented in this volume was made possible by the cooperation and assistance of Metropolitan Edison Company (the operator of Three Mile Island Unit 1) and the Babcock & Wilcox Company (the reactor supplier).

The Project Manager for the Electric Power Research Institute was Dr. Robert N. Whitesel, who contributed many helpful suggestions as the work progressed. Dr. Y. S. Kim of NUS Corporation has participated in the technical and general editing of the final report.

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TABLES

1. INTRODUCTION

This report provides design and operational data for the first two cycles of operation at Three Mile Island Unit 1 (TMI-1). The design data have been gathered primarily from B&W drawings and contract design documents; references to data available in public documents are provided where possible. The operating data provided were obtained from the on-line computer Performance Data Outputs (PDO) taken during plant operation.

2. TMI-1 FUEL ASSEMBLY AND CORE DESIGN DATA

Three Mile Island Unit 1 (TMI-1) is a pressurized water reactor operating at a design power level of 2535 Mwt. The reactor coolant (RC) system comprises two loops with one hot leg and two cold legs per loop. The reactor core contains 177 fuel assemblies each consisting of 208 fuel rods, 16 control rod guide tubes, and one incore instrument guide tube. Reactivity is controlled by 61 full-length Ag-In-Cd control rod assemblies and soluble boron shim. Eight partial-length Ag-In-Cd control rods are used to control the axial power distribution. In cycle 1 only, 68 burnable poison rod assemblies were inserted in the core. These assemblies were used mainly to ensure a negative moderator temperature coefficient of reactivity. The pertinent reactor design data and core loadings for the first two cycles of operation at TMI-1 are presented below.

2.1. Fuel Assembly Design Data

2.1.1. Fuel Assembly Configuration

The Mark B fuel assembly design consisting of a 15 × 15 array of rods is used at TMI-1. An assembly cross section is shown in Figure 2-1; general design information and dimensions are given in Table 2-1. Figure 2-2 shows the axial position of the active elements for a fuel rod, burnable poison rod, and control rod relative to the lower end fitting of an assembly.

2.1.2. Fuel Pin Description

B&W fuel pins consist of low-enriched UO_2 pellets clad in Zircaloy-4. Table 2-2 describes the design data for the fuel pellet and cladding used at TMI-1. Figure 2-3 shows a typical fuel pin.

2.1.3. Instrument Tube Description

The central cell in each fuel assembly consists of an instrument tube sized to accept an incore instrument string. A spacer sleeve prevents unacceptable grid movement and is located around the instrument tube between grid positions. Table 2-3 provides the spacer sleeve and instrument tube dimensions. Figure 2-7, which shows the complete incore instrument, also shows the spacer sleeve and instrument tube.

2.1.4. Guide Tube Description

Each 15 by 15 fuel assembly contains 16 control rod guide tube locations as shown in Figure 2-1. These guide tubes may be empty or may contain a control rod assembly, orifice rod assembly, or burnable poison rod assembly. The guide tube design information is provided in Table 2-4.

2.1.5. Spacer Grid Description

Three different assembly designations were used in TMI-1. The Mark B-2, B-3 and B-4 assemblies are neutronically identical and have the same intermediate spacer grid spacing. The Mark B-2 assemblies, however, contain longer end spacer grids, as shown in Figure 2-4. The grid masses and dimensions are provided in Table 2-5.

2.1.6. Control Rod Assembly Description

Sixty-nine assemblies in the core contain movable Ag-In-Cd control rod assemblies in the guide tube locations. Figures 2-5 and 2-6 are drawings of the full and partial-length control rod assemblies. Details on the cladding, poison material, and dimensions are provided in Table 2-6. Section 2.3.2 describes the locations of the control rod assemblies.

2.1.7. Burnable Poison Rod Assembly Description

During the first cycle of operation at TMI-1 burnable poison rod assemblies (BPRAs) were inserted in selected fuel assemblies (see section 2.3.3) to shape the core radial power distribution and to provide a more negative moderator temperature coefficient. These BPRAs consisted of 16 Al_2O_3-B_4C poison rods which fit into the assembly guide tubes. The BPRA is very similar to the full-length control rod assembly shown in Figure 2-5. The BPRA remains fully inserted during cycle operation. Design information is provided in Table 2-7, and B_4C enrichments are given in Figure 2-9.

2.1.8. Orifice Rod Assembly Description

To prevent excess bypass flow, orifice rod assemblies (ORAs) are employed in selected fuel assemblies for cycles 1 and 2 at TMI-1. These rods did not protrude into the active core region at any time during operation. Design data are given in Table 2-8. The placement of the ORAs for cycles 1 and 2 is given in Figures 2-18, 2-19, and 2-20.

2.1.9. Fuel Assembly Loadings

The fuel assembly loading information for cycles 1 and 2 of TMI-1 is presented in Table 2-9. The placement of the various assemblies from each batch is shown in Figures 2-9 and 2-10 and described in section 2.3.1.

2.2. Instrumentation Design Data

2.2.1. Incore Detectors

There are 364 incore detectors at TMI which are grouped into 52 strings, each containing seven equally spaced rhodium detectors. Figures 2-7 and 2-8 are detector string drawings, and design data are provided in Table 2-10.

2.2.2. Excore Detectors

The excore instrumentation system has four neutron detector channels divided into three ranges of sensitivity: source, intermediate, and power range. The three ranges combine to give a continuous measurement of reactor power from below source level to over 125% of full power.

The source range instrumentation consists of two redundant, high-sensitivity BF_3 proportional counters on opposite sides of the core. The intermediate range instrumentation consists of two electrically gamma-compensated ion chambers on opposite sides of the core. Both sets of instrumentation are positioned axially near the core midplane.

The power range instrumentation has four linear level channels originating in four detector assemblies, each of which contains two uncompensated ion chambers. The ion chambers are positioned to represent the top and bottom halves of the core. The individual currents from the chambers are fed to individual linear amplifiers.

2.3. Core Fuel and Poison Loading

2.3.1. Core Fuel Loading

The core loading diagrams for cycles 1 and 2 of operation at TMI-1 are presented in Figures 2-9 and 2-10, respectively. Fuel assembly locations by assembly identification number for cycle 1 and 2 are given in Figures 2-11 and 2-12. Figure 2-13 shows the cycle 2 core loading on the basis of the location of each assembly in cycle 1. Detailed core design data, including thermal-hydraulic information, is given in Table 2-11. Reactor coolant temperature versus power level is shown in Figure 2-14. Reflector and baffle volume fractions are given in Figure 2-15. The reactor vessel and internals are shown in Figures 2-16 and 2-17.

2.3.2. Control Rod Assembly Core Locations

Figures 2-18 through 2-20 show the CRA locations by operating group for the first two cycles of TMI-1 operation. Two distinct control rod operating group configurations were used during cycle 1, while only one configuration was used for the second cycle.

2.3.3. Burnable Poison Rod Assembly Core Locations

The core locations of the BPRAs used in cycle 1 of TMI-1 are given in Figure 2-9. At the end of cycle 1 the BPRAs were removed from all fuel assemblies, and cycle 2 was operated without BPRAs.

2.3.4. Nuclear Instrumentation Locations

Figure 2-21 shows the incore and excore locations of the nuclear instrumentation used at TMI-1 for both cycles of operation.

Table 2-1. Fuel Assembly Configuration

Item	Value	Source	Comments
Assembly pitch, in.	8.587	Physics Test Manual, TMI-1, Cy-1 p 1.1-1	Hereafter referred to as PTM
Assembly axial length, in.	165.625	TMI-1 Final Safety Analysis Report, Vol 1A, p 3-97; No. 50-289	Hereafter referred to as FSAR
Fuel pins per assembly	208	PTM, p 1.1-4	
Fuel pin pitch, in.	0.568	FSAR Vol 1, p 1-64	
Guide tubes per assembly	16	FSAR Vol 1, p 1-65	
Instrument cells per assembly	1	PTM, p 1.1-1	

Table 2-2. Fuel Pin Description

Item	Value	Source	Comments
Fuel cladding material	Zirc-4	FSAR Vol 1, p 1-64	Cold-worked
Fuel cladding density, lb/in.^{3}	0.238	Internal B&W document	Hereafter referred to as IBWD
Fuel cladding OD, in.	0.430	FSAR Vol 1, p 1-64	
Fuel cladding ID, in.	0.377	FSAR Vol 1, p 1-64	
Fuel pin axial length, in.	153.125	FSAR Vol 1A, p 3-97	
Fuel pin active fuel length, in.	Table 2-9	IBWD	
Pellet-cladding diam. gap, in.	0.007	FSAR Vol 1, p 1-64	
Fuel pellet length, in.	0.700	FSAR Vol 1, p 1-64	
Fuel pellet OD, in.	0.370	FSAR Vol 1, p 1-64	
Fuel pellet dish factor(a)	0.9822	IBWD	
Fuel pellet density	Table 2-9	IBWD	

(a) The solid volume reduction factor from the volume of a solid cylinder without dishing.

Table 2-3. Instrument Tube Description

Item	Value	Source
Instrument Tube		
Material	Zirc-4	FSAR Vol 1A, p 3-97
Density, $lb/in.^3$	0.238	IBWD
OD, in.	0.493	FSAR Vol 1A, p 3-97
ID, in.	0.441	FSAR Vol 1A, p 3-97
Spacer Sleeve		
Material	Zirc-4	FSAR Vol 1A, p 3-97
Density, $lb/in.^3$	0.238	IBWD
OD, in.	0.554	IBWD
ID, in.	0.502	IBWD

Table 2-4. Guide Tube Description

Item	Value	Source
Material	Zirc-4	IBWD
Density, $lb/in.^3$	0.238	IBWD
OD, in.	0.530	IBWD
ID, in.	0.498	IBWD

Table 2-5. Spacer Grid Description

Item	Value	Source
No. per assembly		
Intermed grids	6	FSAR Vol 1, p 1-64
End grids	2	
Material	Inconel 718	FSAR Vol 1A, p 3-97
Density, lb/in.^{3}	0.297	IBWD
Intermed grid ht, in.	1.50	IBWD
Mass, lb		
Intermed grid	1.6	
Mark B-2 end grid	4.6	
Mark B-3, B-4 end grid	3.0	

Table 2-6. Control Rod Assembly Description

Item	Value	Source	Comments
Pins per assembly	16	FSAR Vol 1, p 1-65	
CR driver rate, in./min	3/30		Jog rate/Run rate
CR stroke, in.	139		
Full-length control pins			
Absorber cladding material	304 SS	FSAR Vol 1, p 1-65	Cold-worked
Absorber cladding density, lb/in.^{3}	0.29	IBWD	
Absorber cladding OD, in.	0.440	FSAR Vol 1, p 1-65	
Absorber cladding ID, in.	0.398	FSAR Vol 1, p 1-65	
Absorber material	Ag-In-Cd	FSAR Vol 1, p 1-65	80% Ag, 15% In, 5% Cd
Absorber density, lb/in.^{3}	0.367	IBWD	
Absorber OD, in.	0.392	IBWD	
Absorber length, in.	134	FSAR Vol 1, p 1-65	
Partial-length control pins (APSRs)			
Absorber cladding material	304 SS	FSAR Vol 1, p 1-65	Cold-worked
Absorber cladding density, lb/in.^{2}	0.29	IBWD	
Absorber cladding OD, in.	0.440	FSAR Vol 1, p 1-65	
Absorber cladding ID, in.	0.398	FSAR Vol 1, p 1-65	
Absorber material	Ag-In-Cd	FSAR Vol 1, p 1-65	80% Ag, 15% In, 5% Cd
Absorber density, lb/in.^{3}	0.367	NMM	
Absorber OD, in.	0.375	IBWD	
Absorber length, in.	36	FSAR Vol 1, p 1-65	
Follower tube material	304 SS	IBWD	
Follower tube density, lb/in.^{3}	0.29	IBWD	
Follower tube OD, in.	0.440	IBWD	
Follower tube ID, in.	0.398	IBWD	

Table 2-7. Burnable Poison Rod Assembly Description

Item	Value	Source	Comments
BPRs per assembly	16	FSAR Vol 1, p 1-65	
BPR cladding material	Zirc-4	FSAR Vol 1, p 1-65	Cold-worked
BPR cladding density, lb/in.^{3}	0.238	IBWD	
BPR cladding OD, in.	0.430	IBWD	
BPR cladding ID, in.	0.360	IBWD	
BPR Pellets			
Material	$A\ell_2O_3$-B_4C	FSAR Vol 1, p 1-65	^{10}B in B_4C is the major absorber
Density, lb/in.^{3}	0.119	IBWD	
OD, in.	0.340	IBWD	
Length, in.(a)	126	FSAR Vol 1, p 1-65	
B_4C enrichment	Figure 2-9	--	--

(a)Total of all pellets.

Table 2-8. Orifice Rod Assembly Description

Item	Value	Source	Comments
ORs per assembly	16	FSAR Vol 1, p 1-65	
OR material	304 SS	FSAR Vol 1, p 1-65	Annealed
OR material density, lb/in.^{3}	0.29	IBWD	
OR OD, in.	0.480	IBWD	
OR length, in.	--		The ORs do not reside in the active core.

Table 2-9. Fuel Assembly Loadings, Cycles 1 and 2

Item	Value	Source	Comments
Batch 1			
Assembly design	Mark B-2	IBWD	
Fuel enrich., wt % ^{235}U	2.06	IBWD	
Fuel pellet density, g/cm^3	10.138	IBWD	92.5% TD/assembly
^{238}U loaded, g/assy	454,723	IBWD	
^{235}U loaded, g/assy	9,551	IBWD	
Active length, in.	144.0	PTM, p 1.1-2	Before densif'n
Batch 2			
Assembly design	Mark B-3	IBWD	
Fuel enrich., wt % ^{235}U	2.75	IBWD	
Fuel pellet density, g/cm^3	10.138	IBWD	92.5% TD/assembly
^{238}U loaded, g/assy	451,118	IBWD	
^{235}U loaded, g/assy	12,742	IBWD	
Active length, in.	144.0	PTM, p 1.1-2	Before densif'n
Batch 3			
Assembly design	Mark B-3	IBWD	
Fuel enrich., wt % ^{235}U	3.05	IBWD	
Fuel density, g/cm^3	10.138	IBWD	92.5% TD
^{238}U loaded, g/assy	449,992	IBWD	
^{235}U loaded, g/assy	14,149	IBWD	
Active length, in.	144.0	PTM, p 1.1-2	Before densif'n
Batch 4			
Assembly design	Mark B-4	IBWD	
Fuel enrich., wt % ^{235}U	2.64	IBWD	
Fuel density, g/cm^3	10.25	IBWD	93.5% TD
^{238}U loaded, g/assy	451,942	IBWD	
^{235}U loaded, g/assy	12,248	IBWD	
Active length, in.	142.5	IBWD	Before densif'n

Table 2-10. Incore Instrument Description(a)

Item	Value	Comments
Instr. cladding material	Inconel 600	
Cladding OD, in.	0.062	
Detector material	Rhodium	
Detector mat. density, lb/in.^{3}	0.449	
OD, in.	0.018	
Nominal length, in.	4.75	
Detector leadwire material	Inconel 600	
OD, in.	0.009	
Backgrd detector material	Inconel 600	
OD, in.	0.009	
Insulation material	MgO	
Insulation density,	∿90% TD	
OD, in.	0.042	
Fillerwire material	Inconel 600	
OD, in.	0.062	
Detector axial spacing, in.	20.417	Equally spaced over active fuel length

(a) All values in this table were obtained from internal Babcock & Wilcox documents.

Table 2-11. Core Design Data

Item	Value	Source	Comments
Core rated power, MWt	2535	PTM p 1.1-1	
No. of FAs	177	PTM p 1.1-1	
Core equiv. diam., in.	128.9	FSAR Vol 1A, p 3-81	
Core active height	Table 2-9	--	
Reflector thickness, in. Top/bottom/side	12/12/18	FSAR Vol 1, p 1-66	All water + steel
Reflector volume fractions	Figure 2-15		
Core inlet coolant temp, F	554.0	FSAR Vol 1, p 1-68	100% FP
Core avg coolant temp, F	579.7	FSAR Vol 1, P 1-68	>15% FP
Core avg fuel temp, F	1280.0	FSAR Vol 1A, p 3-79	100% FP
Cycle 1			
Cycle exposure, EFPD	466.4	BAW-1443	14,406 MWd/mtU (core avg fuel BU)
No. of batch 1 assys	56	PTM pp 22-38	
No. of batch 2 assys	61	PTM pp 22-38	
No. of batch 3 assys	60	PTM pp 22-38	
No. of batch 4 assys	0	PTM pp 22-38	
No. of CRAs	69	PTM p 1.1-3	
No. of BPRAs	68	PTM p 1.1-3	
Cycle 2			
Cycle exposure, EFPD	256.2	IBWD	17,547 MWd/mtU (cycle 2 core avg BU)
No. of batch 1 assys	0	IBWD	
No. of batch 2 assys	61	IBWD	
No. of batch 3 assys	60	IBWD	
No. of batch 4 assys	56	IBWD	
No. of CRAs	69	IBWD	
No. of BPRAs	0	IBWD	

Figure 2-1. Mark B Assembly Pin Layout

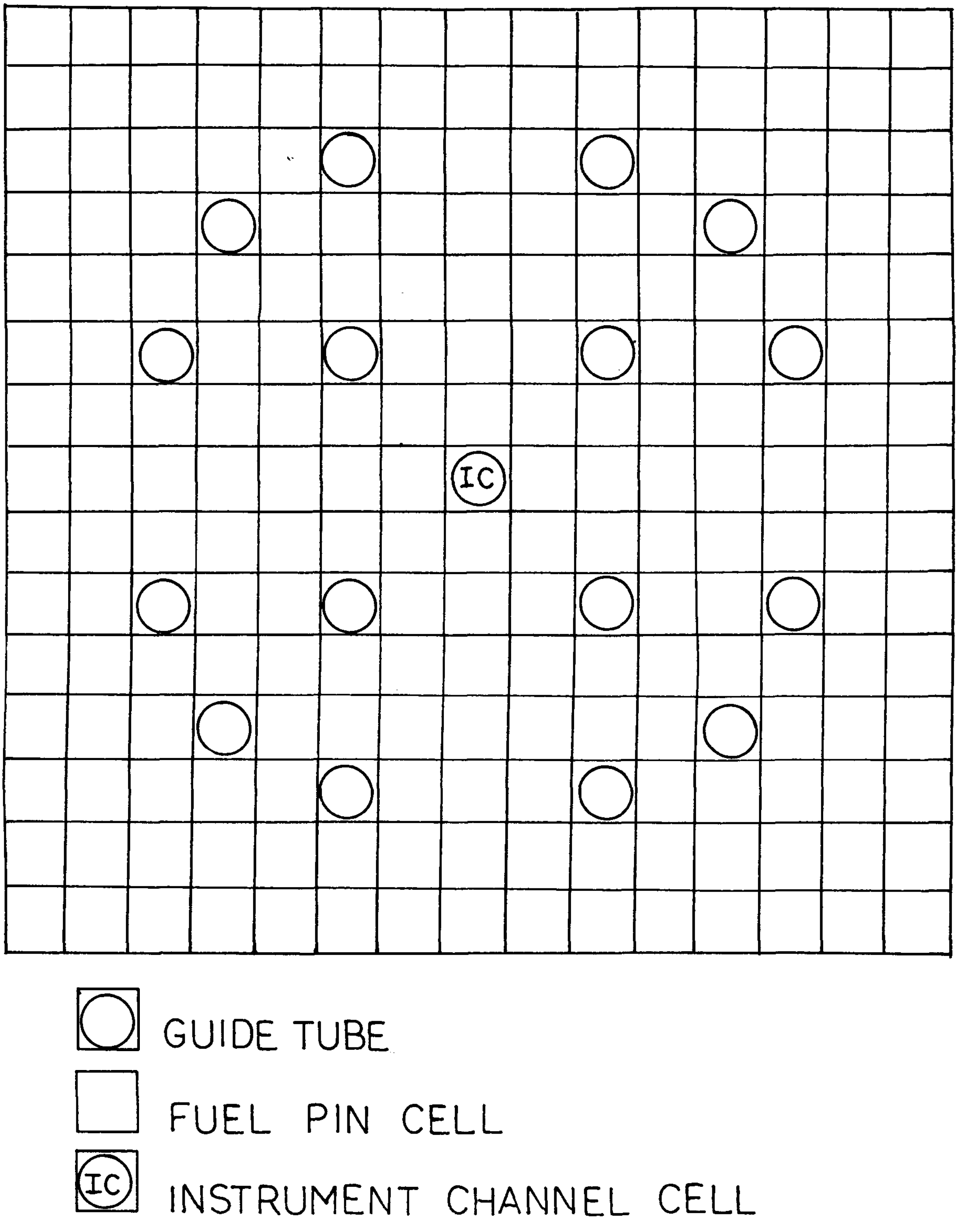
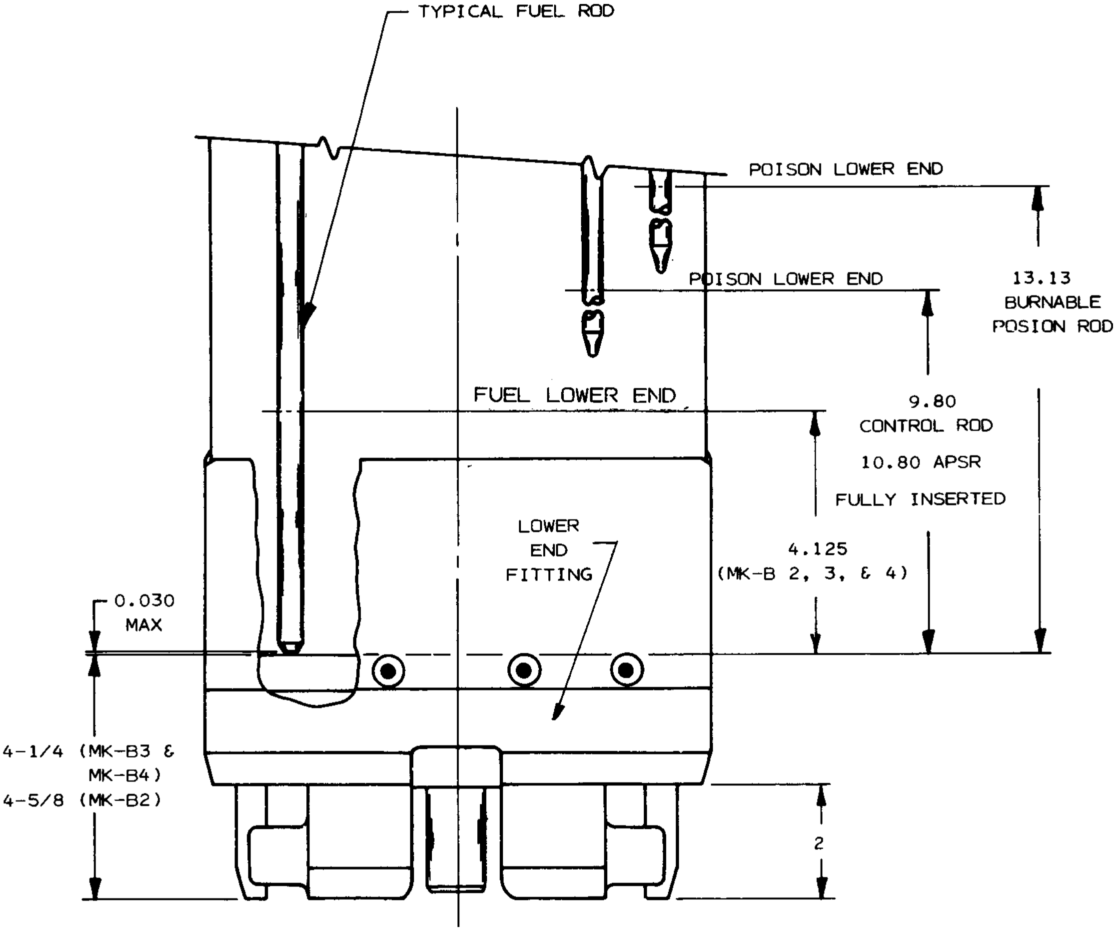


Figure 2-2. Relative Axial Positions of Active Elements of Assembly Components



NOTE: ALL DIMENSIONS IN INCHES.

