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CLASS I
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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL FOR BRUNSWICK STEAM ELECTRIC PLANT UNIT 1, RELOAD 4 (WITHOUT RECIRCULATION PUMP TRIP)

GENERAL ELECTRIC

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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL

FOR

BRUNSWICK STEAM ELECTRIC PLANT
UNIT 1, RELOAD 4
(WITHOUT RECIRCULATION PUMP TRIP)

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GENERAL ELECTRIC

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CONTENTS OF THIS REPORT

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1. PLANT UNIQUE ITEM (1.0)*

Transient Analysis Assumptions: Appendix A

Fuel Mechanical Design Methods: Appendix A

2. RELOAD FUEL BUNDLES (1.0, 2.0, 3.3.1 AND 4.0)

Fuel Type	Cycle Loaded	Number	Number Drilled
Irradiated			
8DRB265L	2	20	20
8DRB283	2	20	20
P8DRB265H	3	16	16
P8DRB285	3	140	140
P8DRB265H	4	72	72
P8DRB284H	4	72	72
P8DRB299	4	36	36
New			
BP8DRB299	5	184	184
Total		560	560

* ( ) Refers to area of discussion in "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-6, dated April 1983. A letter "S" preceding the number refers to the appropriate country-specific supplement.

3. REFERENCE CORE LOADING PATTERN (3.3.1)

Nominal previous cycle core average exposure at end of cycle:	17,518 MWd/ST
Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations:	17,118 MWd/ST
Assumed reload cycle core average exposure at end of cycle:	16,764 MWd/ST
Core loading pattern:	Figure 1

4. CALCULATED CORE EFFECTIVE MULTIPLICATION AND CONTROL SYSTEM WORTH - NO VOIDS, 20°C (3.3.2.1.1 AND 3.3.2.1.2)

Beginning of Cycle, k_{eff}	
Uncontrolled	1.110
Fully Controlled	0.957
Strongest Control Rod Out	0.983
R, Maximum Increase in Cold Core Reactivity with Exposure into Cycle, Δk	0.000

5. STANDBY LIQUID CONTROL SYSTEM SHUTDOWN CAPABILITY (3.3.2.1.3)

ppm	Shutdown Margin (Δk) (20°C, Xenon Free)
600	0.033

6. RELOAD-UNIQUE TRANSIENT ANALYSIS INPUT (3.3.2.1.5 AND S.2.2)

	EOC 5-2000 MWd/ST	EOC 5
Void Fraction (%)	41.3	41.3
Average Fuel Temperature (°F)	1279	1279
Void Coefficient N/A* (¢/% Rg)	-8.45/-10.57	-8.43/-10.54
Doppler Coefficient N/A (¢/°F)	-0.211/-0.200	-0.221/-0.210
Scram Worth N/A* ($)	**	**

7. RELOAD UNIQUE GETAB TRANSIENT ANALYSIS INITIAL CONDITION PARAMETERS (S.2.2)

Fuel Design	Peaking Factors Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
Exposure: BOC 5 to EOC 5-2000 MWd/ST							
BP/P8x8R	1.20	1.52	1.40	1.051	6.488	110.9	1.24
8x8R	1.20	1.52	1.40	1.051	6.470	109.9	1.24
Exposure: EOC 5-2000 MWd/ST to EOC 5							
BP/P8x8R	1.20	1.43	1.40	1.051	6.083	113.9	1.33
8x8R	1.20	1.46	1.40	1.051	6.198	111.9	1.30

8. SELECTED MARGIN IMPROVEMENT OPTIONS (S.2.2.2)

Transient Recategorization: No
Recirculation Pump Trip: No
Rod Withdrawal Limiter: No
Thermal Power Monitor: Yes
Measured Scram Time: No
Exposure Points Analyzed: 2

*N = Nuclear Input Data, A = Used in Transient Analysis

**Generic exposure independent values are used as given in "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-6, dated April 1983.

9. OPERATING FLEXIBILITY OPTIONS (S.2.2.3)

Single-Loop Operation:	No
Load Line Limit:	No
Extended Load Line Limit:	No
Increased Core Flow:	No
Flow Point Analyzed:	N/A
Feedwater Temperature Reduction:	No

10. CORE-WIDE TRANSIENT ANALYSIS RESULTS (S.2.2.1)

Exposure Range: BOC 5 to EOC 5-2000 MWd/ST

Transient	Flux (% NBR)	Q/A (% NBR)	ΔCPR BP/P8x8R	ΔCPR 8x8R	Figure
Load Rejection Without Bypass	365	119	0.15	0.13	2a
Loss of Feedwater Heater	127	125	0.17	0.17	3
Feedwater Controller Failure	223	116	0.09	0.09	4a

Exposure Range: EOC 5-2000 MWd/ST to EOC 5

Transient	Flux (% NBR)	Q/A (% NBR)	ΔCPR BP/P8x8R	ΔCPR 8x8R	Figure
Load Rejection Without Bypass	526	127	0.26	0.23	2b
Loss of Feedwater Heater	127	125	0.17	0.17	3
Feedwater Controller Failure	350	125	0.21	0.19	4b

11. LOCAL ROD WITHDRAWAL ERROR (WITH LIMITING INSTRUMENT FAILURE) TRANSIENT SUMMARY (S.2.2.1)

Limiting Rod Pattern: Figure 5

Includes 2.2% Power Spiking Penalty: Yes

Rod Block Reading	Rod Position (feet withdrawn)	ΔCPR BP/P8x8R	ΔCPR 8x8R	MLHGR (kW/ft) BP/P8x8R and 8x8R
104	3.5	0.12	0.12	17.8
105	4.0	0.13	0.13	18.4
106	4.0	0.13	0.13	18.4
107	4.5	0.15	0.15	18.6
108	5.0	0.16	0.16	18.6
109	6.0	0.19	0.19	18.6
110	10.0	0.23	0.23	18.6

Setpoint Selected: 107

12. CYCLE MCPR VALUES (S.2.2)

Non-Pressurization Events

Exposure Range: BOC to EOC

	BP/P8x8R	8x8R
Loss of Feedwater Heater	1.24	1.24
Fuel Loading Error	1.20	
Rod Withdrawal Error	1.22	1.22

Pressurization Events

	Option A		Option B	
	BP/P8x8R	8x8R	BP/P8x8R	8x8R
Exposure Range: BOC 5 to EOC 5-2000 MWd/ST				
Load Rejection Without Bypass	1.27	1.25	1.08	1.08
Feedwater Controller Failure	1.21	1.21	1.15	1.15
Exposure Range: EOC 5-2000 MWd/ST to EOC 5				
Load Rejection Without Bypass	1.39	1.36	1.27	1.24
Feedwater Controller Failure	1.34	1.32	1.27	1.25

13. OVERPRESSURIZATION ANALYSIS SUMMARY (S.2.3)

Transient	P_{sl} (psig)	P_v (psig)	Plant Response
MSIV Closure (Flux Scram)	1214	1248	Figure 6

14. STABILITY ANALYSIS RESULTS (S.2.4)

Rod Line Analyzed:	105%
Decay Ratio:	Figure 7
Reactor Core Stability Decay Ratio, x_2/x_0:	0.73
Channel Hydrodynamic Performance Decay Ratio, x_2/x_0:	
Channel Type	
BP/P8x8R and 8x8R	0.48

15. LOADING ERROR RESULTS (S.2.5.4)

Variable Water Gap Misoriented Bundle Analysis: Yes

Includes 2.2% Power Spiking Penalty: Yes

Event	Initial MCPR	Resulting MCPR
Misoriented	1.18	1.07

16. CONTROL ROD DROP ANALYSIS RESULTS (S.2.5.1)

Bounding Analysis Results:

Doppler Reactivity Coefficient:	Figure 8
Accident Reactivity Shape Functions:	Figures 9 and 10
Scram Reactivity Functions:	Figures 11 and 12

Plant Specific Analysis Results:

Parameter(s) not Bounded, Cold:	None
Resultant Peak Enthalpy, Cold:	N/A
Parameter(s) not Bounded, HSB:	Accident Reactivity
Resultant Peak Enthalpy, HSB:	220 cal/gm

17. LOSS-OF-COOLANT ACCIDENT RESULTS (S.2.5.2)

"Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 1," General Electric Company, November 1978, (NEDO-24165, as amended).

