

Appendix 4B. Figures

Figure 4-1. 17 X 17 Fuel Assembly Cross Section

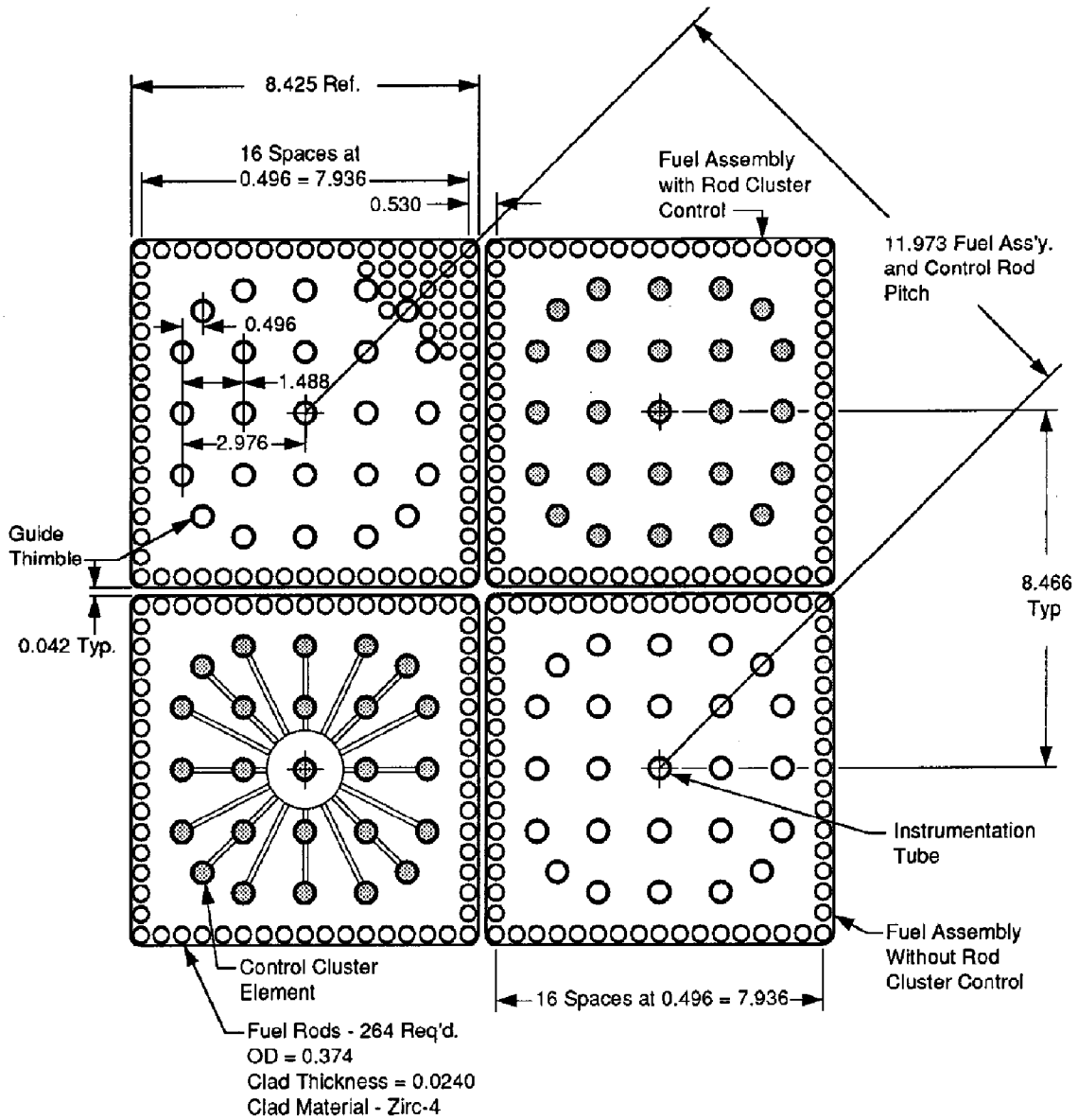


Figure 4-2. Deleted Per 2001 Update

Figure 4-3. Deleted Per 2016 Update.

Figure 4-4. Deleted Per 1993 Update

Figure 4-5. Deleted Per 1993 Update

Figure 4-6. Deleted Per 2001 Update

Figure 4-7. Deleted Per 2001 Update

Figure 4-8. Deleted Per 2001 Update

Figure 4-9. Full Length Rod Cluster Control and Drive Rod Assembly with Interfacing Components

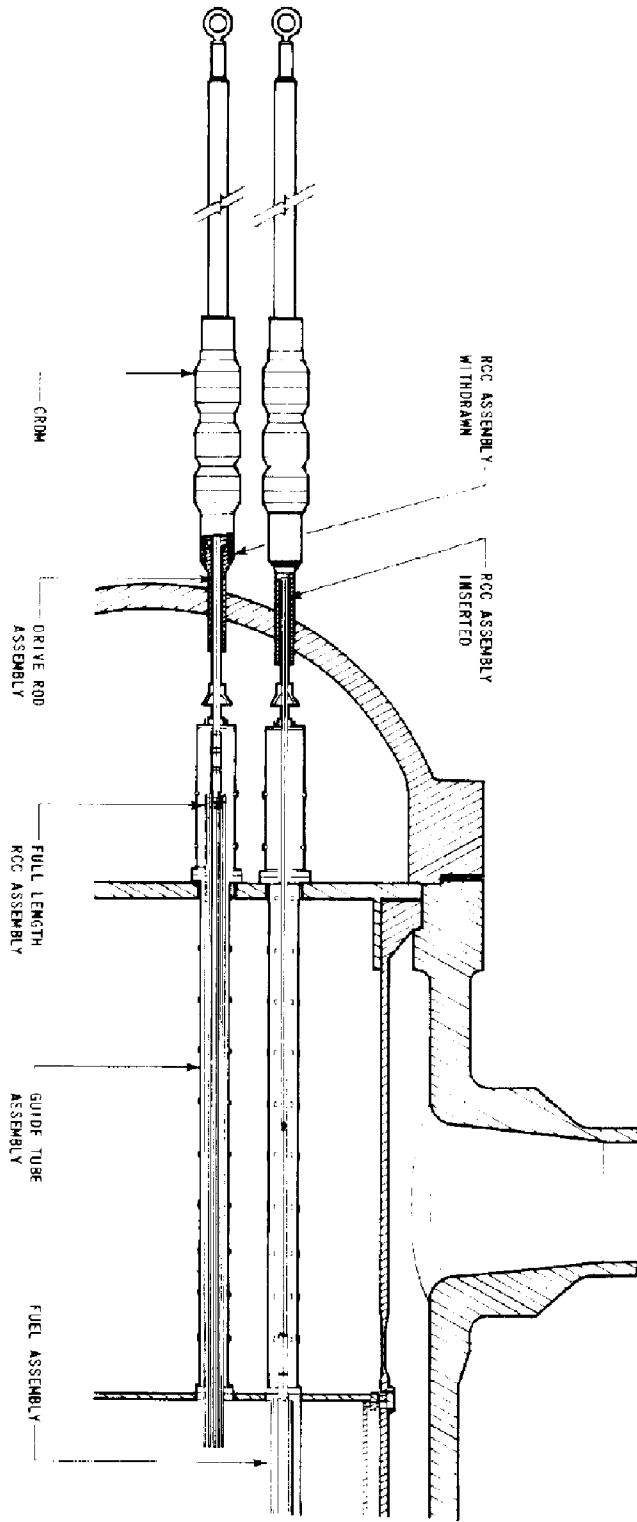


Figure 4-10. Rod Cluster Control Assembly Outline

Catawba Nuclear Station

Appendic 4. Chapter 4 Tables and Figures

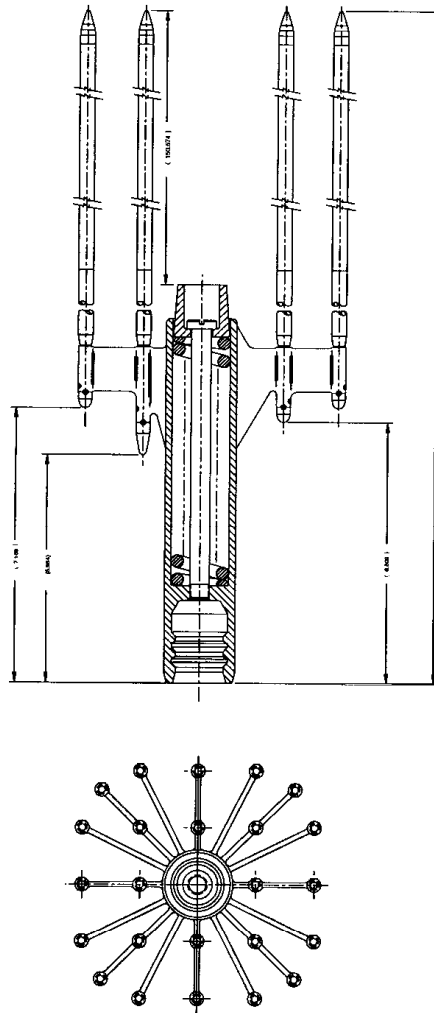


Figure 4-10.
Rod Cluster Control Assembly Outline

Figure 4-11. Hybrid B₄C Absorber Rod

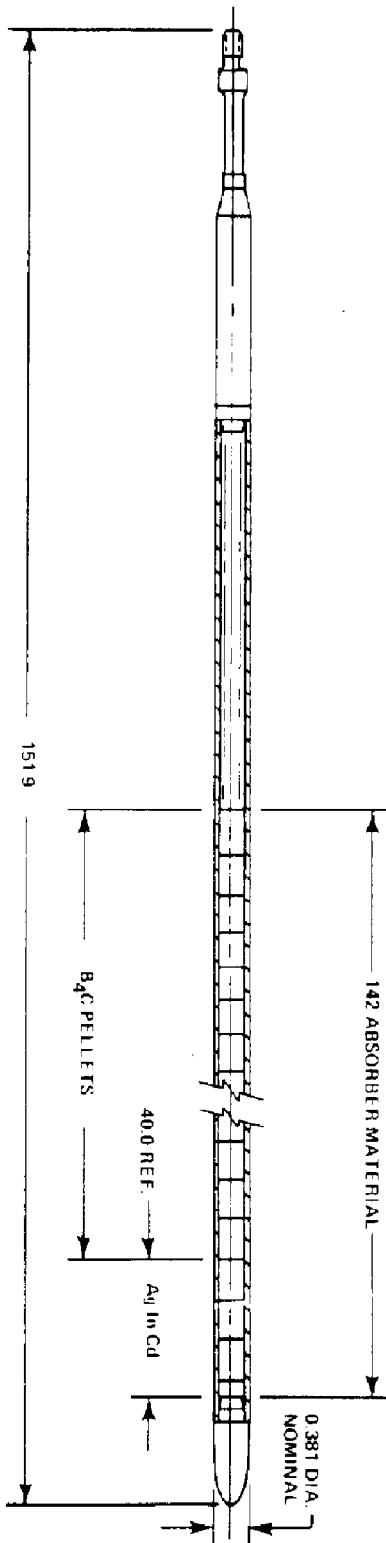


Figure 4-12. Deleted Per 2001 Update

Figure 4-13. Deleted Per 2000 Update

Figure 4-14. Deleted Per 1994 Update

Figure 4-15. Deleted Per 2001 Update

Figure 4-16. Thimble Plug Assembly

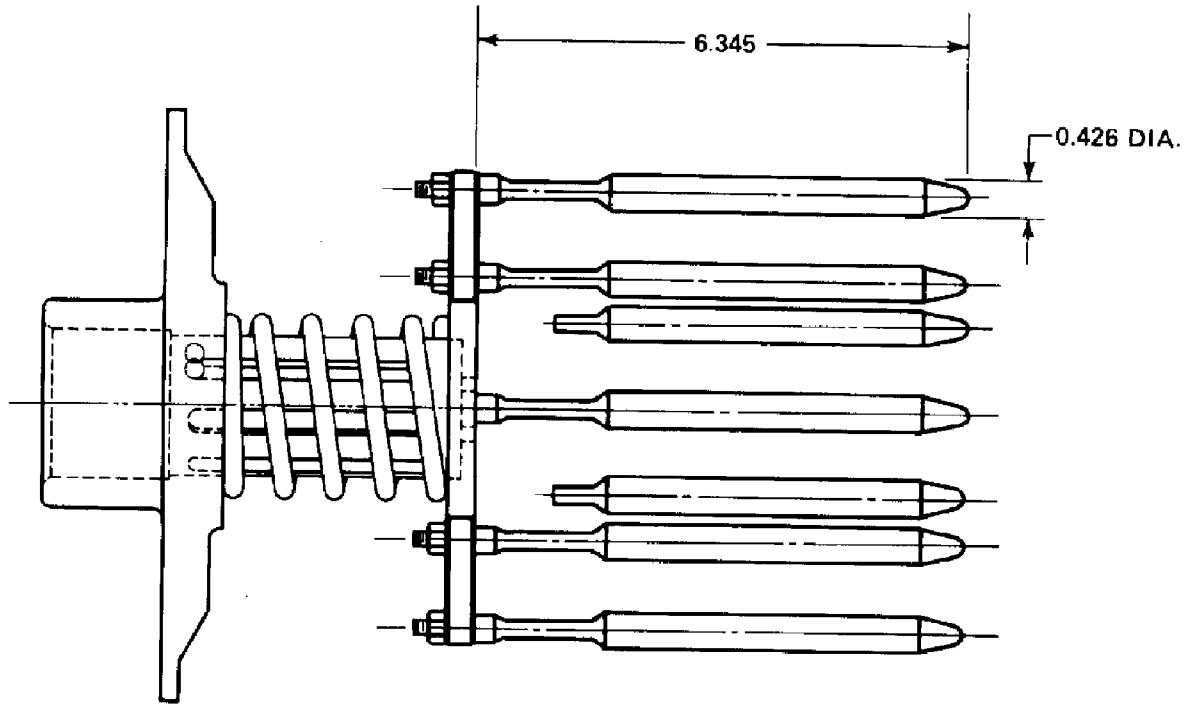


Figure 4-17. Fuel Loading Arrangement

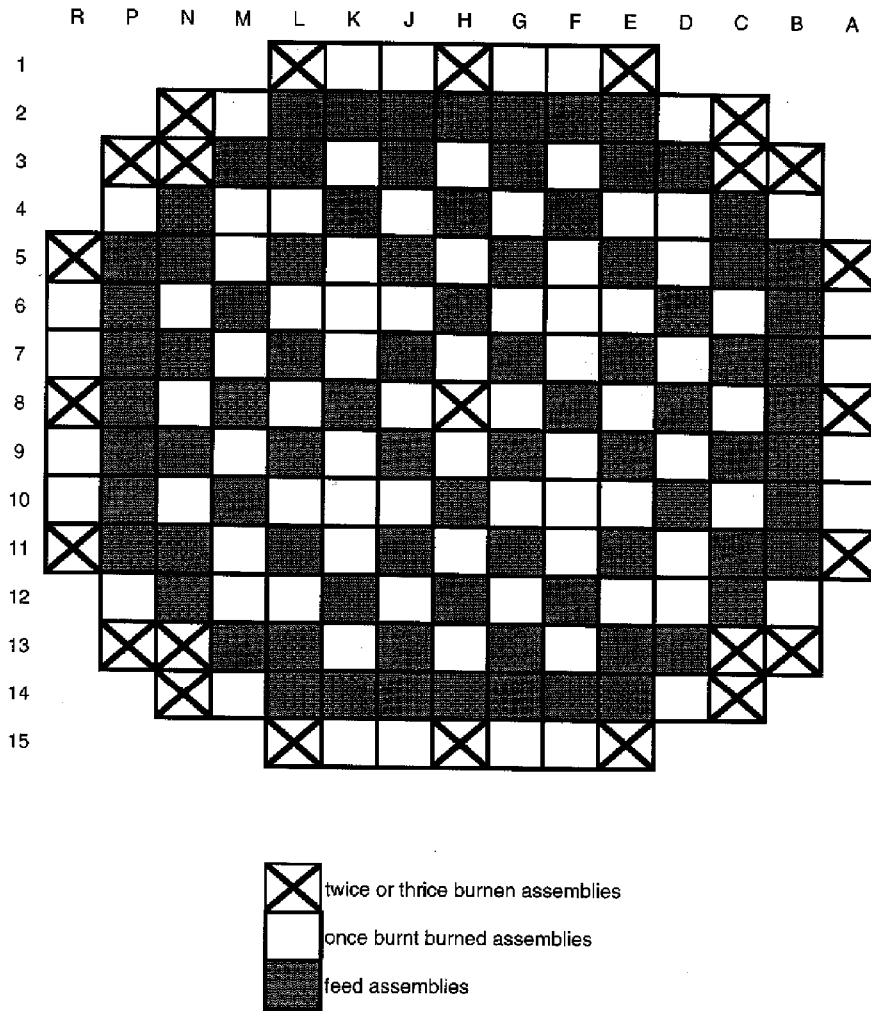


Figure 4-18. Fuel Loading Arrangement

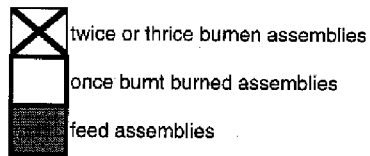
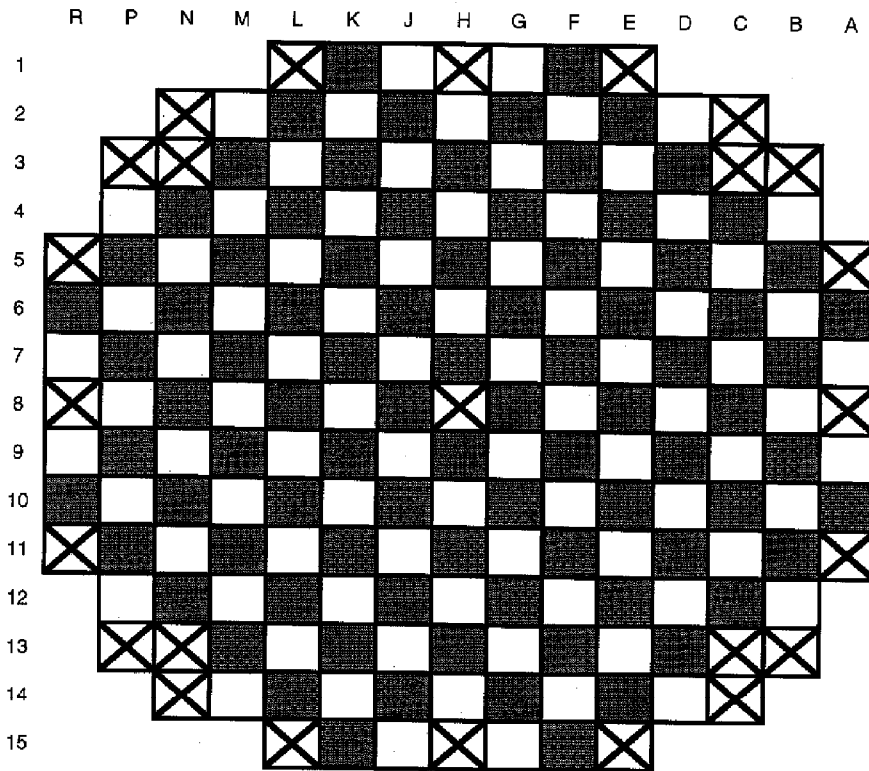


Figure 4-19. Production and Consumption of Higher Isotopes - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