Figure 2-3. Typical Mark B Fuel Pin

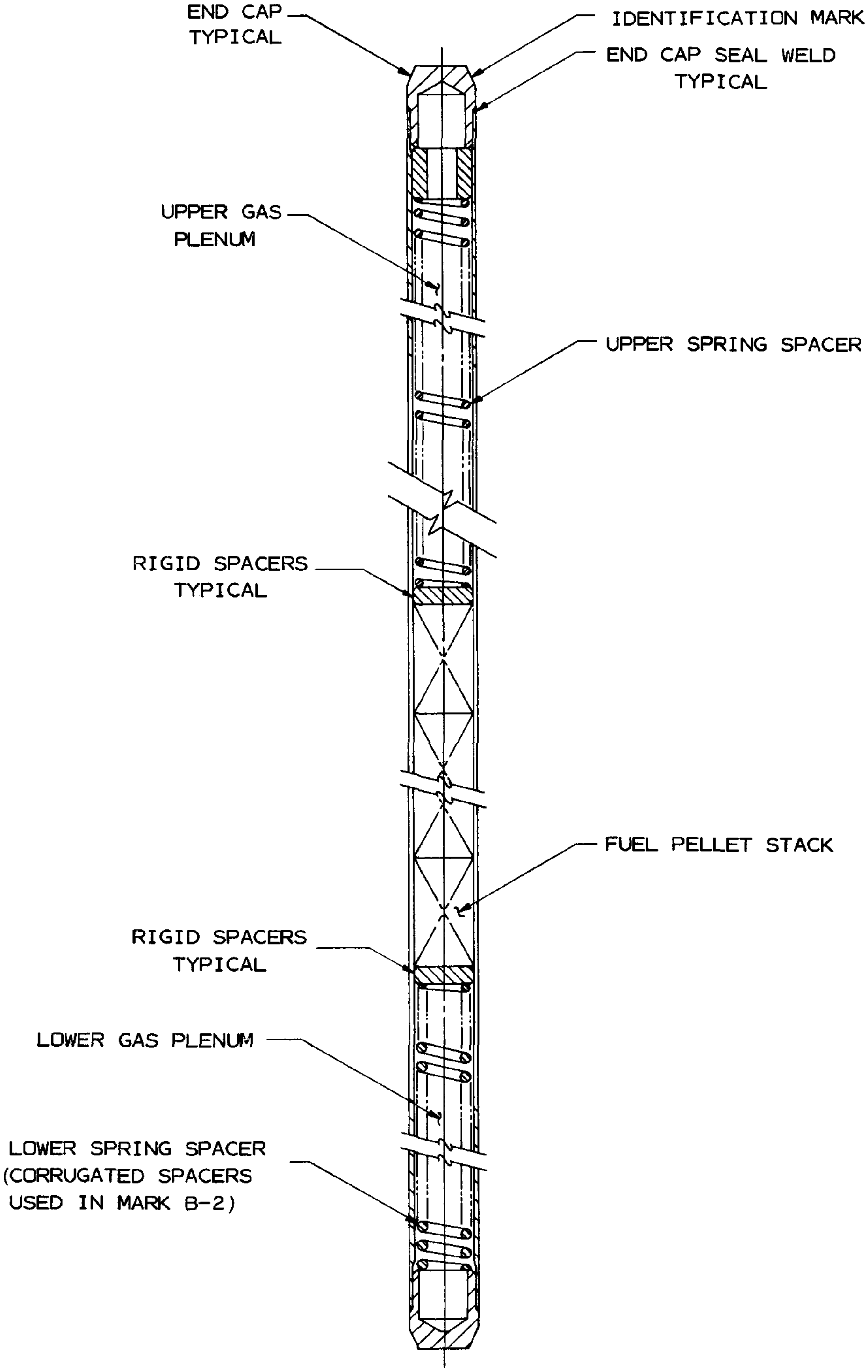
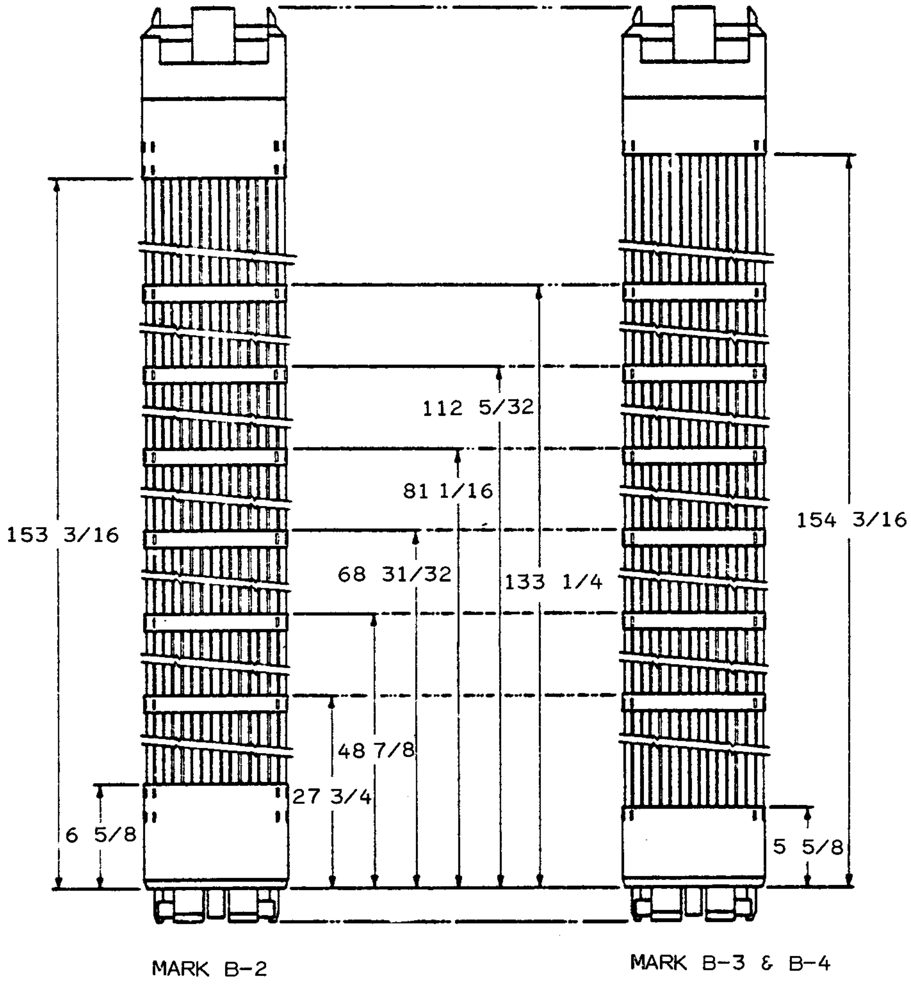


Figure 2-4. Spacer Grid Diagram



NOTE: DIMENSIONS IN INCHES.

Figure 2-5. Full-Length Control Rod Assembly

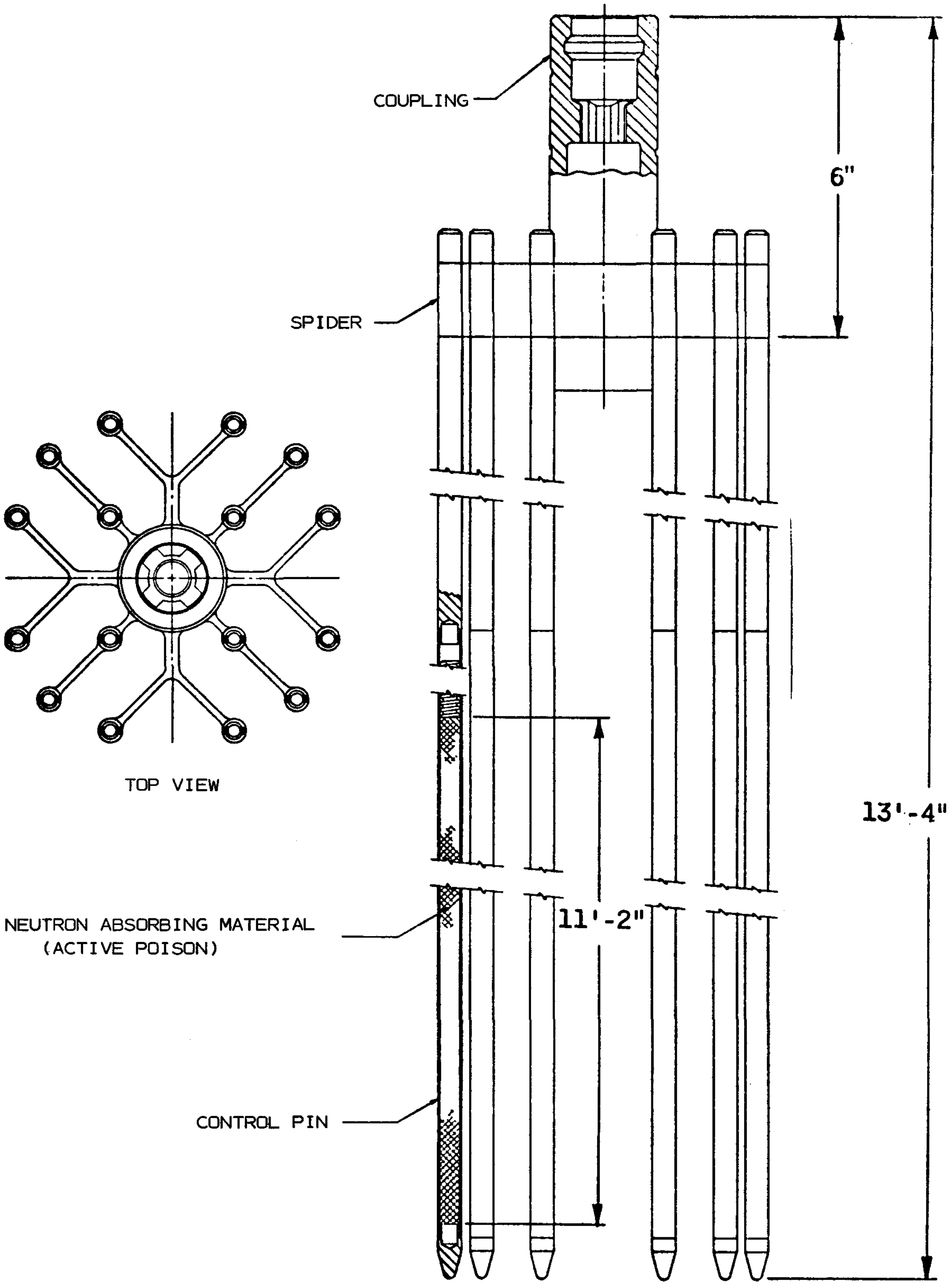


Figure 2-6. Partial-Length Control Rod Assembly

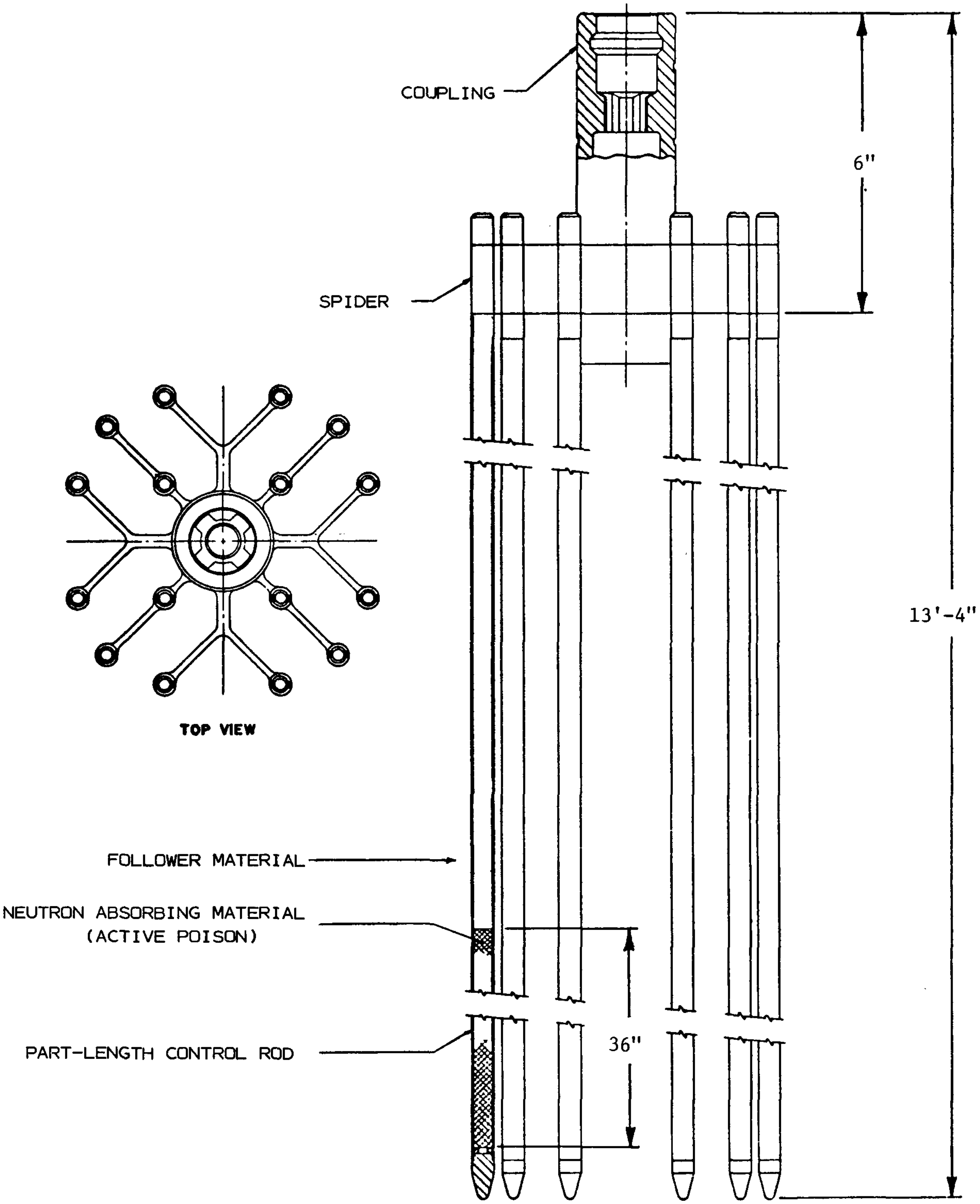
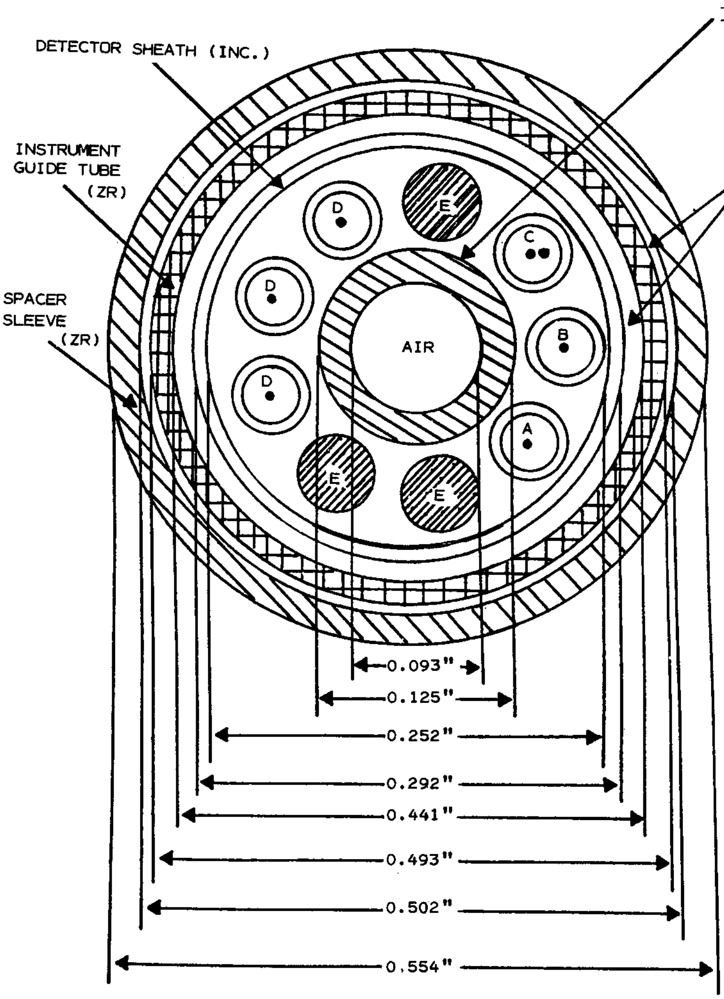


Figure 2-7. B&W Rhodium Emitter, Self-Powered Neutron Detector Assembly at Core Midplane