Fuel Type: BP8DRB299/P8DRB299

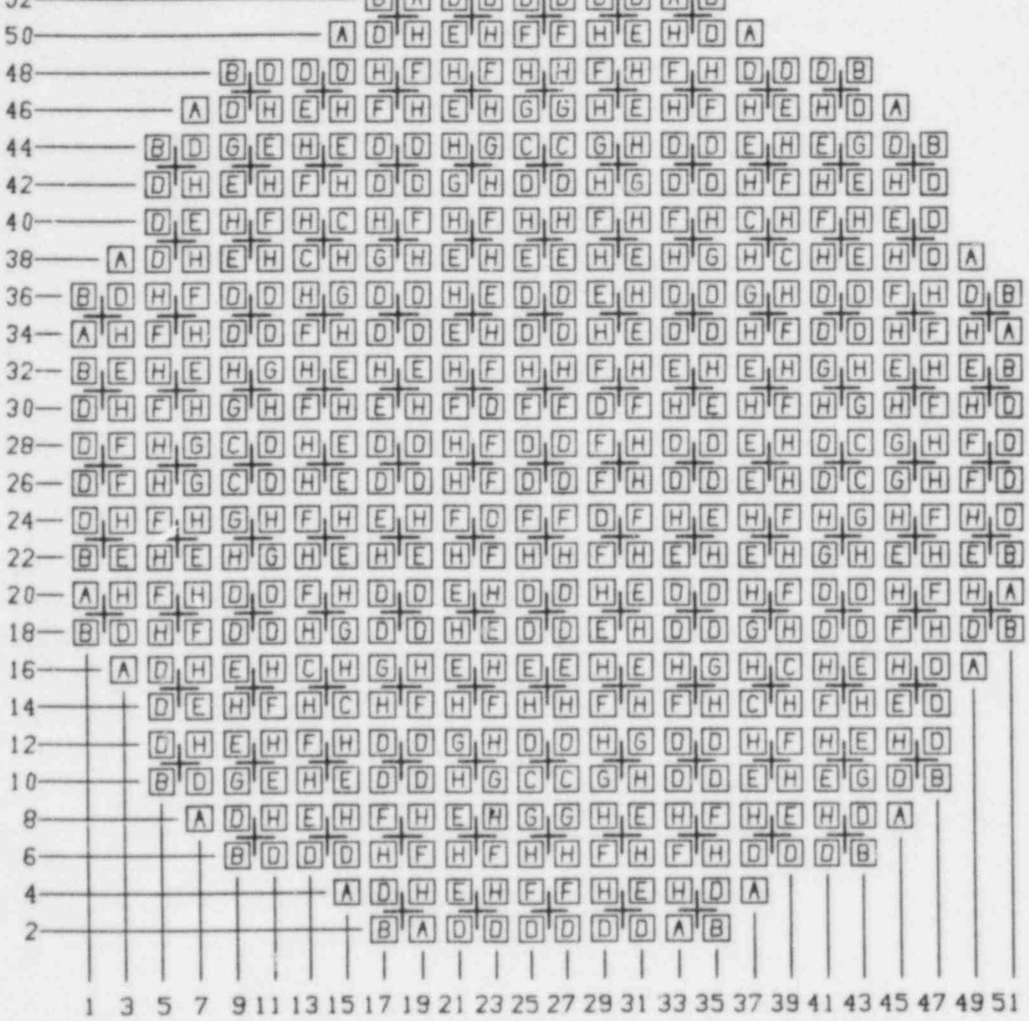
Exposure (MWd/ST)	MAPLHGR (kW/ft)	PCT (°F)	Local Oxidation (Fractions)
200	10.9	2029	0.019
1,000	11.0	2029	0.018
5,000	11.5	2071	0.021
10,000	12.2	2155	0.027
15,000	12.3	2178	0.029
20,000	12.1	2170	0.028
25,000	11.5	2104	0.023
30,000	11.0	2005	0.016
35,000	10.3	1900	0.011
40,000	9.7	1820	0.008
45,000	9.0	1745	0.006

Fuel Type: P8DRB285

Exposure (MWd/ST)	MAPLHGR (kW/ft)	PCT (°F)	Local Oxidation (Fractions)
200	10.9	2038	0.019
1,000	11.0	2048	0.020
5,000	11.8	2141	0.026
10,000	12.3	2177	0.029
15,000	12.2	2174	0.028
20,000	11.8	2131	0.025
25,000	11.0	2031	0.018
30,000	10.4	1928	0.012
35,000	9.8	1844	0.009
40,000	9.2	1761	0.007

Fuel Type: P8DRB265H

Exposure (MWd/ST)	MAPLHGR (kW/ft)	PCT (°F)	Local Oxidation (Fractions)
200	11.5	2103	0.024
1,000	11.6	2111	0.024
5,000	11.9	2135	0.025
10,000	12.1	2147	0.026
15,000	12.1	2157	0.027
20,000	11.9	2138	0.025
25,000	11.3	2063	0.020
30,000	10.7	1977	0.015
35,000	10.3	1891	0.011
40,000	9.6	1801	0.008