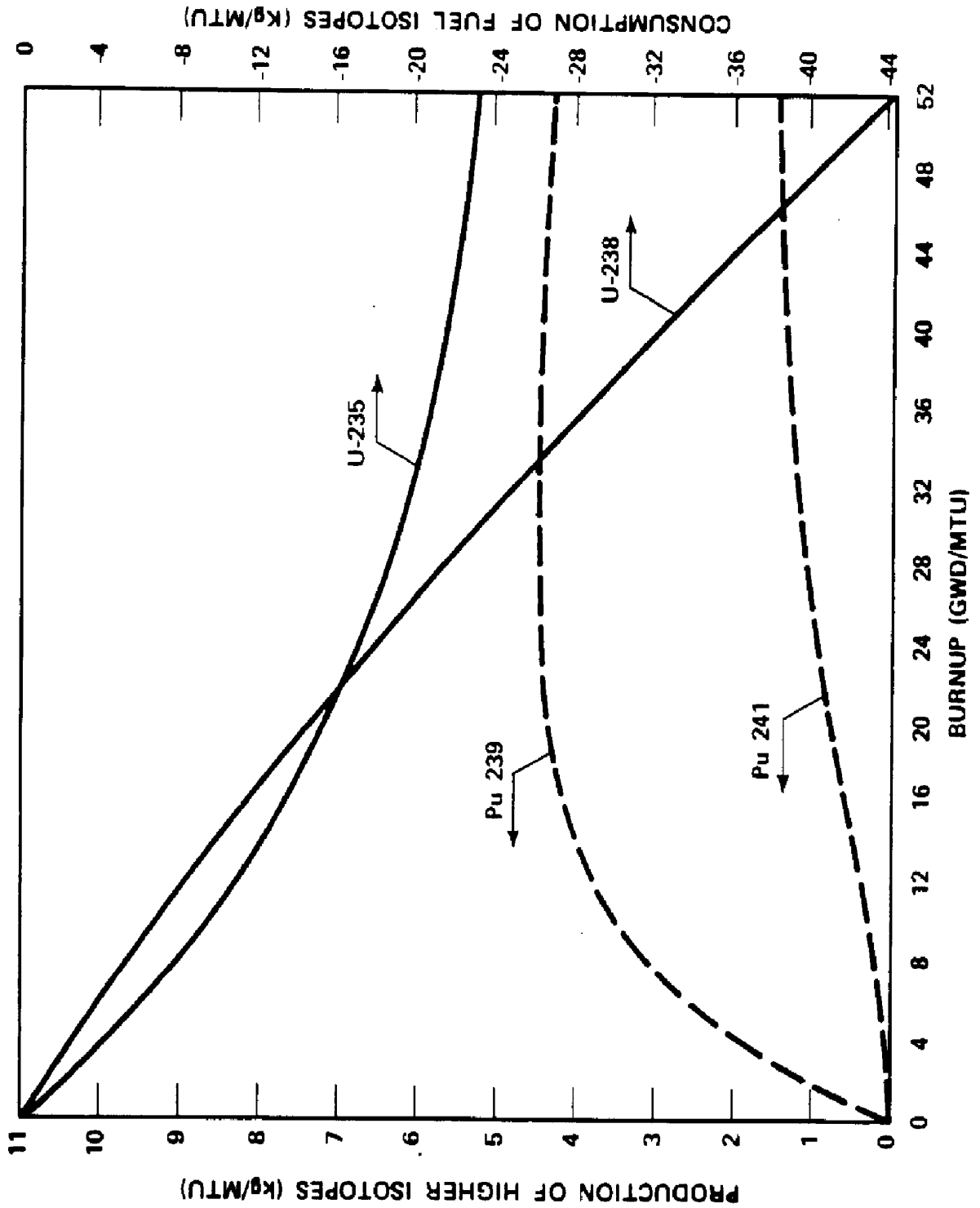


Figure 4-20. Boron Concentration Versus Typical Cycle Burnup With and Without Burnable Poison

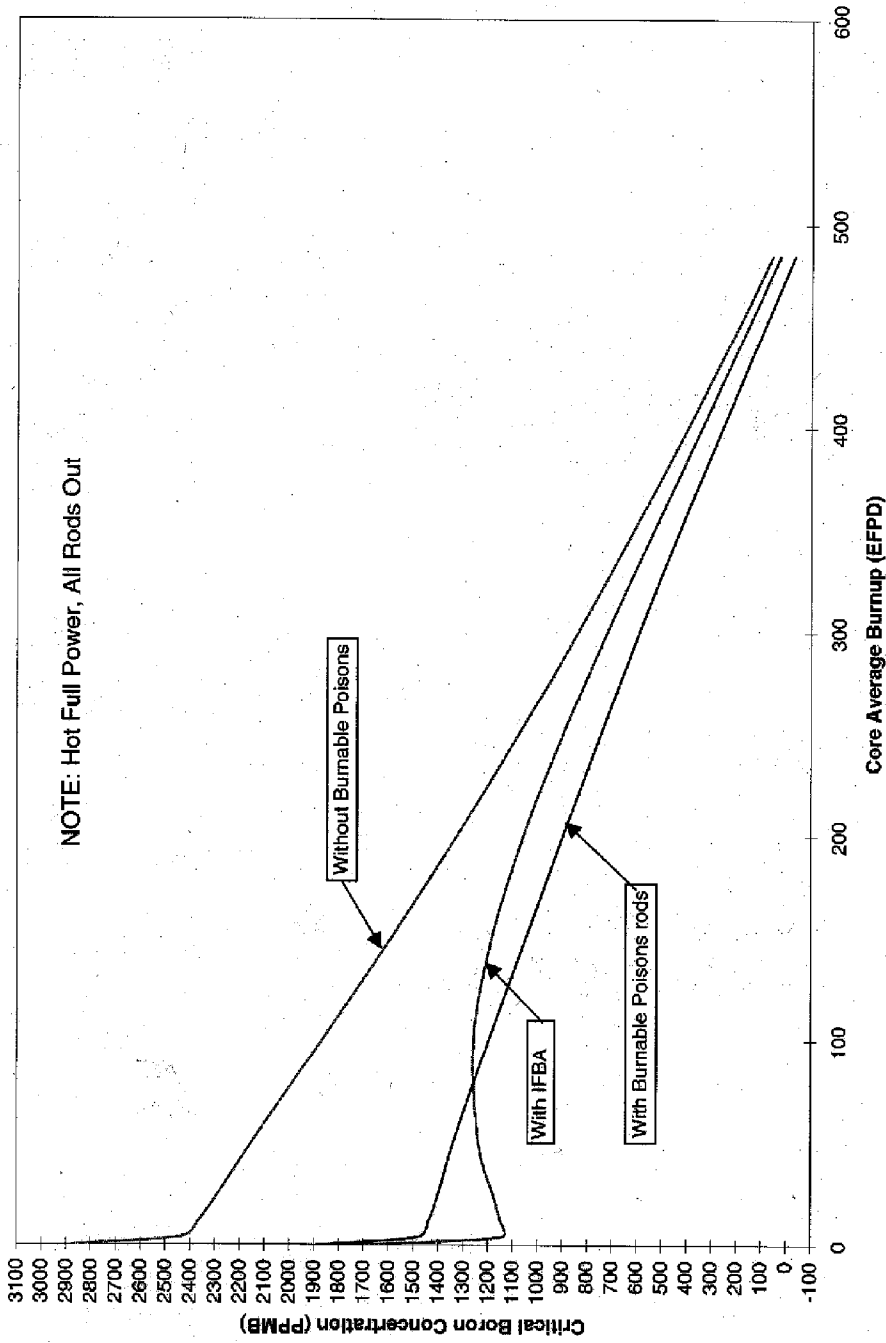


Figure 4-21. Deleted Per 2000 Update

Figure 4-22. Typical Burnable Poison Loading Pattern IBFA Fuel

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2					48	80	80	104	80	80	48				
3				104	104		128		128		104	104			
4			104			128		128		128				104	
5		48	104		128		128		128		128		104	48	
6		80		128				128					128		80
7		80	128		128		128		128		128		128	80	
8		104		128		128				128		128		104	
9		80	128		128		128		128		128		128	80	
10		80		128				128					128		80
11		48	104		128		128		128		128		104	48	
12			104			128		128		128				104	
13				104	104		128		128		104	104			
14					48	80	80	104	80	80	48				
15															

IFBA fuel rods

Figure 4-23. Typical Burnable Poison Loading Pattern Burnable Poison Rods

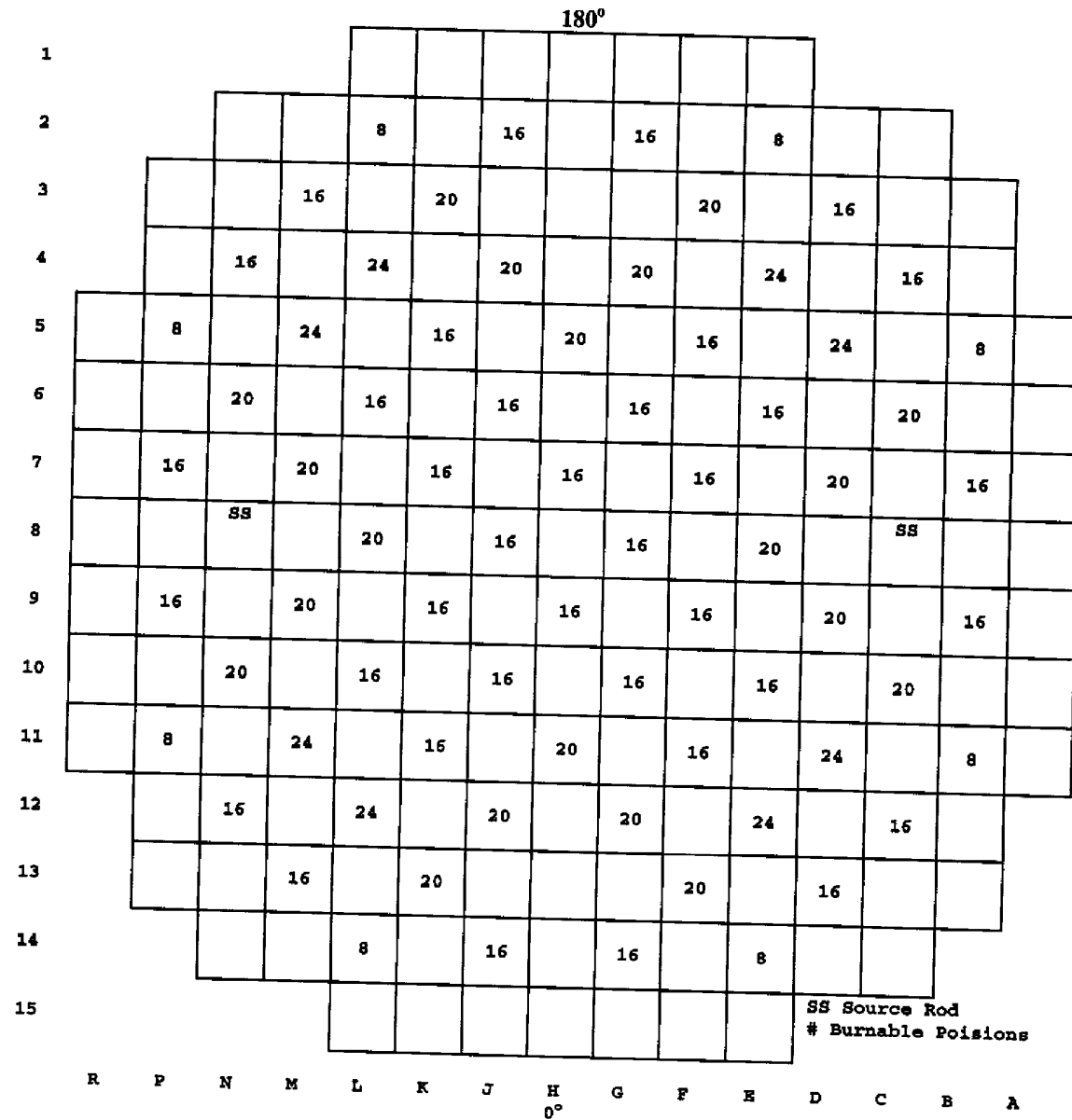


Figure 4-24. Normalized Power Density Distribution Near Beginning-Of-Life, Unrodded Core, Hot Full Power, No Xenon - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

	H	G	F	E	D	C	B	A
8	0.9658	1.2644	0.9792	1.2407	0.9628	1.2797	0.9798	0.4747
9	1.2646	1.1814	1.2876	1.1732	1.2226	1.2075	1.1771	0.4323
10	0.9786	1.2868	0.9911	1.2229	1.2069	1.2358	1.0820	0.4794
11	1.2392	1.1710	1.2219	1.2092	1.2262	1.2116	1.1509	0.3234
12	0.9620	1.2218	1.2067	1.2270	1.1890	1.2276	0.6302	
13	1.2794	1.2074	1.2363	1.2131	1.2298	0.7372	0.2608	
14	0.9799	1.1774	1.0828	1.1522	0.6310	0.2608		
15	0.4748	0.4325	0.4803	0.3239	Assembly Average Power			

Figure 4-25. Normalized Power Density Distribution Near Beginning-Of-Life, Unrodded Core, Hot Full, Equilibrium Xenon - *HISTORICAL INFORMATION NOT NOT REQUIRED TO BE REVISED*

	H	G	F	E	D	C	B	A
8	0.9735	1.2608	0.9845	1.2363	0.9678	1.2725	0.9861	0.4908
9	1.2610	1.1806	1.2808	1.1707	1.2156	1.2046	1.1757	0.4462
10	0.9840	1.2800	0.9922	1.2142	1.2005	1.2264	1.0864	0.4943
11	1.2349	1.1686	1.2133	1.2034	1.2148	1.2061	1.1475	0.3353
12	0.9671	1.2149	1.2003	1.2156	1.1819	1.2182	0.6395	
13	1.2722	1.2045	1.2268	1.2075	1.2203	0.7471	0.2728	
14	0.9861	1.1759	1.0871	1.1487	0.6403	0.2728		
15	0.4908	0.4464	0.4952	0.3358	Assembly Average Power			

Figure 4-26. Normalized Power Density Distribution Near Beginning-Of-Life, Group D 28% Inserted, Hot Full Power, Equilibrium Xenon - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

	H	G	F	E	D	C	B	A
8	0.8992	1.2510	0.9931	1.2622	0.9848	1.2947	1.0010	0.4972
9	1.2510	1.1779	1.2984	1.1865	1.2375	1.2214	1.1927	0.4506
10	0.9921	1.2967	1.0001	1.2267	1.2061	1.2374	1.0941	0.4978
11	1.2602	1.1836	1.2251	1.1955	1.1938	1.1905	1.1497	0.3331
12	0.9837	1.2362	1.2055	1.1947	1.0838	1.1822	0.6243	
13	1.2942	1.2209	1.2376	1.1916	1.1844	0.7171	0.2622	
14	1.0009	1.1928	1.0946	1.1506	0.6249	0.2622		
15	0.4972	0.4508	0.4985	0.3336	Assembly Average Power			

Figure 4-27. Normalized Power Density Distribution Near Middle-Of-Life, Hot Full Power, Equilibrium Xenon - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

	H	G	F	E	D	C	B	A
8	1.0071	1.3360	1.0102	1.3325	1.0036	1.3031	0.9455	0.5075
9	1.3362	1.1723	1.3397	1.1828	1.3208	1.1597	1.1339	0.4568
10	1.0099	1.3393	1.0251	1.3312	1.1902	1.2623	1.0044	0.4942
11	1.3316	1.1813	1.3305	1.2044	1.2761	1.1132	1.0317	0.3353
12	1.0031	1.3203	1.1900	1.2766	1.1054	1.1396	0.6100	
13	1.3029	1.1596	1.2624	1.1138	1.1408	0.7160	0.2863	
14	0.9455	1.1340	1.0047	1.0322	0.6103	0.2861		
15	0.5075	0.4569	0.4948	0.3356	Assembly Average Power			

Figure 4-28. Normalized Power Density Distribution Near End-Of-Life, Unrodded Core, Hot Full Power, Equilibrium Xenon - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

	H	G	F	E	D	C	B	A
8	0.9644	1.2601	0.9760	1.2918	0.9897	1.2699	0.9453	0.5614
9	1.2603	1.0998	1.2859	1.1312	1.3044	1.1246	1.1286	0.5060
10	0.9759	1.2857	1.0017	1.3150	1.1604	1.2829	1.0106	0.5493
11	1.2916	1.1304	1.3147	1.1780	1.3149	1.1029	1.0409	0.3854
12	0.9895	1.3044	1.1603	1.3152	1.0996	1.1441	0.6582	
13	1.2699	1.1246	1.2829	1.1032	1.1448	0.7630	0.3405	
14	0.9454	1.1287	1.0107	1.0411	0.6583	0.3403		
15	0.5614	0.5060	0.5498	0.3857	Assembly Average Power			

Figure 4-29. Normalized Power Density Distribution Near End-Of-Life, Group D 28% Inserted, Hot Full Power, Equilibrium Xenon - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

	H	G	F	E	D	C	B	A
8	0.8710	1.2422	0.9833	1.3183	1.0083	1.2975	0.9674	0.5735
9	1.2425	1.0947	1.3023	1.1476	1.3292	1.1439	1.1531	0.5163
10	0.9833	1.3018	1.0106	1.3274	1.1655	1.2971	1.0212	0.5562
11	1.3181	1.1466	1.3268	1.1665	1.2877	1.0849	1.0415	0.3846
12	1.0082	1.3291	1.1655	1.2882	0.9844	1.1003	0.6410	
13	1.2976	1.1439	1.2972	1.0853	1.1012	0.7322	0.3264	
14	0.9674	1.1532	1.0213	1.0417	0.6410	0.3262		
15	0.5736	0.5163	0.5567	0.3849	Assembly Average Power			

Figure 4-32. Typical Axial Power Shapes Occurring at Beginning-Of-Life - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

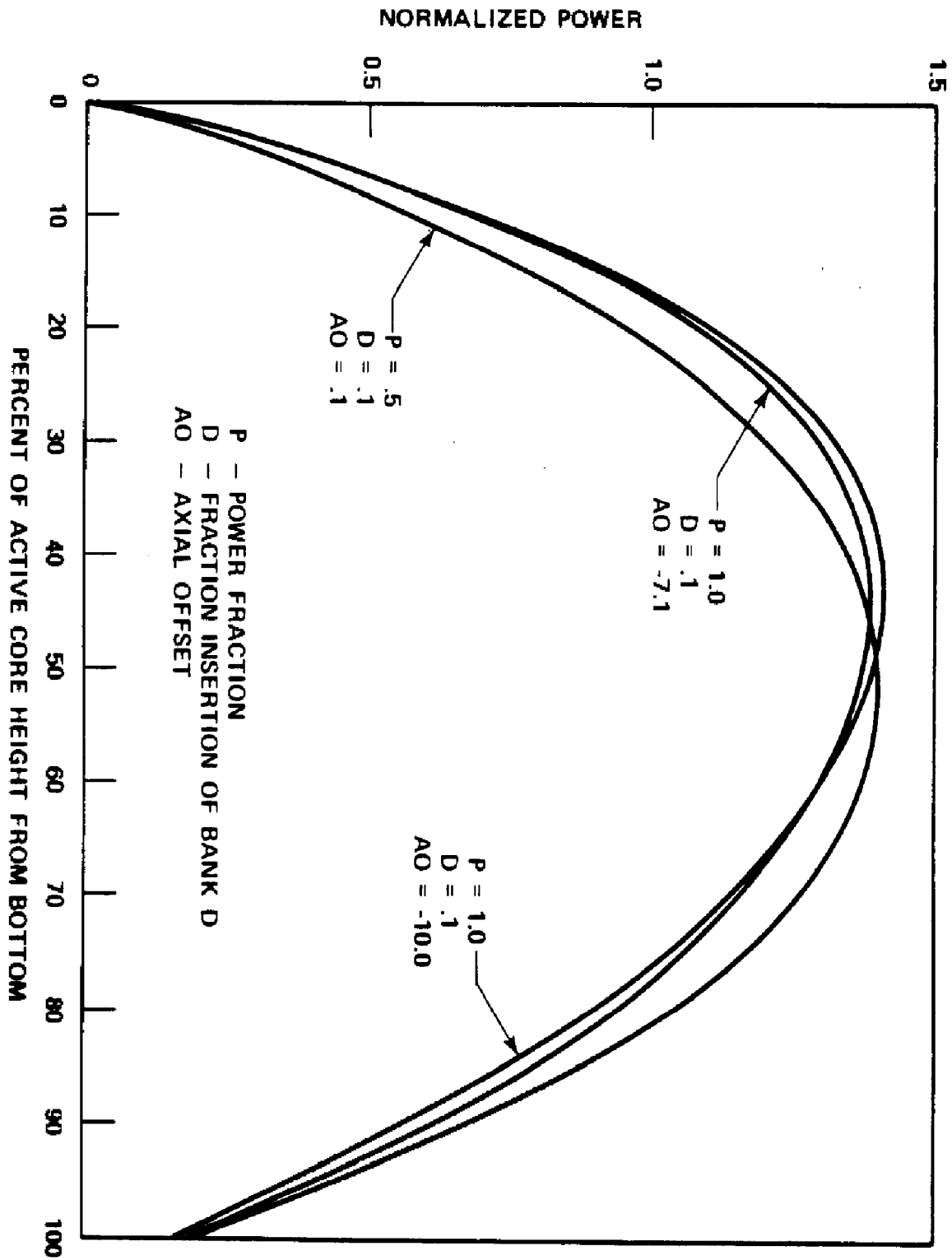


Figure 4-33. Typical Axial Power Shapes Occurring at Middle-Of-Life - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