LEGEND

A - BACKGROUND DETECTOR

0.062" OD INC.
0.042" OD MGO
0.009" INC. BKGD WIRE

B - INCORE DETECTOR, LEVEL 4

0.062" OD INC.
0.042" OD MGO
0.018" RHODIUM EMITTER

C - TWO THERMOCOUPLE LEADWIRES

0.062" OD INC.
0.042" OD MGO
TWO 0.010" OD INC. THERMOCOUPLES

D - INCORE DETECTOR LEADWIRE FOR LEVELS 5, 6, & 7

0.062" OD INC.
0.042" OD MGO
0.009" OD INC. LEADWIRE

E - FILLER WIRES FOR LEVELS 1, 2, & 3 DETECTORS BELOW MIDPLANE

0.062" OD STAINLESS STEEL

Figure 2-8. Incore Detector Axial Spacing

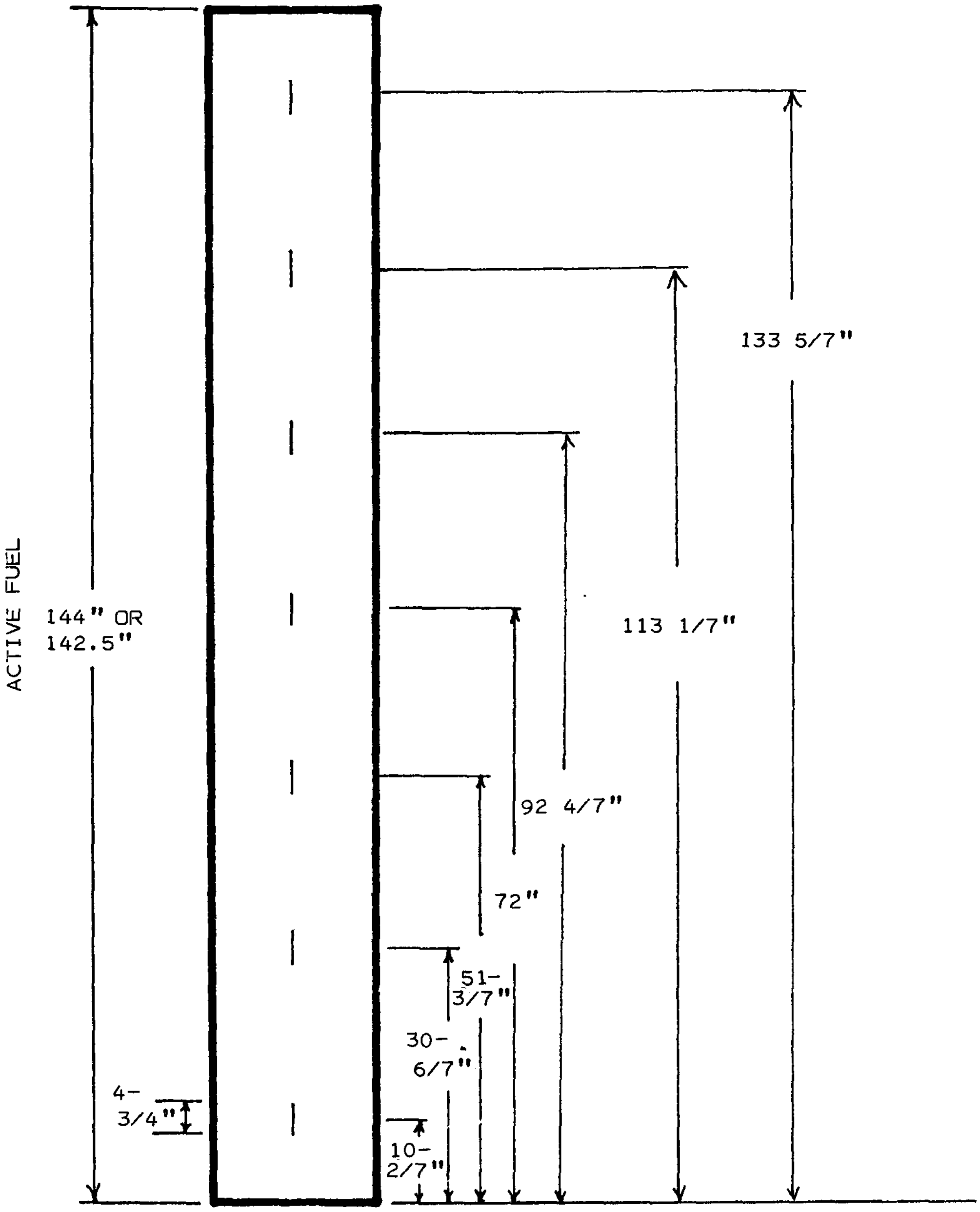


Figure 2-9. Cycle 1 Enrichment and BPRA Configuration

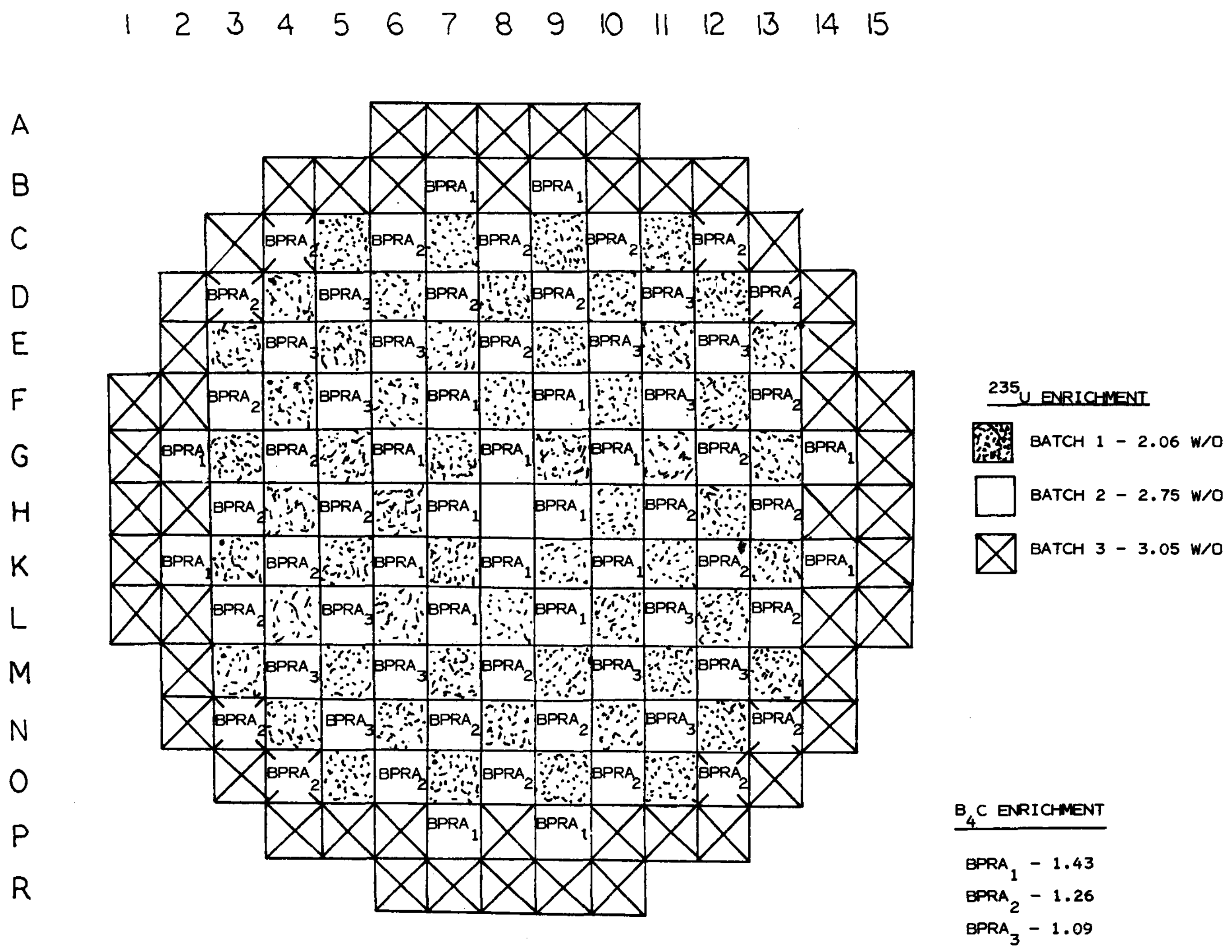


Figure 2-10. TMI-1 Cycle 2 Enrichment Configuration

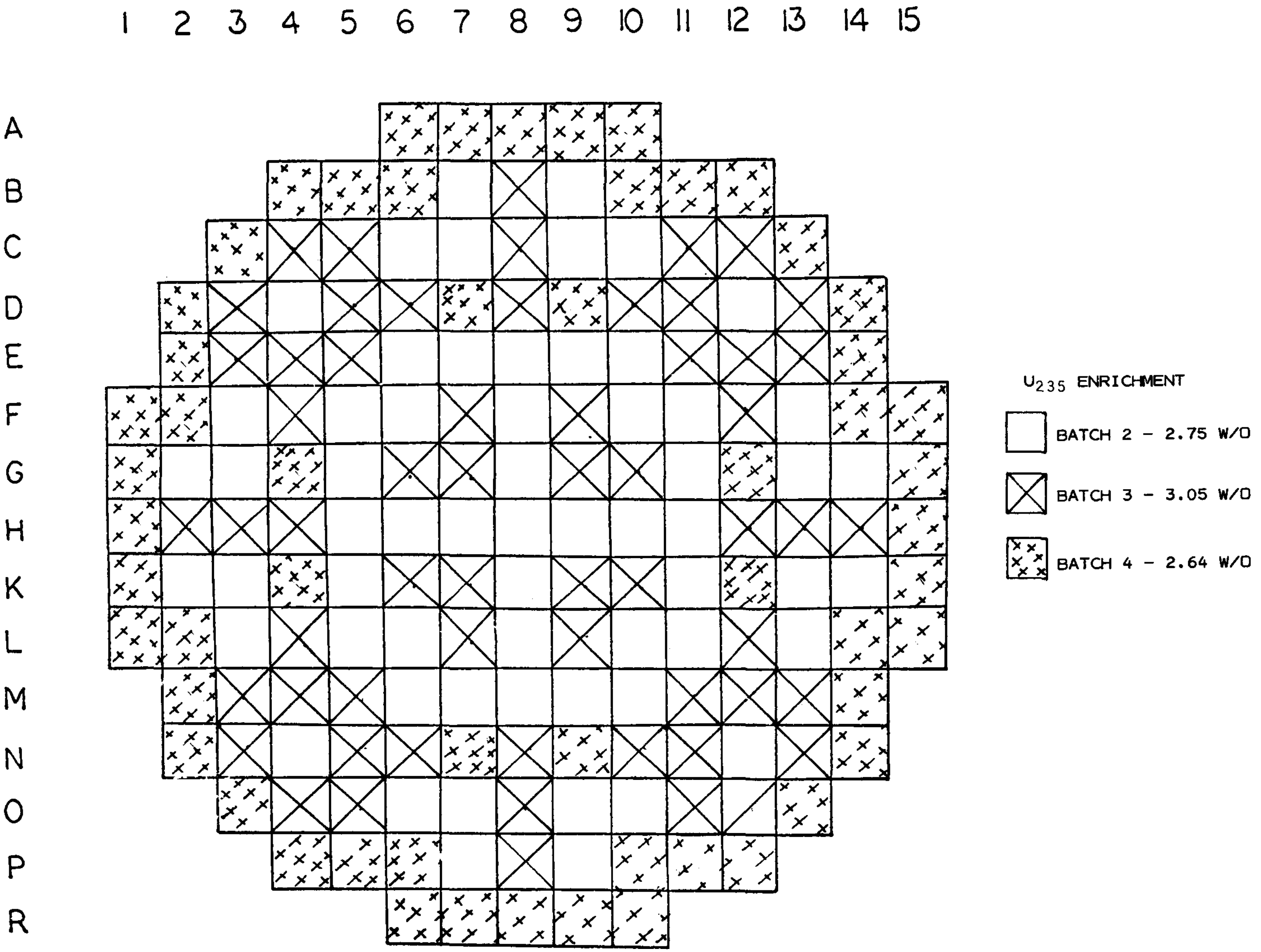


Figure 2-11. TMI-1 Cycle 1 Fuel Assembly ID Loading Diagram

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						C1	C2	C3	C4	C5					
B				C6	C7	C8	B1	C9	B2	C10	C11	C12			
C			C13	C14	A1	B3	A2	B4	A3	B5	A4	C15	C16		
D		C17	C18	A5	B6	A6	B7	A7	B8	A8	B9	A9	C19	C20	
E		C21	A10	B10	A11	B11	A12	B12	A13	B13	A14	B14	A15	C22	
F	C23	C24	B15	A16	B16	A17	B17	A18	B18	A19	B19	A20	B20	C25	C26
G	C27	B21	A21	B22	A22	B23	A23	B24	A24	B25	A25	B26	A26	B27	C28
H	C29	C30	B28	A27	B29	A28	B30	B31	B32	A29	B33	A30	B34	C31	C32
K	C33	B35	A31	B36	A32	B37	A33	B38	A34	B39	A35	B40	A36	B41	C34
L	C35	C36	B42	A37	B43	A38	B44	A39	B45	A40	B46	A41	B47	C37	C38
M		C39	A42	B48	A43	B49	A44	B50	A45	B51	A46	B52	A47	C40	
N		C41	C42	A48	B53	A49	B54	A50	B55	A51	B56	A52	C43	C44	
O			C45	C46	A53	B57	A54	B58	A55	B59	A56	C47	C48		
P				C49	C50	C51	B60	C52	B61	C53	C54	C55			
R						C56	C57	C58	C59	C60					

INITIAL ENRICHMENT

A - BATCH 1, 2.06 W/O
B - BATCH 2, 2.75 W/O
C - BATCH 3, 3.05 W/O

XNN FUEL ASSEMBLY ID

Figure 2-12. TMI-1 Cycle 2 Fuel Assembly ID Loading Diagram

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						D1	D2	D3	D4	D5					
B				D6	D7	D8	B17	C3	B18	D9	D10	D11			
C			D12	C6	C1	B3	B6	C9	B9	B5	C5	C12	D13		
D		D14	C17	B12	C2	C7	D15	C14	D16	C11	C4	B33	C20	D17	
E		D18	C23	C27	C13	B11	B1	B22	B2	B13	C16	C28	C26	D19	
F	D20	D21	B15	C21	B16	B7	C8	B4	C10	B26	B19	C22	B20	D22	D23
G	D24	B23	B10	D25	B21	C24	C18	B24	C15	C25	B27	D26	B14	B25	D27
H	D28	C29	C30	C42	B54	B28	B30	B31	B32	B34	B8	C19	C31	C32	D29
K	D30	B37	B48	D31	B35	C36	C46	B38	C43	C37	B41	D32	B52	B39	D33
L	D34	D35	B42	C39	B43	B36	C51	B58	C53	B55	B46	C40	B47	D36	D37
M		D38	C35	C33	C45	B49	B60	B40	B61	B51	C48	C34	C38	D39	
N		D40	C41	B29	C57	C50	D41	C47	D42	C54	C59	B50	C44	D43	
O			D44	C49	C56	B57	B53	C52	B56	B59	C59	C55	D45		
P				D46	D47	D48	B44	C58	B45	D49	D50	D51			
R						D52	D53	D54	D55	D56					

INITIAL ENRICHMENT

B – BATCH 2, 2.75 W/O
C – BATCH 3, 3.05 W/O
D – BATCH 4, 2.64 W/O

XNN FUEL ASSEMBLY ID

Figure 2-13. TMI-1, Cycle 1-Cycle 2 Full Shuffle Pattern

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A						4	4	4	4	4					
B				4	4	4	2 F-7	3 A-8	2 F-9	4	4	4			
C			4	3 B-4	3 A-6	2 C-6	2 D-5	3 B-8	2 D-11	2 C-10	3 A-10	3 B-12	4		
D		4	3 D-2	2 E-8	3 A-7	3 B-5	4	3 C-4	4	3 B-11	3 A-9	2 H-11	3 D-14	4	
E		4	3 F-1	3 G-1	3 C-3	2 E-6	2 B-7	2 G-4	2 B-9	2 E-10	3 C-13	3 G-15	3 F-15	4	
F	4	4	2 F-3	3 E-2	2 F-5	2 D-7	3 B-6	2 C-8	3 B-10	2 G-12	2 F-11	3 E-14	2 F-13	4	4
G	4	2 G-6	2 E-4	4	2 G-2	3 F-2	3 D-3	2 G-8	3 C-12	3 F-14	2 G-14	4	2 E-12	2 G-10	4
H	4	3 H-1	3 H-2	3 N-3	2 N-7	2 H-3	2 H-7	2 H-8	2 H-9	2 H-13	2 D-9	3 D-13	3 H-14	3 H-15	4
K	4	2 K-6	2 M-4	4	2 K-2	3 L-2	3 O-4	2 K-8	3 N-13	3 L-14	2 K-14	4	2 M-12	2 K-10	4
L	4	4	2 L-3	3 M-2	2 L-5	2 K-4	3 P-6	2 O-8	3 P-10	2 N-9	2 L-11	3 M-14	2 L-13	4	4
M		4	3 L-1	3 K-1	3 O-3	2 M-6	2 P-7	2 K-12	2 P-9	2 M-10	3 O-13	3 K-15	3 L-15	4	
N		4	3 N-2	2 H-5	3 R-7	3 P-5	4	3 O-12	4	3 P-11	3 R-9	2 M-8	3 N-14	4	
O			4	3 P-4	3 R-6	2 O-6	2 N-5	3 P-8	2 N-11	2 O-10	3 R-10	3 P-12	4		
P				4	4	4	2 L-7	3 R-8	2 L-9	4	4	4			
R						4	4	4	4	4					

X	BATCH
Y	PREVIOUS CORE LOCATION IN CYCLE 1

Figure 2-14. Reactor Temperature Vs Power Level

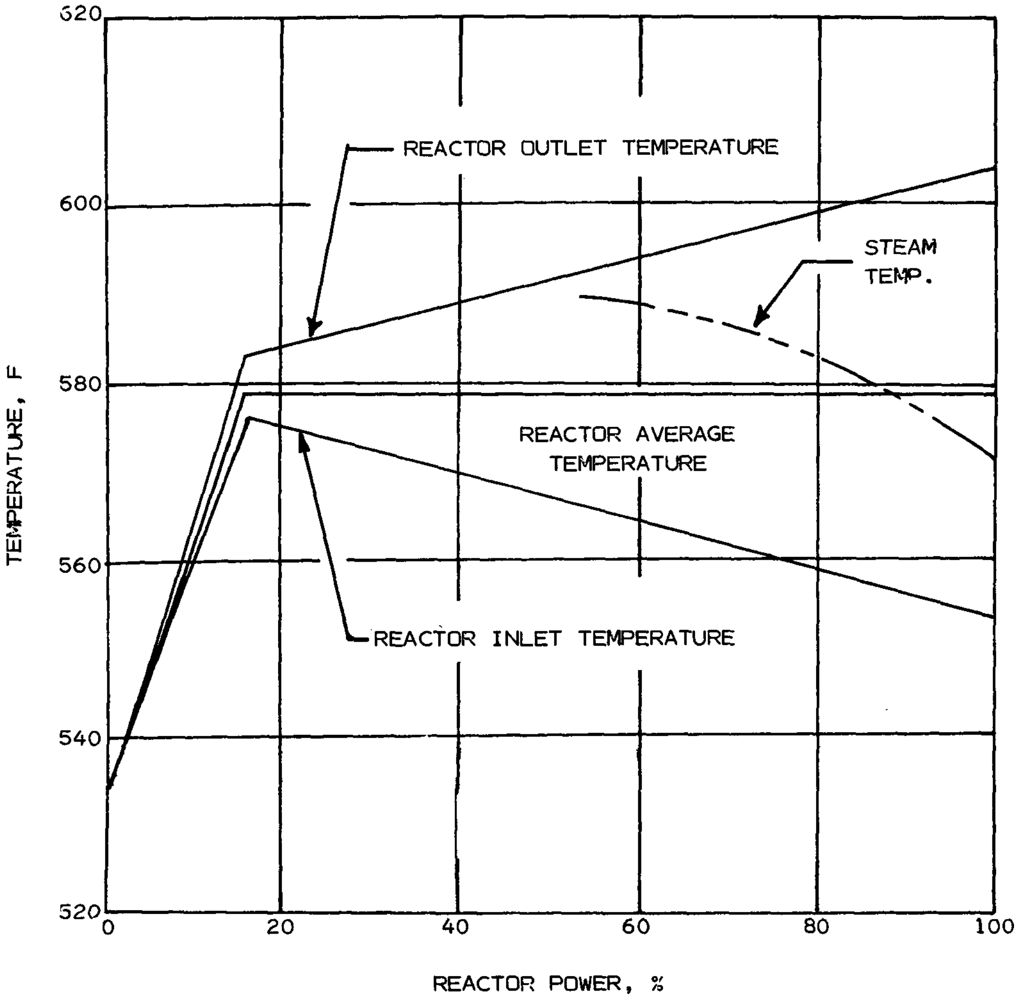
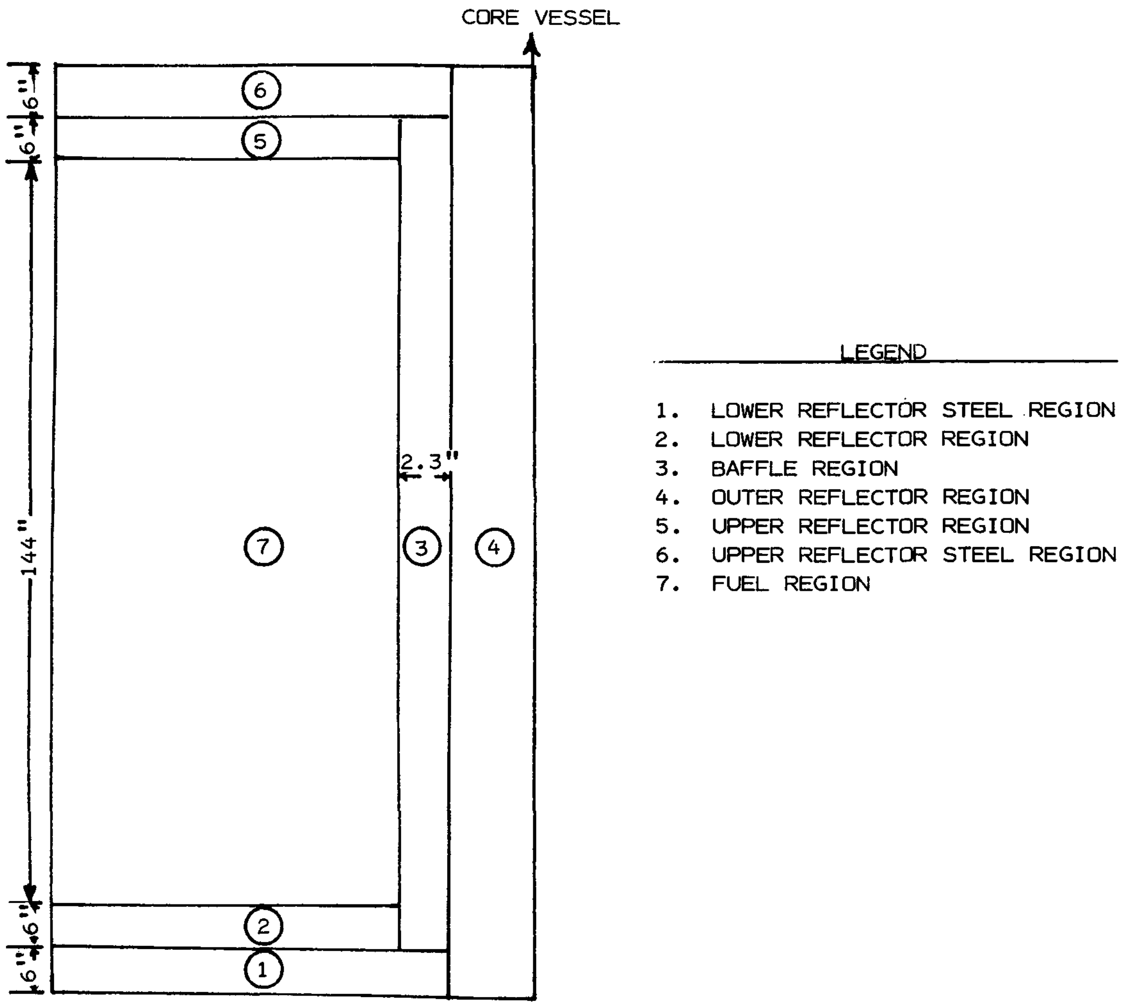


Figure 2-15. Reflector and Baffle Volume Fractions



REGION	VOID	ZR CLADDING	SS	MODERATOR
1	--	--	0.426	0.574
2	0.315	0.102	--	0.583
3	--	--	0.330	0.670
4	--	--	0.198	0.802
5	0.315	0.102	--	0.583
6	--	--	0.196	0.803