FUEL TYPE	
A = 8DRB265L B = 8DRB283 C = P8DRB265H D = P8DRB285	E = P8DRB265H F = P8DRB284H G = P8DRB299 H = BP8DRB299

Figure 1. Reference Core Loading Pattern

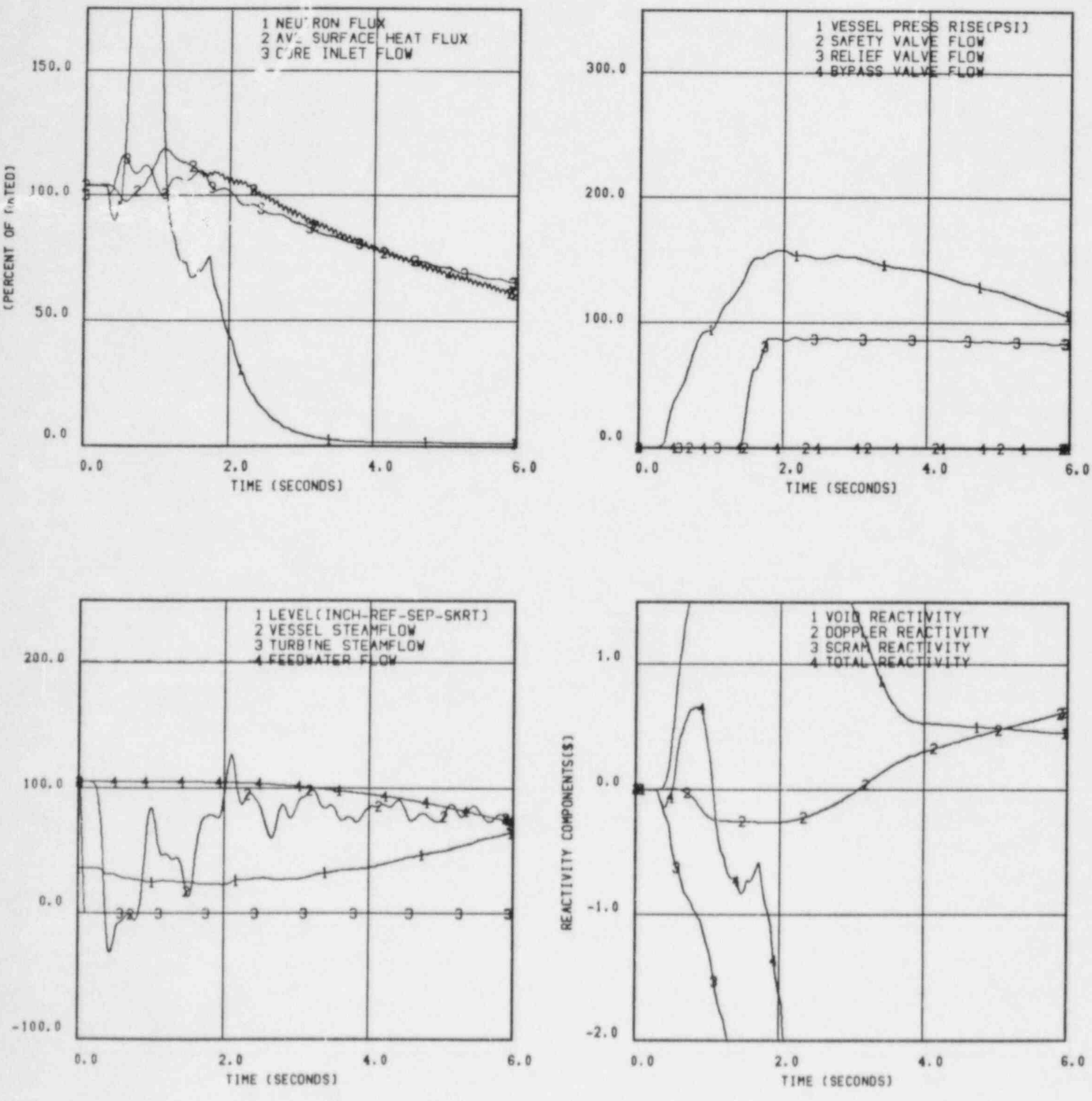


Figure 2a. Plant Response to Generator Load Rejection Without Bypass (EOC 5-2000 MWd/ST)

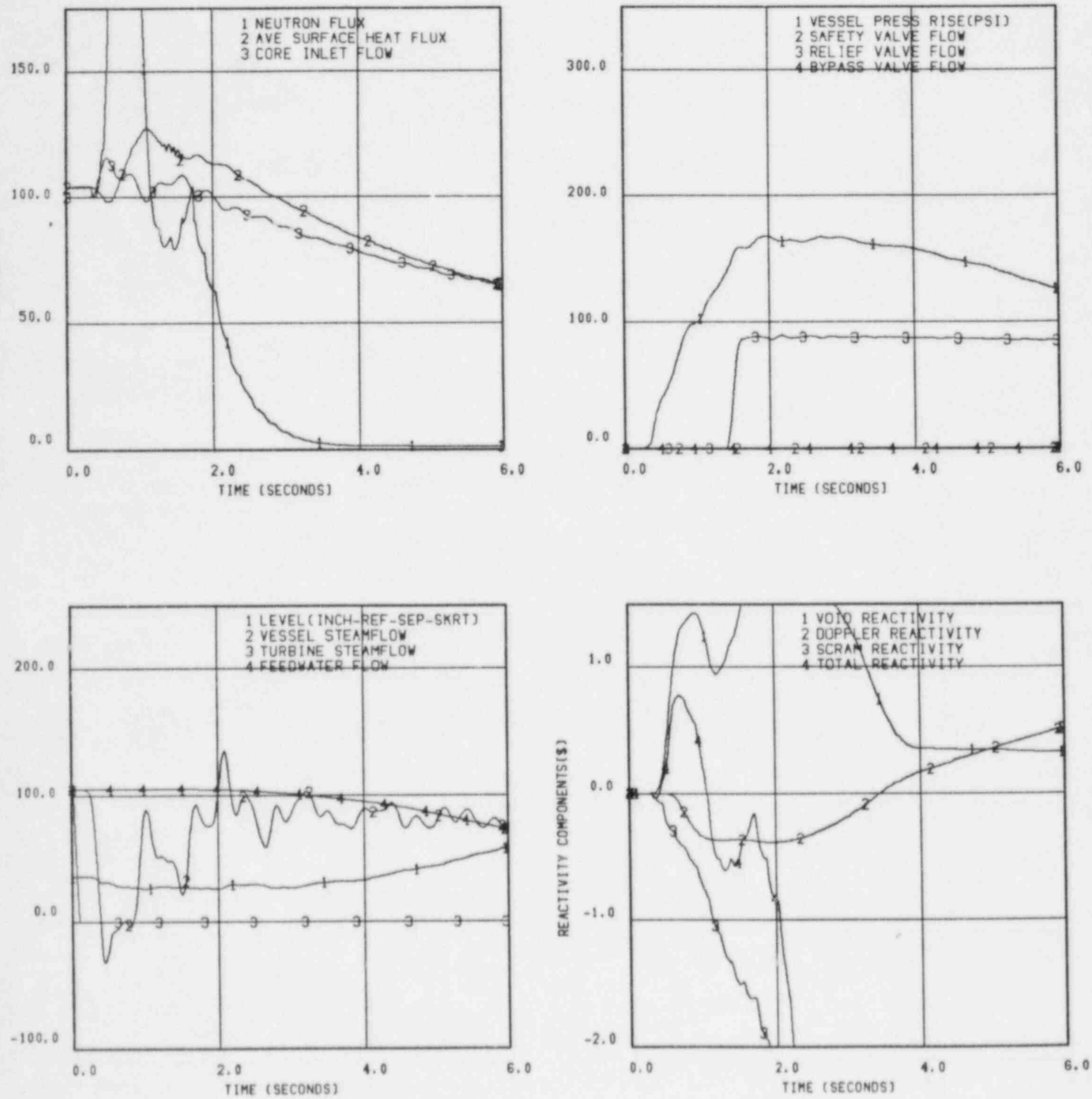


Figure 2b. Plant Response to Generator Load Rejection Without Bypass (EOC 5)