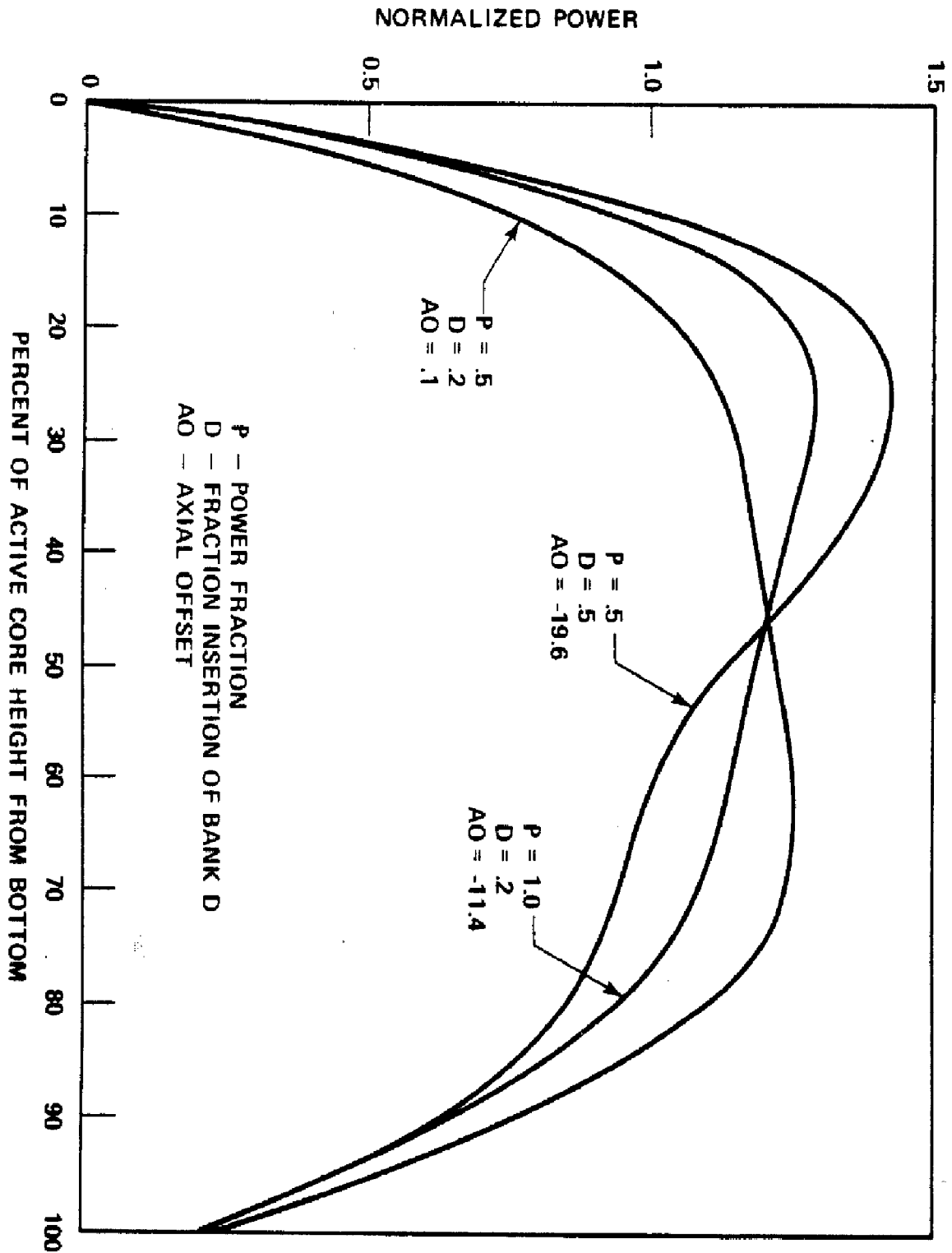


Figure 4-34. Typical Axial Power Shapes Occurring at End-Of-Life - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

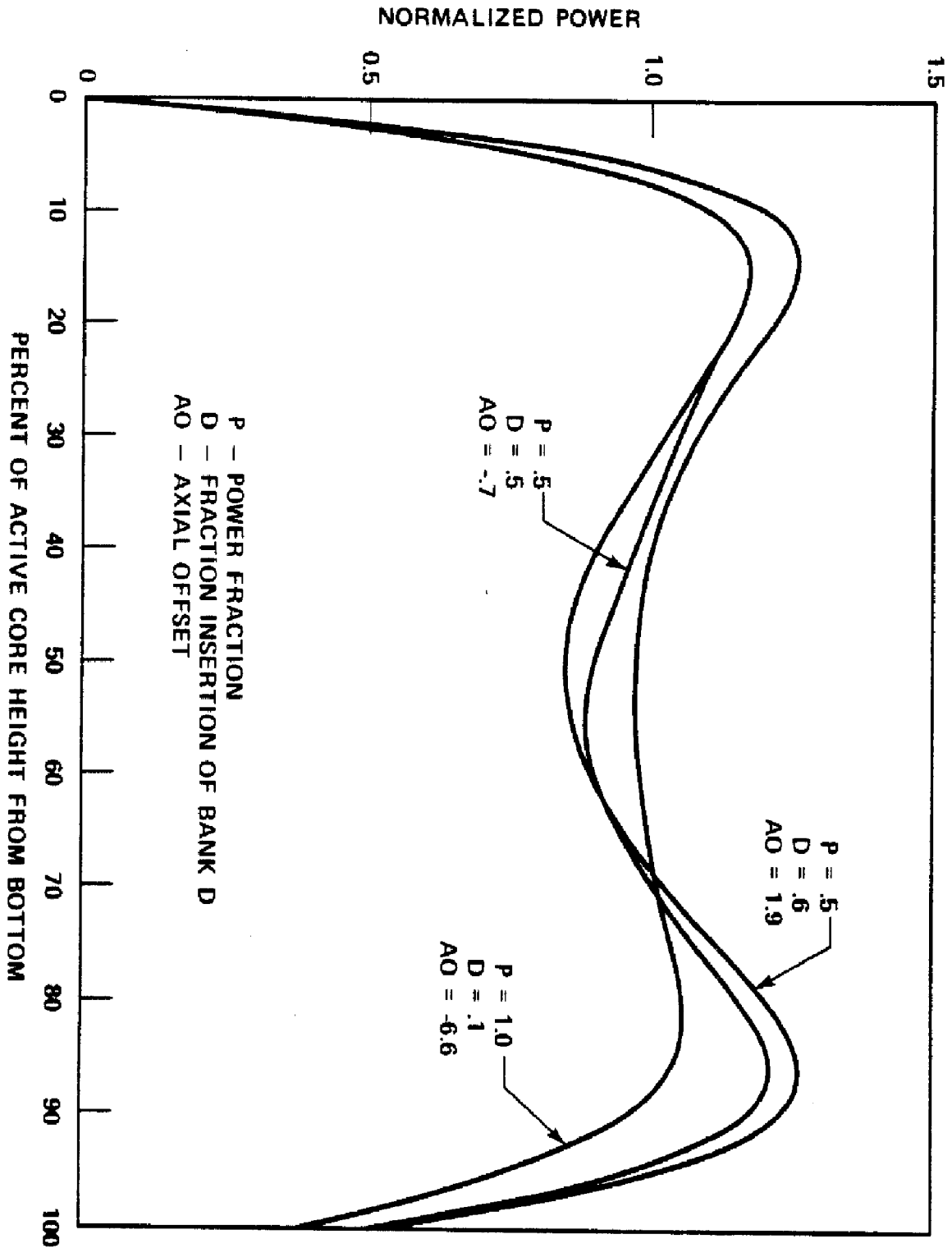


Figure 4-35. Comparison of Assembly Axial Power Distribution with Core Average Axial Distribution, D Bank Slightly Inserted - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

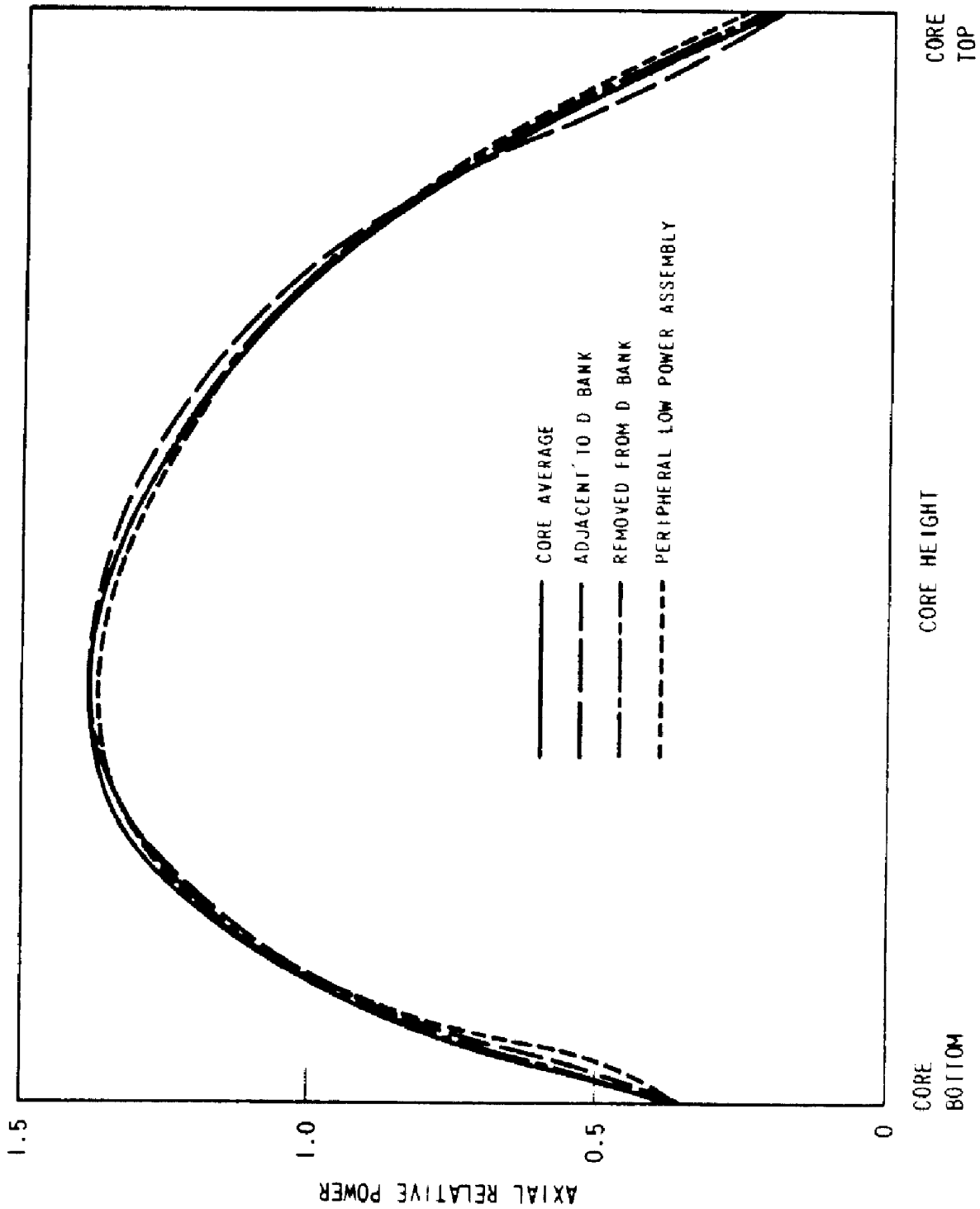


Figure 4-36. Deleted Per 1998 Update

Figure 4-37. Deleted Per 2000 Update

Figure 4-38. Deleted Per 2000 Update

Figure 4-39. Deleted Per 2000 Update

Figure 4-40. Peak Linear Power During Control Rod Malfunction Overpower Transient -
HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

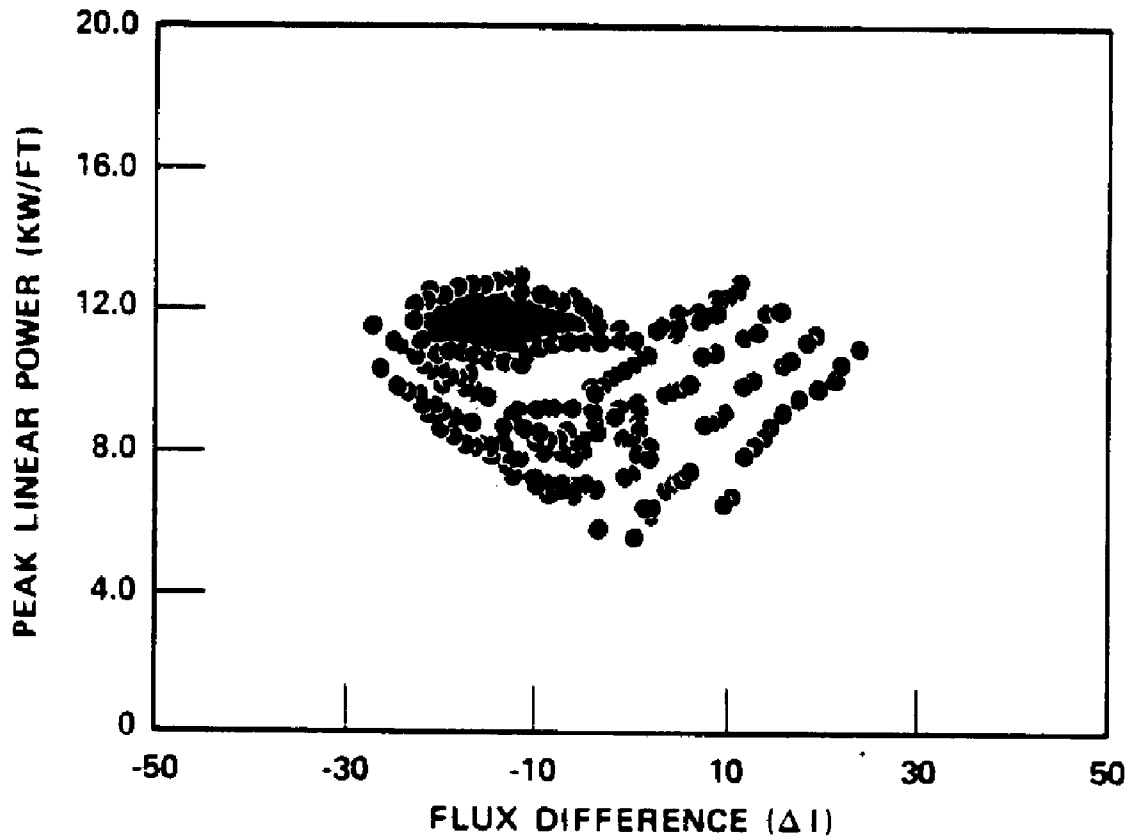


Figure 4-41. Peak Linear Power During Boration/Dilution Overpower Transients - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

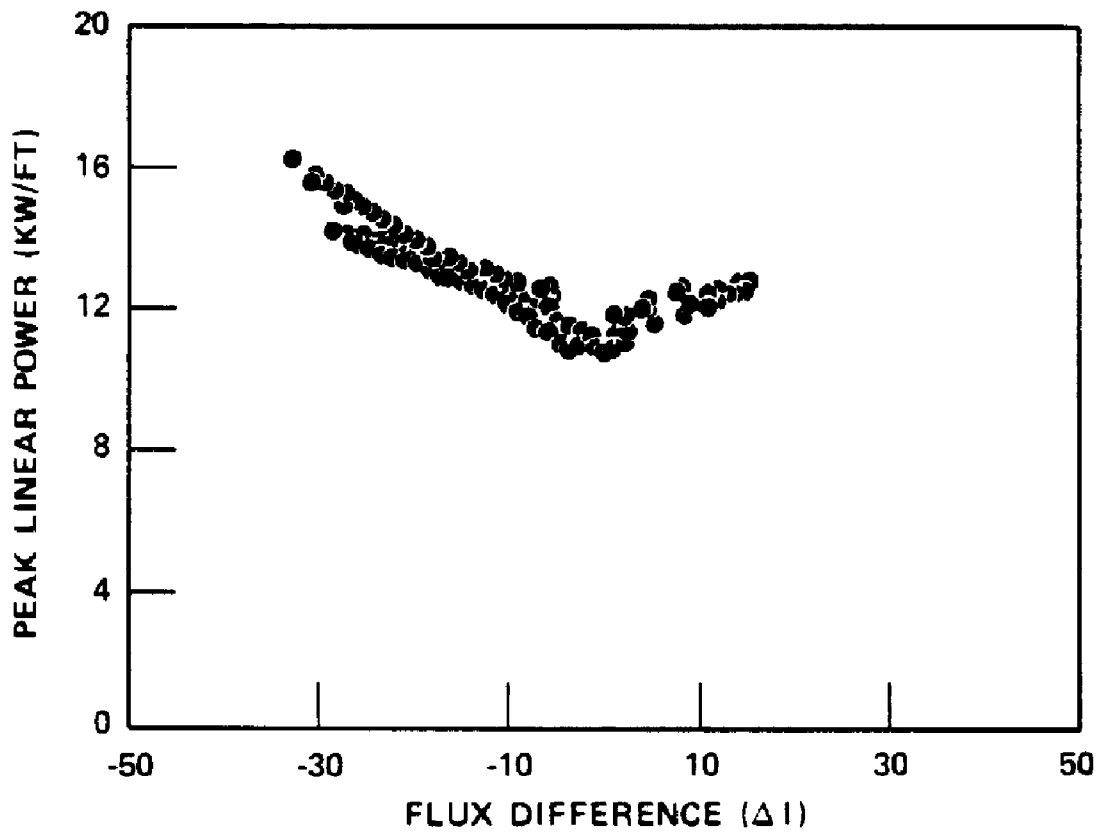


Figure 4-42. Typical Comparison Between Calculated and Measured Relative Fuel Assembly Power Distribution - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

	H	G	F	E	D	C	B	A
8				1.326 1.329 -0.002		0.896 0.909 -0.014		0.436 0.436 0.000
9	1.340 1.341 -0.001		1.346 1.346 0.000				1.149 1.133 0.014	
10					1.055 1.061 -0.006			
11	1.330 1.329 0.001		1.354 1.345 0.007	1.214 1.216 -0.002		1.110 1.104 0.005		0.400 0.320 0.250
12								
13	0.904 0.909 -0.006					0.831 0.821 0.012	0.317 0.315 0.005	
14		1.160 1.135 0.022					Calculated Measured Error (C-M/M)	
15	0.439 0.436 0.007			0.318 0.320 -0.006				

Figure 4-43. Comparison of Calculated and Measured Axial Shape - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

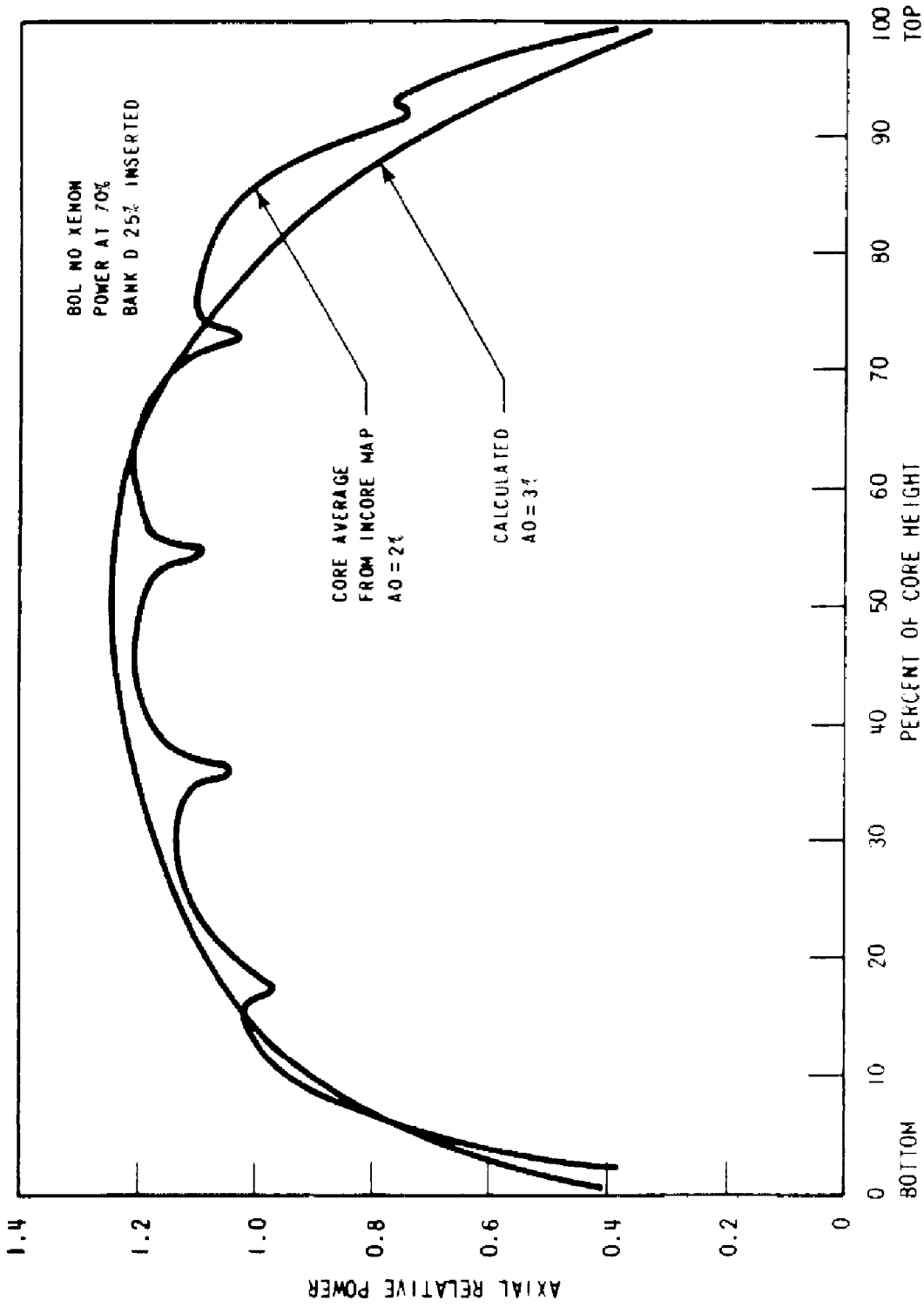


Figure 4-44. Comparison of Calculated and Measured Peaking Factors, $F_Q \times \text{PREL MAX}$ Envelope as a Function of Core Height - HIST. INFOR. NOT REQUIRED TO BE REVISED