Figure 2-16. Reactor Vessel View Diagram

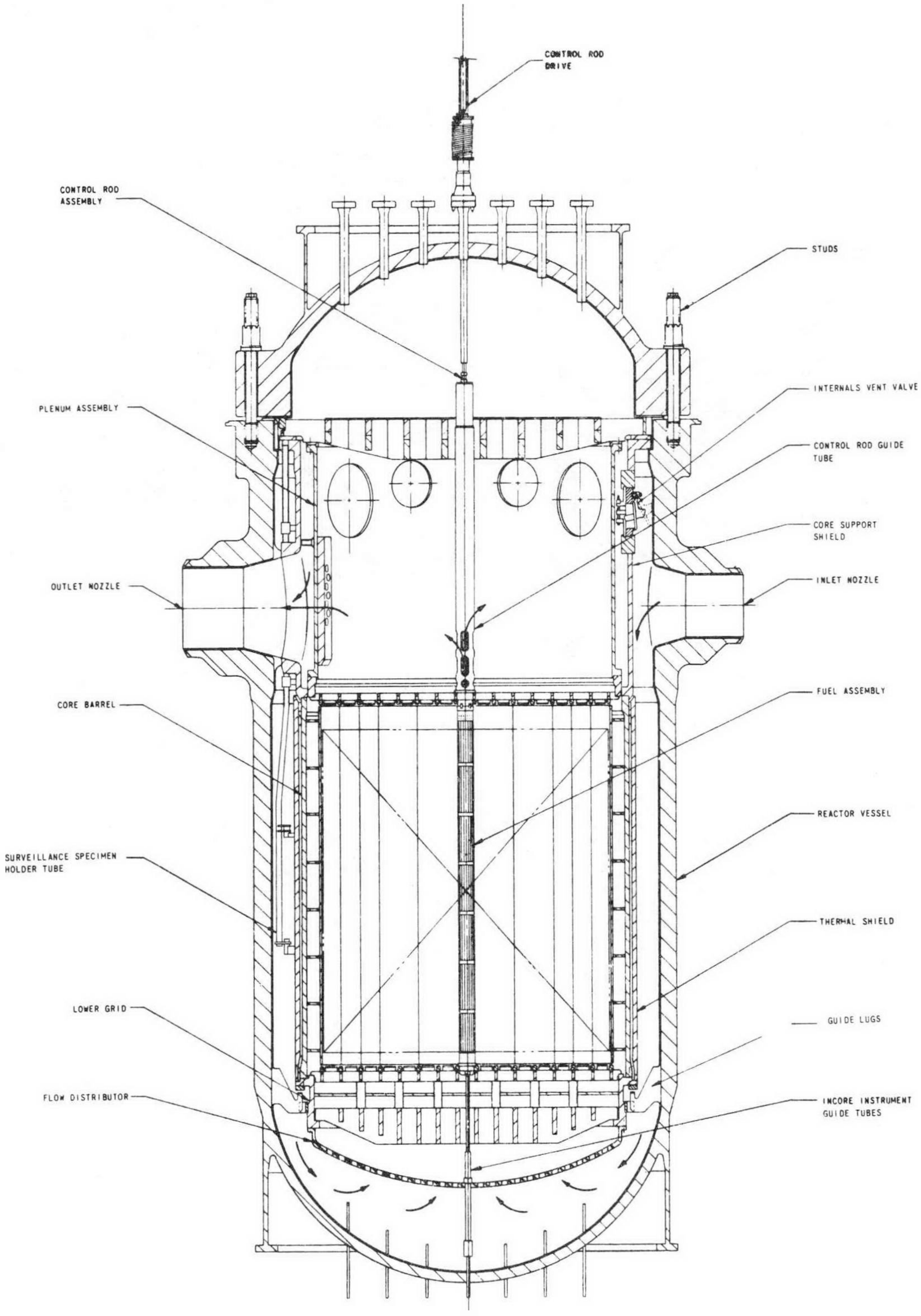
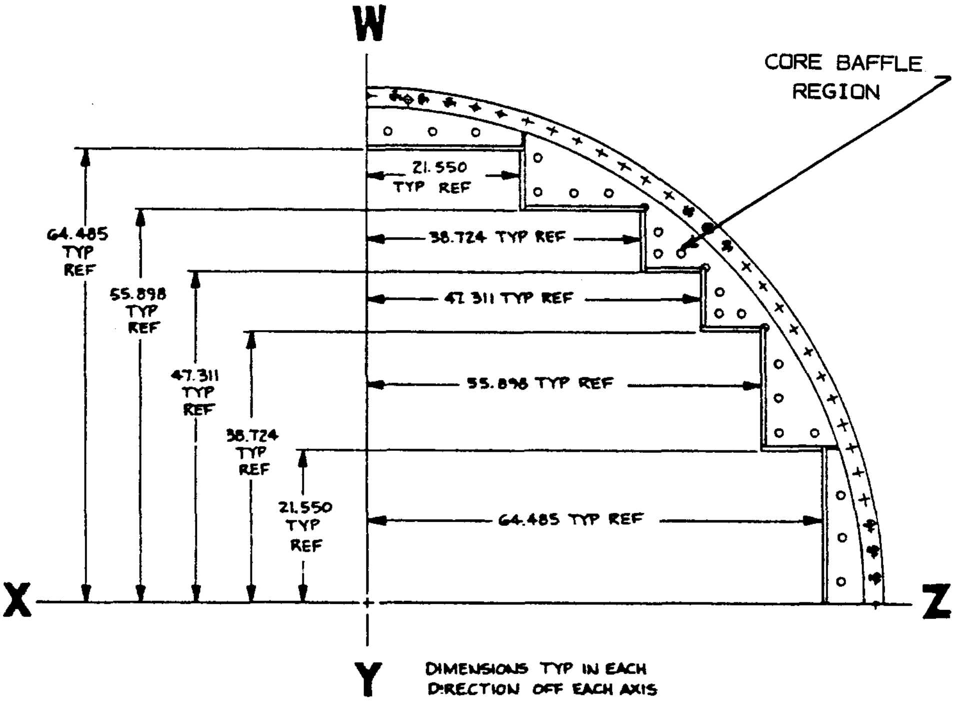
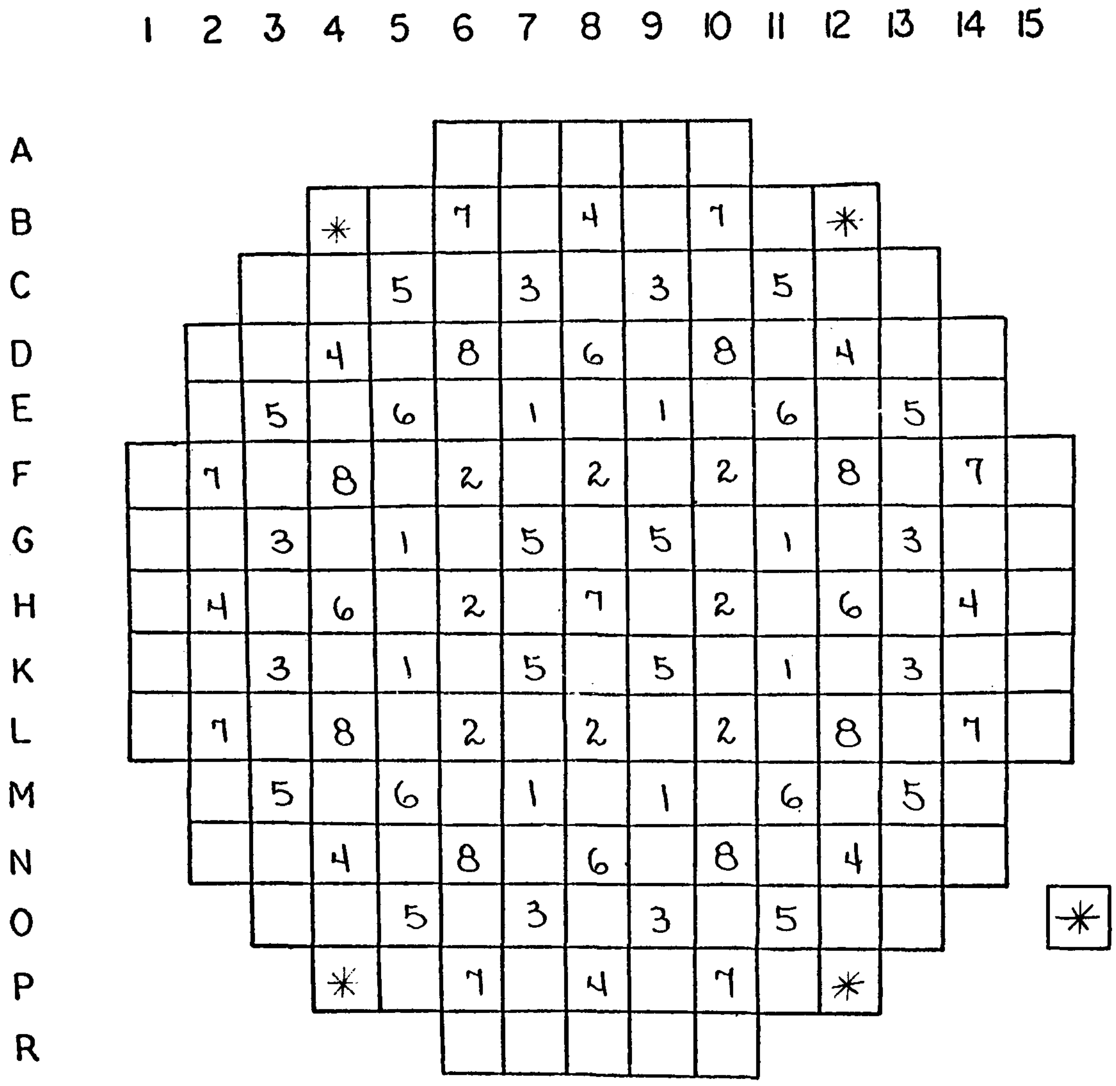


Figure 2-17. Reactor Vessel Internals



NOTE: ALL DIMENSIONS IN INCHES.

Figure 2-18. TMI-1 Cycle 1 Control Rod Configuration, 0-250 EFPD



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B				✳		7		4		7		✳			
C					5		3		3		5				
D				4		8		6		8		4			
E			5		6		1		1		6		5		
F		7		8		2		2		2		8		7	
G			3		1		5		5		1		3		
H		4		6		2		7		2		6		4	
K			3		1		5		5		1		3		
L		7		8		2		2		2		8		7	
M			5		6		1		1		6		5		
N				4		8		6		8		4			
O					5		3		3		5				
P				✳		7		4		7		✳			
R															

CR GROUP	PURPOSE
1-4	SAFETY
5	DOPPLER
6	DOPPLER
7	TRANSIENT
8	APSR

✳ ORIFICE ROD ASSEMBLY LOCATIONS

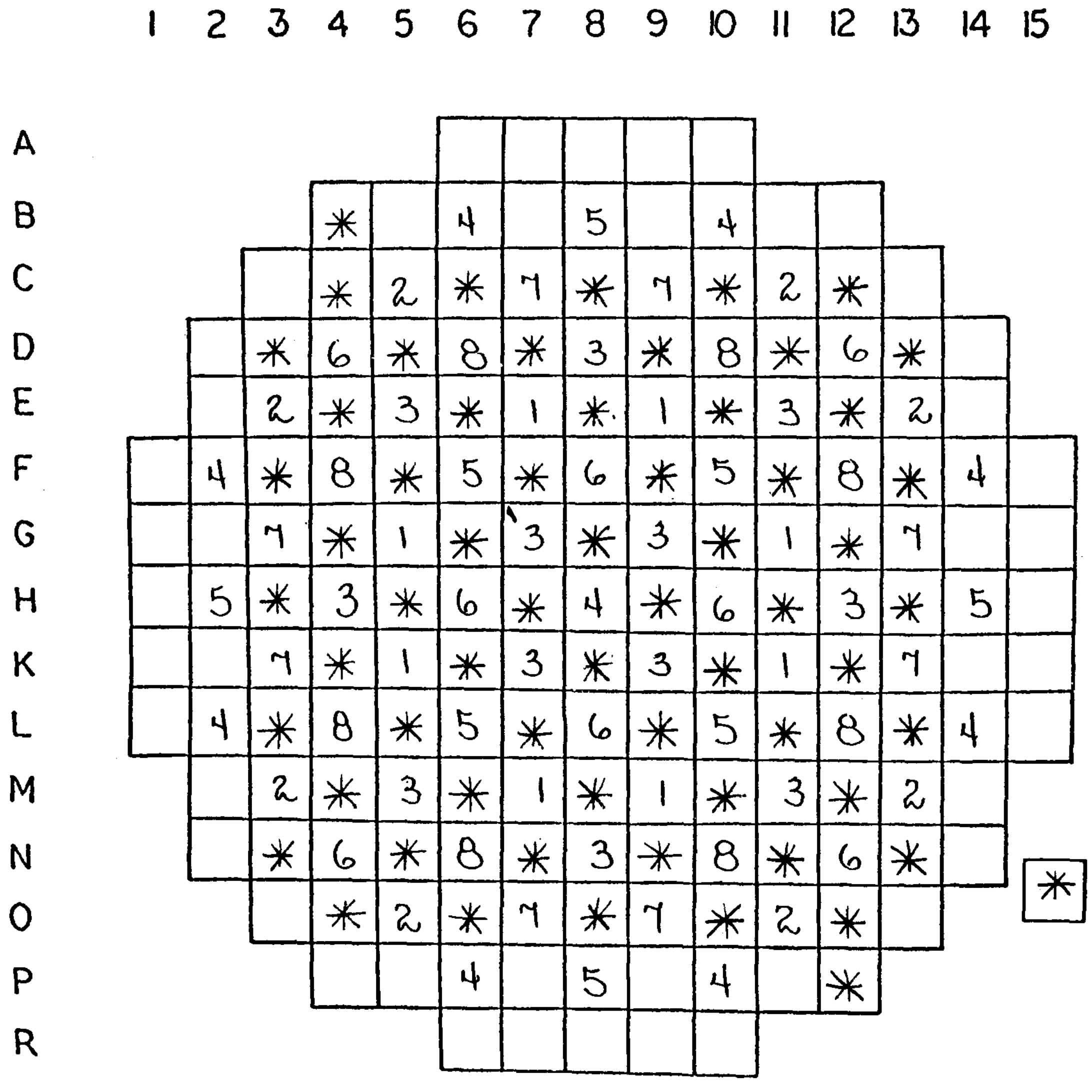
Figure 2-19. TMI-1 Cycle 1 Control Rod Configuration, 250-466 EFPD

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B				*		4		7		4		*			
C					5		3		3		5				
D				7		8		6		8		7			
E			5		6		1		1		6		5		
F		4		8		2		2		2		8		4	
G			3		1		5		5		1		3		
H		7		6		2		7		2		6		7	
K			3		1		5		5		1		3		
L		4		8		2		2		2		8		4	
M			5		6		1		1		6		5		
N				7		8		6		8		7			
O					5		3		3		5				
P				*		4		7		4		*			
R															

CR GROUP	ASSIGNMENT
1-4	SAFETY
5	DOPPLER
6	DOPPLER
7	TRANSIENT
8	APSR

* ORIFICE ROD ASSEMBLY LOCATIONS

Figure 2-20. TMI-1 Cycle 2 Control Rod Configuration, 0-256.2 EFPD

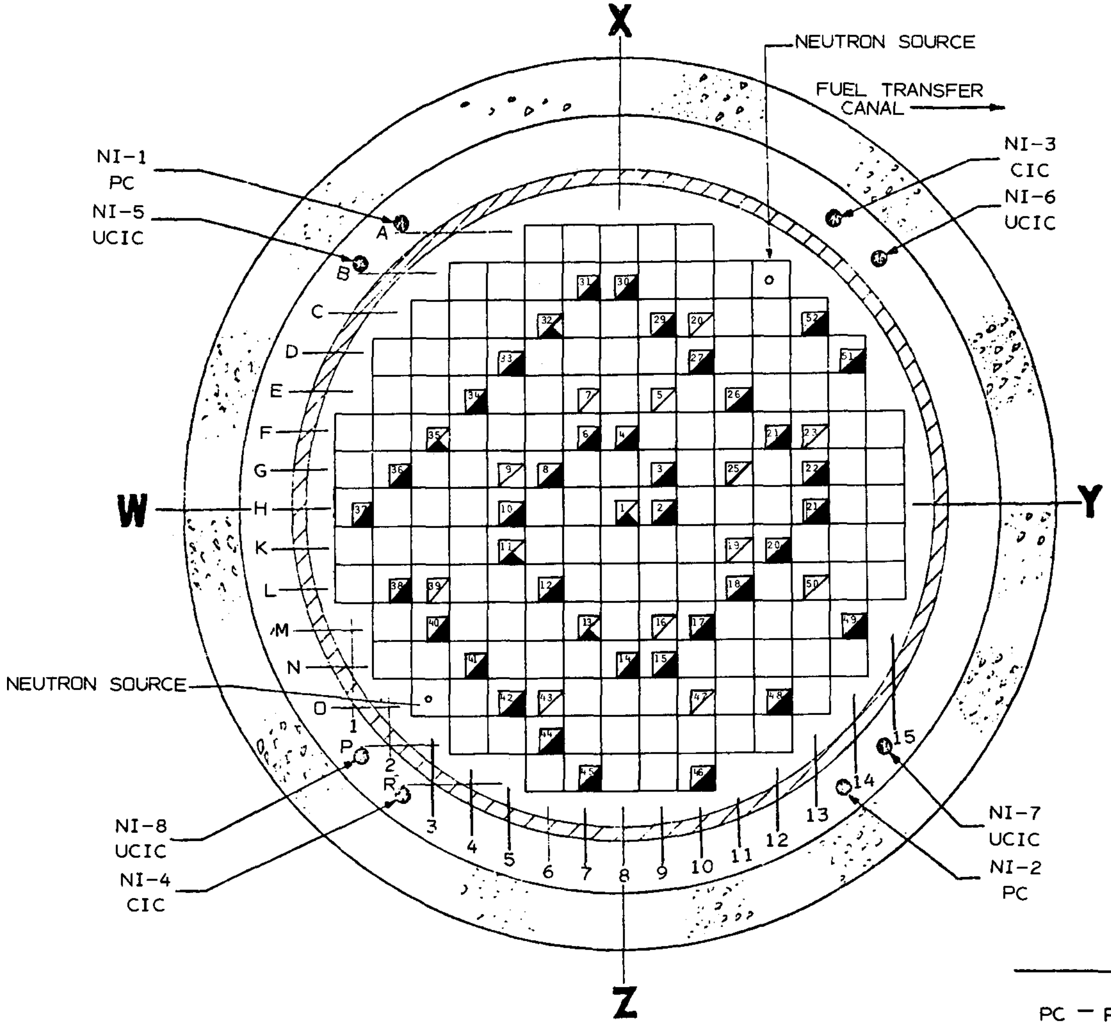


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B				*		4		5		4					
C				*	2	*	7	*	7	*	2	*			
D			*	6	*	8	*	3	*	8	*	6	*		
E			2	*	3	*	1	*	1	*	3	*	2		
F		4	*	8	*	5	*	6	*	5	*	8	*	4	
G			7	*	1	*	3	*	3	*	1	*	7		
H		5	*	3	*	6	*	4	*	6	*	3	*	5	
K			7	*	1	*	3	*	3	*	1	*	7		
L		4	*	8	*	5	*	6	*	5	*	8	*	4	
M			2	*	3	*	1	*	1	*	3	*	2		
N			*	6	*	8	*	3	*	8	*	6	*		
O				*	2	*	7	*	7	*	2	*			
P						4		5		4		*			
R															

CR GROUP	PURPOSE
1–4	SAFETY
5–7	CONTROL
8	APSR

* ORIFICE ROD ASSEMBLY LOCATIONS

Figure 2-21. Nuclear Instrumentation Detector Locations



INCORE MONITOR NUMBER

▨ TOTAL CORE MONITOR

▨ TOTAL CORE & SYMMETRY MONITOR

▨ SYMMETRY MONITOR

CRX-Y CONTROL ROD NUMBER Y OF CONTROL ROD GROUP X

LEGEND

PC — PROPORTIONAL COUNTER SOURCE RANGE 1 DETECTOR

CIC — COMPENSATED ION CHAMBER-INTERMEDIATE RANGE DETECTOR

UCIC — UNCOMPENSATED ION CHAMBER-POWER RANGE DETECTOR

3. STARTUP TEST RESULTS

Startup tests were conducted both at hot zero power (HZP) and during power escalation for the first two cycles of operation at TMI-1. A brief description of the tests and the measurement results are given below.

3.1. All-Rods-Out Critical Boron Concentration and Differential Boron Worth

The all-rods-out critical boron concentration (AROCBC) test was conducted at HZP by borating the reactor coolant system so that control rod groups 1-6 and 8 were fully withdrawn and group 7 was positioned to maintain criticality (approximately 80% withdrawn). Once steady-state conditions were established, control rod group 7 was withdrawn to 100% (full out), and the resultant reactivity change was measured with a reactimeter.* The reactivity addition from the group 7 rod worth was then converted to an equivalent change in boron concentration and added to the equilibrium critical boron concentration to yield the measured results. The AROCBC test results for cycles 1 and 2 are presented in Table 3-1.

Measurements of the differential boron worths at HZP were performed in conjunction with the control rod worth measurements. The control rod worths were measured by the boron swap technique in which a boration/deboration rate was established and the control rods were withdrawn/inserted to compensate for the changing core reactivity. The reactimeter was used to provide a continuous reactivity calculation throughout the measurement. The differential boron worth was then determined by summing the incremental reactivity values measured with the reactimeter during the rod worth measurements over a known boron concentration range. The average differential boron worth is the measured change in reactivity divided by the change in boron concentration. Table 3-1 gives the differential boron worth measured for cycles 1 and 2.

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* "Reactimeter" is the name given to the Babcock & Wilcox reactivity meter, which solves the monoenergetic, point reactor kinetics equations with six delayed neutron groups for core net reactivity based on periodic samples of neutron flux.

3.2. Control Rod Group Worths

Control rod group reactivity worth was measured at HZP using the rod drop and boron/rod swap methods. The boron/rod swap method was used to determine differential and integral rod worths for control rod groups 5 through 8 from 100 to 0% withdrawn, and for group 4 from 100 to 50% withdrawn. The rod drop method was used to obtain the total worth of groups 1 through 4 (group 4 from 50 to 0% withdrawn). The HZP rod group worths are given in Table 3-2 for TMI-1 cycles 1 and 2. Figures 3-1 through 3-3 provide integral rod worth curves for cycle 1.

For cycle 1, rod worths were determined at three different power levels using an insert/withdrawal technique to measure differential rod worths. Using the reactimeter, the differential worth was obtained by dividing the known change in core reactivity by the change in rod position. Results are summarized in Table 3-3.

3.3. Reactivity Coefficients

The four measured coefficients of reactivity presented in this report are defined as follows:

- The temperature coefficient of reactivity is the fractional change in core net reactivity per unit change in fuel and moderator temperature.
- The moderator temperature coefficient of reactivity is the fractional change in core net reactivity per unit change in moderator temperature.
- The power Doppler coefficient of reactivity is the fractional change in core net reactivity per unit change in core power.
- The Doppler coefficient of reactivity is fractional change in core net reactivity per unit change in fuel temperature.

The technique used to measure the isothermal temperature coefficient at zero power was to first establish steady-state conditions and then initiate a positive heatup by closing the turbine bypass valves. After the core average temperature increased by about 10F, core temperature and neutron flux were stabilized and the process was reversed by decreasing the core average temperature to the initial value by opening the turbine bypass valves. This procedure was repeated two times at each chosen boron concentration to establish the reproducibility of measured value. The temperature coefficient from the measured data was then calculated by dividing the change in core reactivity by the corresponding change in core temperature. The measured HZP temperature coefficients for cycles 1 and 2 are summarized in Table 3-4.

The temperature coefficients at power were measured by increasing the reactor coolant average temperature by 5F. The actual temperature change, rod movement, reactivity additions, and any power changes were monitored. The individual reactivity effects were summed and then divided by the change in core average temperature to obtain the temperature coefficient.

The power Doppler coefficient of reactivity was measured in a similar manner. After the prerequisite conditions were established, reactor power was decreased by 5% while the data were recorded. The reactivity effects of the power change were summed and then divided by the change in power to obtain the power Doppler coefficient. The measurement was repeated by increasing core power by 5% to the initial level.

The moderator, temperature, and Doppler coefficients* of reactivity were calculated from the measured temperature and power Doppler coefficients.

Table 3-5 contains the various reactivity coefficients at power measured for the first two cycles of operation at TMI-1.

3.4. Dropped Control Rod Test

The dropped control rod test for cycle 1 was conducted at 40% full power by measuring the worth of the control rod in location H-4 as it was inserted in the core and by measuring the resultant maximum quadrant power tilt with the dropped rod at 86, 49, and 0% withdrawn. In cycle 2 the maximum quadrant power tilt was measured with the control rod in location E-11 at 0% withdrawn. The results of these measurements are provided in Table 3-6.

3.5. Pseudo-Ejected Rod Worth Test

The Pseudo-ejected rod test was conducted during cycle 1 startup at 40% FP with equilibrium xenon established in the core. Control rod groups 1 through 5 were positioned at 100% withdrawn, group 6 at 75%, group 7 at 0%, and group 8 at 13% withdrawn to maintain core axial imbalance# at 0 ± 2%.

Control rod H-8 was withdrawn to 100% (in small increments) by performing a rod swap with control rod group 6. Differential reactivity worth was measured on group 6 using the fast insert/withdrawal technique with control rod H-8 positioned at 0% withdrawn and again at every 20% withdrawal interval. The total reactivity

---

*The Doppler coefficient is determined from the power Doppler coefficient and the calculated relationship between power and fuel temperature.

#Axial imbalance = [(% power in top half of core) - (% power in bottom half of core)](fraction of total core power).

worth of rod H-8 from 0 to 100% withdrawn was then obtained by integrating the differential worth data measured on group 6. Core power distribution measurements were taken with control rod H-8 positioned at 100% withdrawn. The test results are summarized in Table 3-7.