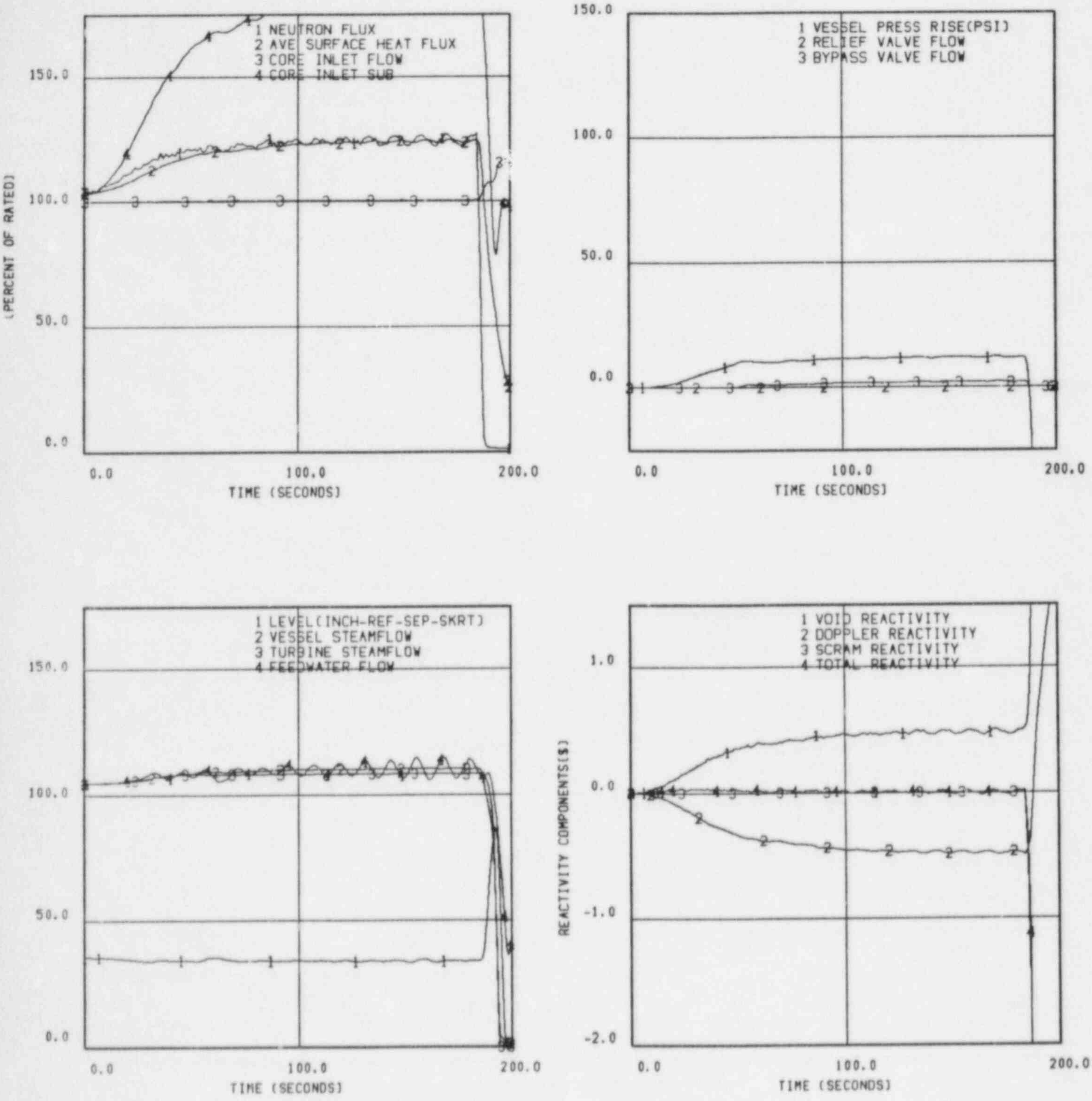


Figure 3. Plant Response to Loss of 100°F Feedwater Heating

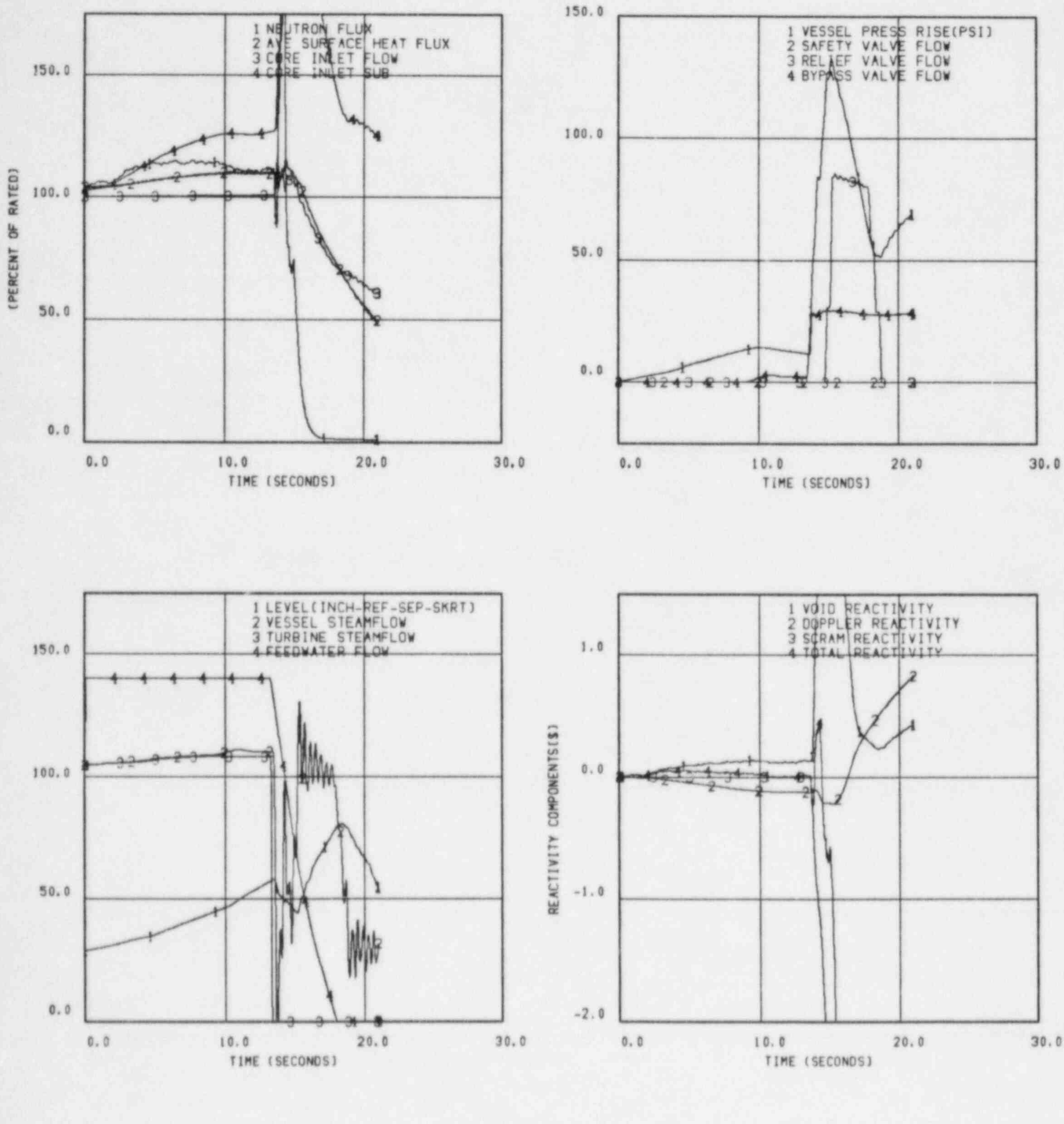


Figure 4a. Plant Response to Feedwater Controller Failure
(EOC 5-2000 MWd/ST)