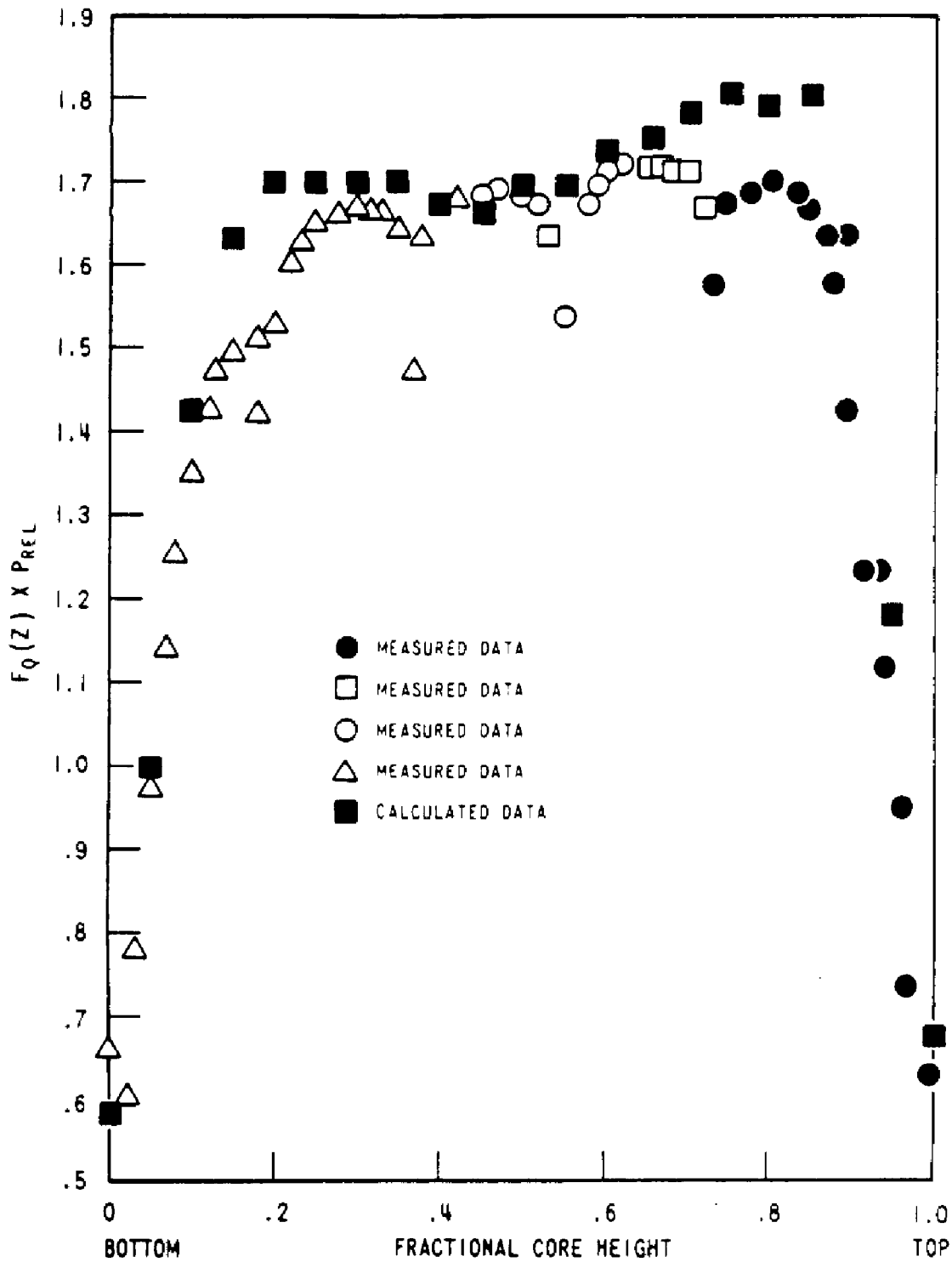


Figure 4-45. Doppler Temperature Coefficient at BOL and EOL, Cycle 1 - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

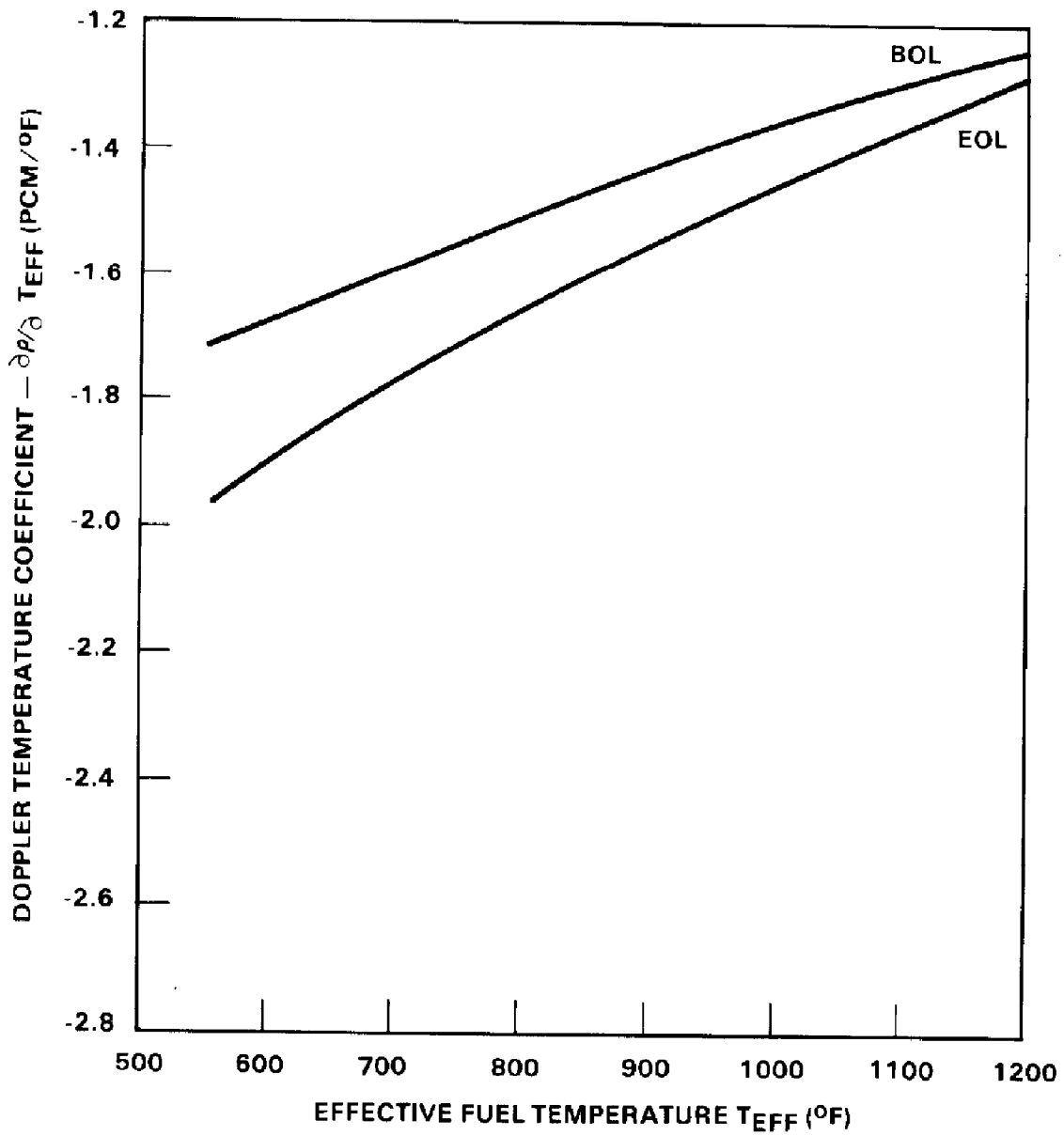


Figure 4-46. Doppler - Only Power Coefficient - BOL, EOL, Cycle 1 - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

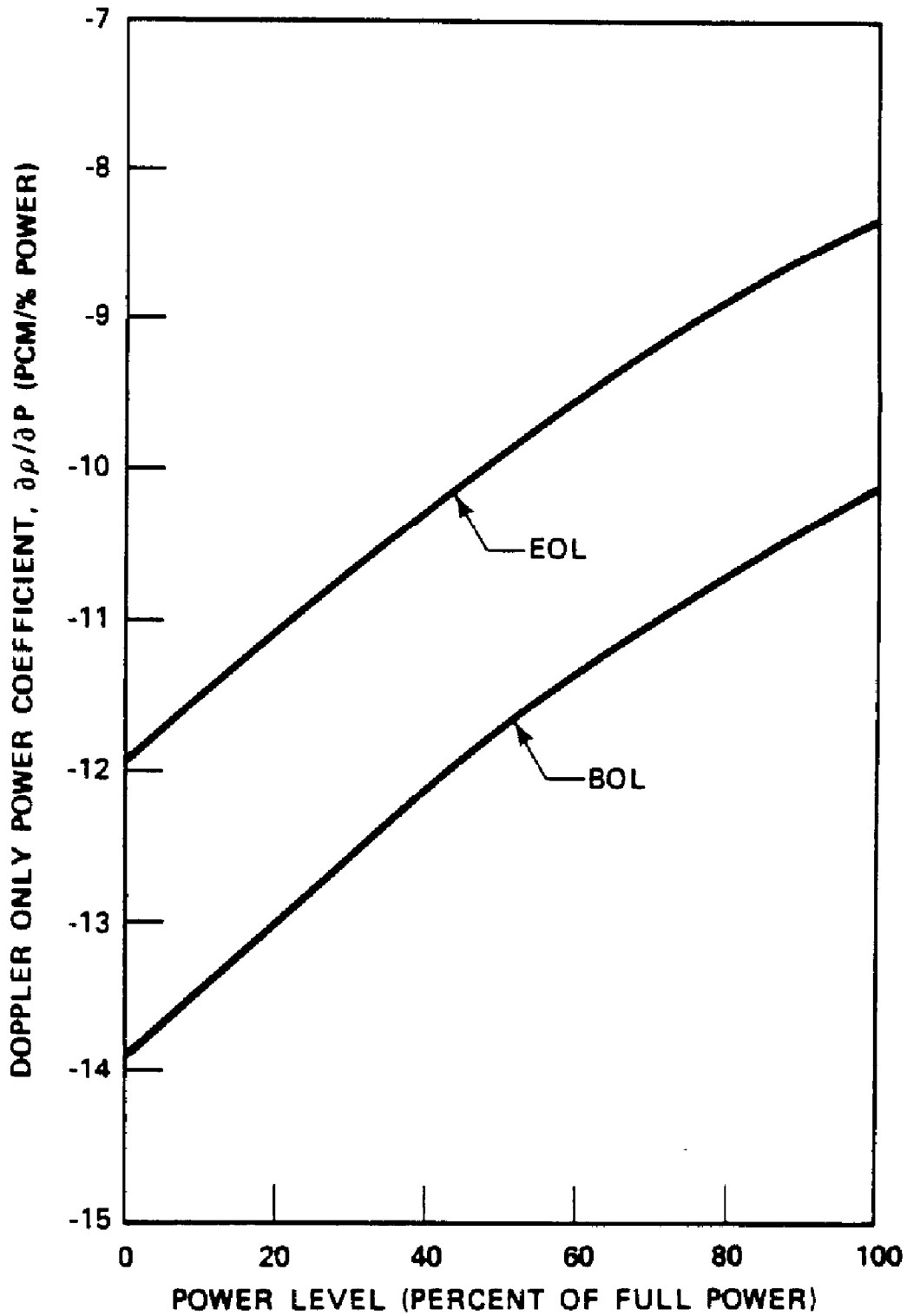


Figure 4-47. Doppler - Only Power Defect Coefficient - BOL, EOL, Cycle 1 - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

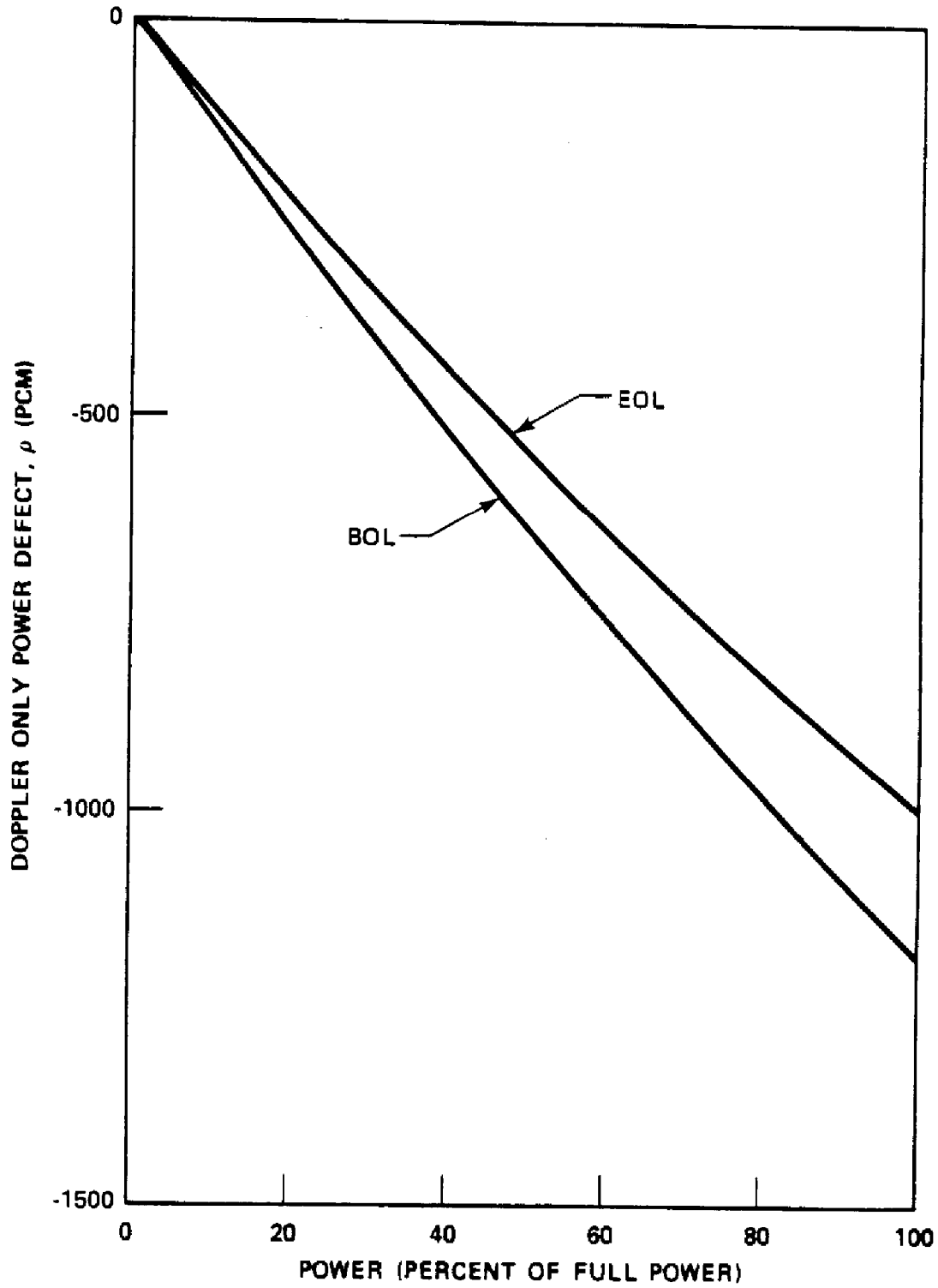


Figure 4-48. Moderator Temperature Coefficient - BOL Cycle 1, No Rods - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

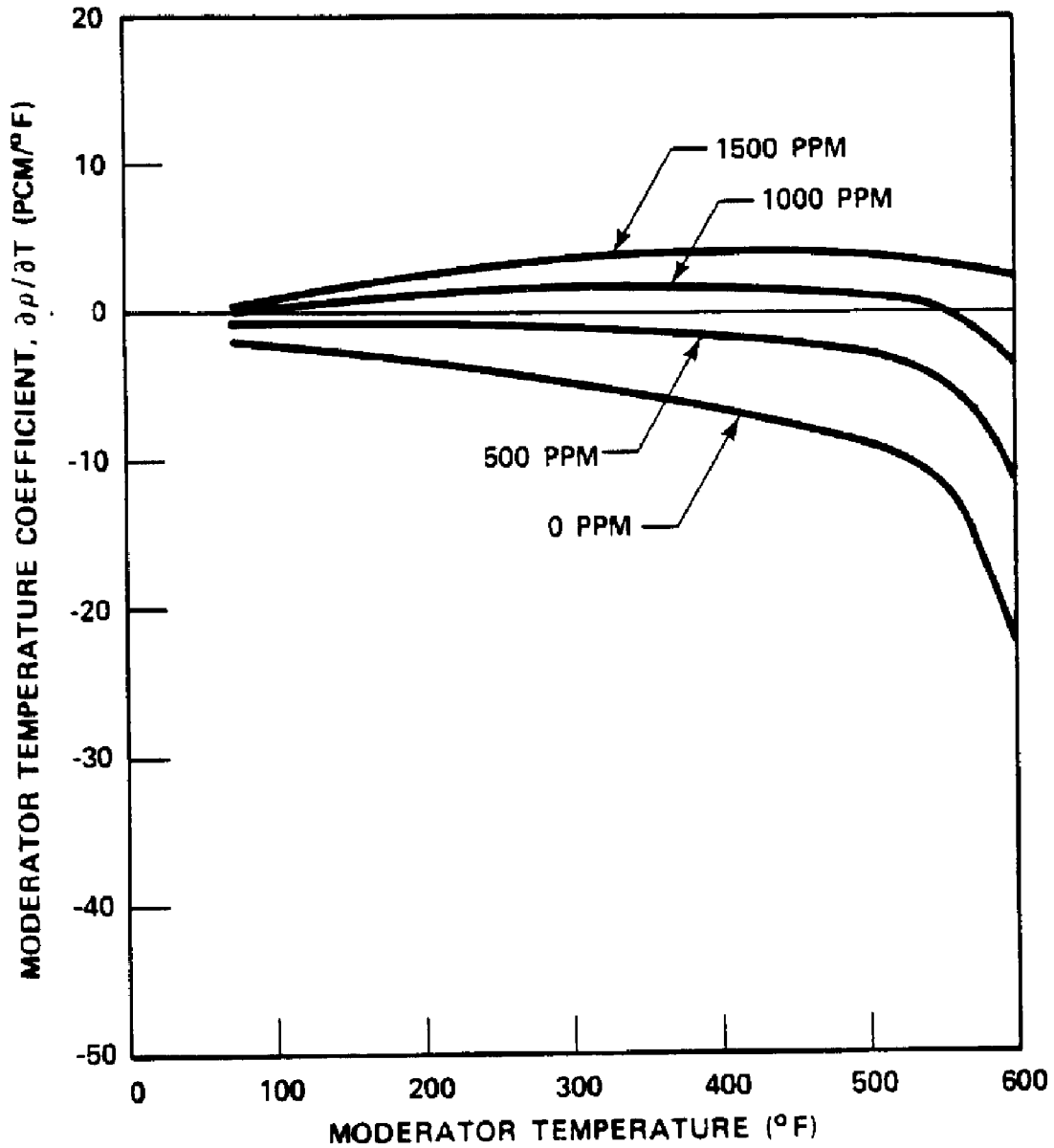


Figure 4-49. Moderator Temperature Coefficient - EOL Cycle 1 - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