Table 3-1. Critical Boron Concentration and Boron Worth — Hot Zero Power

Item	Value	Source	Comments
AROCBC, ppmB			
Cycle 1	1617	TMI-1 Initial Startup Report No. 50-289	At 532F mod temp.
Cycle 2	1384	IBWD	At 532F mod temp.
Differential B worth, % Δk/k/100 ppmB			
Cycle 1	1.06 1.05 1.06	TMI-Initial Startup Report No. 50-289	At ∿1320 ppmB At ∿1520 ppmB At ∿1590 ppmB
Cycle 2	0.97	IBWD	At ∿1257 ppmB

Table 3-2. Control Rod Worths at Hot Zero Power

Item	Value	Source	Comments
CR group integral worths, % Δk/k			
Cycle 1			
Group 1 (8 rods, 0-100%(a)	4.33(b)	TMI-Initial Startup Report, No. 50-289	Corrected measured worth is 5.85 based on previous plant comparisons to calculation
2 (8, 0-100)			
3 (8, 0-100)			
4 (8, 0-49)			
5 (12 rods)	1.03		
6 (8)	1.25		
7 (9)	1.10		
8 (8)	0.39		
Cycle 2			
Group 1-4 (37 rods)	7.444	IBWD	
5 (8)	0.68		
6 (8)	1.06		
7 (8)	0.772		
Total 1-7 (61 rods)	9.956		

(a) 0-100% withdrawn interval.

(b) Uncorrected.

Table 3-3. TMI-1, Cycle 1 — Measured Differential Rod Worths at Power

Power level, % FP	Boron conc, ppmB	Rod group position, % wd				Δ rod worth, 10^{-3} % Δk/k/% wd
		1-5	6	7	8	
40	1192	100	72.2	0	33	9.44
40	1188	100	65.5	0	13	11.39
76	1120	100	85.5	15.0	20	15.03
100	1092	100	86.0	11.0	0	11.55

Table 3-4. TMI-1 Temperature Coefficient Measurements at Hot Zero Power Conditions

Boron conc, ppmB	Control rod position (% wd)	Temp coeff, 10^{-4} Δk/k/°F
Cycle 1		
1601	Groups 1-6 (100)	+0.449
	7 (78)	
	8 (100)	
1461	Groups 1-5 (100)	+0.304
	6 (78)	
	7 (0)	
	8 (27)	
1269	Groups 1-3 (100)	-0.527
	4 (95)	
	5-7 (0)	
	8 (27)	
1245	Groups 1-3 (100)	-0.604
	4 (50)	
	5-7 (0)	
	8 (27)	
Cycle 2		
1375	Groups 1-7 (100)	+0.094
	8 (0)	
1154	Groups 4 (100)	-0.530
	5-8 (0)	

Table 3-5. TMI-1 Reactivity Coefficients at Power

Core power, % FP	Boron conc, ppmB	Coeff of reactivity, 10^{-4} Δk/k			
		Temp	Power Doppler	Moder.	Doppler
Cycle 1					
100	1090	-0.329	-1.14	-0.222	-0.107
Cycle 2					
100	820	-1.26	-1.17	-1.1	--

Table 3-6. TMI-1 Dropped Rod Test

CR position, % wd	Max quadrant power tilt, % (incore det's)(b)
Cycle 1, H-4(a)	
86	+0.26 XY, -0.71 ZW
49	+5.69 XY, -6.01 ZW
0	+13.98 YZ, -14.07 ZW
Measured reactivity worth of CR in location H-4 = 0.094% Δk/k.	
Cycle 2, E-11(a)	
0	+12.59 ZW, -23.18 XY

(a) Banks 1-5 100% wd, bank 6 88%, bank 7 15%, and bank 8 35%.

(b) Quadrant tilt % =

$$100\left(\frac{\text{power in any quadrant}}{\text{avg power in all quadrants}} - 1\right).$$

Quadrant axes shown in Figure 2-21.

Table 3-7. TMI-1, Cycle 1 — Core Tilt and Rod Worth During Pseudo-Rod Ejection

Rod position, % wd	Incore imbalance, % wd	Quadrant tilt, %				Fuel assembly location
		WX	XY	WZ	YZ	
0	-1.90	-0.28	+0.26	-0.21	+0.22	K-10
100	-8.37	-0.28	+0.01	-0.15	+0.42	H-8

The measured worth of CR in location H-8 was 0.278% Δk/k.

Figure 3-1. TMI-1 Cycle 1 — Control Rod Group Integral Worth at Zero Power, 532F, 0 EFPD

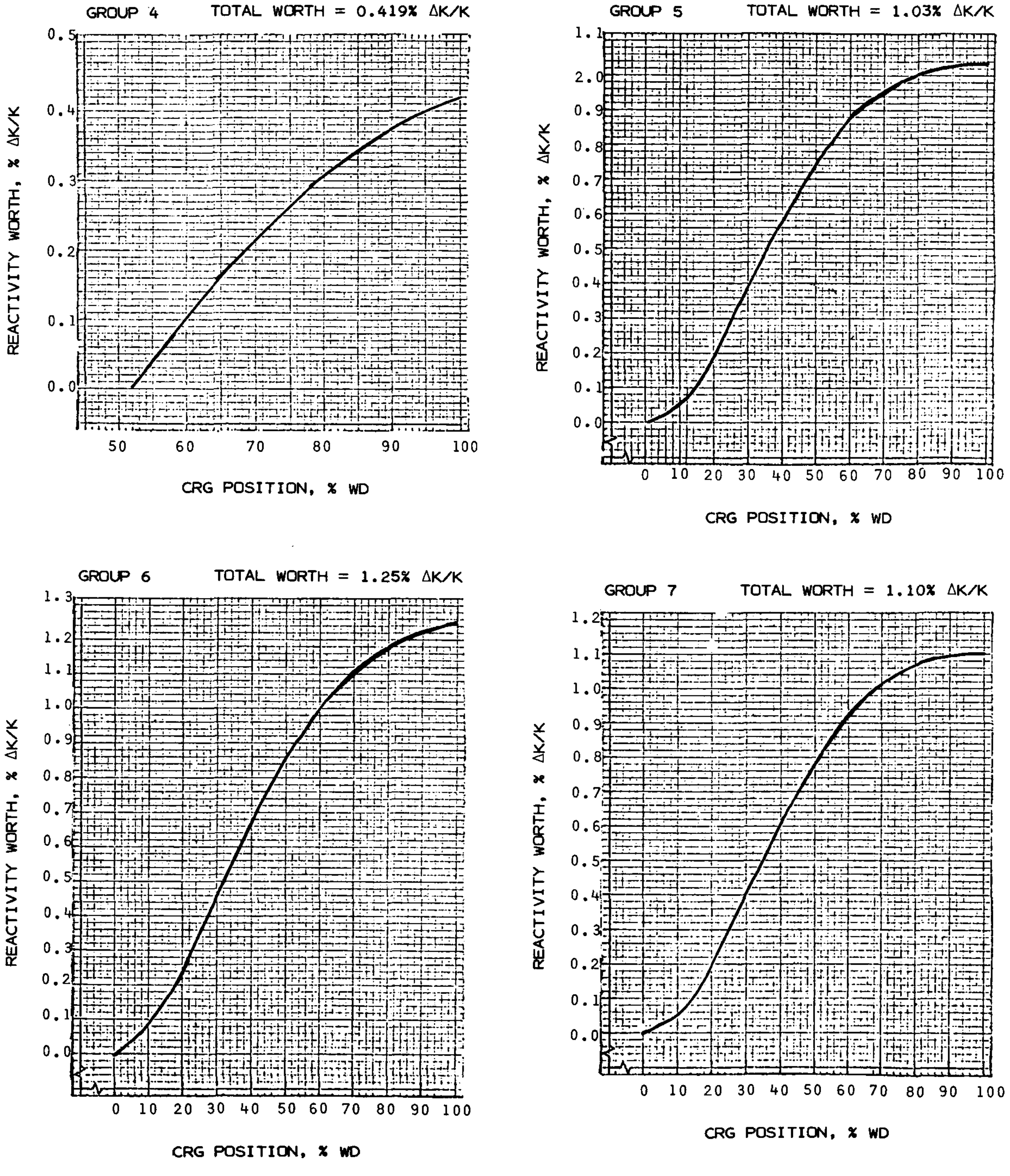


Figure 3-2. TMI-1 Cycle 1 — Control Rod Group 8 Integral Worth at Zero Power, 532F, 0 EFPD

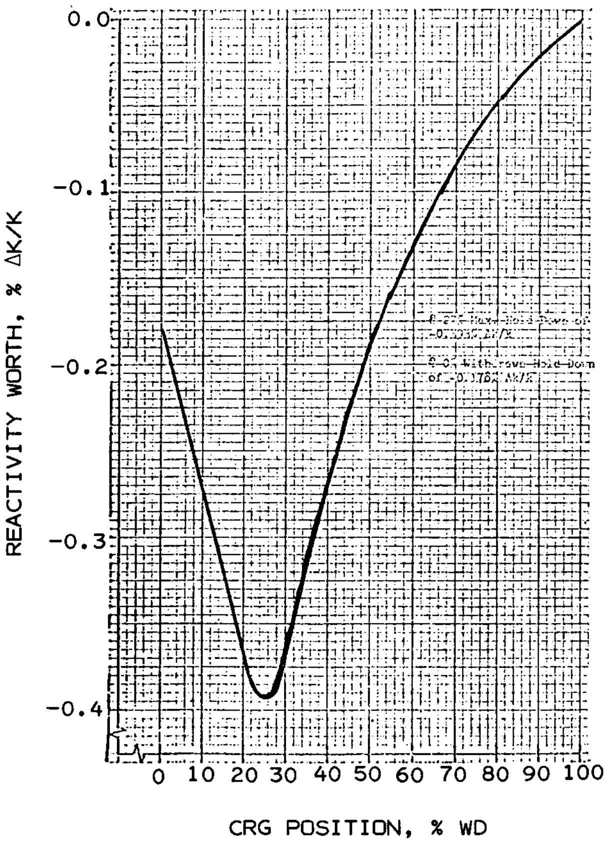
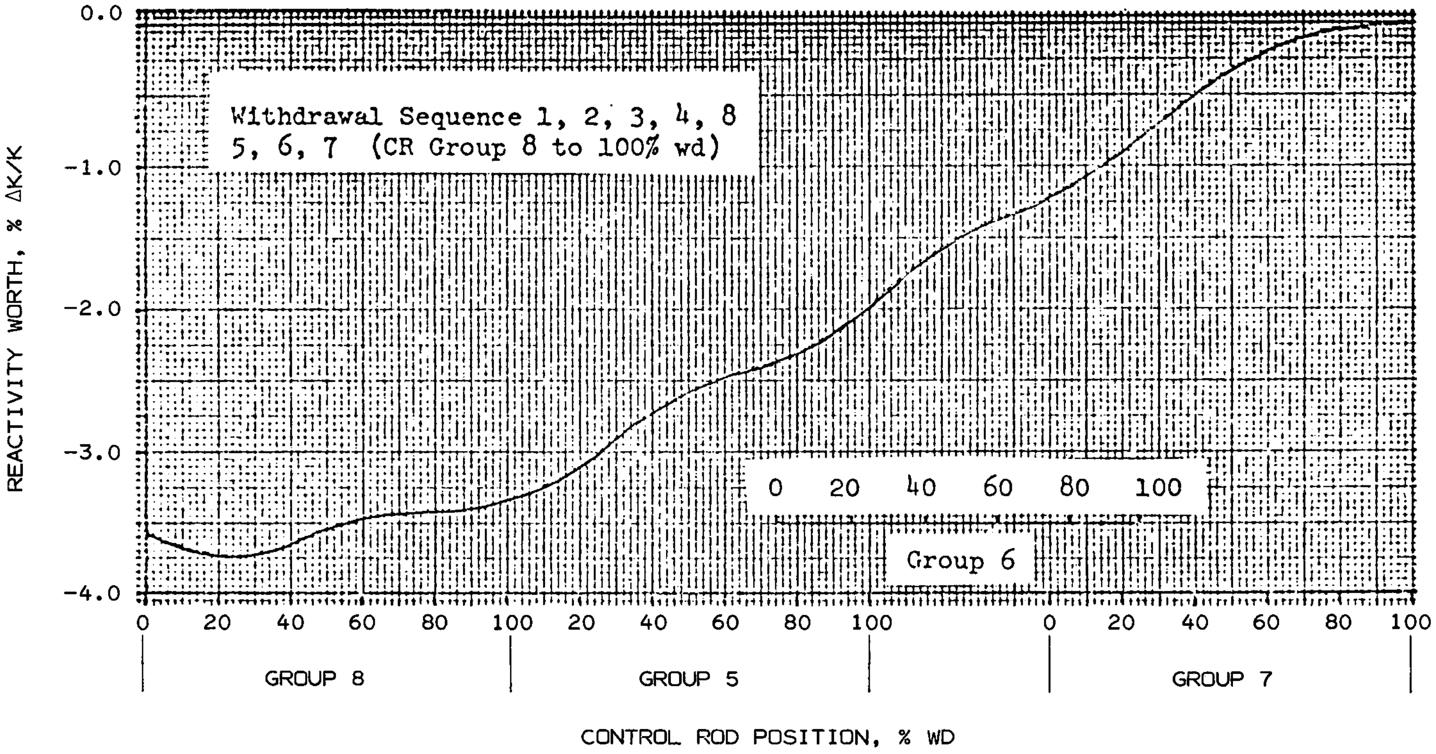


Figure 3-3. TMI-1 Cycle 1 — Total Reactivity Worth Vs Rod Withdrawal at Zero Power, 532F, 0 EFPD



4. TMI-1 OPERATING DATA

The operating data for the first two cycles at TMI-1 have been obtained from core performance data computer outputs taken during plant operation.

4.1. Operational Histograms

Figures 4-1 through 4-4 show the core power, critical boron concentration, and rod position histories in 500-MWd/mtU increments for cycles 1 and 2.

4.2. Core Performance

4.2.1. Operating Data

Core performance data for the first two cycles of operation at TMI-1 are provided in Appendixes A and B. The following definitions have been used in preparing the tables:

Core Power — Core power in megawatts thermal (MWt) is based on a reactor heat balance.

Core Boron Concentration — This figure is based on samples taken periodically by the plant staff.

Core Outlet Pressure — The core outlet pressure is measured outside the core by a pressure tap. The plant computer corrects the pressure reading back to the core elevation by applying the Bernoulli equation. The correction (about 50 psi) is added to the reading and printed by the computer.

Reactor Coolant Total Flow — Total primary side system flow.

Feedwater Flow — Secondary side flow for the designated loop.

RODW — The rod withdrawal in percent as measured by magnetic reed switches, having 2-inch spacing and which start at the fully inserted position.

SPND-UNC — The uncorrected incore detector signal in nanoamps for each detector in the core. One SPND-UNC map is included in the first case for each cycle. Each block represents a detector string with the first value being that for the level 1 detector in the string located nearest the bottom of the active fuel length.

BKCAL — The calibrated background signal (in nanoamps) measured for each detector string.

SPNDBC — The corrected incore detector signal (in nanoamps).

4.2.2. Incore Detector Signal Processing

The SPNDBC signals in Appendixes A and B represent the measured signal that would be expected if all the incore detectors were undepleted and of nominal sensitivity and there were no signal losses during measurement. This consistent set of instrument-independent signals is obtained from the raw detector signals, SPND-UNC, by applying several corrections.

A correction (CALFI) is applied to the detector signal to correct for current losses in the cables connecting the incore detectors to the multiplexer. This correction factor is based on leakage measurements taken at the plant and is usually small.

The leakage-corrected signals are adjusted by a factor (SCF) to account for as-built variations in detectors. These slight variations in length and lateral surface area cause small differences in the initial sensitivity. Based on tests conducted by B&W, a correlation between detector length and sensitivity was developed and is applied to each detector to yield a leakage- and sensitivity-corrected signal.

Signals generated by each detector are also affected by the amount of rhodium depletion that has occurred in the detector. To adjust for the depletion effects, a correction factor is calculated based on the following equation:

$$\mathrm{DCF} = \frac{Q_\infty}{Q_\infty - Q_t}$$

where

DCF = depletion correction factor (inverse of fraction depleted),

Q_∞ = total output charge available from detector,

Q_t = total output charge generated to date by the detector.

The value of Q_∞ is determined for each detector based on a B&W correlation, while Q_t is constantly updated by the on-line computer system.

A final correction is required to account for background losses caused primarily by gamma interaction with the detector sheath and leadwire. The background signal is measured for each string at level 7 and is corrected for current leakage to obtain a calibrated value, BKCAL. A background signal (BKG) for each level is obtained by proportioning the level 7 background signal over the axial length of the assembly based on the measured power shape.

The instrument-independent signal is then calculated as follows:

$$SPNDBC = (SPND - UNC) * CALFI * DCF * SCF + BKG$$

where

SPNDBC = instrument-independent Rh signal, n-amps,
SPND-UNC = raw measured Rh signal, n-amps,
CALFI = detector leakage correction,
DCF = detector depletion correction factor,
SCF = detector sensitivity correction factor,
BKG = background signal correction.

For further information on signal processing and the conversion from detector signals to assembly powers, see "Nuclear Applications Software Package," BAW-10123, Babcock & Wilcox, February 1978.

4.2.3. Heat Balance Calculations

The core power calculated for each data case is determined by weighing the plant primary and secondary side heat balances. The core power above 50% of full power is given by

$$Q = *QSEC + (1 - \alpha)QPRIM$$

where

Q = core power Btu/h,
QSEC = core power from secondary side heat balance, Btu/h,
QPRIM = core power from primary side heat balance, Btu/h,
α = weighing factor.

The weighing factor used above is

$$\frac{PWR - 15.0}{85.0} \quad \text{for } 15.0 < PWR < 100.0$$

where PWR is the percent of full power using QSEC above 50% and QPRIM below 50%. Heat balance calculations are made on approximately 6-minute intervals.

The primary side heat balance for TMI-1 is calculated as follows:

$$QPRIM_A = W_A[H(T_{OUT,A},P) - H(T_{IN,A},P)] - WLET \times H(T_{IN,LET},P) + QPRO - QPUMP$$

where

$QPRIM_A$ = primary side power for loop A, Btu/h,
$H(T_{OUT,A},P)$ = coolant enthalpy for loop A at $T_{OUT,A}$ and P, Btu/lb,
$T_{OUT,A}$ = loop A outlet temperature, F,
P = core pressure, psia,
W_A = core flow in loop A, lb/h,

WLET = letdown flow rate, lb/h,
QPRO = primary side surface heat loss, Btu/h
QPUMP = heat addition from two pumps, Btu/h.

The inlet temperature $T_{IN,A}$ is obtained by flow weighing the measured inlet temperatures for each inlet leg of the loop. The primary side heat balance QPRIM is the sum of the heat balances performed for the two primary loops.

The secondary side heat balance is calculated as follows:

$$QSEC = FF_A(H_A - H_{IN,A}) - H_{MKUP} \times MKUP - QPUMP + QPRO + FF_B(H_B - H_{IN,B}) + H_{IN,B} \times WLET - QPUMP + QPRO$$

where

QSEC = secondary side power, Btu/h,
FF_A = feedwater flow rate for loop A, lb/h,
FF_B = feedwater flow rate for loop B, lb/h,
MKUP = makeup flow rate, lb/h (equals WLET),
H_{MKUP} = makeup coolant enthalpy, Btu/lb
H_A, H_B = outlet steam enthalpy, loop A or B, Btu/lb,
$H_{IN,A}$, $H_{IN,B}$ = enthalpy of inlet coolant, loop A or B, Btu/lb.

Following is a sample heat balance calculation for TMI-1 using Case 1 from cycle 2.

Primary heat balance	Flow rate, 10^6 lb/h	Temperature, F
Loop A inlet	68.99	571.32, 569.58 = 570.45
Loop B inlet	69.436	570.35, 570.08 = 570.22
Letdown	0.0246	∿570.3
Loop A outlet	68.99	589.23
Loop B outlet	69.436	589.00

Core pressure = 2178.3
H(570,2178) = 572.34
H(589,2178) = 597.82

$$QPRIMA = 68.99 \times 10^6(597.82 - 572.34) - 0.02466 \times 10^6(572.34) + 0.93 \times 10^6 - (34.812 \times 10^6) = 1.71 \times 10^9 \text{ Btu/h}$$

$$QPRIMB = 69.436 \times 10^6(597.82 - 572.34) - 0.02466 \times 10^6 (572.34) + 0.93 \times 10^6 - (34.812 \times 10^6) = 1.72 \times 10^9 \text{ Btu/h}$$

$$QRPIM = 3.43 \times 10^9 \text{ Btu/h} = 1005.3 \text{ MWt.}$$

Secondary side heat balance	Flow 10^6lb/h	Temp, F
Feedwater loop A	1.9887	374.18
Feedwater loop B	2.0246	374.18
Steam loop A	1.9887	590.73
Steam loop B	2.0246	587.71

Core pressure = 908.7

H(590.7, 908.7) = 1250.20 H(374.18, 908.7) = 348.57

H(587.7, 908.7) = 1248.78 H(makeup) = 93.58

$$QSEC = 1.9887 \times 10^6(1250.20 - 348.57) - (93.58 \times 0.02466 \times 10^6) - 34.812 \times 10^6$$

$$+ 0.93 \times 10^6 + 2.0246 \times 10^6 (1248.78 - 348.57) + (348.57 \times 0.02466 \times 10^6)$$

$$-34.812 \times 10^6 + 0.93 \times 10^6 = 3.55 \times 10^9 \text{ Btu/h}$$

$$= 3.55 \times 10^9 \text{ Btu/h} = 1041.4 \text{ MWt}$$

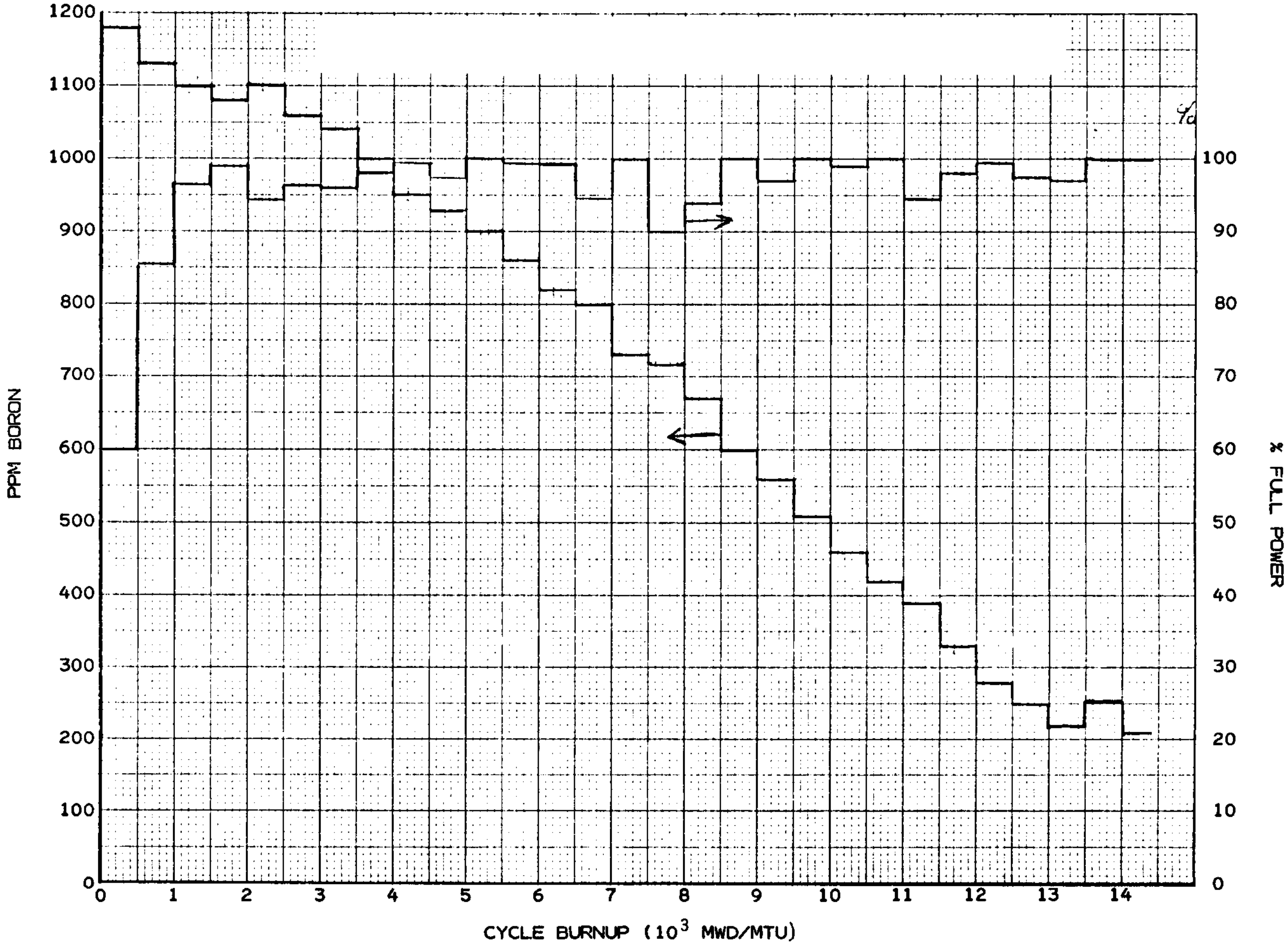
$$\alpha = 0.29$$

$$\text{Core power} = 1041.4 \ (0.29) + (1 - 0.29)(1005.3) = 1015.77$$

The difference between the on-line computer (OLC) core power and this number is caused by the use of handbook-interpolated enthalpy values instead of the OLC-calculated values.