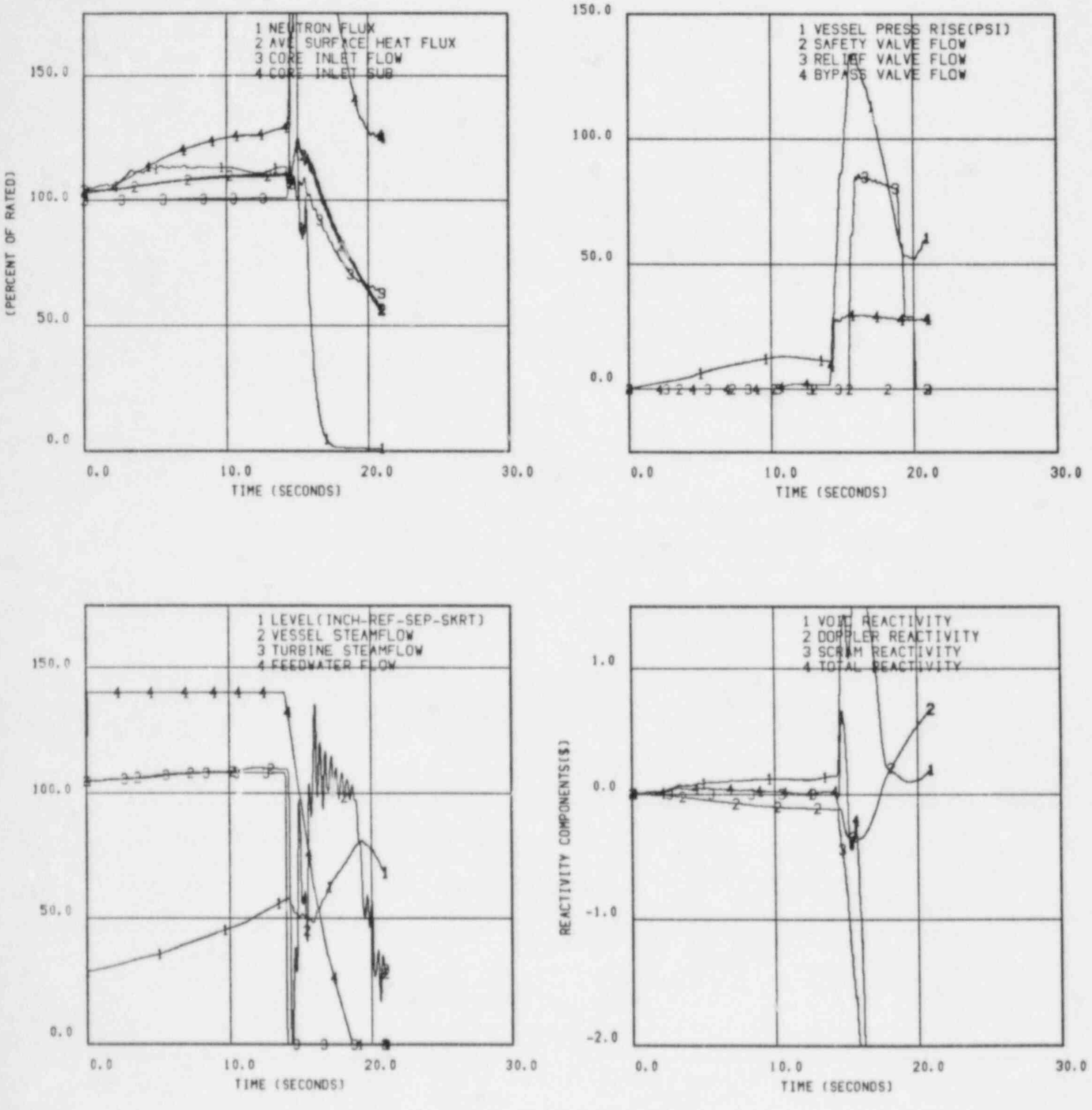


Figure 4b. Plant Response to Feedwater Controller Failure (EOC 5)

	2	6	10	14	18	22	26	30	34	38	42	46	50
51						16		16					
47			46								46		
43		16		12		6		6		12		16	
39													
35		12		6		20		20		6		12	
31							40						
27		6		20		0		0		20		6	
23							40						
19		12		6		20		20		6		12	
15													
11		16		12		6		6		12		16	
7			46								46		
3						16		16					

NOTES:
1. NUMBER INDICATES NUMBER OF NOTCHES WITHDRAWN OUT OF 48. BLANK IS A WITHDRAWN ROD.
2. ERROR ROD IS (22,27).

Figure 5. Limiting Rod Withdrawal Error Rod Pattern

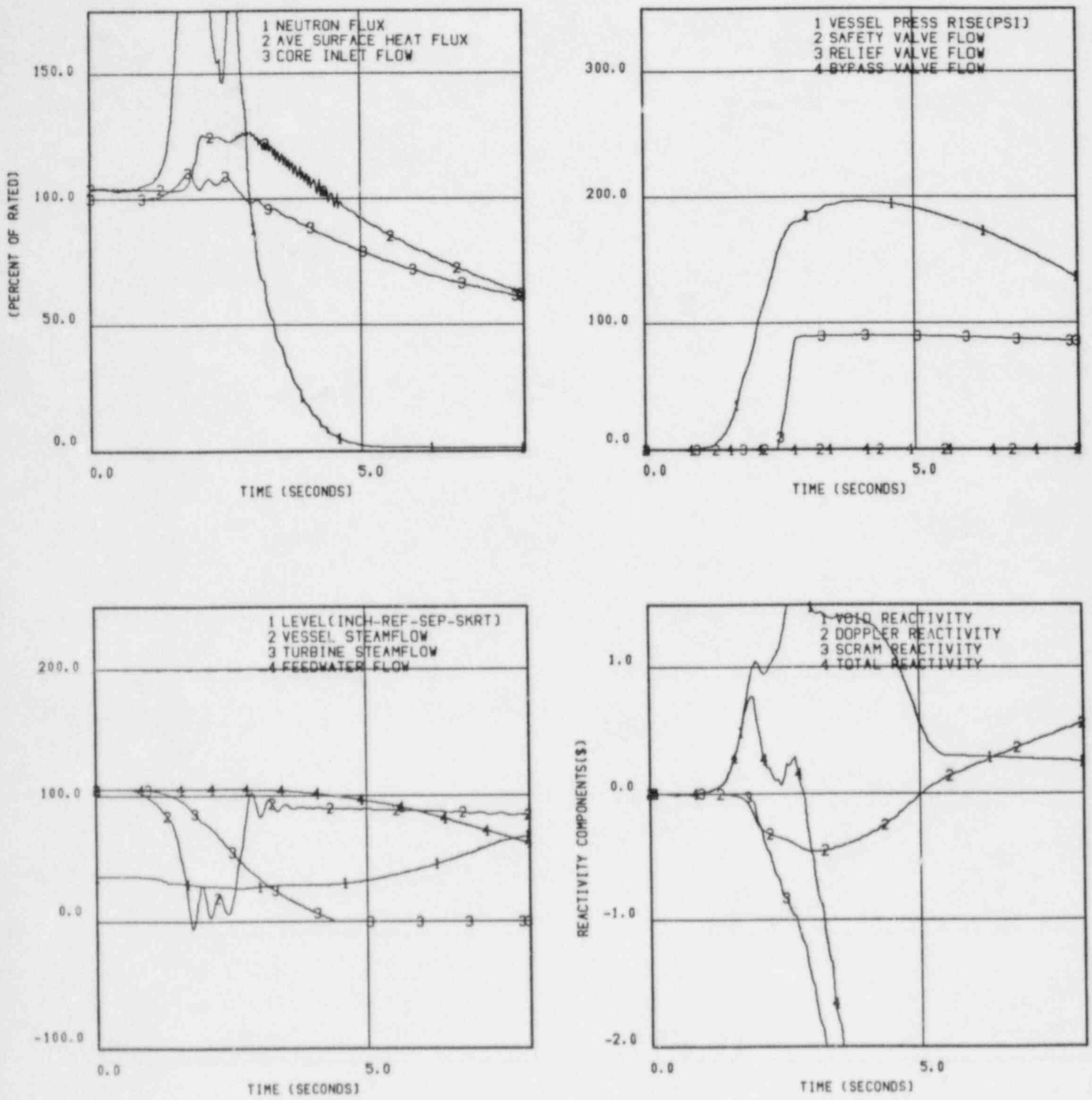


Figure 6. Plant Response to MSIV Closure (Flux Scram)

