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CLASS I
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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL FOR BRUNSWICK STEAM ELECTRIC PLANT UNIT 2, RELOAD 5

GENERAL ELECTRIC

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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL
FOR
BRUNSWICK STEAM ELECTRIC PLANT
UNIT 2, RELOAD 5

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CONTENTS OF THIS REPORT
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1. PLANT UNIQUE ITEM (1.0)*

Plant Parameter Changes — Appendix A

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

	Cycle Loaded	Number	Number Drilled
Irradiated			
8DB274L	2	8	8
8DRB265H	3	40	40
8DRB283	3	36	36
P8DRB265H	4	132	132
P8DRB284H	5	24	24
P8DRB265H	5	136	136
New			
BP8DRB299	6	184	184
TOTAL		560	560

3. REFERENCE CORE LOADING PATTERN (3.3.1)

Nominal previous cycle core average exposure at end of cycle: 15680 MWd/ST

Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations: 15680 MWd/ST

Assumed reload cycle core average exposure at end of cycle: 16336 MWd/ST

Core loading pattern: Figure 1

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*( ) Refers to area of discussion in "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-6, April 1983. A letter "S" preceding the number refers to the appropriate section in the United States Supplement, NEDE-24011-P-A-6-US, April 1983.

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	0.955
Strongest Control Rod Out	0.986
R, Maximum Increase in Cold Core Reactivity with Exposure into Cycle, Δk	0.0

5. STANDBY LIQUID CONTROL SYSTEM SHUTDOWN CAPABILITY (3.3.2.1.3)

ppm	Shutdown Margin (Δ) (20°C, Xenon Free)
600	0.036

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

(COLD WATER INJECTION EVENTS ONLY)

Void Fraction (%)	41.3
Average Fuel Temperature (°F)	1292
Void Coefficient N/A* (¢/% Rg)	-7.00/-8.75
Doppler Coefficient N/A (¢/°F)	-0.175/0.166
Scram Worth N/A ($)	**

*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-US, April 1983.

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

Fuel Design	Peaking Factors				Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
	Local	Radial	Axial	R-Factor			
Exposure: BOC to EOC-2000 MWd/ST							
BP/P8x8R	1.20	1.55	1.40	1.051	6.583	113.5	1.23
8x8R	1.20	1.54	1.40	1.051	6.545	112.3	1.23
8x8	1.22	1.40	1.40	1.098	5.975	112.0	1.23
Exposure: EOC-2000 MWd/ST to EOC							
BP/P8x8R	1.20	1.42	1.40	1.051	6.062	116.5	1.34
8x8R	1.20	1.46	1.40	1.051	6.199	114.2	1.31
8x8	1.22	1.33	1.40	1.098	5.674	113.9	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
Improved Scram Time:	No
Exposure Dependent Limits:	Yes
Exposure Points Analyzed:	EOC and EOC-2000 MWd/ST

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 to EOC-2000 MWd/ST

Transient	Flux (% NBR)	Q/A (% NBR)	ΔCPR BP/P8x8R	ΔCPR 8x8R	ΔCPR 8x8	Figure
Load Rejection Without Bypass	469	119	0.16	0.14	0.13	2a
Loss of Feedwater Heater	126	124	0.16	0.16	0.16	3
Feedwater Controller Failure	115	110	0.05	0.05	0.05	4a

Exposure Range: EOC-2000 MWd/ST to EOC

Transient	Flux (% NBR)	Q/A (% NBR)	ΔCPR BP/P8x8R	ΔCPR 8x8R	ΔCPR 8x8	Figure
Load Rejection Without Bypass	516	128	0.27	0.24	0.23	2b
Loss of Feedwater Heater	126	124	0.16	0.16	0.16	3
Feedwater Controller Failure	141	111	0.05	0.05	0.05	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	ΔCPR 8x8*	MLHGR (kW/ft) BP/P/8x8R	MLHGR (kW/ft) 8x8*
104	3.5	0.12	0.12		17.68	
105	4.0	0.15	0.15		18.23	
106	4.0	0.15	0.15		18.23	
107	4.5	0.17	0.17		18.40	
108	5.0	0.19	0.19		18.40	
109	5.5	0.20	0.20		18.40	
110	6.5	0.23	0.23		18.40	

Setpoint Selected: 107

*On periphery of core (low power region) and not limiting

12. CYCLE MCPR VALUES (S.2.2)

Non-Pressurization Events

Exposure Range: BOC to EOC	BP/P8x8R	8x8R	8x8
Loss of Feedwater Heater	1.23	1.23	1.23
Fuel Loading Error	1.20		
Rod Withdrawal Error	1.24	1.24	

Pressurization Events

	Option A			Option B		
	BP/P8x8R	8x8R	8x8	BP/P8x8R	8x8R	8x8
Exposure Range: BOC to EOC-2000 MWd/ST						
Load Rejection Without Bypass	1.28	1.26	1.25	1.09	1.08	1.08
Feedwater Controller Failure	1.17	1.17	1.17	1.11	1.11	1.11
Exposure Range: EOC-2000 MWd/ST to EOC						
Load Rejection Without Bypass	1.40	1.37	1.36	1.28	1.25	1.24
Feedwater Controller Failure	1.17	1.17	1.17	1.11	1.11	1.11