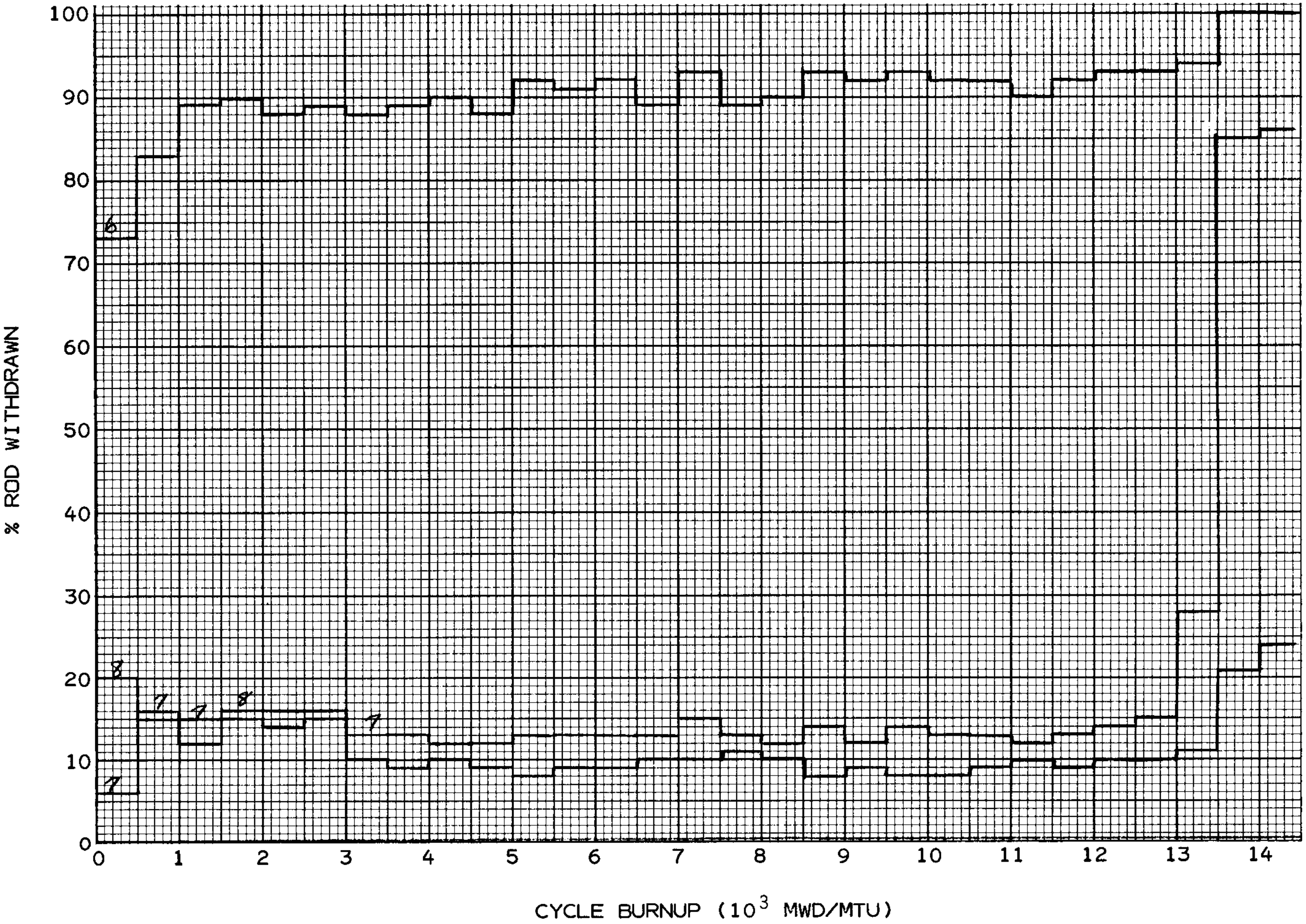
CORE AVERAGE		
MWD/MTU	POWER	PPMB
0 500	60.0	1179
500 1,000	86.5	1131
1,000 1,500	96.5	1098
1,500 2,000	99.0	1077
2,000 2,500	94.5	1104
2,500 3,000	96.5	1056
3,000 3,500	96.0	1039
3,500 4,000	100.0	980
4,000 4,500	99.5	950
4,500 5,000	97.5	933
5,000 5,500	100.0	900
5,500 6,000	99.5	864
6,000 6,500	99.5	822
6,500 7,000	94.5	796
7,000 7,500	100.0	733
7,500 8,000	90.0	717
8,000 8,500	94.0	674
8,500 9,000	100.0	601
9,000 9,500	97.0	556
9,500 10,000	100.0	512
10,000 10,500	99.0	463
10,500 11,000	100.0	418
11,000 11,500	94.5	391
11,500 12,000	98.0	329
12,000 12,500	99.5	276
12,500 13,000	97.5	246
13,000 13,500	97.0	221
13,500 14,000	100.0	255
14,000 14,406	100.0	212

Figure 4-1. TMI-1 Cycle 1 — Power and Boron History



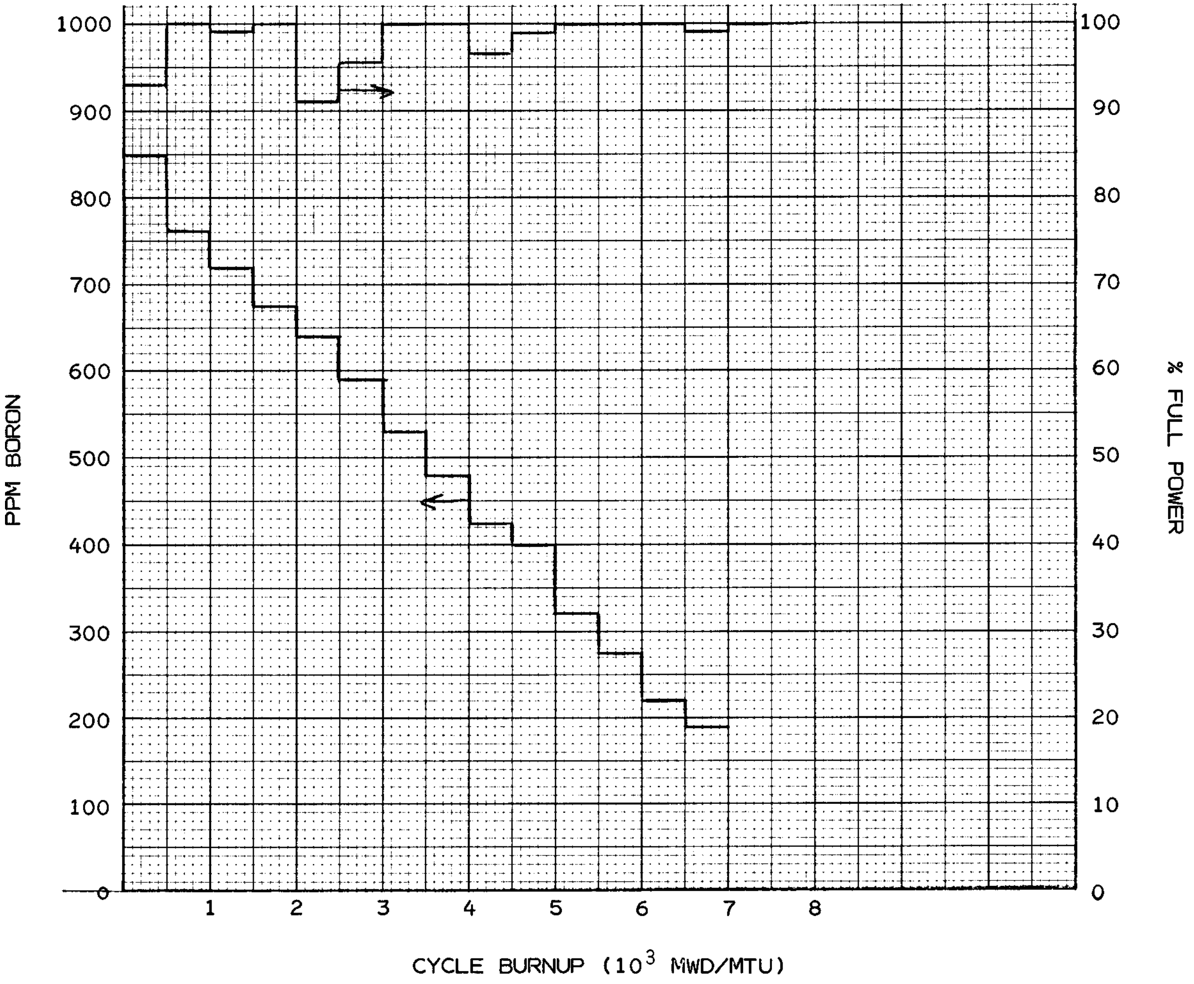
	AVERAGE % WD		
MWD/MTU	GP6	GP7	GP8
0 500	73	6	20
500 1,000	83	16	15
1,000 1,500	89	15	12
1,500 2,000	90	15	16
2,000 2,500	88	14	16
2,500 3,000	89	15	16
3,000 3,500	98	13	10
3,500 4,000	89	13	9
4,000 4,500	90	12	10
4,500 5,000	88	12	9
5,000 5,500	92	13	8
5,500 6,000	91	13	9
6,000 6,500	92	13	9
6,500 7,000	89	13	10
7,000 7,500	93	15	10
7,500 8,000	89	13	11
8,000 8,500	90	12	10
9,500 9,000	93	14	8
9,000 9,500	92	12	9
9,500 10,000	93	14	8
10,000 10,500	92	13	8
10,500 11,000	92	13	9
11,000 11,500	90	12	10
11,500 12,000	92	13	9
12,000 12,500	93	14	10
12,500 13,000	93	15	10
13,000 13,500	94	28	11
13,500 14,000	100	85	21
14,000 14,406	100	86	24

Figure 4-2. TMI-1 Cycle 1 — Rod Position History



CORE AVERAGE		
MWD/MTU	POWER	PPMB
0 500	93.0	850
500 1,000	100.0	763
1,000 1,500	99.0	720
1,500 2,000	100.0	674
2,000 2,500	91.0	640
2,500 3,000	95.5	590
3,000 3,500	100.0	532
3,500 4,000	100.0	478
4,000 4,500	96.5	434
4,500 5,000	99.0	400
5,000 5,500	100.0	321
5,500 6,000	100.0	276
6,000 6,500	100.0	232
6,500 7,000	99.0	189
7,000 7,500	100.0	
7,500 7,940	100.0	

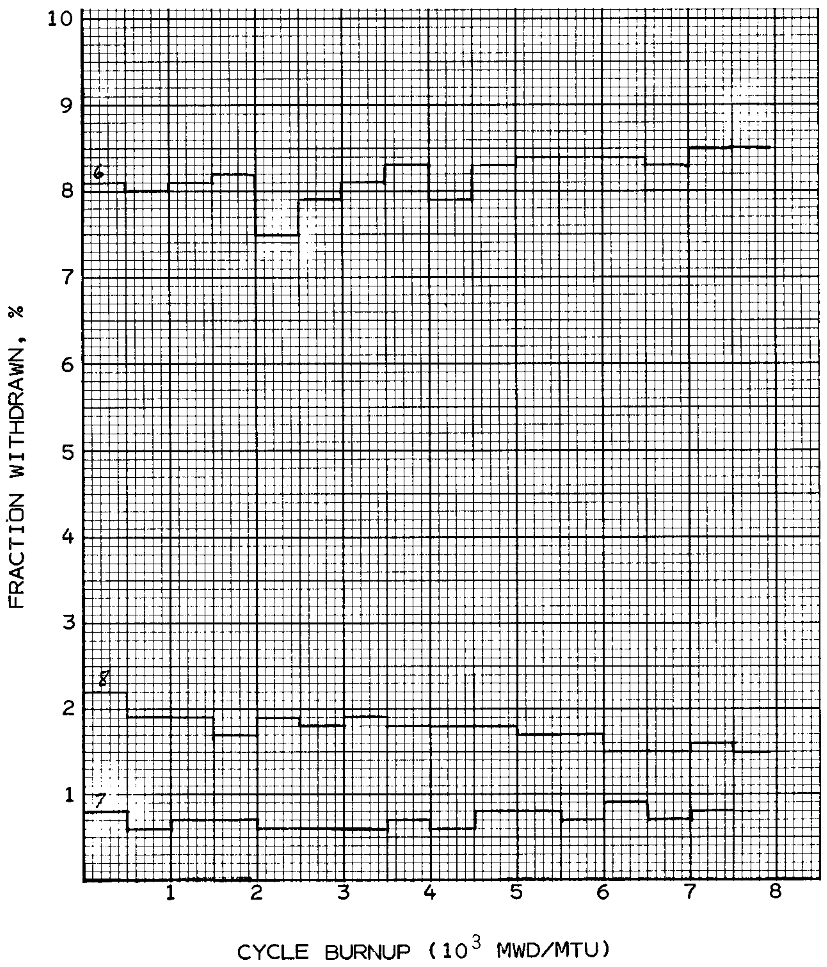
Figure 4-3. TMI-1 Cycle 2 — Power and Boron History



AVERAGE % WD*

MWD/MTU	GP6	GP7	GP8
0 500	81	8	22
500 1,000	80	6	19
1,000 1,500	81	7	19
1,500 2,000	82	7	17
2,000 2,500	75	6	19
2,500 3,000	79	6	18
3,000 3,500	81	6	19
3,500 4,000	83	7	18
4,000 4,500	79	6	18
4,500 5,000	83	8	18
5,000 5,500	84	8	17
5,500 6,000	84	7	17
6,000 6,500	84	9	15
6,500 7,000	83	7	15
7,000 7,500	85	8	16
7,500 7,940	85	8	15

Figure 4-4. TMI-1 Cycle 2 — Rod Position History



APPENDIX A

Operating Data, Cycle 1

Table A-1. Operating Data, Cycle 1

Case	Core burnup, MWd/mtU	Core power, MWt	Core boron conc, ppmB
1	655.0	2513.1	1101.0
2	986.0	2559.5	1095.0
3	1756.0	2506.5	1083.0
4	2001.0	2516.2	1083.0
5	2248.0	2538.7	1073.0
6	2520.3	2500.3	1069.0
7	2763.0	2481.4	1057.0
8	3223.0	2500.8	1039.0
9	3409.0	2526.1	1008.0
10	3652.0	2495.0	1001.0
11	3836.0	2518.2	997.0
12	4055.0	2515.1	983.0
13	5082.0	2540.9	910.0
14	5296.0	2521.4	896.0
15	5727.0	2495.3	888.0
16	5939.0	2532.0	858.0
17	6154.0	2515.7	824.0
18	6549.0	2509.9	801.0
19	6759.0	2523.7	785.0
20	6968.0	2534.7	753.0
21	7199.0	2526.2	743.0
22	7711.0	2528.2	706.0
23	8459.0	2540.2	633.0
24	9133.0	2511.1	576.0
25	9326.0	2539.9	548.0
26	10187.0	2512.3	462.0
27	10400.0	2524.5	456.0
28	10600.0	2495.6	440.0
29	10814.0	2515.1	408.0
30	11808.0	2538.5	310.0
31	12850.0	2505.2	227.0
32	13745.0	2529.0	258.0

```
                                                                                    CASE    1

                                           TMI-1  CY-1

                                YEAR 74 MONTH 08 DAY 09 HOUR 08 MINUTE 34 REF EST +


              CORE POWER                   CORE AVG BURNUP                  CORE BORON CONC
                (MWT)                         (MWD/MTU)                          (PPMB)


               2513.1                          655.00                            1101.0



              COOLANT FLOWS                    PRESSURE                  COOLANT TEMPERATURES
             (LB/HR * E-6)                      (PSIA)                         DEGREES F

        RC FLOW LOOP A          70.085     CORE OUTLET          2179.5     LOOP A INLET TEMP(1)    556.43

        RC FLOW LOOP B          69.469     SECONDARY LOOP A     893.70     LOOP A INLET TEMP(2)    554.93

        RC TOTAL FLOW           139.72     SECONDARY LOOP B     893.70     LOOP B INLET TEMP(1)    555.54

        FEEDWATER FLOW LOOP A   5.2800                                     LOOP B INLET TEMP(2)    555.45

        FEEDWATER FLOW LOOP B   5.4085                                     FEEDWATER (LOOP A)      461.09

        LETDOWN   FLOW          .51508E-01                                 FEEDWATER (LOOP B)      461.09

                                                                           REACTOR OUTLET (LOOP A) 601.06

                                                                           REACTOR OUTLET (LOOP B) 600.84

                                                                           STEAM TEMP (LOOP A)     591.15

                                                                           STEAM TEMP (LOOP B)     591.56
```

ROOW

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B						19.60		99.70		19.70					
C					100.00		101.00		98.80		101.00				
D				99.70		10.00		92.30		7.89		99.90			
E			99.80		93.20		98.70		98.70		92.30		99.80		
F		18.60		6.66		99.80		99.80		99.70		13.20		19.60	
G			99.70		99.70		99.70		101.00		98.70		98.70		
H		99.80		92.30		99.80		19.70		99.80		92.20		99.80	
K			99.90		99.70		99.70		101.00		98.60		99.70		
L		19.60		5.85		99.90		99.70		99.70		5.70		19.60	
M			101.00		91.30		98.80		99.90		92.30		99.70		
N				99.80		5.73		93.30		7.92		99.70			
O					99.70		99.00		99.50		99.70				
P						19.90		85.10		19.60					
R															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

SPND-UNC

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							452.20 583.90 527.50 554.50 551.40 405.30 157.00	540.80 758.20 756.60 769.40 708.50 539.40 188.80							
C						448.80 498.00 490.60 595.50 574.80 453.60 172.90			575.20 747.10 776.90 867.40 844.20 684.20 312.50	441.60 507.30 521.20 616.90 574.40 446.40 179.20			193.20 272.00 282.70 315.90 296.10 242.30 96.90		
D					405.50 491.70 573.30 724.80 715.10 543.30 256.80					482.10 397.50 539.20 916.30 847.00 717.80 297.70				179.70 236.80 245.50 269.20 254.40 183.20 41.60	
E				401.80 503.90 629.80 757.80 725.80 545.20 232.20			592.00 810.70 913.50 1028.90 960.60 728.90 307.20		580.80 815.60 925.40 1047.20 935.80 772.00 383.50		515.60 663.80 776.40 923.10 931.30 725.70 247.60				
F			415.70 530.50 547.40 633.90 593.20 463.30 213.20				518.50 724.00 815.60 851.20 825.60 633.40 311.30	637.90 923.30 1006.80 1014.90 941.90 706.30 310.20				557.50 417.40 427.40 940.00 908.20 750.80 327.20	456.60 527.90 498.80 603.50 623.90 495.50 224.40		
G		459.10 601.20 593.50 607.00 556.00 399.70 216.80			564.10 834.30 954.00 1049.50 959.00 824.80 395.50	496.10 712.50 794.40 858.20 793.40 652.90 288.50			645.40 883.20 919.50 1014.80 919.90 721.00 364.00		592.70 815.60 897.70 1040.50 995.70 807.10 -200.00		594.70 745.10 719.40 830.90 793.10 583.50 197.20		
H	349.40 487.90 488.00 483.80 443.40 310.20 85.30				482.60 699.70 818.80 895.70 799.80 675.10 249.40			680.00 788.30 524.00 534.00 478.70 392.70 160.80	569.70 763.20 752.60 745.70 707.60 552.80 245.60				506.30 712.80 740.00 802.10 711.10 574.60 275.40		
K					546.70 824.00 963.90 1034.90 1017.80 836.90 406.20						576.50 827.60 976.30 1063.40 1003.60 820.90 411.60	460.40 611.30 703.60 817.70 782.60 612.30 254.10			
L		413.10 461.40 293.40 303.40 254.70 198.50 35.90	410.10 467.30 583.70 631.30 560.00 455.00 168.70			587.20 826.80 993.30 1033.20 951.80 788.50 337.70					460.60 591.90 745.80 857.30 821.40 655.80 274.30		412.50 515.90 561.60 669.70 609.90 500.80 239.00		
M			403.10 583.90 650.80 756.80 701.40 525.50 230.40				548.60 833.70 965.20 1043.10 952.70 828.00 391.60		597.30 818.80 930.60 1093.80 1013.30 798.60 334.80	440.90 639.30 761.70 908.30 812.90 668.40 275.00				296.50 393.40 374.80 400.70 344.60 272.00 78.50	
N				407.50 587.40 695.20 815.00 747.80 631.50 255.60				577.10 855.70 959.40 1080.00 1007.90 788.20 289.80	461.60 587.50 653.30 764.20 735.20 581.40 201.70						
O					441.50 562.80 658.80 729.80 679.70 493.20 198.60	423.00 511.80 535.20 633.90 581.80 460.30 183.20				438.00 517.00 548.60 652.20 571.80 453.80 209.20		283.90 390.90 452.80 489.30 451.30 367.50 167.90			
P						413.40 476.40 304.90 328.80 312.50 237.60 0.00									
R							310.90 440.90 425.30 415.30 393.70 322.70 128.40			227.30 278.20 243.30 252.00 227.80 164.20 54.40					