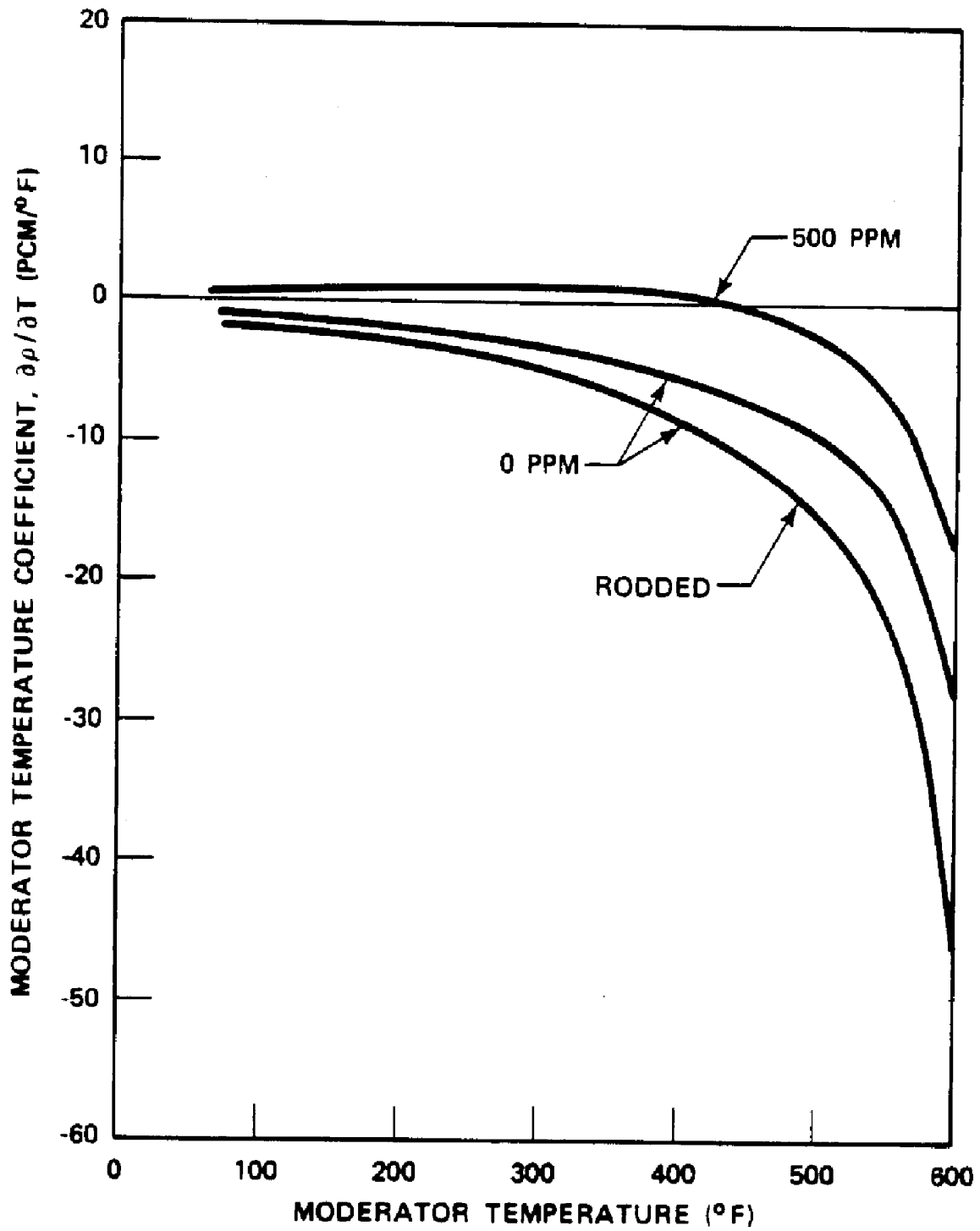


Figure 4-50. Moderator Temperature Coefficient as a Function of Boron Concentration - BOL Cycle 1, No Rods - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

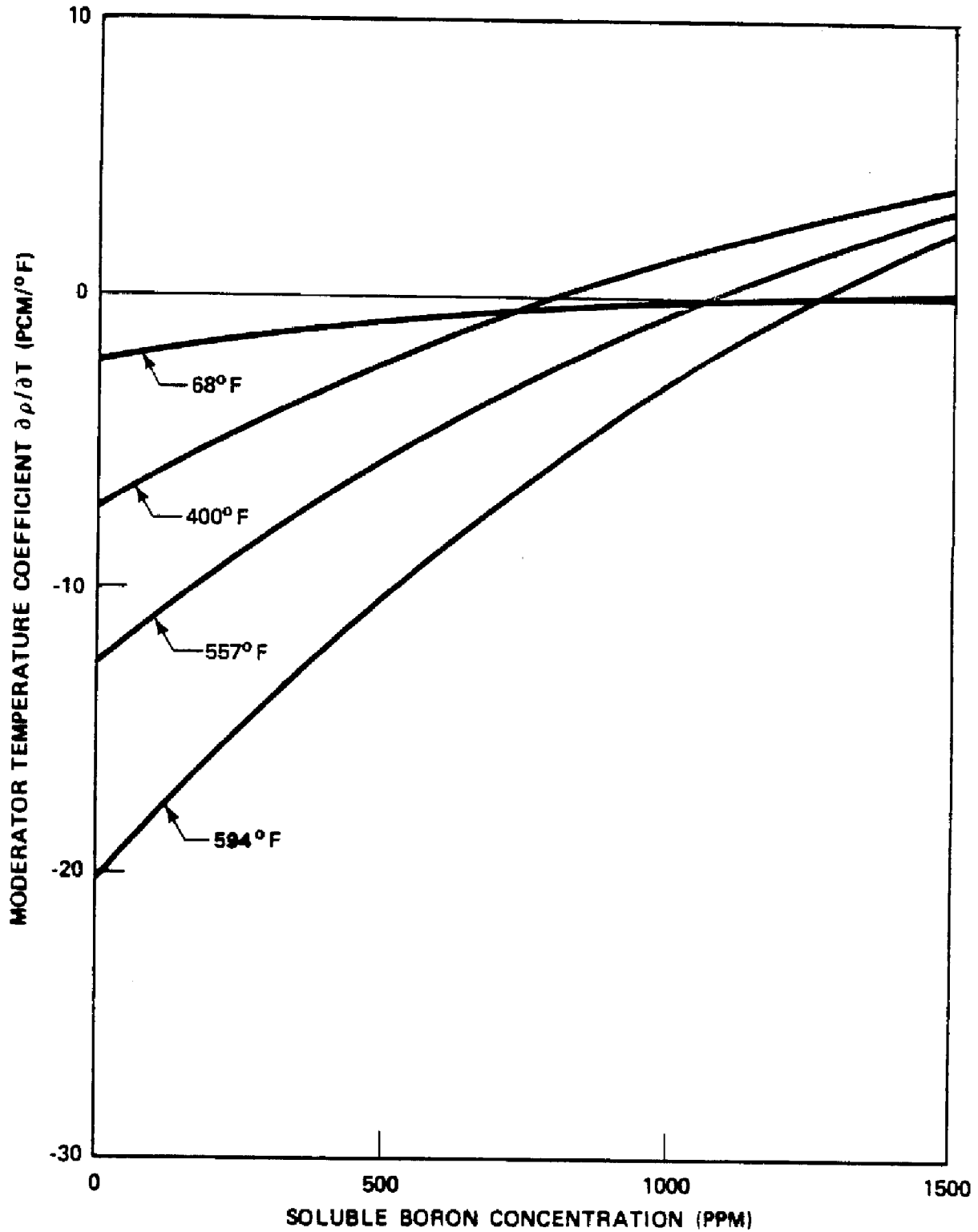


Figure 4-51. Hot Full Power Temperature Coefficient During Cycle 1 for the Critical Boron Concentration - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

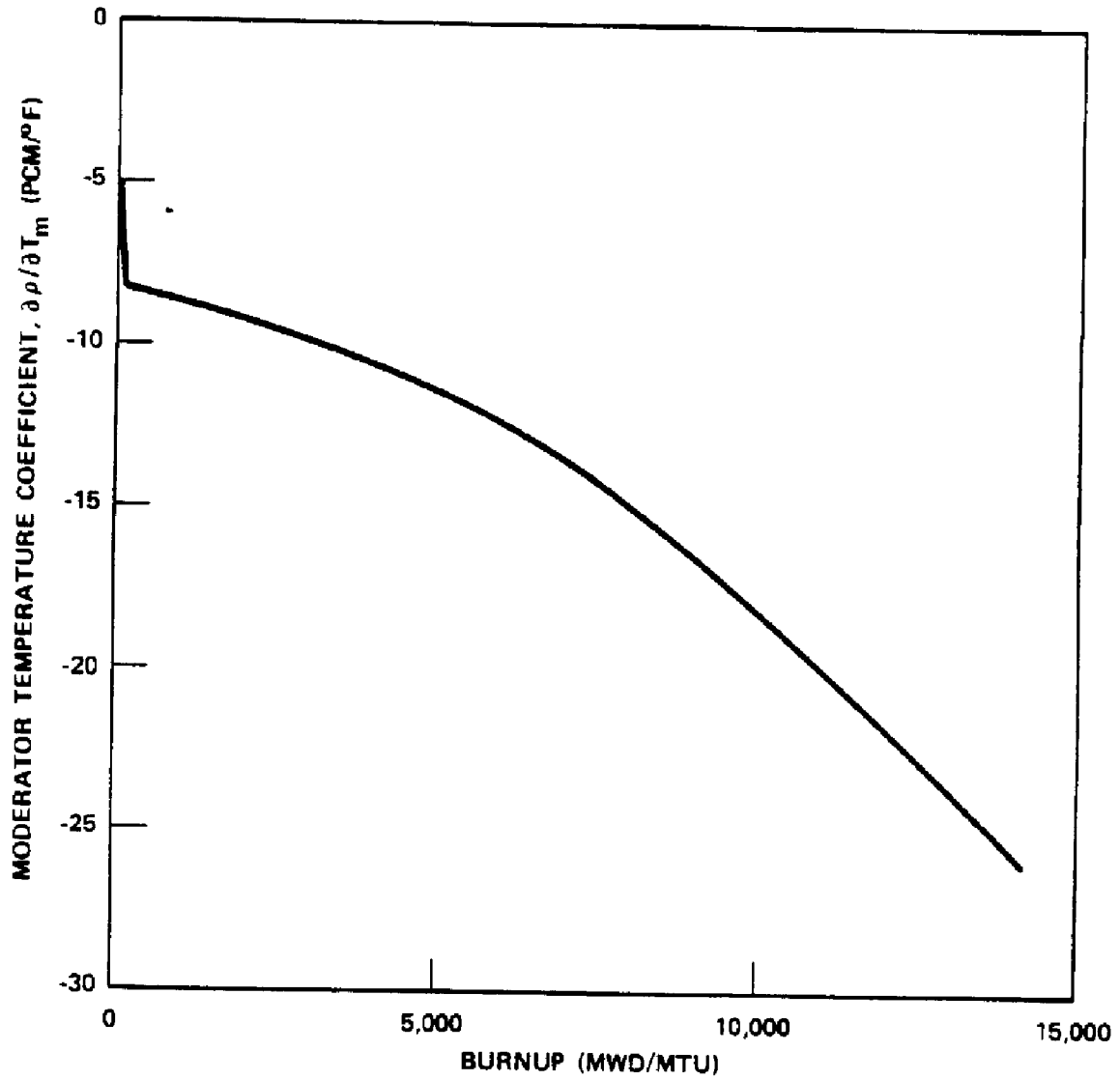


Figure 4-52. Total Power Coefficient - BOL, EOL, Cycle 1 - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

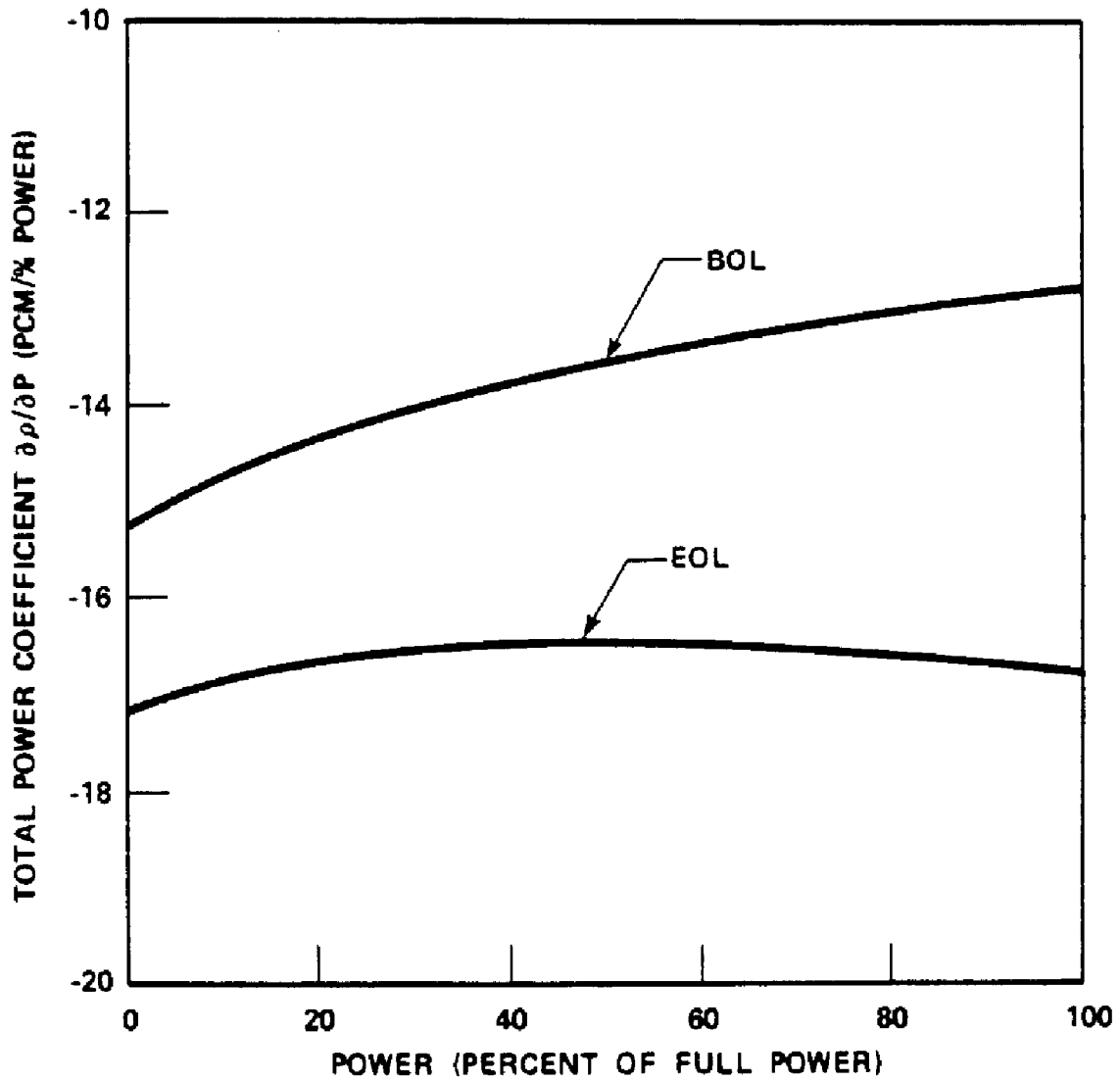


Figure 4-53. Total Power Defect - BOL, EOL, Cycle 1 - *HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED*

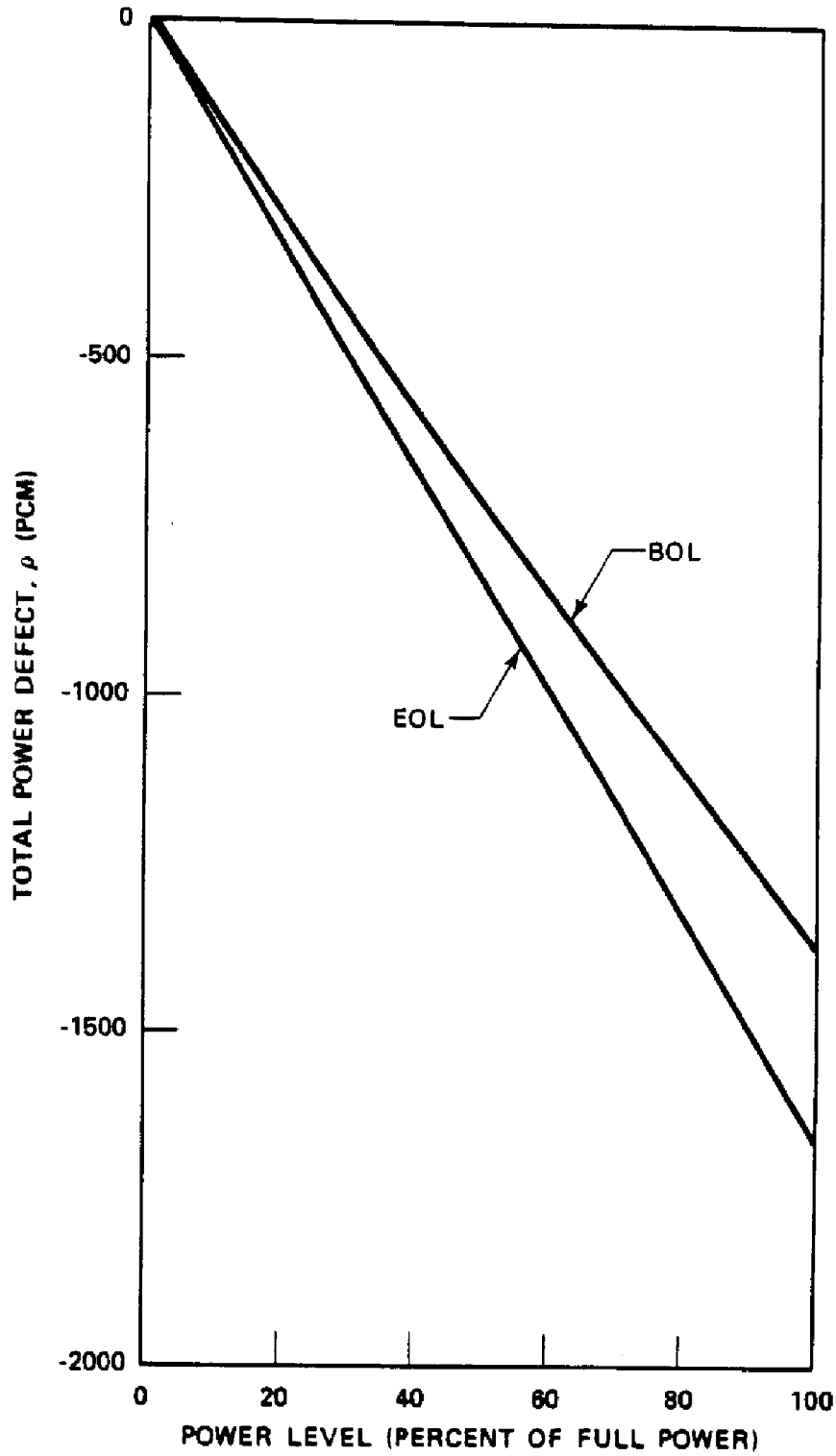
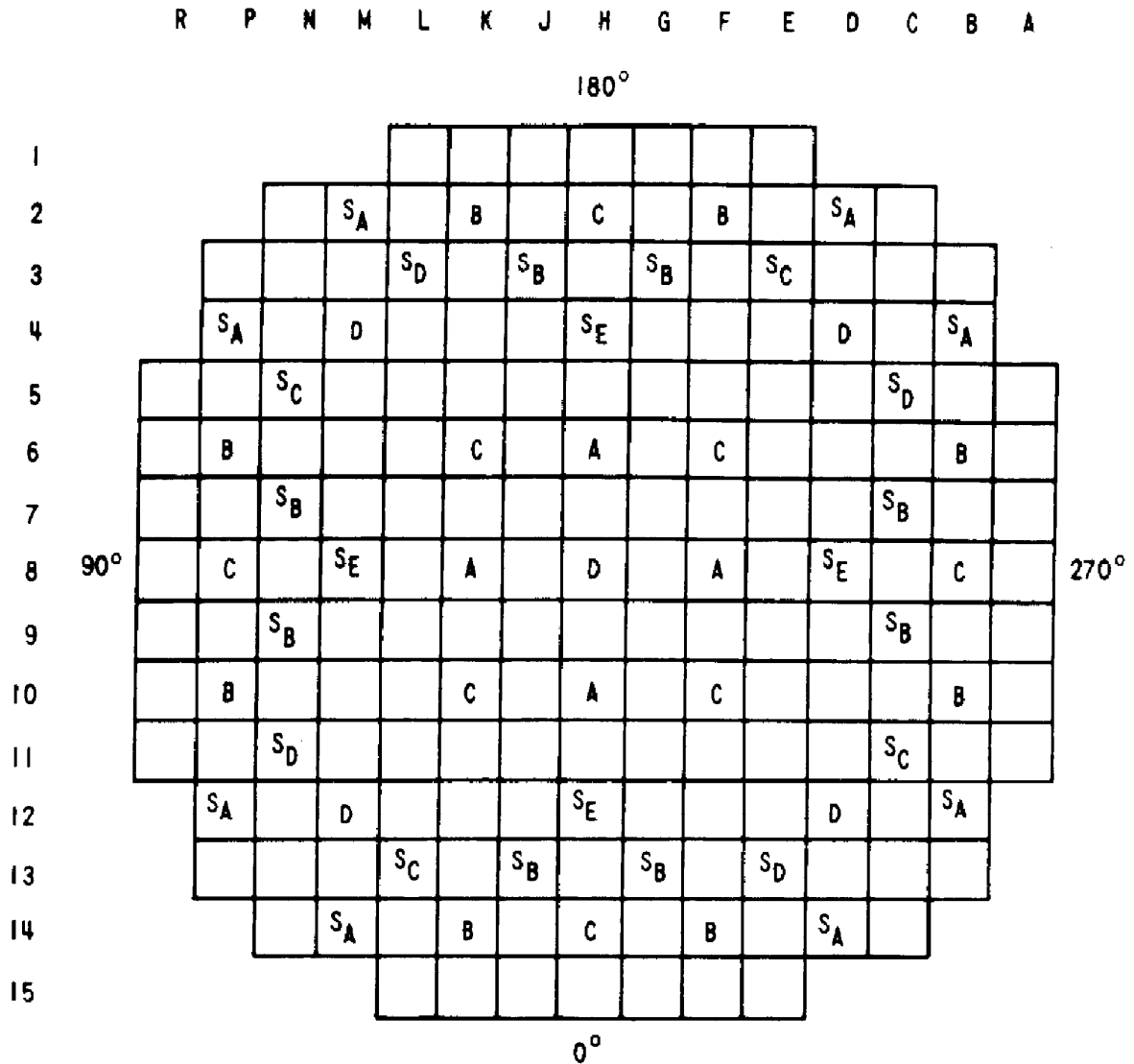