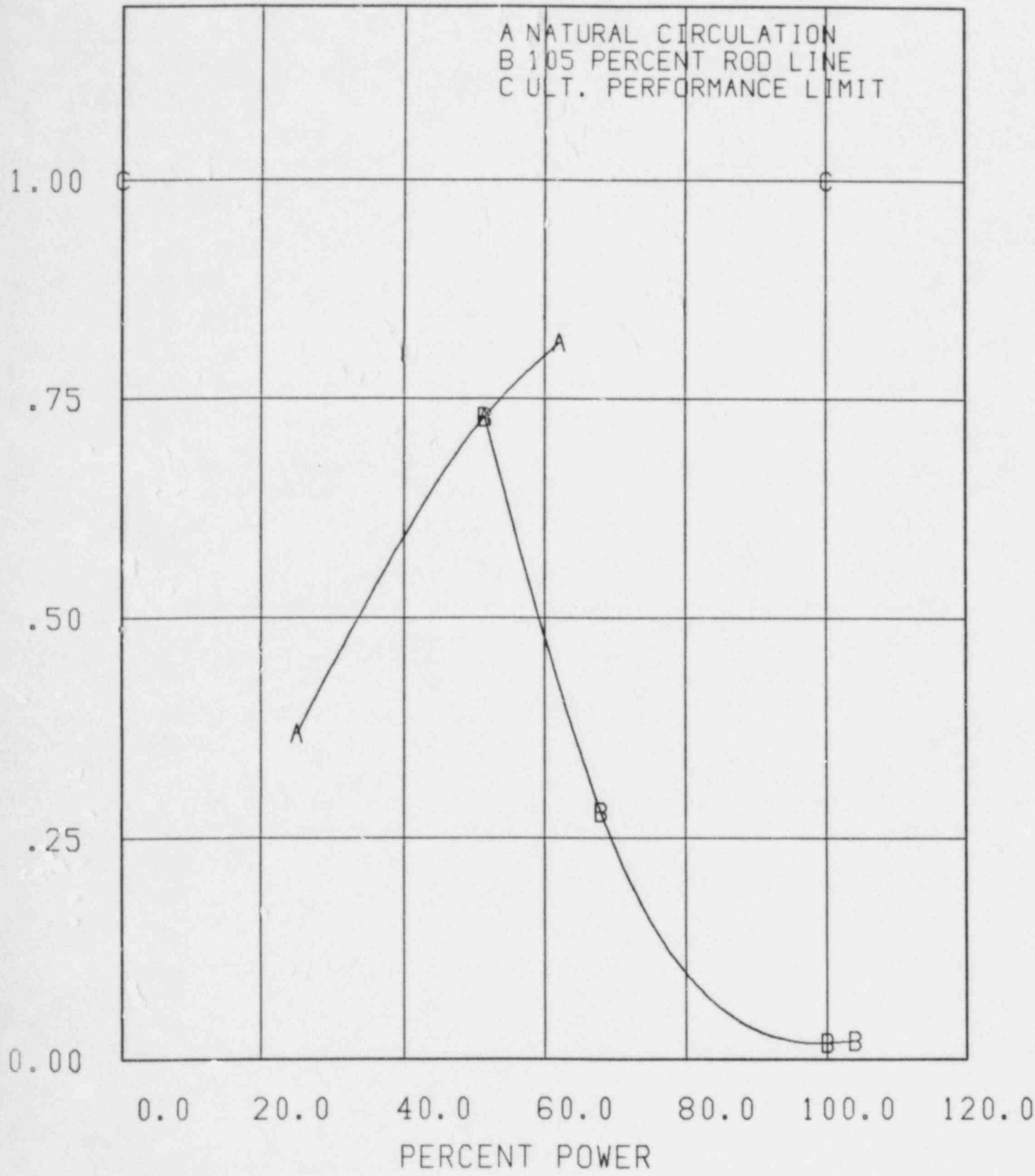


Figure 7. Reactor Core Decay Ratio

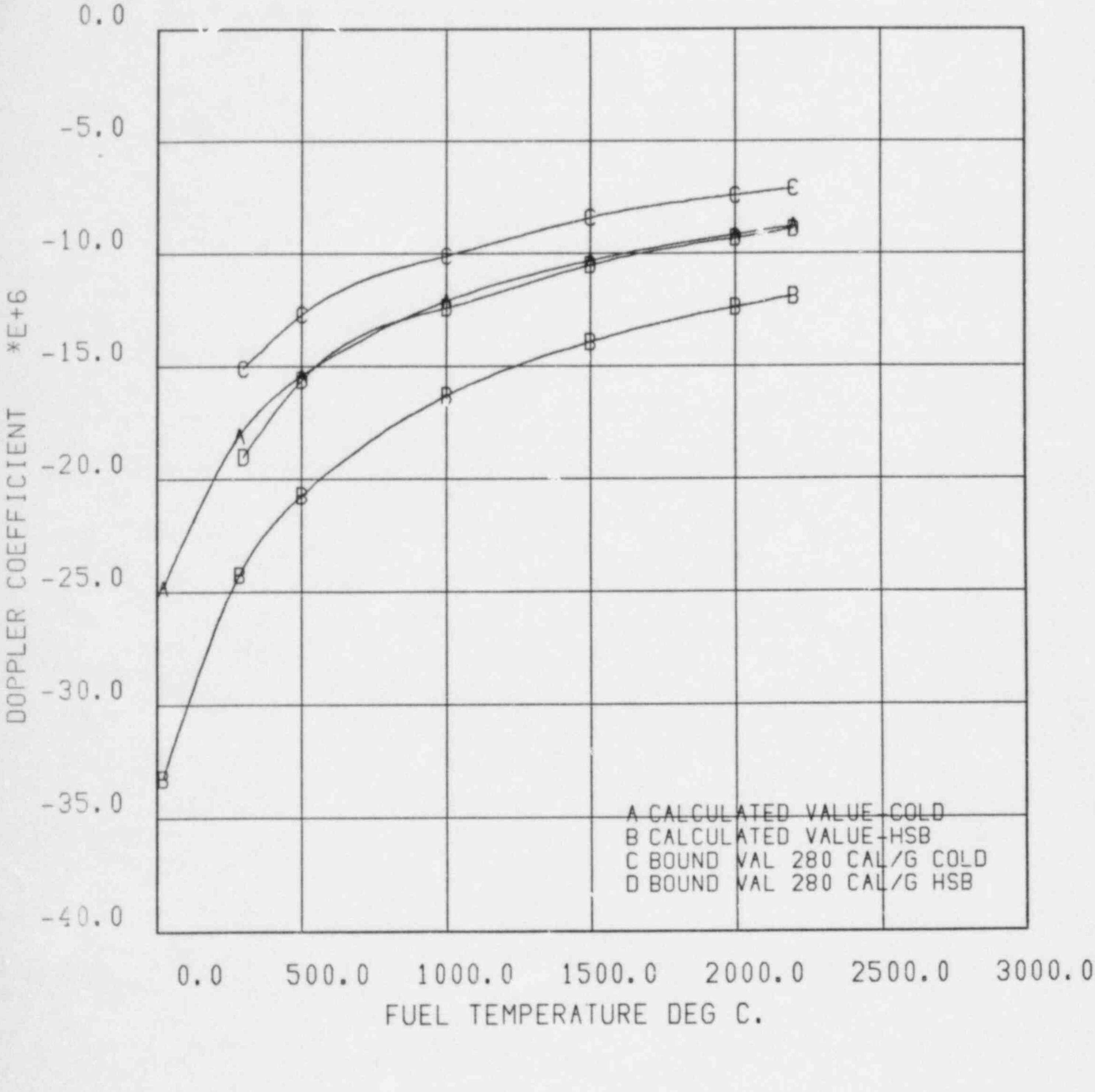


Figure 8. Fuel Doppler Coefficient in 1/ Δ°C

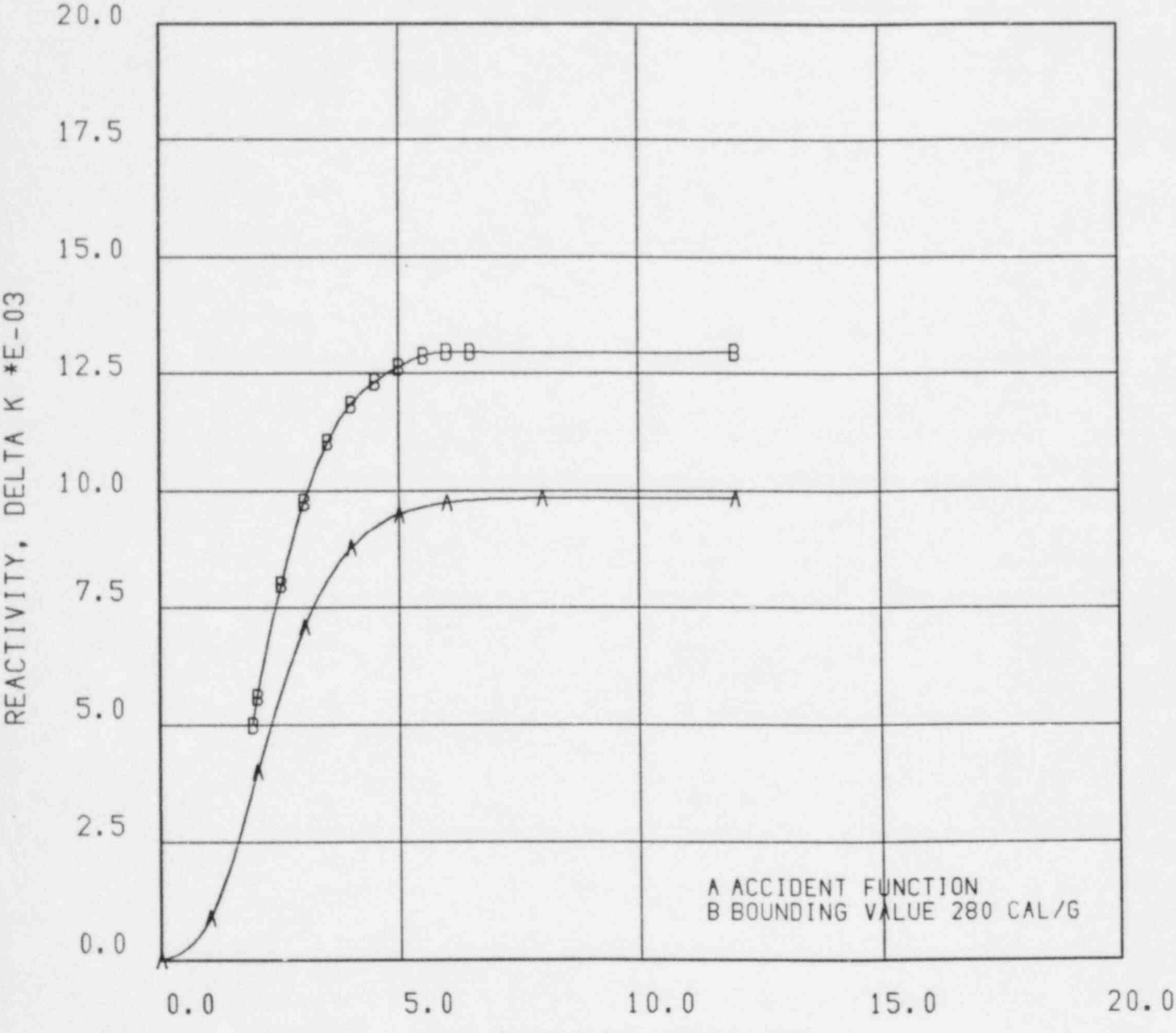


Figure 9. Accident Reactivity Shape Function, Cold Startup

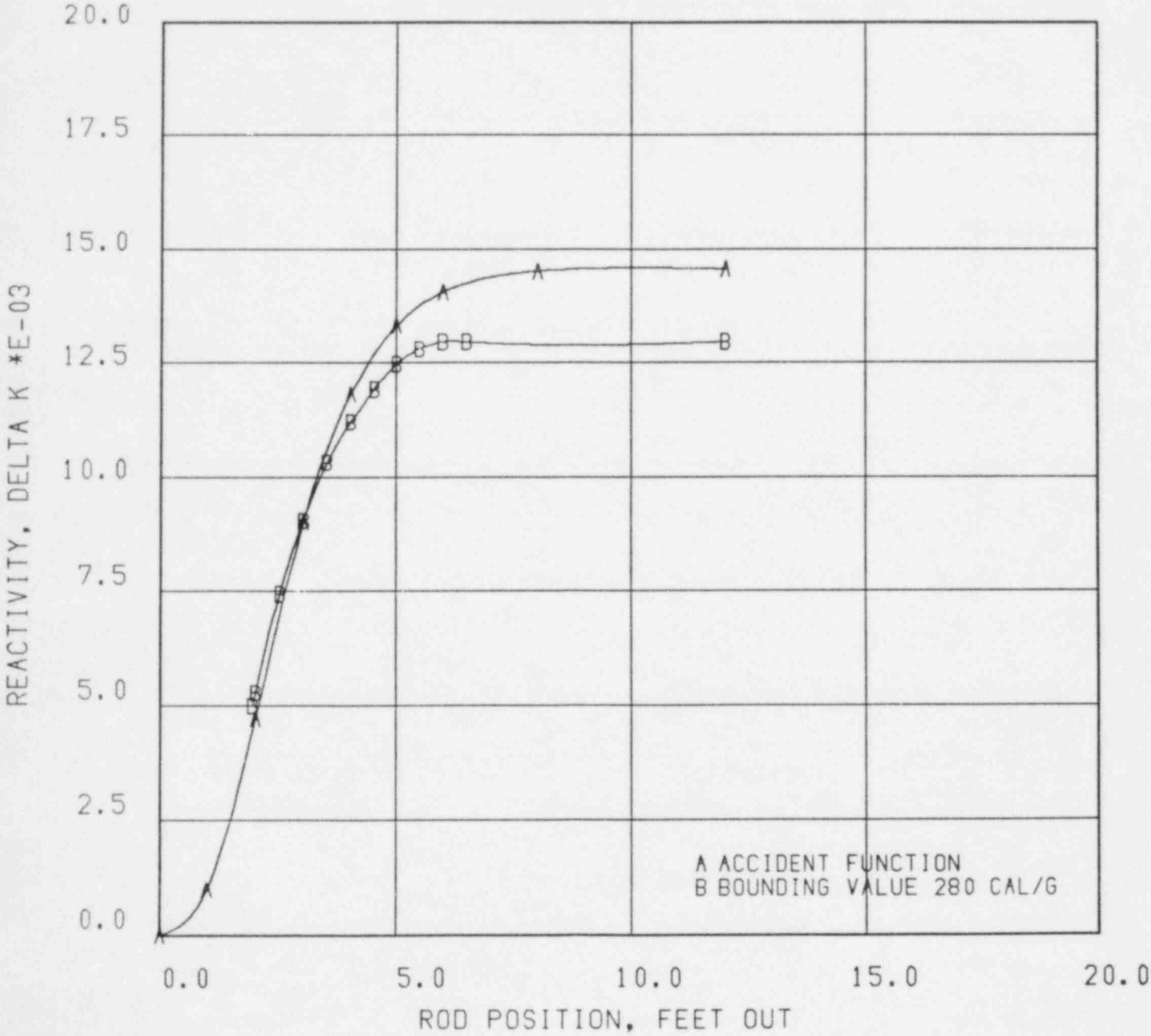


Figure 10. Accident Reactivity Shape Function, Hot Standby