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

```
                                                                             BKCAL

            1         2         3         4         5         6         7         8         9        10        11        12        13        14        15

                                                         ***************************************************
                                                         *         *         *         *         *         *
A                                                        *         *         *         *         *         *
                                                         *         *         *         *         *         *
                                     *******************************************************************************************
                                     *         *         *         *         *         *         *         *         *         *
B                                    *         *         *         *    84.30*   119.29*         *         *         *         *
                                     *         *         *         *         *         *         *         *         *         *
                           ***************************************************************************************************************
                           *         *         *         *         *         *         *         *         *         *         *         *
C                          *         *         *         *    79.00*         *         *    89.30*    96.80*         *         *    44.35*
                           *         *         *         *         *         *         *         *         *         *         *         *
                 ***********************************************************************************************************************************
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
D                *         *         *         *    86.70*         *         *         *         *    87.50*         *         *         *    68.25*
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
                 ***********************************************************************************************************************************
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
E                *         *         *    91.00*         *         *   124.99*         *   113.99*         *    78.10*         *         *         *
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
       *******************************************************************************************************************************************************
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
F      *         *         *    61.30*         *         *         *   110.39*   152.19*         *         *         *    89.60*    78.70*         *         *
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
       *******************************************************************************************************************************************************
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
G      *         *    76.30*         *         *   129.39*    99.80*         *         *   102.79*         *   120.79*         *   135.89*         *         *
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
       *******************************************************************************************************************************************************
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
H      *   119.69*         *         *         *   103.49*         *         *    97.15*    98.10*         *         *         *    85.10*         *         *
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
       *******************************************************************************************************************************************************
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
K      *         *         *         *         *   121.29*         *         *         *         *         *   113.89*   102.59*         *         *         *
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
       *******************************************************************************************************************************************************
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
L      *         *   111.09*    89.00*         *         *   101.29*         *         *         *         *   107.89*         *    76.85*         *         *
       *         *         *         *         *         *         *         *         *         *         *         *         *         *         *         *
       *******************************************************************************************************************************************************
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
M                *         *    85.60*         *         *         *   128.99*         *   102.39*    92.80*         *         *         *    93.15*
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
                 ***********************************************************************************************************************************
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
N                *         *         *    83.65*         *         *         *   107.49*   149.89*         *         *         *         *         *
                 *         *         *         *         *         *         *         *         *         *         *         *         *         *
                 ***********************************************************************************************************************************
                           *         *         *         *         *         *         *         *         *         *         *         *
O                          *         *         *   144.14*    84.55*         *         *         *    81.00*         *    72.55*         *
                           *         *         *         *         *         *         *         *         *         *         *         *
                           ***************************************************************************************************************
                                     *         *         *         *         *         *         *         *         *         *
P                                    *         *         *    61.35*         *         *         *         *         *         *
                                     *         *         *         *         *         *         *         *         *         *
                                     *******************************************************************************************
                                                         *         *         *         *         *         *
R                                                        *         *    62.20*         *         *    64.40*
                                                         *         *         *         *         *         *
                                                         ***************************************************

            1         2         3         4         5         6         7         8         9        10        11        12        13        14        15
```

SPNDBC

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							464.25 608.33 581.69 613.62 616.76 483.53 244.72	549.26 791.47 825.93 865.63 817.15 663.26 308.30							
C						455.08 518.88 527.85 650.48 636.49 533.68 250.83			584.37 782.30 825.56 937.24 940.90 783.71 405.01	449.49 529.84 560.22 674.78 647.64 531.70 274.02			198.30 280.42 303.23 344.36 330.28 281.29 140.96		
D					421.14 521.60 613.56 796.02 796.72 633.27 345.65					499.70 418.78 570.12 989.10 935.04 809.49 392.02				188.61 257.72 277.44 317.21 308.50 247.26 110.42	
E				413.74 527.50 675.56 820.10 800.05 640.80 329.44			604.60 853.88 977.00 1124.80 1072.80 859.12 435.05		593.14 852.34 997.29 1130.20 1044.00 886.88 496.98		529.28 700.54 815.69 985.60 1016.40 817.77 330.30				
F			427.97 520.28 579.73 685.82 651.36 535.98 280.96				533.12 765.62 869.70 929.49 940.39 748.99 425.45	656.31 979.03 1113.90 1149.40 1099.10 866.53 476.91				565.03 437.22 454.82 982.16 974.23 830.18 416.15	465.38 547.61 535.68 657.59 684.32 567.68 301.66		
G		468.86 623.63 639.82 667.33 619.54 474.52 296.11			576.45 868.00 1013.70 1149.90 1073.80 947.97 529.78	515.01 752.37 859.44 944.08 900.75 758.01 394.15			671.45 933.08 995.62 1106.20 1032.90 847.73 476.54		611.24 859.05 961.33 1133.00 1139.80 931.95 490.33		624.09 806.90 791.86 944.57 936.57 742.64 345.15		
H	366.62 530.43 555.24 574.17 557.78 435.08 210.62				508.58 747.15 886.09 984.70 896.04 775.23 364.23			699.93 842.28 587.90 604.94 564.56 488.85 261.66	591.12 809.83 818.38 828.31 806.57 661.47 352.63				518.98 741.70 795.83 859.72 791.64 659.33 359.43		
K					559.57 863.32 1036.00 1167.00 1134.40 961.96 531.83						586.68 859.81 1035.50 1155.90 1110.20 955.56 544.24	470.00 640.88 752.07 886.81 868.19 715.89 359.98			
L		436.75 515.24 361.66 388.42 354.81 313.86 150.47	415.84 485.16 616.51 683.58 628.19 537.52 259.77			598.82 869.65 1056.50 1138.00 1063.20 908.96 449.52					470.12 618.68 709.85 943.22 925.60 766.56 386.92		415.77 532.17 590.21 711.35 670.18 575.48 317.51		
M			407.95 633.82 689.86 817.31 767.37 607.70 317.15				564.83 867.38 1033.80 1140.80 1071.60 959.10 526.11		607.61 856.34 984.19 1169.30 1111.70 910.35 444.95	456.31 637.01 806.33 984.04 908.48 765.70 373.07				307.60 424.13 426.65 464.97 429.40 370.11 176.71	
N				416.19 614.54 739.61 883.92 823.83 715.84 338.46				582.16 881.87 1005.60 1147.30 1099.00 889.88 394.61	480.61 637.21 728.62 880.35 877.92 747.02 362.96						
O					457.05 605.74 723.85 827.53 816.44 640.33 351.60	429.93 535.58 570.99 689.42 653.53 538.95 267.95				445.31 541.32 586.30 707.28 640.05 530.72 292.35		289.27 416.05 485.73 535.40 513.26 437.96 240.85			
P						422.01 498.42 340.89 370.38 364.48 293.42 164.52									
R							318.11 460.68 452.46 455.14 442.77 380.10 194.45			236.29 303.50 278.42 297.22 284.47 227.82 119.92					

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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                                                                                    CASE   2

                                              TMI-1  CY-1

                                YEAR 74 MONTH 09 DAY 05 HOUR 16 MINUTE 12 REF EST


              CORE POWER                     CORE AVG BURNUP                     CORE BORON CONC
                (MWT)                          (MWD/MTU)                            (PPMB)


               2559.5                          986.00                               1095.0



              COOLANT FLOWS                    PRESSURE                        COOLANT TEMPERATURES
              (LB/HR * E-6)                     (PSIA)                             DEGREES F

        RC FLOW LOOP A           70.203    CORE OUTLET           2178.8    LOOP A INLET TEMP(1)     555.93

        RC FLOW LOOP B           69.276    SECONDARY LOOP A      892.30    LOOP A INLET TEMP(2)     554.45

        RC TOTAL FLOW            139.53    SECONDARY LOOP B      892.30    LOOP B INLET TEMP(1)     555.09

        FEEDWATER FLOW LOOP A    5.3278                                    LOOP B INLET TEMP(2)     555.26

        FEEDWATER FLOW LOOP B    5.4804                                    FEEDWATER (LOOP A)       463.09

        LETDOWN   FLOW           .34974E-01                                FEEDWATER (LOOP B)       463.09

                                                                           REACTOR OUTLET (LOOP A)  600.81

                                                                           REACTOR OUTLET (LOOP B)  600.58

                                                                           STEAM TEMP (LOOP A)      590.80

                                                                           STEAM TEMP (LOOP B)      591.28
```

ROOW

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B						16.50		99.70		16.50					
C					100.00		98.80		98.80		101.00				
D				99.70		11.10		89.10		11.00		99.90			
E			99.70		90.10		99.70		98.70		89.00		99.70		
F		16.50		10.90		99.70		99.80		99.70		11.10		16.40	
G			99.60		99.70		99.70		99.80		101.00		98.70		
H		99.80		90.20		99.80		16.50		99.80		89.00		99.70	
K			100.00		99.70		99.70		101.00		99.70		99.70		
L		16.40		14.30		99.90		99.70		99.70		11.00		15.40	
M			99.80		90.30		99.70		99.90		90.10		99.70		
N				99.80		10.90		89.00		12.20		98.60			
O					99.70		98.90		99.50		99.70				
P						16.70		99.70		16.40					
R															

```
                                   SPNCBC

      1       2       3       4       5       6       7       8       9       10      11      12      13      14      15

                                          *       *       *       *       *       *
                                          *       *       *       *       *       *
                                          *       *       *       *       *       *
A                                         *       *       *       *       *       *
                                          *       *       *       *       *       *
                                          *       *       *       *       *       *
                                          *       *       *       *       *       *

                          *       *       *       * 454.44* 540.63*       *       *       *       *
                          *       *       *       * 572.48* 755.35*       *       *       *       *
                          *       *       *       * 579.29* 804.91*       *       *       *       *
B                         *       *       *       * 630.52* 870.14*       *       *       *       *
                          *       *       *       * 651.11* 853.33*       *       *       *       *
                          *       *       *       * 514.41* 703.02*       *       *       *       *
                          *       *       *       * 247.27* 316.44*       *       *       *       *

                  *       *       *       * 459.43*       *       * 590.35* 458.20*       *       * 195.64*
                  *       *       *       * 495.72*       *       * 757.61* 502.13*       *       * 274.20*
                  *       *       *       * 519.07*       *       * 805.58* 541.88*       *       * 301.55*
C                 *       *       *       * 654.68*       *       * 950.50* 691.84*       *       * 353.81*
                  *       *       *       * 674.26*       *       * 988.61* 696.71*       *       * 348.53*
                  *       *       *       * 567.04*       *       * 828.35* 573.99*       *       * 294.33*
                  *       *       *       * 247.32*       *       * 408.79* 284.34*       *       * 144.31*

          *       *       *       * 445.54*       *       *       *       * 534.71*       *       *       * 179.67*
          *       *       *       * 532.54*       *       *       *       * 428.43*       *       *       * 242.42*
          *       *       *       * 595.43*       *       *       *       * 495.04*       *       *       * 276.58*
D         *       *       *       * 806.16*       *       *       *       *1007.00*       *       *       * 326.33*
          *       *       *       * 841.07*       *       *       *       * 988.08*       *       *       * 322.51*
          *       *       *       * 677.34*       *       *       *       * 852.96*       *       *       * 259.53*
          *       *       *       * 340.86*       *       *       *       * 386.96*       *       *       * 110.27*

          *       *       * 458.56*       *       * 628.89*       * 616.20*       * 541.16*       *       *       *
          *       *       * 544.97*       *       * 866.66*       * 868.55*       * 701.35*       *       *       *
          *       *       * 627.89*       *       * 965.64*       * 992.69*       * 811.71*       *       *       *
E         *       *       * 825.35*       *       *1136.10*       *1158.40*       *1012.70*       *       *       *
          *       *       * 844.67*       *       *1124.80*       *1109.50*       *1068.80*       *       *       *
          *       *       * 685.94*       *       * 906.50*       * 933.45*       * 861.30*       *       *       *
          *       *       * 324.54*       *       * 431.13*       * 501.86*       * 235.83*       *       *       *

  *       *       * 463.36*       *       *       * 557.31* 675.04*       *       *       * 549.92* 444.85*       *       *
  *       *       * 501.32*       *       *       * 783.32* 976.33*       *       *       * 424.96* 501.36*       *       *
  *       *       * 527.51*       *       *       * 874.73*1106.10*       *       *       * 482.60* 551.78*       *       *
F *       *       * 684.77*       *       *       * 961.80*1170.80*       *       *       *1015.50* 685.31*       *       *
  *       *       * 682.90*       *       *       *1003.50*1145.10*       *       *       *1020.60* 725.67*       *       *
  *       *       * 569.07*       *       *       * 807.85* 911.20*       *       *       * 868.52* 603.87*       *       *
  *       *       * 285.43*       *       *       * 444.56* 478.43*       *       *       * 408.29* 307.73*       *       *

  *       * 482.40*       *       * 627.06* 548.20*       *       * 684.24*       * 619.10*       * 604.80*       *       *
  *       * 587.56*       *       * 889.54* 767.05*       *       * 916.17*       * 857.84*       * 762.95*       *       *
  *       * 611.17*       *       * 970.18* 855.71*       *       *1003.10*       * 976.07*       * 789.88*       *       *
G *       * 665.54*       *       *1149.20* 969.99*       *       *1133.90*       *1166.50*       * 968.05*       *       *
  *       * 643.43*       *       *1111.30* 955.45*       *       *1102.80*       *1177.90*       * 977.13*       *       *
  *       * 496.18*       *       * 990.23* 815.32*       *       * 897.13*       * 988.93*       * 778.80*       *       *
  *       * 306.13*       *       * 531.18* 415.10*       *       * 496.94*       * 514.93*       * 343.85*       *       *

  * 369.83*       *       *       * 556.59*       *       * 714.12* 607.06*       *       *       * 517.61*       *       *
  * 504.18*       *       *       * 775.56*       *       * 584.54* 785.44*       *       *       * 724.75*       *       *
  * 523.37*       *       *       * 865.11*       *       * 592.99* 835.94*       *       *       * 788.12*       *       *
H * 557.12*       *       *       * 990.06*       *       * 629.38* 861.19*       *       *       * 879.83*       *       *
  * 567.66*       *       *       * 949.98*       *       * 604.24* 867.30*       *       *       * 838.96*       *       *
  * 448.62*       *       *       * 831.48*       *       * 528.98* 714.74*       *       *       * 699.77*       *       *
  * 215.30*       *       *       * 360.16*       *       * 277.82* 373.67*       *       *       * 356.20*       *       *

  *       *       *       *       * 623.68*       *       *       *       *       * 624.90* 505.27*       *       *       *
  *       *       *       *       * 905.30*       *       *       *       *       * 871.73* 652.43*       *       *       *
  *       *       *       *       * 968.83*       *       *       *       *       * 997.14* 715.66*       *       *       *
K *       *       *       *       *1143.80*       *       *       *       *       *1159.90* 905.64*       *       *       *
  *       *       *       *       *1189.50*       *       *       *       *       *1162.20* 918.76*       *       *       *
  *       *       *       *       *1020.90*       *       *       *       *       *1012.50* 763.60*       *       *       *
  *       *       *       *       * 549.82*       *       *       *       *       * 556.39* 353.98*       *       *       *

  *       * 461.61* 476.78*       *       * 660.28*       *       *       *       * 523.21*       * 438.98*       *       *
  *       * 364.66* 438.49*       *       * 899.00*       *       *       *       * 641.55*       * 511.15*       *       *
  *       * 333.27* 541.46*       *       *1007.80*       *       *       *       * 751.64*       * 545.15*       *       *
L *       * 373.52* 662.61*       *       *1126.30*       *       *       *       * 957.45*       * 712.49*       *       *
  *       * 364.52* 665.98*       *       *1111.10*       *       *       *       * 981.99*       * 707.38*       *       *
  *       * 327.41* 575.41*       *       * 963.42*       *       *       *       * 819.39*       * 611.57*       *       *
  *       * 153.88* 267.77*       *       * 457.98*       *       *       *       * 382.00*       * 326.81*       *       *

          *       * 463.41*       *       *       * 615.68*       * 651.82* 505.25*       *       *       * 312.32*
          *       * 612.81*       *       *       * 897.68*       * 876.09* 663.64*       *       *       * 383.12*
          *       * 619.99*       *       *       * 995.72*       * 951.31* 770.89*       *       *       * 398.09*
M         *       * 782.95*       *       *       *1142.90*       *1166.50* 988.61*       *       *       * 457.84*
          *       * 787.12*       *       *       *1129.20*       *1159.60* 956.46*       *       *       * 442.55*
          *       * 640.26*       *       *       *1012.80*       * 965.46* 812.10*       *       *       * 378.71*
          *       * 323.19*       *       *       * 536.03*       * 439.51* 358.77*       *       *       * 168.74*

          *       *       * 465.77*       *       *       * 618.85* 517.22*       *       *       *       *       *
          *       *       * 633.69*       *       *       * 893.58* 653.43*       *       *       *       *       *
          *       *       * 682.22*       *       *       * 966.21* 688.23*       *       *       *       *       *
N         *       *       * 854.20*       *       *       *1139.20* 877.88*       *       *       *       *       *
          *       *       * 858.24*       *       *       *1138.90* 914.39*       *       *       *       *       *
          *       *       * 748.61*       *       *       * 930.49* 780.41*       *       *       *       *       *
          *       *       * 343.69*       *       *       * 294.54* 341.37*       *       *       *       *       *

                  *       *       * 490.77* 464.53*       *       *       * 469.94*       * 305.00*       *
                  *       *       * 593.25* 520.31*       *       *       * 520.90*       * 415.08*       *
                  *       *       * 666.06* 528.69*       *       *       * 549.64*       * 464.28*       *
O                 *       *       * 800.82* 686.31*       *       *       * 712.48*       * 532.13*       *
                  *       *       * 830.71* 684.12*       *       *       * 672.55*       * 536.40*       *
                  *       *       * 658.60* 571.79*       *       *       * 567.91*       * 459.61*       *
                  *       *       * 351.82* 273.66*       *       *       * 291.57*       * 247.82*       *

                          *       *       * 426.13*       *       *       *       *       *       *
                          *       *       * 341.79*       *       *       *       *       *       *
                          *       *       * 320.64*       *       *       *       *       *       *
P                         *       *       * 361.53*       *       *       *       *       *       *
                          *       *       * 378.22*       *       *       *       *       *       *
                          *       *       * 309.40*       *       *       *       *       *       *
                          *       *       * 163.81*       *       *       *       *       *       *

                                          *       * 315.55*       *       * 231.36*
                                          *       * 427.54*       *       * 261.81*
                                          *       * 428.91*       *       * 263.05*
R                                         *       * 447.47*       *       * 291.56*
                                          *       * 455.64*       *       * 291.87*
                                          *       * 394.76*       *       * 236.47*
                                          *       * 197.59*       *       * 123.19*

      1       2       3       4       5       6       7       8       9       10      11      12      13      14      15
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APPENDIX B

Operating Data, Cycle 2

Table B-1. Operating Data, Cycle 2

Case	Core burnup, MWd/mtU	Core power, MWt	Core boron conc, ppmB
1	9654.0	1013.4	1075.0
2	9657.0	1003.2	1075.0
3	9694.0	1879.3	923.0
4	9702.0	1834.5	896.0
5	9706.0	1859.5	894.0
6	9796.0	2517.5	838.0
7	10038.0	2524.5	799.0
8	10254.0	2526.4	778.0
9	10446.0	2517.1	769.0
10	10799.0	2507.3	731.0
11	10890.0	2497.4	731.0
12	11103.0	2531.5	699.0
13	11290.0	2502.7	699.0
14	11477.0	2541.6	660.0
15	11710.0	1168.5	660.0
16	11855.0	2540.6	660.0
17	12040.0	2525.4	595.0
18	12239.0	2531.6	589.0
19	12379.0	2508.4	556.0
20	12629.0	2517.5	550.0
21	12839.0	2524.0	520.0
22	13051.0	1279.6	629.0
23	13298.0	2518.3	489.0
24	13482.0	2533.7	470.0
25	13697.0	2513.6	442.0
26	13888.0	2522.9	434.0
27	14094.0	2522.6	409.0
28	14315.0	2530.5	394.0
29	14508.0	2518.7	440.0
30	14727.0	2519.0	330.0
31	14935.0	2524.3	328.0
32	15152.0	2525.2	300.0
33	15372.0	2523.2	274.0
34	15578.0	2515.2	268.0
35	15793.0	2529.6	241.0
36	16046.0	2513.9	206.0
37	16224.0	2498.4	206.0
38	16422.0	2541.5	182.0
39	16642.0	2527.1	182.0
40	16857.0	2524.1	149.0
41	17075.0	2504.8	123.0
42	17229.0	2515.9	115.0
43	17261.0	2515.8	115.0
44	17473.0	2512.9	115.0
45	17545.0	2520.0	115.0

```
                                                                                CASE   1

                                            TMI-1  CY-2

                                YEAR 76 MONTH 05 DAY 28 HOUR 21 MINUTE 07 REF EST

          CORE POWER                      CORE AVG BURNUP                     CORE BORON CONC
            (MWT)                            (MWD/MTU)                            (PPMB)

           1013.4                             9654.0                              1075.0


          COOLANT FLOWS                       PRESSURE                     COOLANT TEMPERATURES
          (LB/HR * E-6)                        (PSIA)                           DEGREES F

     RC FLOW LOOP A          68.990     CORE OUTLET         2178.3    LOOP  A INLET TEMP(1)     571.32

     RC FLOW LOOP B          69.436     SECONDARY LOOP A    908.70    LOOP  A INLET TEMP(2)     569.58

     RC TOTAL FLOW           138.30     SECONDARY LOOP B    908.70    LOOP  B INLET TEMP(1)     570.35

     FEEDWATER FLOW LOOP A   1.9887                                   LOOP  B INLET TEMP(2)     570.08

     FEEDWATER FLOW LOOP B   2.0246                                   FEEDWATER  (LOOP A)       374.18

     LETDOWN   FLOW          .24663E-01                               FEEDWATER  (LOOP B)       374.18

                                                                      REACTOR OUTLET  (LOOP A)  589.23

                                                                      REACTOR OUTLET  (LOOP B)  589.00

                                                                      STEAM TEMP(LOOP A)        590.73

                                                                      STEAM TEMP (LOOP B)       587.71
```