Figure 4-54. Rod Cluster Control Assembly Pattern



CONTROL BANK	NUMBER OF RODS
A	4
B	8
C	8
D	5
TOTAL	25

SHUTDOWN BANK	NUMBER OF RODS
SA	8
SB	8
SC	4
SD	4
SE	4
TOTAL	28

Figure 4-55. Accidental Simultaneous Withdrawal of Two Control Banks, EOL, HZP, Banks C and B Moving in the Same Plane - HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

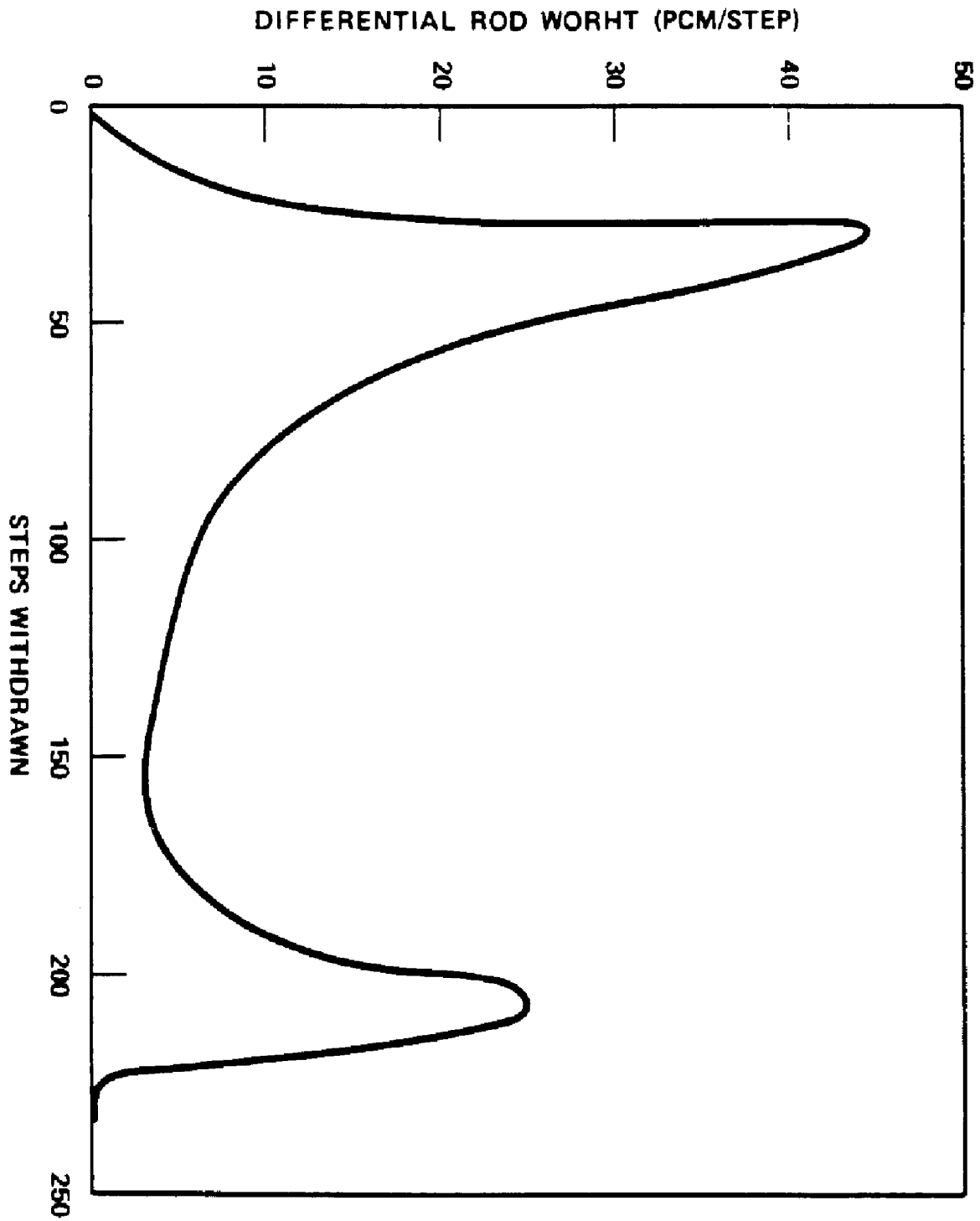


Figure 4-56. Deleted Per 1998 Update

Figure 4-57. Deleted Per 1998 Update

Figure 4-58. Axial Offset Versus Time PWR Core with 12-ft. Height and 121 Assemblies

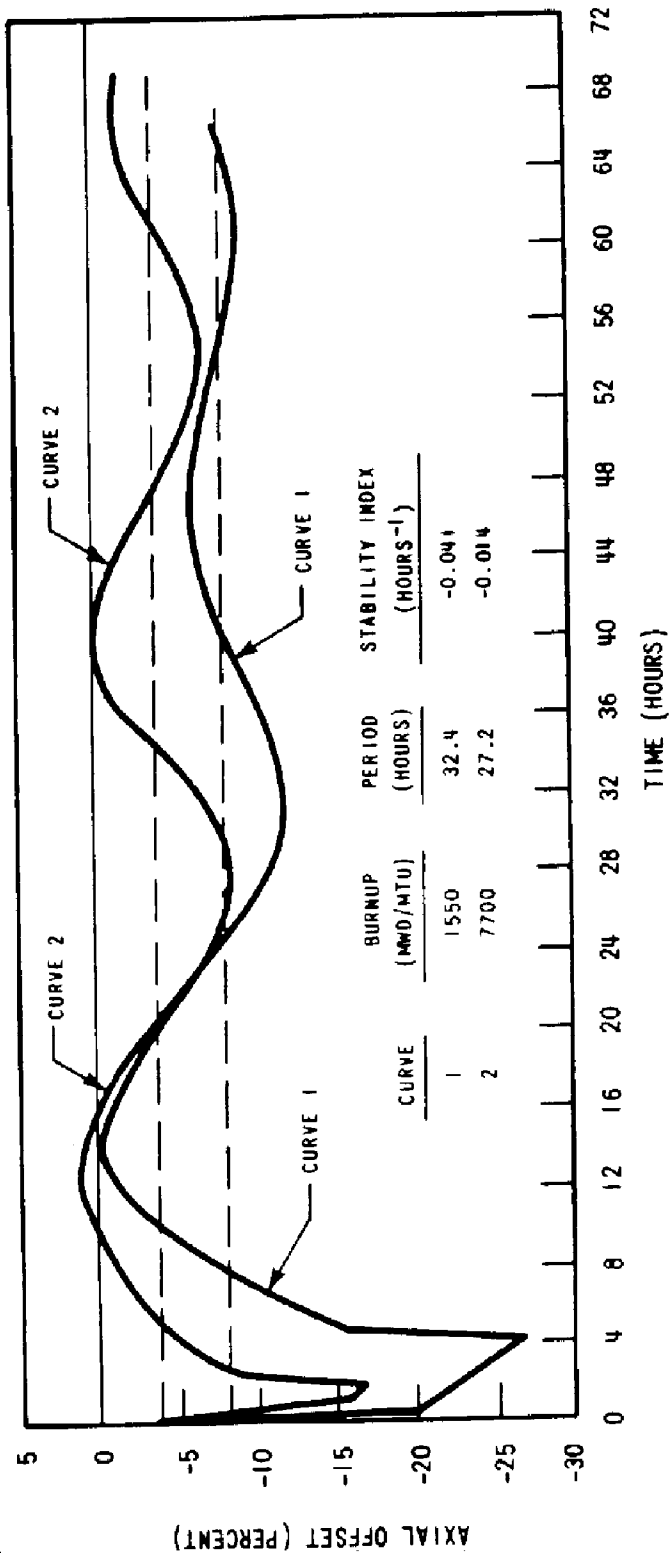


Figure 4-59. XY Xenon Test Thermocouple Response Quadrant Tilt Difference Versus Time

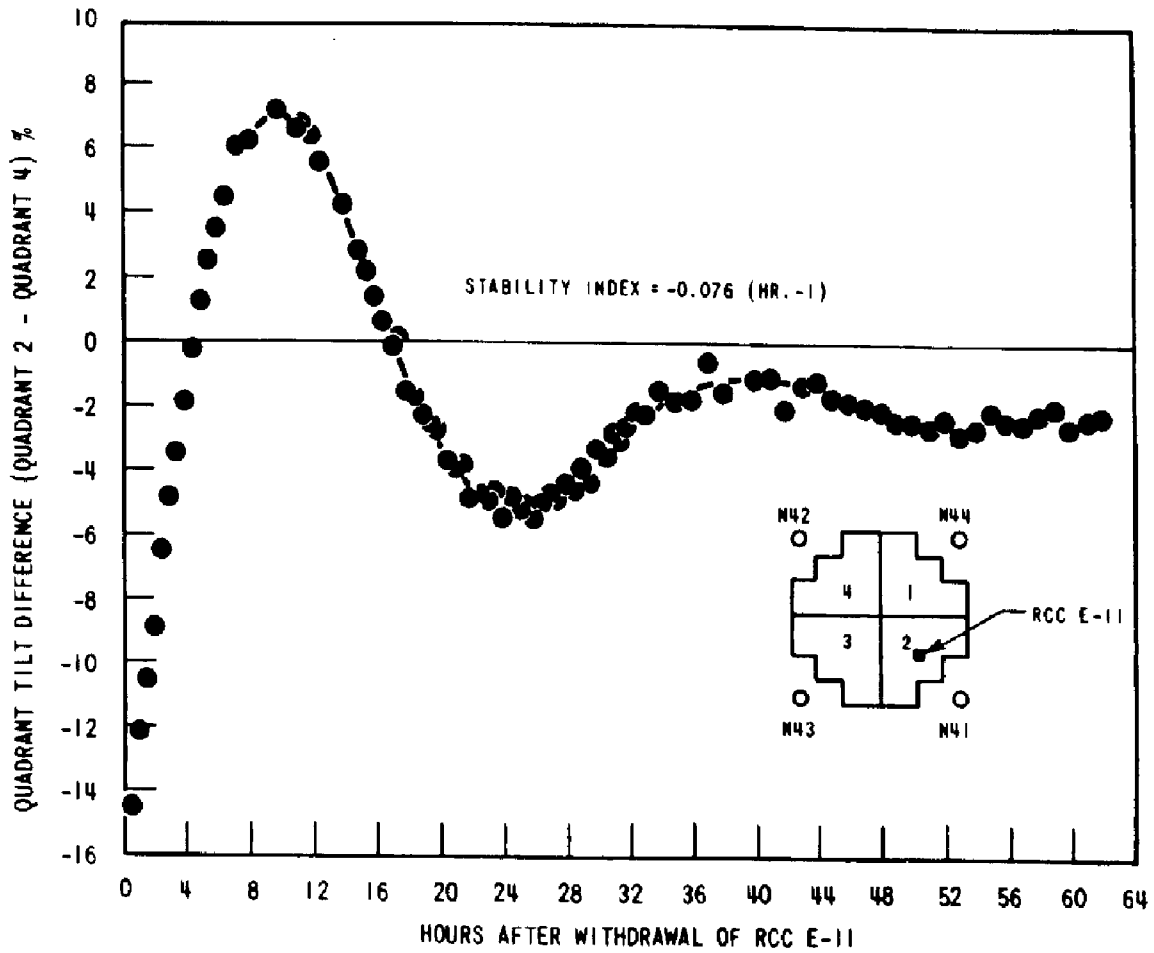


Figure 4-60. Deleted Per 1998 Update

Figure 4-61. Comparison of Calculated and Measured Boron Concentration for 2-Loop Plant, 121 Assemblies, 12-Foot Core

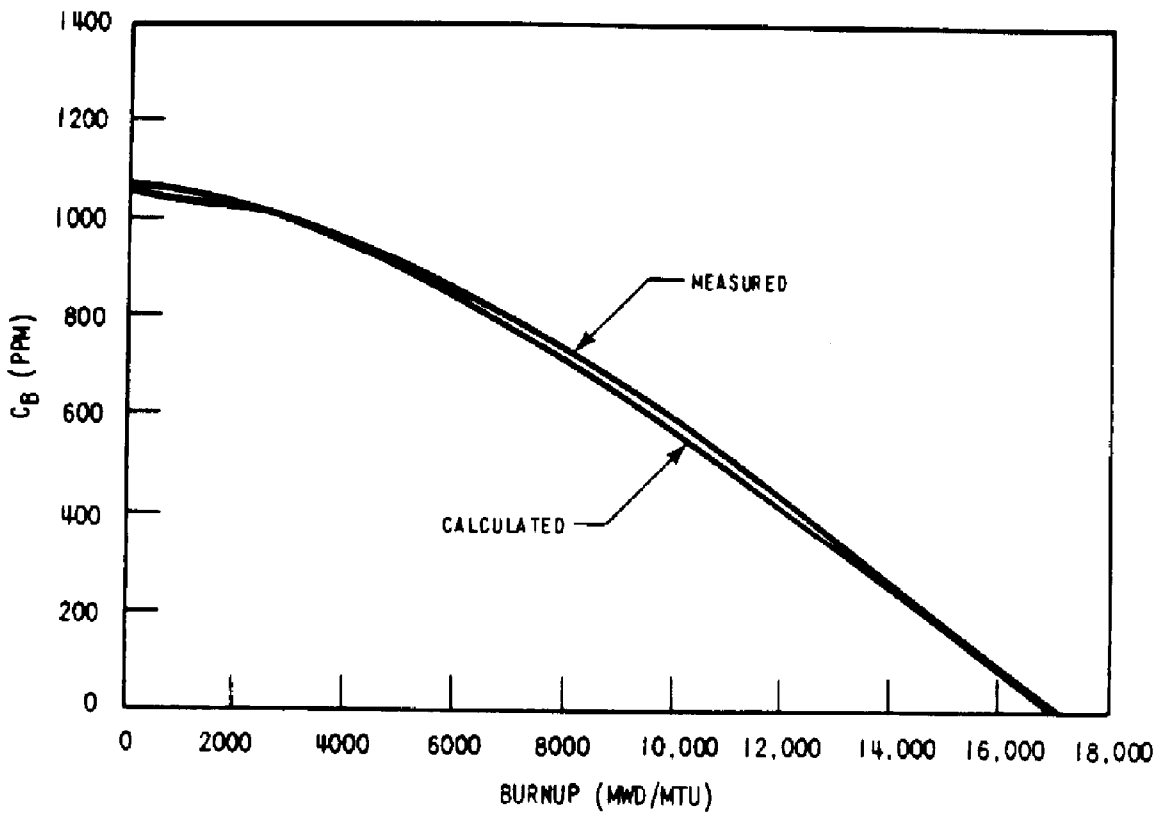


Figure 4-62. Comparison of Calculated and Measured CB 3-Loop Plant with 157 Assemblies, 12-Foot Core

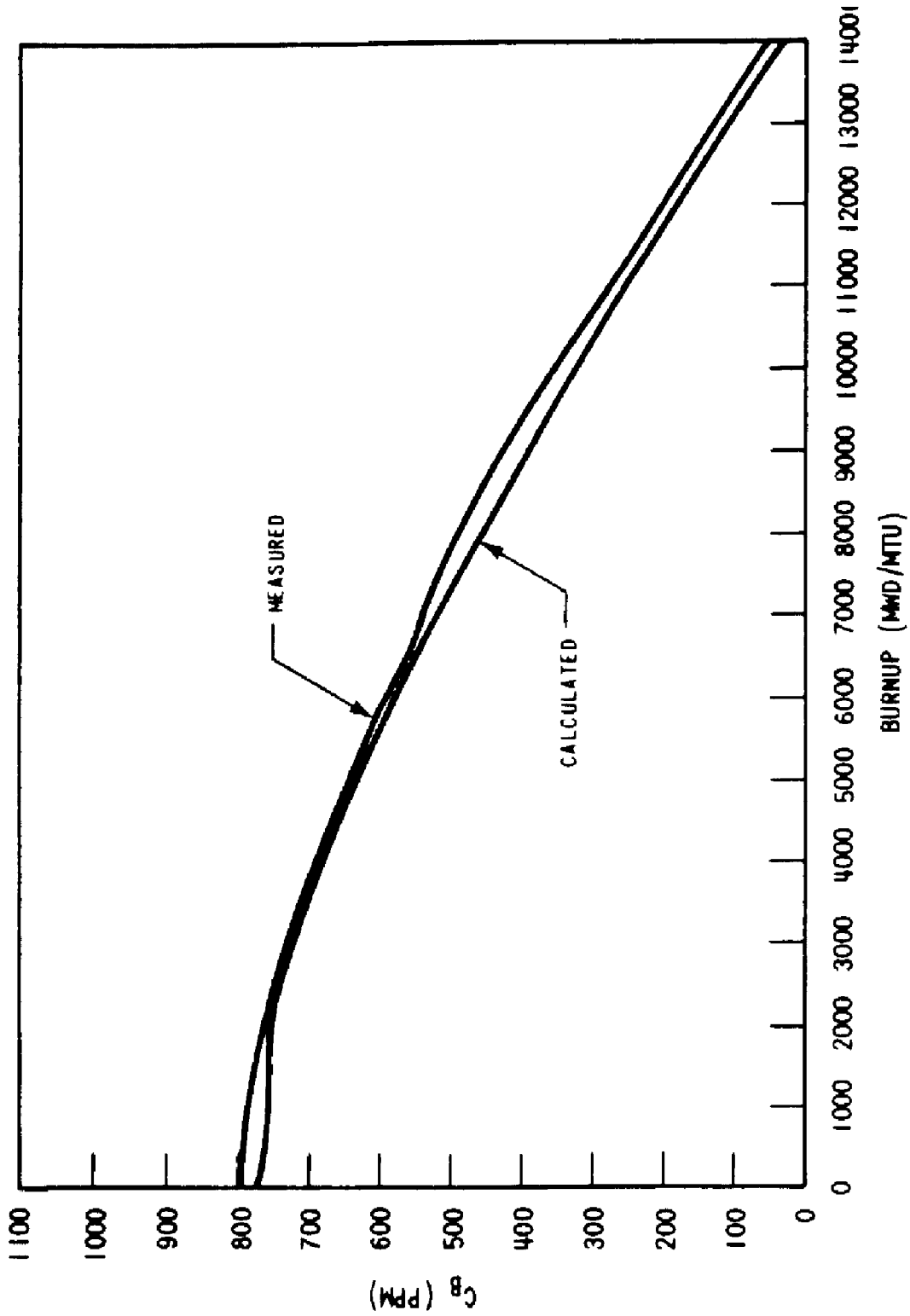


Figure 4-63. Comparison of Calculated and Measured CB 4-Loop Plant, 193 Assemblies, 12-Foot Core