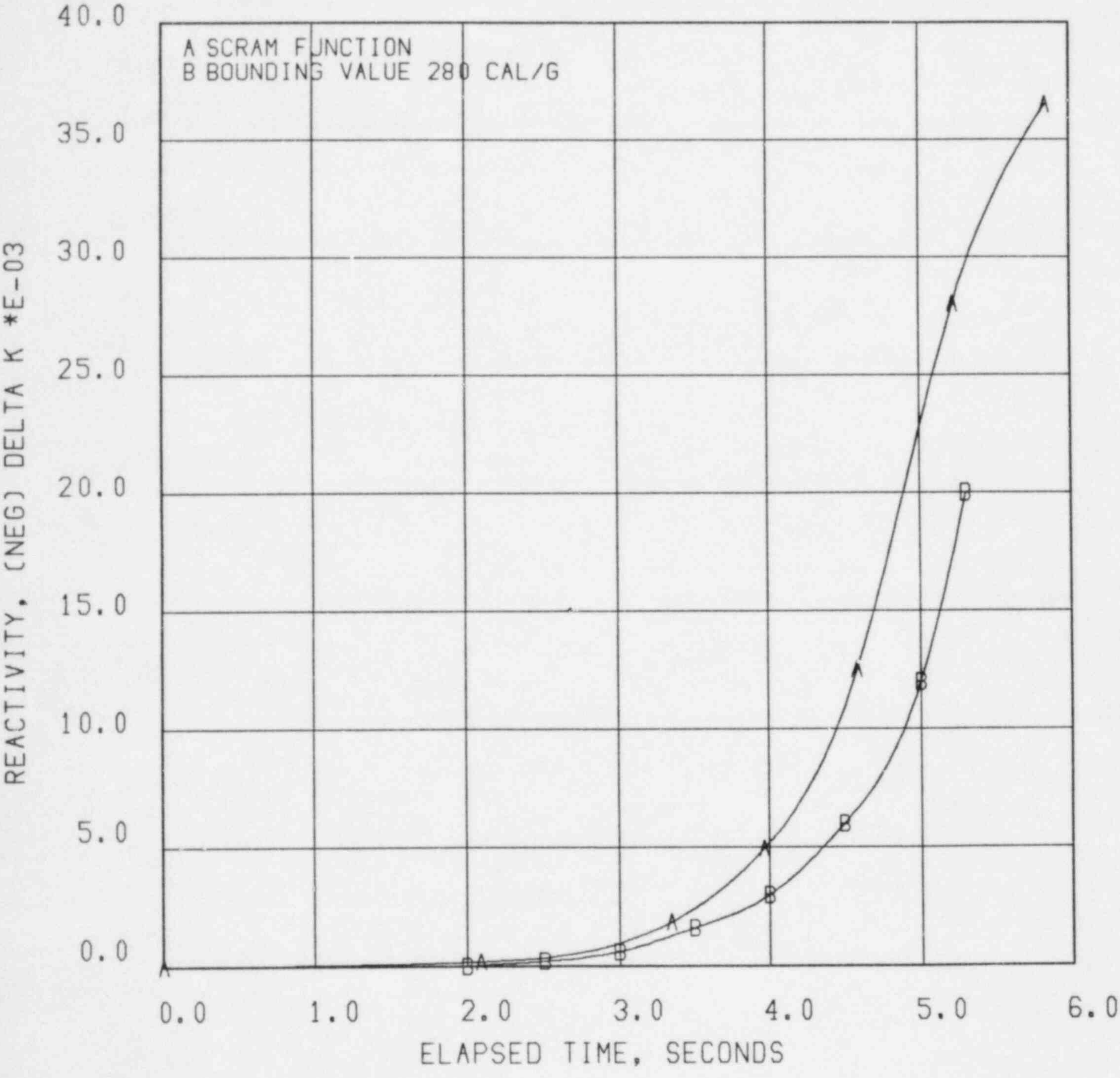


Figure 11. Scram Reactivity Function, Cold Startup

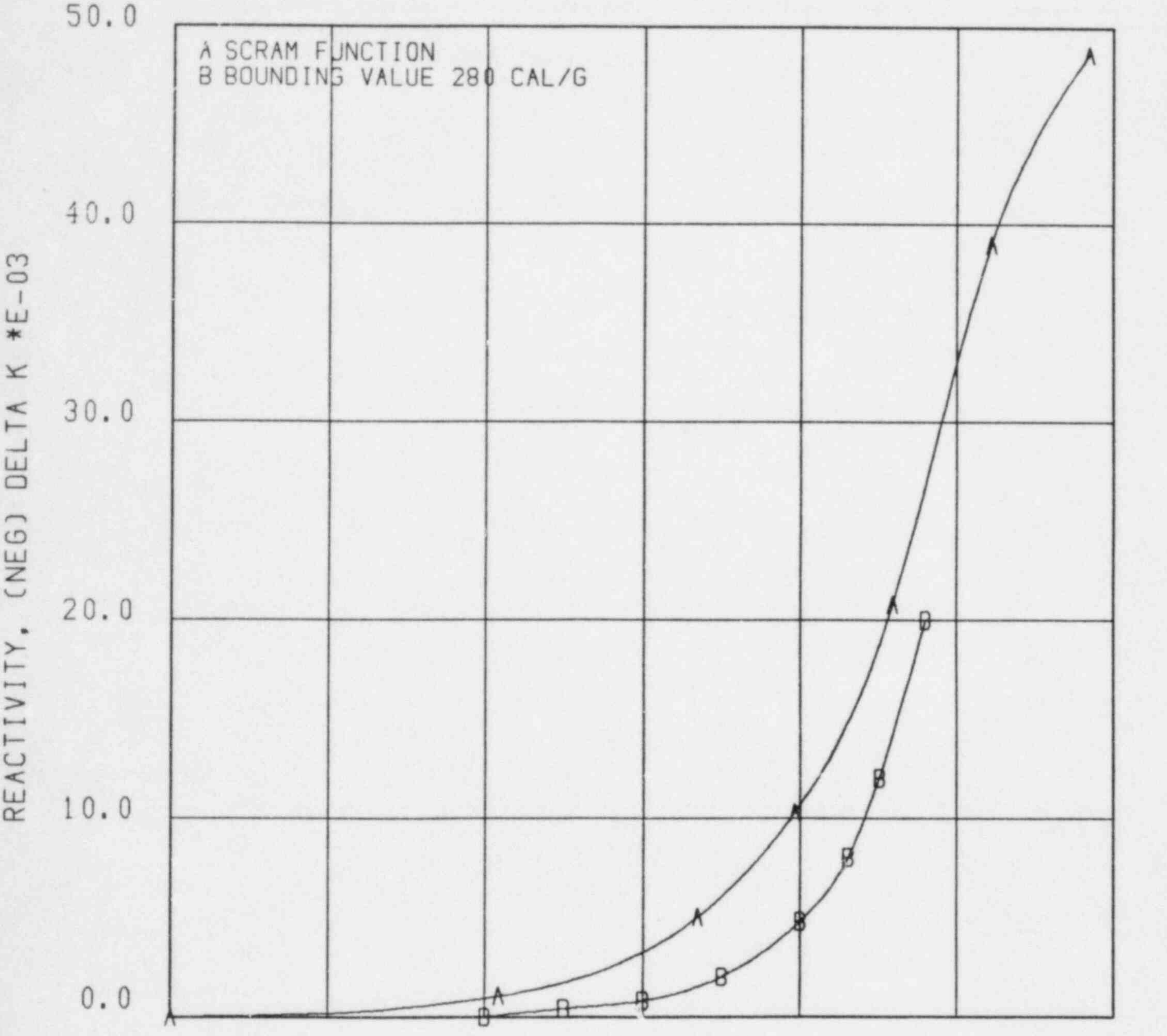


Figure 12. Scram Reactivity Function, Hot Standby

APPENDIX A
ADDITIONAL INFORMATION

1. The transient and GETAB analyses presented in the body of this report are based on turbine control valves in a full-arc configuration and on the power supply to the recirculation Motor-Generator Sets from offsite power.

2. General Electric's approved fuel thermal mechanical design model, TEXICO (documented in Revision 6 to NEDE-24011-P-A), was used in the analysis of Brunswick 1, Reload 4.

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