RODW

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B						99.69		99.81		100.00					
C					99.78		8.85		8.91		99.84				
D				81.63		37.80		99.78		36.78		81.75			
E			99.84		99.84		99.78		98.70		98.76		99.84		
F		98.85		37.77		100.00		81.66		100.00		35.76		99.72	
G			8.88		99.72		99.75		99.69		98.73		8.91		
H		99.87		99.81		81.69		99.93		81.60		99.69		100.00	
K			8.88		99.69		99.81		100.00		98.70		8.91		
L		99.78		36.72		99.90		81.57		99.84		36.66		99.72	
M			99.81		99.75		99.78		99.84		99.69		99.99		
N				81.81		36.75		99.60		36.78		81.60			
O					99.69		8.94		8.88		100.00				
P						99.84		99.81		99.66					
R															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

```
                                                        SPND-UNC
        1       2       3       4       5       6       7       8       9      10      11      12      13      14      15

                                            *****************************************
                                            *       *       *       *       *       *
                                            *       *       *       *       *       *
                                            *       *       *       *       *       *
                                            *       *       *       *       *       *
A                                           *       *       *       *       *       *
                                            *       *       *       *       *       *
                                            *       *       *       *       *       *
                                            *       *       *       *       *       *
                                            *       *       *       *       *       *
                            *************************************************************************
                            *       *       *       *       *       *       *       *       *       *
                            *       *       *       * 122.40* 121.00*       *       *       *       *
                            *       *       *       * 157.40* 159.70*       *       *       *       *
                            *       *       *       * 143.60* 146.80*       *       *       *       *
B                           *       *       *       * 125.60* 129.70*       *       *       *       *
                            *       *       *       * 125.10* 144.00*       *       *       *       *
                            *       *       *       * 127.10* 137.90*       *       *       *       *
                            *       *       *       *  90.10*  94.60*       *       *       *       *
                            *       *       *       *       *       *       *       *       *       *
                    *****************************************************************************************
                    *       *       *       *       *       *       *       *       *       *       *       *
                    *       *       *       * 179.00*       *       * 153.90* 174.60*       *       * 121.80*
                    *       *       *       * 232.80*       *       * 120.40* 222.70*       *       * 177.10*
                    *       *       *       * 217.90*       *       * 115.70* 219.90*       *       * 173.50*
C                   *       *       *       * 163.10*       *       *  90.00* 153.60*       *       * 149.90*
                    *       *       *       * 168.20*       *       *  93.90* 154.80*       *       * 149.90*
                    *       *       *       * 186.80*       *       * 108.00* 183.00*       *       * 138.70*
                    *       *       *       * 126.00*       *       *  87.40* 118.40*       *       *  62.90*
                    *       *       *       *       *       *       *       *       *       *       *       *
            *********************************************************************************************************
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *       *       *       * 214.60*       *       *       *       * 188.70*       *       *       * 108.10*
            *       *       *       * 290.80*       *       *       *       * 280.40*       *       *       * 160.70*
            *       *       *       * 274.80*       *       *       *       * 244.60*       *       *       * 154.90*
D           *       *       *       * 204.00*       *       *       *       * 107.10*       *       *       * 139.80*
            *       *       *       * 209.50*       *       *       *       * 137.00*       *       *       * 143.70*
            *       *       *       * 229.20*       *       *       *       * 211.90*       *       *       * 128.20*
            *       *       *       * 168.70*       *       *       *       * 144.50*       *       *       *  63.40*
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *********************************************************************************************************
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *       *       * 224.20*       *       * 177.00*       * 171.60*       * 207.50*       *       *       *
            *       *       * 310.60*       *       * 241.40*       * 226.30*       * 272.60*       *       *       *
            *       *       * 286.60*       *       * 226.40*       * 218.70*       * 250.00*       *       *       *
E           *       *       * 219.00*       *       * 177.40*       * 181.40*       * 188.90*       *       *       *
            *       *       * 222.40*       *       * 188.90*       * 189.10*       * 199.40*       *       *       *
            *       *       * 231.00*       *       * 201.70*       * 198.10*       * 229.10*       *       *       *
            *       *       * 148.20*       *       * 140.90*       * 152.10*       * 163.00*       *       *       *
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *************************************************************************************************************************
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *       *       * 176.10*       *       *       * 161.70* 153.40*       *       *       * 209.90* 176.20*       *       *
    *       *       * 227.00*       *       *       * 219.00* 201.80*       *       *       * 285.40* 231.90*       *       *
    *       *       * 217.20*       *       *       * 225.90* 204.60*       *       *       * 253.30* 215.70*       *       *
F   *       *       * 162.40*       *       *       * 199.50* 184.90*       *       *       * 110.90* 155.50*       *       *
    *       *       * 156.10*       *       *       * 197.70* 179.50*       *       *       * 154.50* 172.60*       *       *
    *       *       * 180.30*       *       *       * 201.50* 170.80*       *       *       * 219.70* 195.60*       *       *
    *       *       * 130.60*       *       *       * 136.40*  60.30*       *       *       * 148.30* 130.90*       *       *
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *************************************************************************************************************************
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *       * 124.10*       *       * 178.20* 160.90*       *       * 147.10*       * 169.80*       * 151.50*       *       *
    *       * 152.50*       *       * 236.30* 219.60*       *       * 206.50*       * 221.90*       * 114.10*       *       *
    *       * 148.20*       *       * 223.60* 225.90*       *       * 210.90*       * 213.40*       * 106.70*       *       *
G   *       * 127.80*       *       * 185.40* 203.00*       *       * 193.10*       * 178.40*       *  79.70*       *       *
    *       * 125.20*       *       * 184.80* 193.20*       *       * 195.50*       * 183.40*       *  82.90*       *       *
    *       * 122.90*       *       * 208.80* 210.50*       *       * 185.70*       * 202.00*       *  88.50*       *       *
    *       * 100.40*       *       * 158.00* 135.40*       *       * 131.10*       * 138.40*       *  64.20*       *       *
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *************************************************************************************************************************
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *  99.60*       *       *       * 168.90*       *       * 132.40* 138.30*       *       *       * 141.50*       *       *
    * 134.60*       *       *       * 218.90*       *       * 208.90* 196.90*       *       *       * 161.90*       *       *
    * 136.00*       *       *       * 221.80*       *       * 230.50* 207.70*       *       *       * 152.40*       *       *
H   * 120.30*       *       *       * 188.70*       *       * 218.00* 188.20*       *       *       * 132.70*       *       *
    * 115.50*       *       *       * 180.00*       *       * 211.20* 188.00*       *       *       * 131.00*       *       *
    * 114.10*       *       *       * 201.70*       *       * 201.50* 181.50*       *       *       * 148.30*       *       *
    *  61.80*       *       *       * 110.40*       *       * 133.30* 110.40*       *       *       * 122.80*       *       *
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *************************************************************************************************************************
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *       *       *       *       * 174.40*       *       *       *       *       * 173.90* 231.10*       *       *       *
    *       *       *       *       * 239.40*       *       *       *       *       * 234.00* 300.40*       *       *       *
    *       *       *       *       * 231.10*       *       *       *       *       * 228.20* 276.40*       *       *       *
K   *       *       *       *       * 189.60*       *       *       *       *       * 184.50* 215.10*       *       *       *
    *       *       *       *       * 194.30*       *       *       *       *       * 186.70* 230.30*       *       *       *
    *       *       *       *       * 227.30*       *       *       *       *       * 207.00* 249.40*       *       *       *
    *       *       *       *       * 168.80*       *       *       *       *       * 163.50* 177.10*       *       *       *
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *************************************************************************************************************************
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *       * 167.60* 177.70*       *       * 170.10*       *       *       *       * 187.70*       * 176.30*       *       *
    *       * 242.80* 225.30*       *       * 221.50*       *       *       *       * 247.40*       * 235.70*       *       *
    *       * 235.60* 220.00*       *       * 214.90*       *       *       *       * 234.70*       * 221.20*       *       *
L   *       * 188.90* 154.00*       *       * 175.40*       *       *       *       * 171.40*       * 171.30*       *       *
    *       * 187.50* 168.90*       *       * 174.30*       *       *       *       * 175.80*       * 174.20*       *       *
    *       * 185.60* 183.10*       *       * 183.90*       *       *       *       * 214.60*       * 199.00*       *       *
    *       * 108.00* 116.80*       *       * 132.30*       *       *       *       * 155.50*       * 143.20*       *       *
    *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
    *************************************************************************************************************************
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *       * 193.00*       *       *       * 171.30*       * 182.60* 184.90*       *       *       * 163.70*
            *       * 287.00*       *       *       * 244.80*       * 233.90* 250.00*       *       *       * 232.40*
            *       * 267.50*       *       *       * 233.20*       * 223.30* 242.40*       *       *       * 223.90*
M           *       * 218.00*       *       *       * 181.10*       * 181.10* 177.30*       *       *       * 199.60*
            *       * 208.40*       *       *       * 180.40*       * 190.00* 180.10*       *       *       * 187.90*
            *       * 216.40*       *       *       * 203.60*       * 200.40* 207.50*       *       *       * 180.30*
            *       * 130.40*       *       *       * 153.60*       * 172.40* 143.80*       *       *       *  90.00*
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *********************************************************************************************************
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *       *       * 188.60*       *       *       * 188.00* 238.60*       *       *       *       *       *
            *       *       * 260.40*       *       *       * 240.10* 307.50*       *       *       *       *       *
            *       *       * 250.90*       *       *       * 228.50* 281.90*       *       *       *       *       *
N           *       *       * 202.60*       *       *       * 192.00* 210.30*       *       *       *       *       *
            *       *       * 198.10*       *       *       * 190.00* 219.30*       *       *       *       *       *
            *       *       * 208.20*       *       *       * 200.20* 239.20*       *       *       *       *       *
            *       *       *  62.70*       *       *       * 157.90* 157.90*       *       *       *       *       *
            *       *       *       *       *       *       *       *       *       *       *       *       *       *
            *********************************************************************************************************
                    *       *       *       *       *       *       *       *       *       *       *       *
                    *       *       * 202.20* 184.30*       *       *       * 187.50*       * 180.60*       *
                    *       *       * 274.80* 228.80*       *       *       * 240.10*       * 245.00*       *
                    *       *       * 259.90* 219.90*       *       *       * 230.20*       * 247.20*       *
O                   *       *       * 204.60* 161.60*       *       *       * 174.70*       * 223.90*       *
                    *       *       * 198.70* 161.70*       *       *       * 175.90*       * 208.00*       *
                    *       *       * 197.70* 179.50*       *       *       * 197.10*       * 191.50*       *
                    *       *       * 121.30* 123.30*       *       *       * 116.80*       *-200.00*       *
                    *       *       *       *       *       *       *       *       *       *       *       *
                    *****************************************************************************************
                            *       *       *       *       *       *       *       *       *       *
                            *       *       * 164.50*       *       *       *       *       *       *
                            *       *       * 236.70*       *       *       *       *       *       *
                            *       *       * 234.70*       *       *       *       *       *       *
P                           *       *       * 199.20*       *       *       *       *       *       *
                            *       *       * 205.10*       *       *       *       *       *       *
                            *       *       * 204.00*       *       *       *       *       *       *
                            *       *       * 119.90*       *       *       *       *       *       *
                            *       *       *       *       *       *       *       *       *       *
                            *************************************************************************
                                            *       *       *       *       *       *
                                            *       * 100.10*       *       *  87.30*
                                            *       * 139.50*       *       * 126.80*
                                            *       * 135.00*       *       * 128.10*
R                                           *       * 119.80*       *       * 114.00*
                                            *       * 127.20*       *       * 110.60*
                                            *       * 122.40*       *       * 102.70*
                                            *       *  77.10*       *       *  56.50*
                                            *       *       *       *       *       *
                                            *****************************************

        1       2       3       4       5       6       7       8       9      10      11      12      13      14      15
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BKCAL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							24.01	25.78							
C						29.32			22.72	40.74			20.32		
D					44.24					39.07				21.52	
E				42.88			44.29		36.71		25.30				
F			34.37				41.62	36.79				29.63	30.44		
G		21.09			34.54	38.44			33.65		41.83		25.27		
H	22.50				27.29			35.01	44.70				29.55		
K					38.61						42.13	41.21			
L		36.53	37.70			38.03					39.85		34.51		
M			44.64				43.60		37.90	33.70				34.75	
N				34.24				35.92	44.85						
O					43.15	33.46				37.07		29.63			
P						33.83									
R							14.20			22.03					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

SPNDBC

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							148.45 201.48 191.52 170.59 171.40 175.26 127.84	147.28 203.13 193.81 177.66 199.42 193.61 131.92							
C						215.54 295.37 283.08 222.16 233.37 261.55 173.27			193.18 165.41 157.12 133.79 145.13 165.58 129.78	210.75 284.05 291.73 218.75 224.14 263.07 176.77			136.00 201.88 206.09 182.30 184.18 172.63 87.56		
D					264.42 375.85 361.41 290.42 301.73 329.23 242.52					237.55 346.69 311.26 167.37 211.35 314.95 214.75				120.60 186.64 183.93 173.24 177.95 162.59 90.10	
E				275.44 398.20 381.03 307.95 315.73 332.41 217.40			223.64 333.85 320.66 264.64 286.85 309.20 215.35		216.02 310.05 312.54 267.59 283.10 297.37 222.56		259.83 364.07 333.44 263.19 284.42 323.38 212.02				
F			216.30 290.46 285.93 229.84 222.88 260.01 189.69				201.25 296.12 309.69 284.57 296.34 301.31 207.47	196.75 284.28 302.37 281.32 276.86 264.90 112.43				260.13 346.84 315.16 161.83 223.61 312.02 205.54	213.39 294.79 284.33 215.58 241.05 273.96 182.29		
G		150.34 194.13 196.15 173.83 170.85 168.30 138.82			224.47 321.36 309.00 272.76 272.00 308.34 230.16	201.88 295.50 314.58 292.88 285.28 311.34 202.37			190.70 285.69 299.92 280.99 291.18 281.38 196.38		216.61 304.46 302.32 267.75 281.58 312.10 213.53		196.61 160.98 152.66 123.85 132.13 142.46 104.33		
H	116.93 165.87 172.18 157.73 156.52 156.30 92.40				215.38 296.14 305.22 267.78 254.44 286.29 159.07			168.91 265.85 296.01 283.90 281.72 275.53 187.33	175.84 269.29 291.26 272.06 280.17 278.04 177.94				175.08 215.47 211.11 187.57 190.63 215.37 174.58		
K					219.54 329.23 328.76 277.92 295.21 347.47 250.50						219.46 319.33 324.41 278.15 295.40 327.75 254.82	282.53 393.52 369.01 304.81 331.15 359.22 252.70			
L		204.02 306.32 301.33 254.19 254.80 261.01 161.79	214.43 283.25 287.89 215.02 239.60 263.62 173.88			216.48 307.14 305.67 264.66 266.76 284.26 201.35					230.78 321.63 319.66 251.16 261.97 318.68 225.89		210.16 300.25 288.43 236.04 245.48 285.23 205.29		
M			232.96 374.23 358.18 309.80 296.37 314.43 197.83				217.79 338.05 334.42 272.41 277.50 316.92 236.70		231.75 321.40 311.76 264.94 285.54 305.00 248.66	230.01 326.76 327.03 256.44 263.96 310.68 204.04				189.74 285.07 284.09 259.49 253.09 249.56 137.31	
N				230.51 330.39 325.50 276.83 273.00 288.66 104.17				235.23 328.41 328.26 280.45 284.10 297.12 218.08	297.99 411.08 383.62 308.55 326.83 360.05 235.83						
O					249.59 362.35 351.42 291.85 296.23 291.98 188.76	224.09 295.20 287.86 225.44 230.38 253.45 176.77				228.27 310.01 335.10 246.69 251.14 281.03 172.56		208.68 303.23 307.83 287.28 272.60 253.95 172.09			
P						195.56 289.37 295.48 256.23 272.01 271.36 172.27									
R							114.29 166.44 161.62 146.34 158.16 153.88 120.99			97.50 149.96 155.46 143.28 143.39 136.93 84.03					

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                                                                                              CASE   2

                                                TMI-1  CY-2

                                  YEAR 76 MONTH 05 DAY 29 HOUR 02 MINUTE 44 REF EST


                  CORE POWER                  CORE AVG BURNUP                 CORE BORON CONC
                    (MWT)                        (MWD/MTU)                         (PPMB)


                   1003.2                        9657.0                          1075.0



                  COOLANT FLOWS                   PRESSURE                  COOLANT TEMPERATURES
                  (LB/HR * E-6)                    (PSIA)                         DEGREES F

            RC FLOW LOOP A          68.702     CORE OUTLET          2176.2    LOOP  A INLET TEMP(1)    569.04

            RC FLOW LOOP B          69.044     SECONDARY LOOP A     907.40    LOOP  A INLET TEMP(2)    567.36

            RC TOTAL FLOW           138.29     SECONDARY LOOP B     907.40    LOOP  B INLET TEMP(1)    571.20

            FEEDWATER FLOW LOOP A   1.8915                                    LOOP  B INLET TEMP(2)    570.89

            FEEDWATER FLOW LOOP B   2.0961                                    FEEDWATER  (LOOP A)      373.90

            LETDOWN   FLOW          .24599E-01                                FEEDWATER  (LOOP B)      373.90

                                                                              REACTOR OUTLET  (LOOP A) 587.67

                                                                              REACTOR OUTLET  (LOOP B) 590.11

                                                                              STEAM TEMP(LOOP A)       587.78

                                                                              STEAM TEMP (LOOP B)      589.01
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                                                                 RODW

          1       2       3       4       5       6       7       8       9      10      11      12      13      14      15

                                              *****************************************
                                              *       *       *       *       *       *
A                                             *       *       *       *       *       *
                                              *       *       *       *       *       *
                                              *       *       *       *       *       *
                              *************************************************************************
                              *       *       *       *       *       *       *       *       *       *
B                             *       *       *  99.69*       *  99.75*       * 100.00*       *       *
                              *       *       *       *       *       *       *       *       *       *
                      *****************************************************************************************
                      *       *       *       *       *       *       *       *       *       *       *       *
C                     *       *       *  99.78*       *  15.21*       *  15.33*       *  99.81*       *       *
                      *       *       *       *       *       *       *       *       *       *       *       *
              *********************************************************************************************************
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
D             *       *       *  88.02*       *  33.51*       *  99.75*       *  34.62*       *  88.17*       *       *
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
              *********************************************************************************************************
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
E             *       *  99.84*       *  99.81*       *  99.75*       *  98.73*       *    .06*       *  99.84*       *
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
      *************************************************************************************************************************
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
F     *       *  95.82*       *  35.61*       * 100.00*       *  88.05*       * 100.00*       *  33.66*       *  99.75*       *
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
      *************************************************************************************************************************
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
G     *       *       *  14.25*       *  99.75*       *  99.78*       *  99.69*       *  98.70*       *  15.36*       *       *
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
      *************************************************************************************************************************
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
H     *       *  99.90*       *  99.78*       *  88.08*       *  99.93*       *  88.02*       *  99.69*       * 100.00*       *
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
      *************************************************************************************************************************
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
K     *       *       *  15.30*       *  99.66*       *  99.81*       * 100.00*       *  98.70*       *  15.33*       *       *
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
      *************************************************************************************************************************
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
L     *       *  99.81*       *  35.64*       *  99.90*       *  87.93*       *  99.84*       *  34.50*       *  99.75*       *
      *       *       *       *       *       *       *       *       *       *       *       *       *       *       *       *
      *************************************************************************************************************************
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
M             *       *  99.81*       *  99.69*       *  99.78*       *  99.81*       *  99.72*       *  99.96*       *
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
              *********************************************************************************************************
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
N             *       *       *  88.20*       *  35.67*       *  99.57*       *  35.70*       *  87.99*       *       *
              *       *       *       *       *       *       *       *       *       *       *       *       *       *
              *********************************************************************************************************
                      *       *       *       *       *       *       *       *       *       *       *       *
O                     *       *       *  99.69*       *  14.37*       *  15.27*       * 100.00*       *       *
                      *       *       *       *       *       *       *       *       *       *       *       *
                      *****************************************************************************************
                              *       *       *       *       *       *       *       *       *       *
P                             *       *       *  99.84*       *  99.81*       *  99.69*       *       *
                              *       *       *       *       *       *       *       *       *       *
                              *************************************************************************
                                              *       *       *       *       *       *
R                                             *       *       *       *       *       *
                                              *       *       *       *       *       *
                                              *       *       *       *       *       *
                                              *****************************************

          1       2       3       4       5       6       7       8       9      10      11      12      13      14      15
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SPNDBC

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							147.64 191.76 167.41 156.28 172.73 189.45 142.61	139.31 180.64 158.38 151.50 188.27 194.44 136.79							
C						215.22 286.05 254.49 213.12 257.95 304.94 208.02			161.49 133.14 113.37 103.36 125.49 150.39 122.44	150.91 192.14 183.41 147.92 174.30 214.84 150.32			83.84 118.54 119.21 113.70 129.69 135.66 73.89		
D					263.94 363.61 334.10 287.46 343.14 405.45 301.12					157.14 217.75 174.70 107.63 177.27 248.38 178.19				75.56 113.85 108.98 111.16 126.24 129.01 74.93	
E				282.14 395.16 360.20 310.78 366.46 417.30 279.77			209.23 302.85 277.81 244.51 299.18 352.46 256.19		164.99 228.21 224.22 210.50 249.87 284.78 217.12		92.44 117.51 104.49 87.88 111.55 139.26 94.67				
F			235.94 303.49 275.39 234.78 260.47 319.14 238.72				186.45 269.05 275.06 270.31 310.87 355.64 256.12	169.88 239.00 253.26 250.06 276.64 311.66 138.08				170.88 215.13 173.44 102.75 187.51 248.16 170.31	151.59 197.99 178.30 146.51 186.62 224.50 155.65		
G		174.91 213.65 195.70 181.81 195.44 236.50 173.01			234.99 323.71 295.98 274.60 308.34 383.73 293.33	199.32 284.16 295.77 288.55 313.66 385.04 260.03			157.97 231.93 243.83 244.09 280.31 308.76 223.94		165.02 222.79 214.46 208.70 246.55 294.71 207.91		163.86 126.73 107.19 94.08 113.72 129.73 97.89		
H	137.10 182.45 175.48 165.75 181.01 190.85 116.25				228.44 301.91 296.91 274.21 292.67 362.60 215.40			155.72 240.68 267.85 270.91 296.64 330.41 238.20	154.17 232.61 251.62 251.11 284.56 321.85 217.96				160.38 188.92 168.59 156.23 179.29 213.93 178.93		
K					233.95 339.40 320.23 285.48 339.73 434.57 323.44						200.74 283.95 278.85 254.12 294.50 366.47 294.18	265.69 359.11 309.89 273.04 339.77 394.39 284.10			
L		233.19 333.31 307.39 271.53 297.90 327.96 209.82	242.55 304.83 286.53 227.06 286.82 333.46 228.25			224.62 308.46 297.92 272.73 308.21 361.99 262.87					221.09 300.05 285.26 239.95 288.11 372.43 273.93		207.07 285.35 255.82 223.27 263.94 320.94 236.23		
M			256.74 394.36 362.16 328.55 350.53 403.61 262.51				231.64 346.05 325.14 278.50 318.61 395.37 304.13		238.96 318.01 293.91 267.41 323.27 375.09 254.79	230.39 316.89 302.37 253.17 299.44 362.71 255.17				184.48 268.75 259.06 250.67 272.58 291.45 166.22	
N				246.29 343.21 326.99 291.84 322.91 385.42 148.93				260.92 344.68 319.41 287.12 324.58 363.19 275.66	323.43 423.69 363.76 311.94 378.67 442.15 296.07						
O					271.07 378.33 351.02 307.87 353.11 375.67 251.50	251.13 315.43 283.21 235.24 274.30 318.53 228.09				244.54 317.04 287.30 249.33 289.00 339.44 218.59		208.03 294.30 291.28 287.31 304.45 317.47 223.55			
P						220.81 311.83 297.62 269.52 315.24 334.42 217.73									
R							131.64 180.95 162.60 154.28 181.49 187.73 125.49			106.59 156.17 152.68 146.72 160.97 163.94 104.39					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15