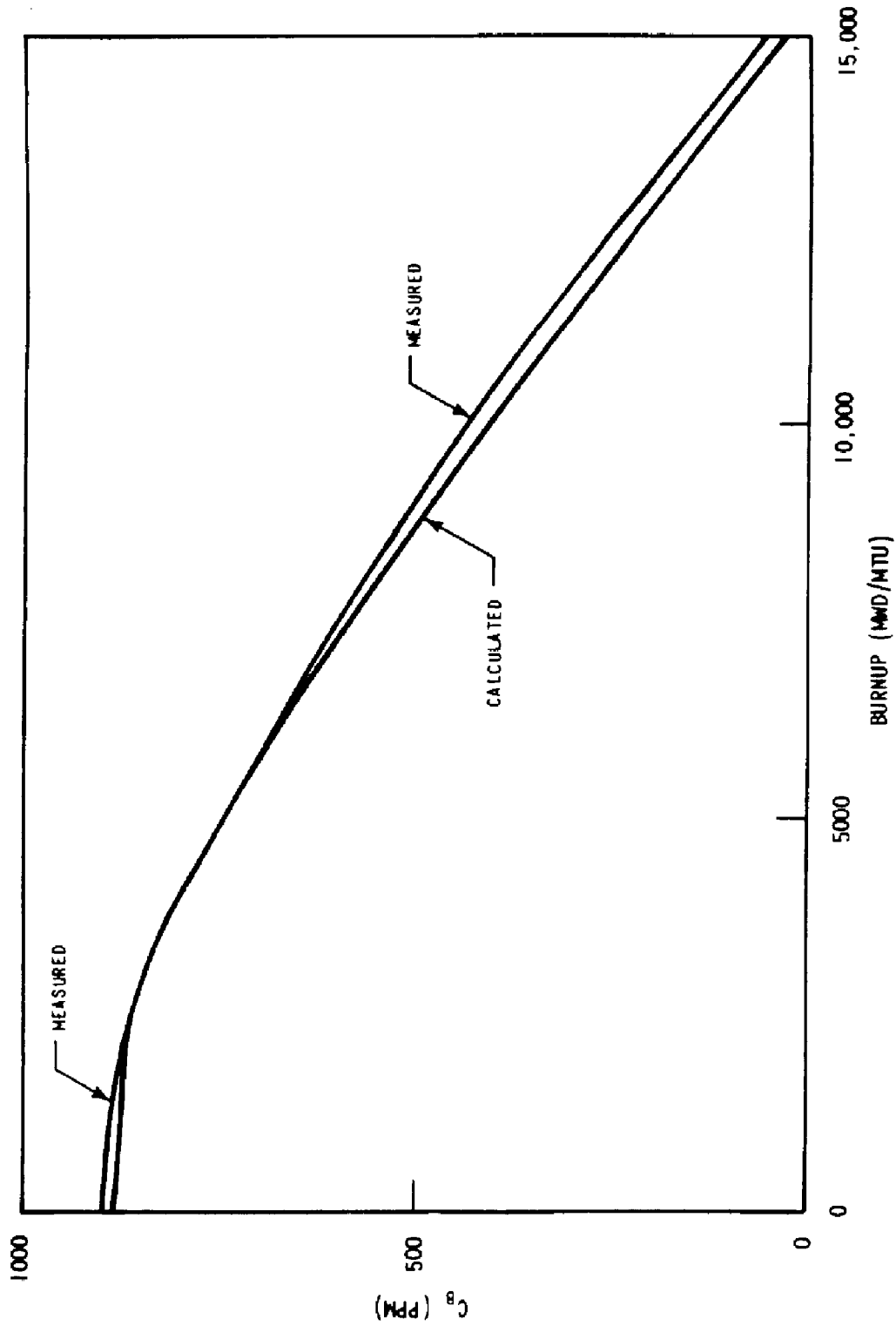


Figure 4-64. Deleted Per 1997 Update

Figure 4-65. Measured Versus Predicted Critical Heat Flux - BWCMV

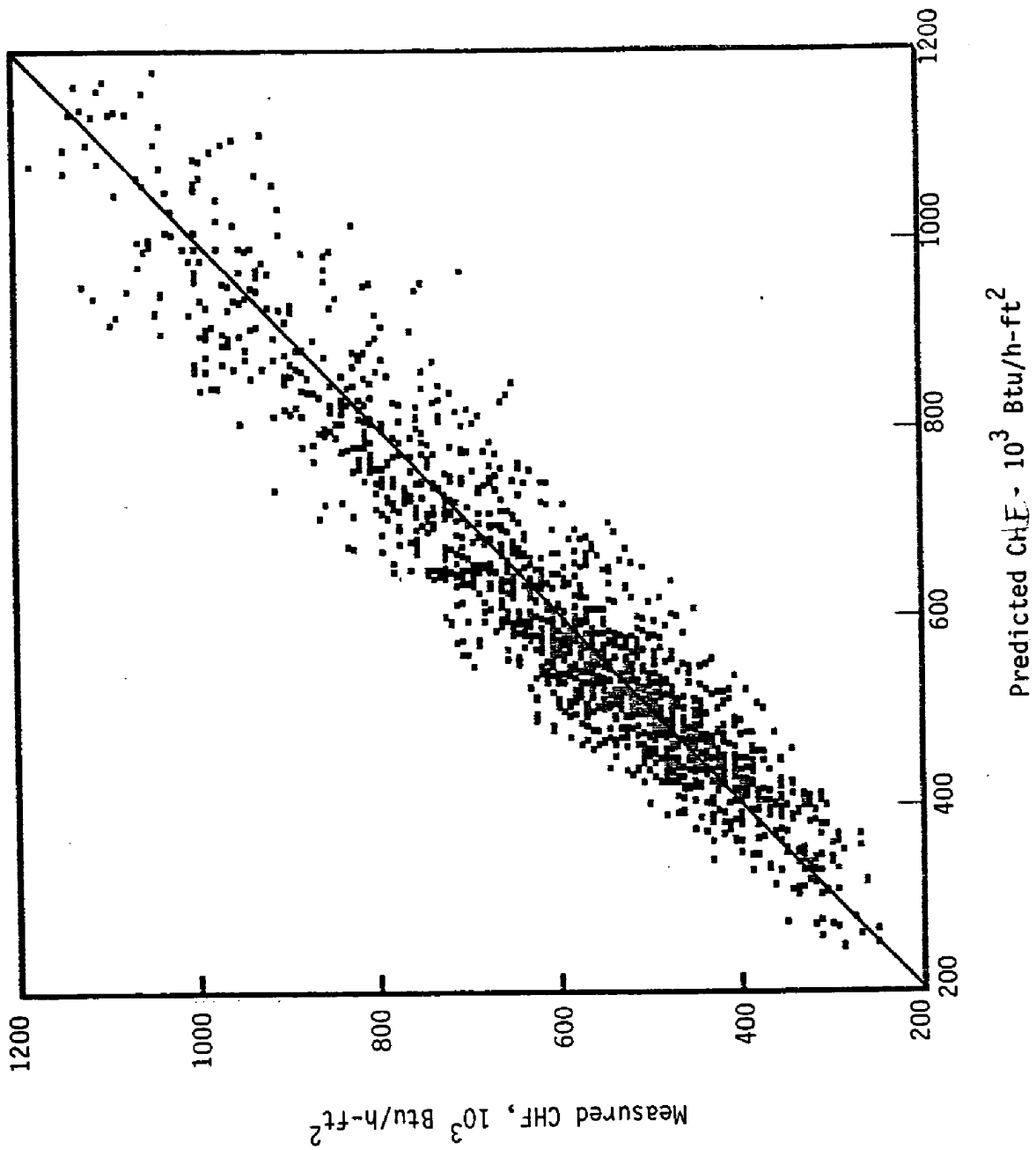


Figure 4-66. TDC Versus Reynolds Number for 26-inch Grid Spacing

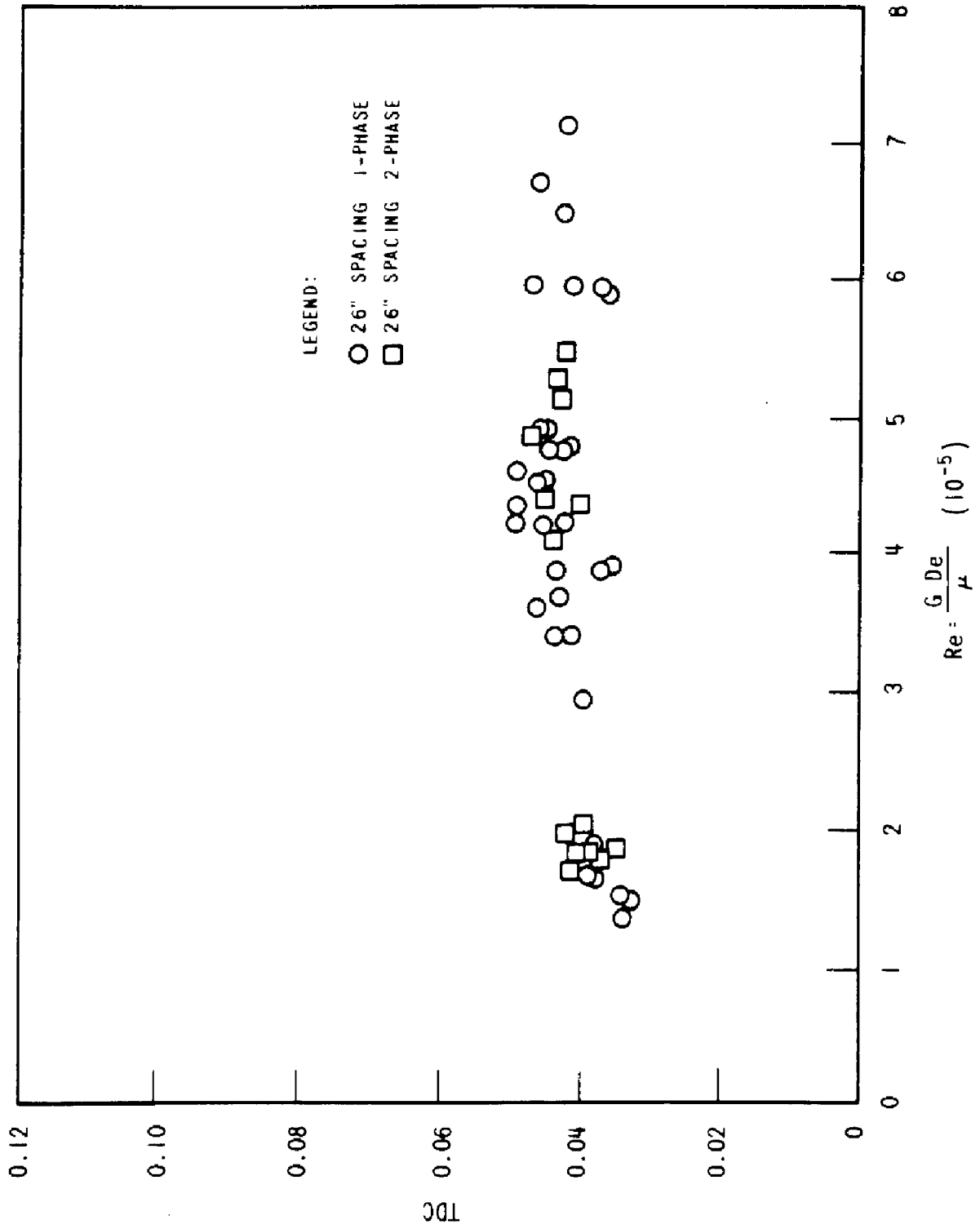


Figure 4-67. Deleted Per 2001 Update

Figure 4-68. Deleted Per 2001 Update

Figure 4-69. Deleted Per 2001 Update

Figure 4-70. Void Fraction Versus Thermodynamic Quality $H-H_{sat}/H_g-H_{sat}$

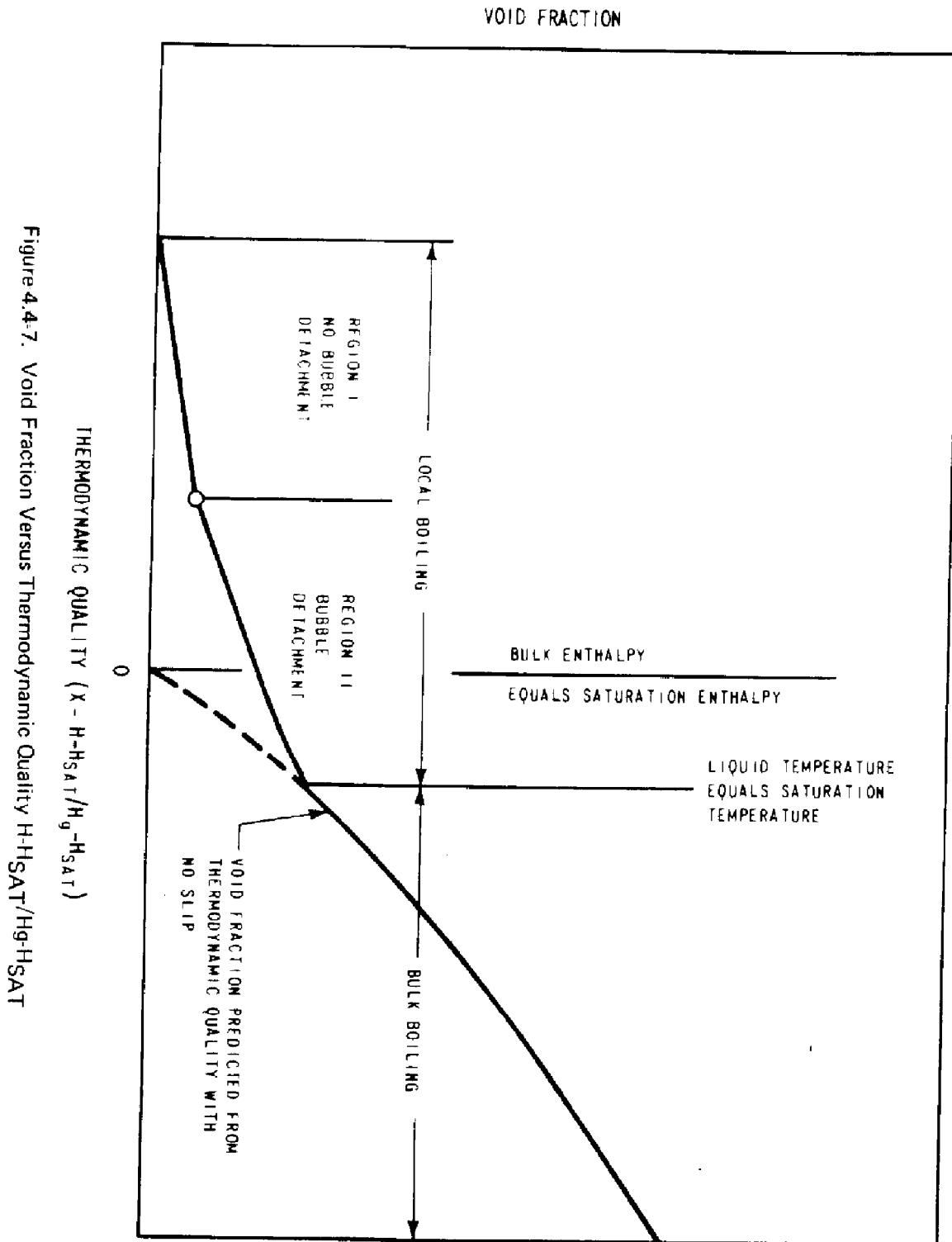


Figure 4.4-7. Void Fraction Versus Thermodynamic Quality $H-H_{SAT}/H_g-H_{SAT}$

Figure 4-71. Deleted Per 2001 Update

Figure 4-72. Deleted Per 1995 Update

Figure 4-73. Deleted per 1992 Update

Figure 4-75. Deleted Per 2016 Update

Figure 4-76. Unit 1 Reactor Coolant System Temperature - Percent Power Map

Refer to [4.4.3.4](#) for applicability.

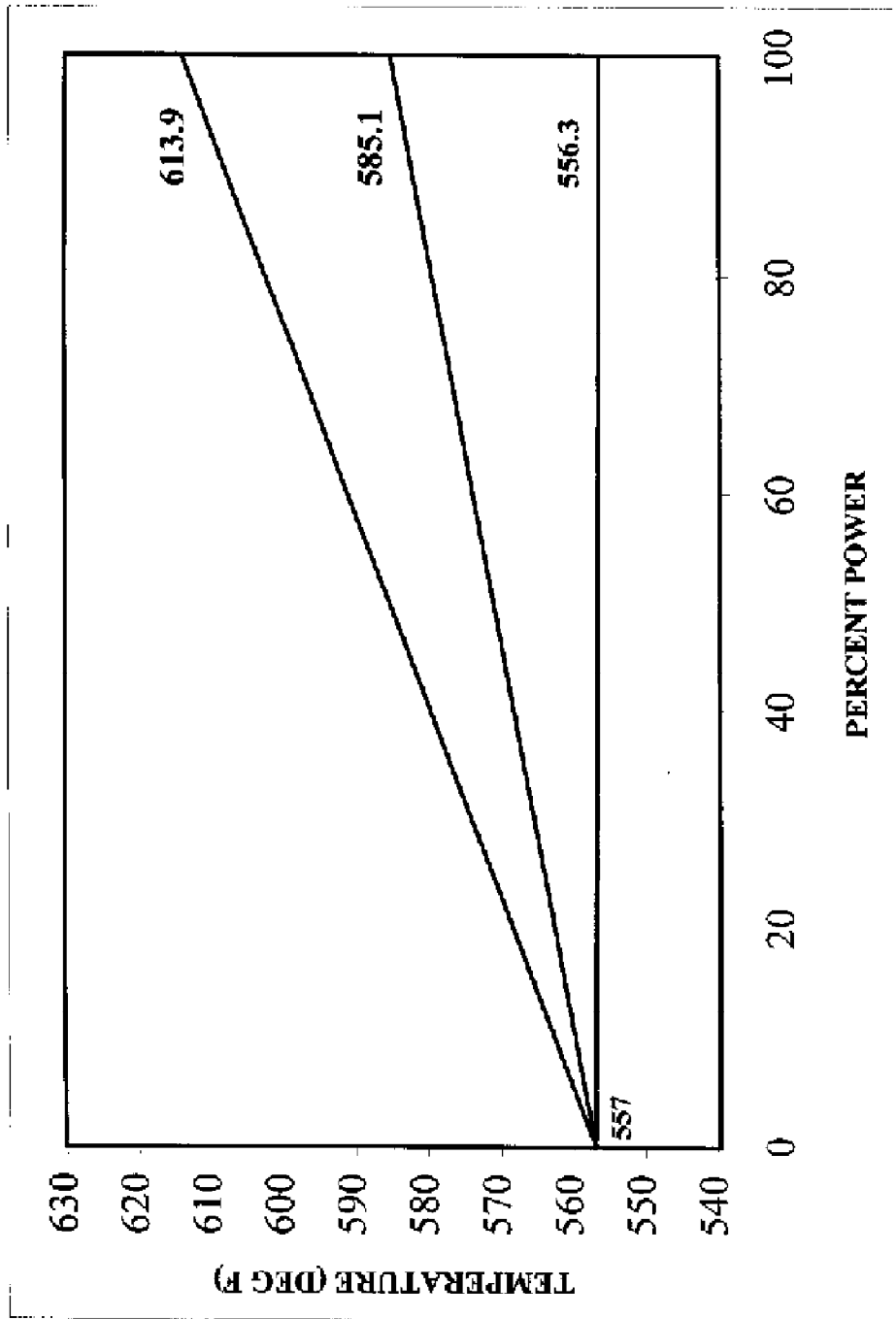


Figure 4-77. Unit 2 Reactor Coolant System Temperature - Percent Power Map

Refer to [4.4.3.4](#) for applicability.

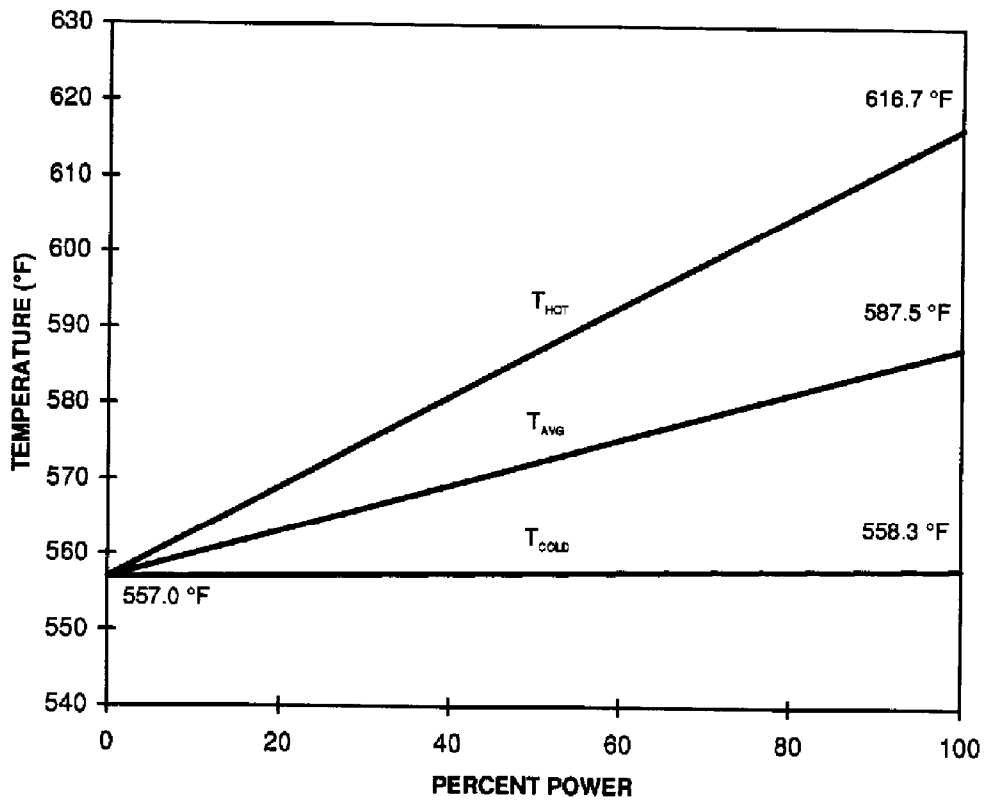


Figure 4-79. Typical Burnable Poison Rod (BWFC) Cross Section

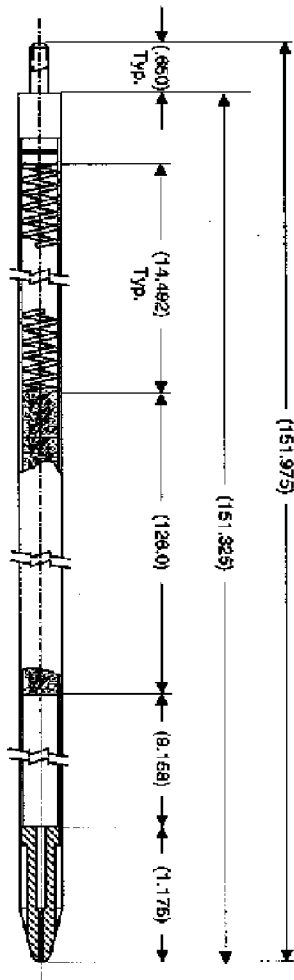
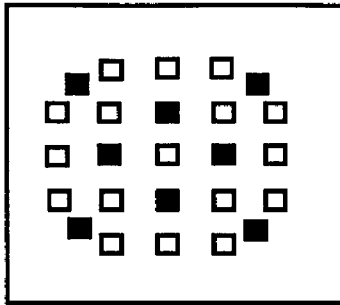
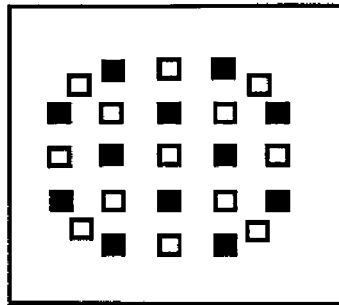


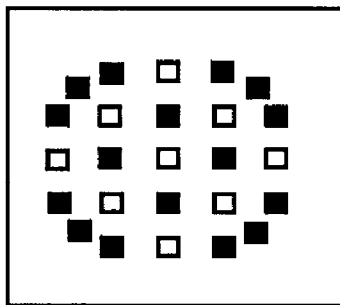
Figure 4-80. Typical Burnable Poison Arrangement within An Assembly Burnable Poison Rods



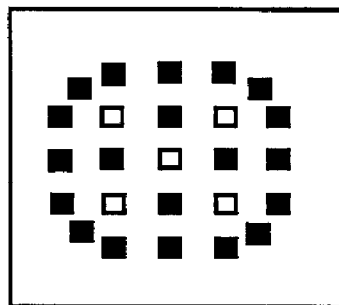
8 BP/Assembly Configuration



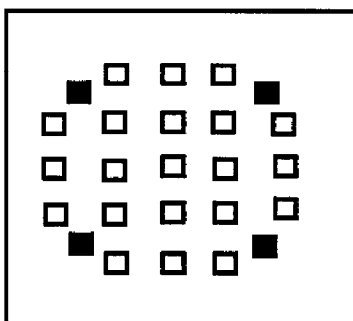
12 BP/Assembly Configuration



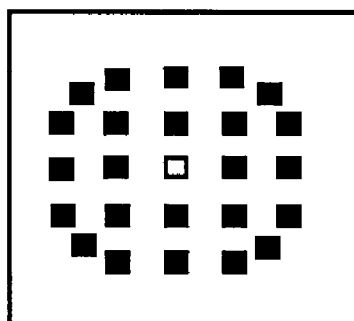
16 BP/Assembly Configuration



20 BP/Assembly Configuration



4 BP/Assembly Configuration



24 BP/Assembly Configuration

Figure 4-81. Typical Burnable Poison Arrangement within An Assembly IFBA Fuel Rods

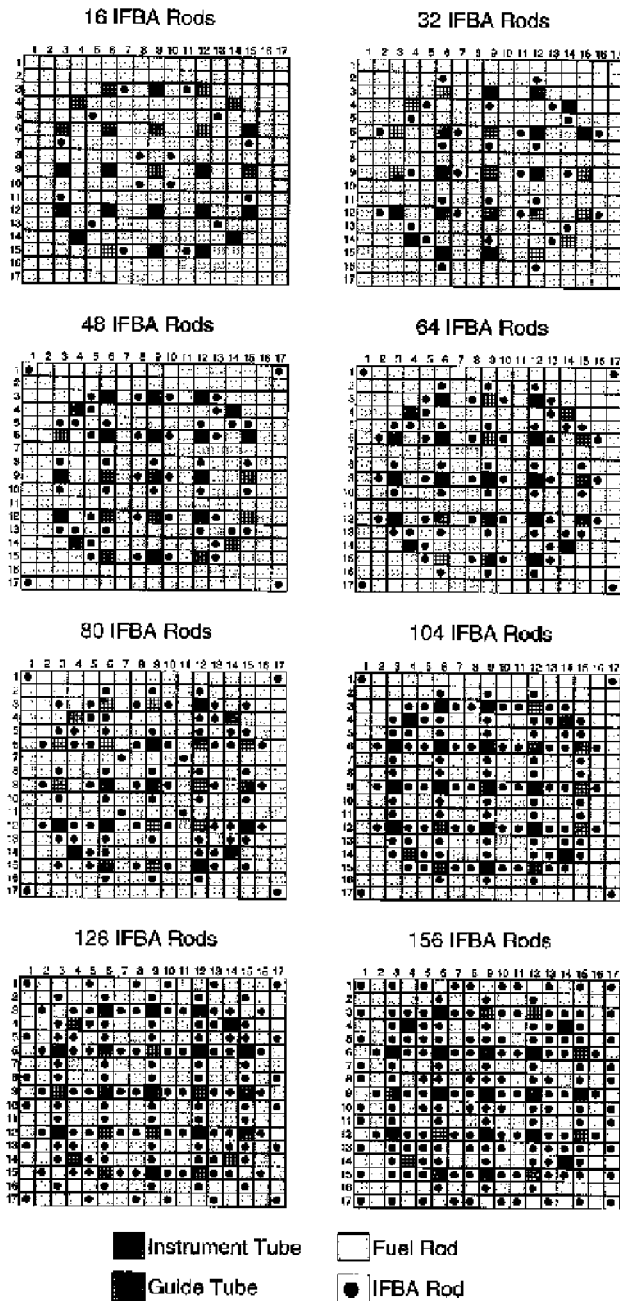


Figure 4-82. RFA 17 x 17 Fuel Assembly Cross Section

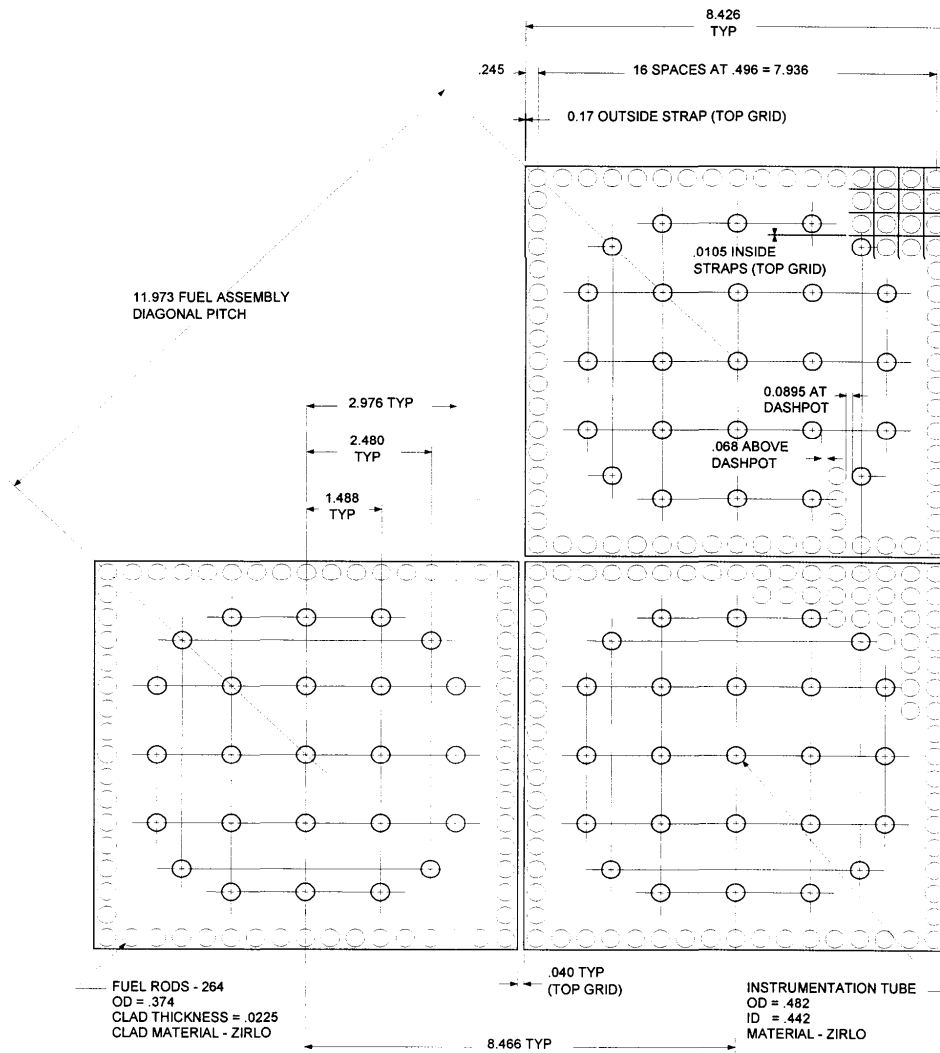


Figure 4-83. WABA Assembly Diagram

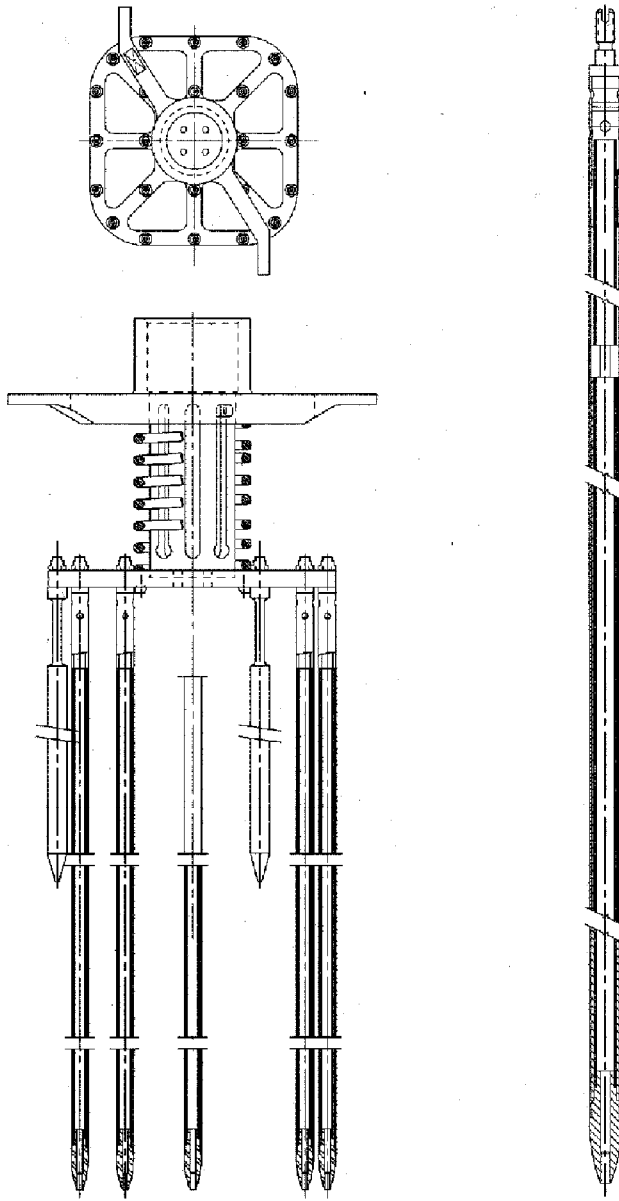


Figure 4-84. WABA Burnable Poison Rod Cross Section

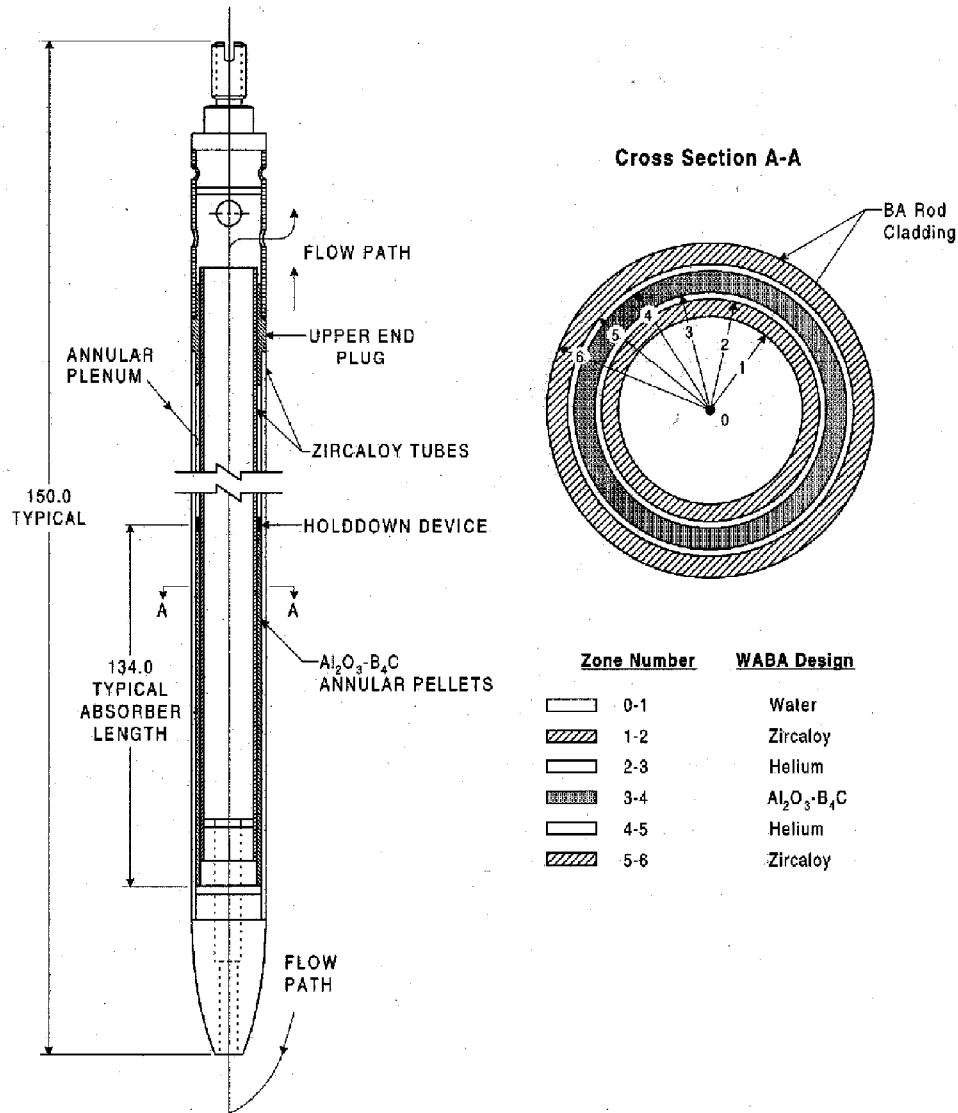


Figure 4-85. 17x17 Westinghouse Robust Fuel Assembly Outline

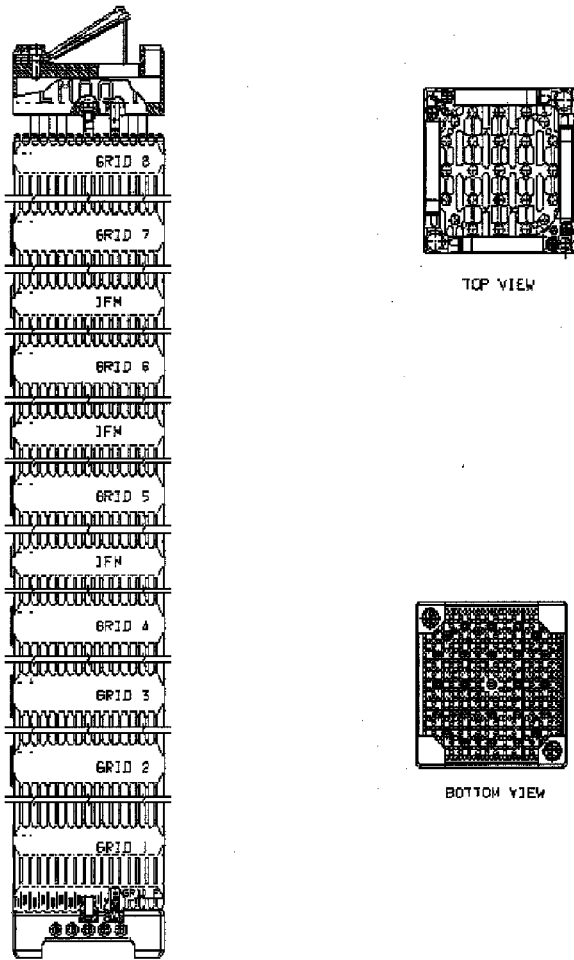


Figure 4-86. Westinghouse Robust Fuel Rod Assembly

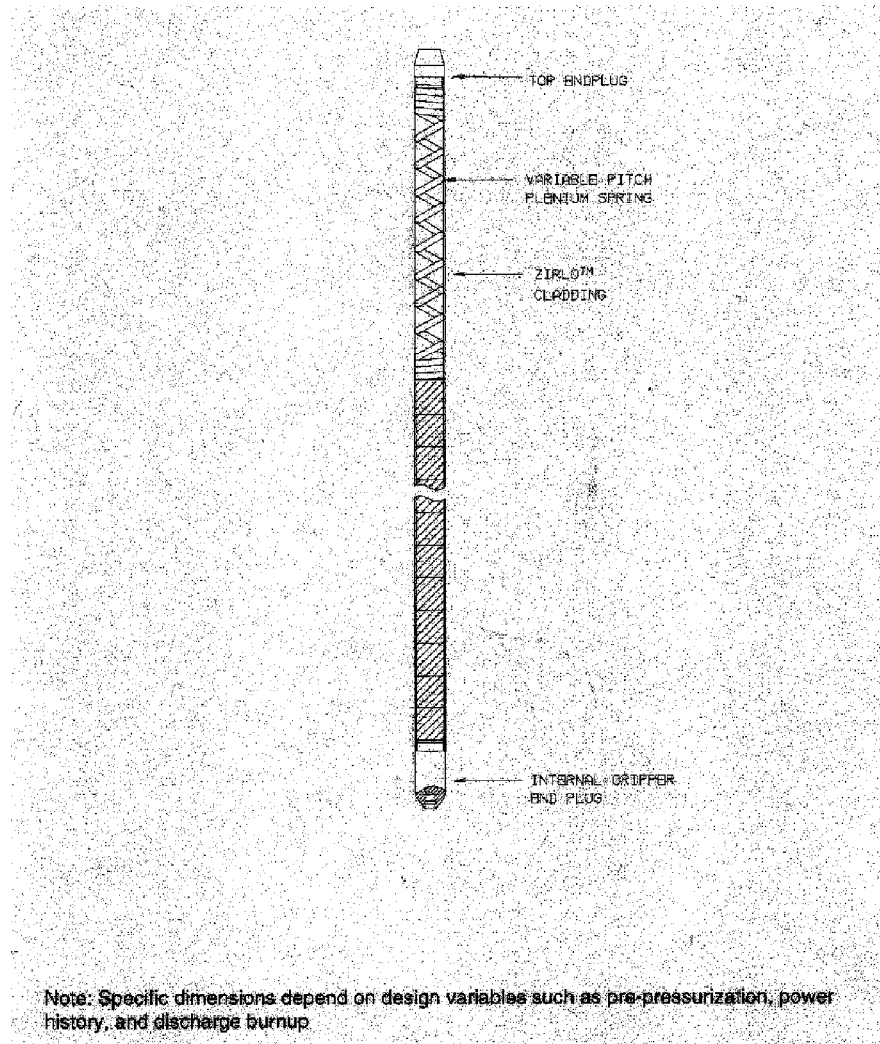


Figure 4-87. Hybrid B₄C Absorber Rod (BWFC Demo)

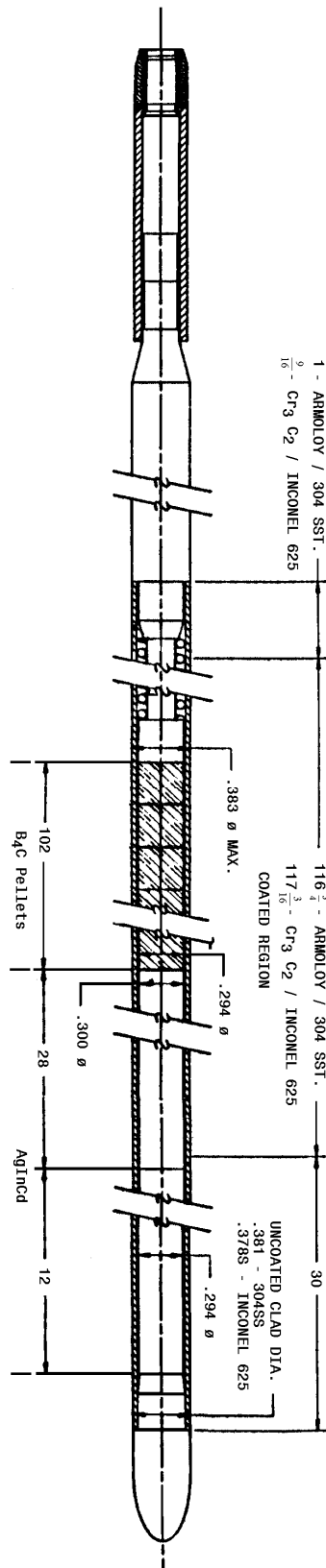


Figure 4-88 Typical 17 x 17 Mark BW/MOX1 Fuel Assembly Configuration