13. OVERPRESSURIZATION ANALYSIS SUMMARY (S.2.3)

Transient	P_{sl} (psig)	P_v (psig)	Plant Response
MSIV Closure (Flux Scram)	1218	1255	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:	0.67
Channel Hydrodynamic Performance Decay Ratio, x_2/x_0	
Channel Type	
BP/P8x8R	0.20
8x8R	0.20
8x8	0.28

15. LOADING ERROR RESULTS (S.2.5.4)

Variable Water Gap Misoriented Bundle Analysis: 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:	197.6

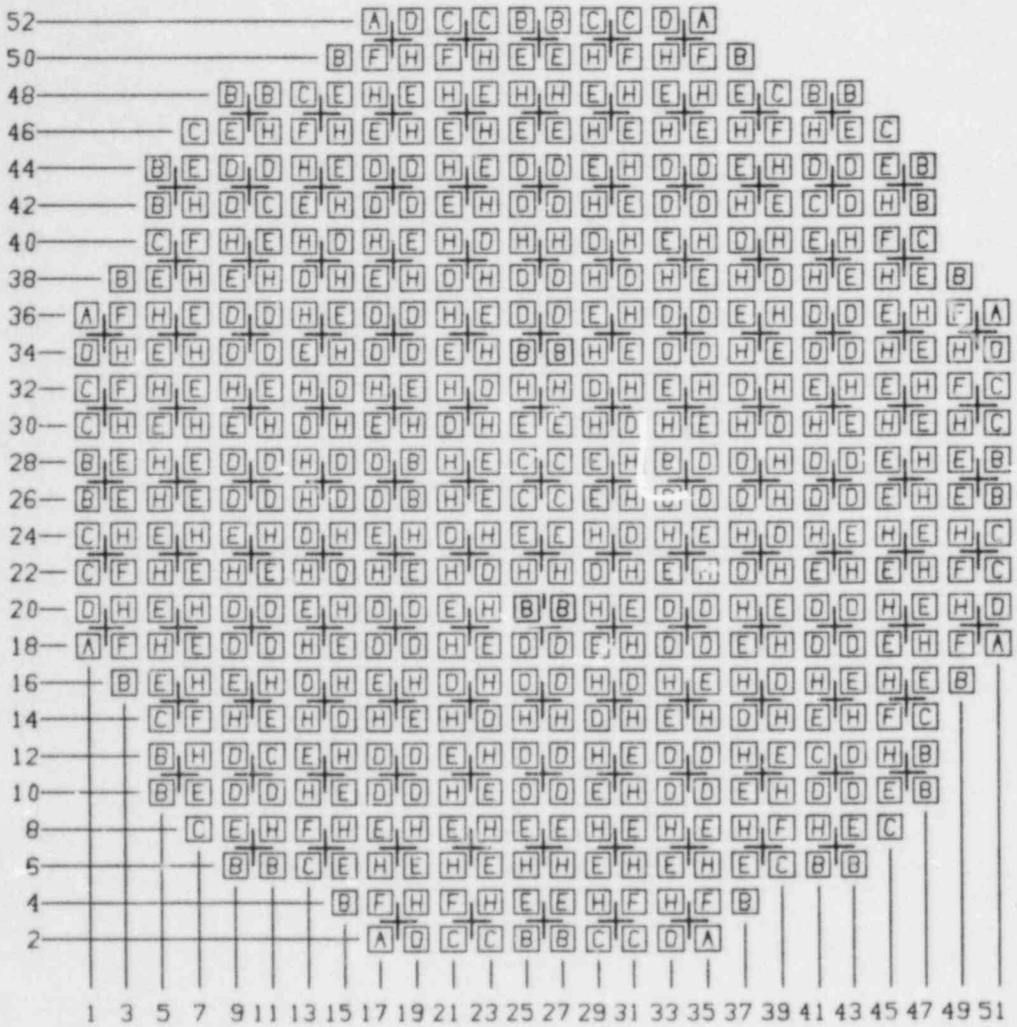
*ΔCPR penalty of 0.02 for the tilted misoriented bundle is applied to the cycle MCPR value reported in Section 12.

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

See "Loss-of-Coolant Analysis Report for Brunswick Steam Electric Plant Unit No. 2," September 1977 (NEDO-24053, as amended).

Fuel Type: BP8DRB299

Average Planar Exposure (MWd/t)	MAPLHGR (kW/ft)	PCT (°F)	Oxidation Fraction
200	10.9	2061	0.022
1000	11.0	2063	0.022
5000	11.5	2108	0.025
10000	12.2	2194	0.032
15000	12.1	2198	0.032
20000	12.0	2197	0.032
25000	11.5	2141	0.027
30000	11.0	2048	0.020
35000	10.3	1960	0.029
40000	9.7	1846	0.009
45000	9.0	1772	0.007



FUEL TYPE	
A = 8DB274L	E = P8DRB265H
B = 8DRB265H	F = P8DRB284H
C = 8DRB283	H = BP8DRB299
D = P8DRB265H	

Figure 1. Reference Core Loading Pattern

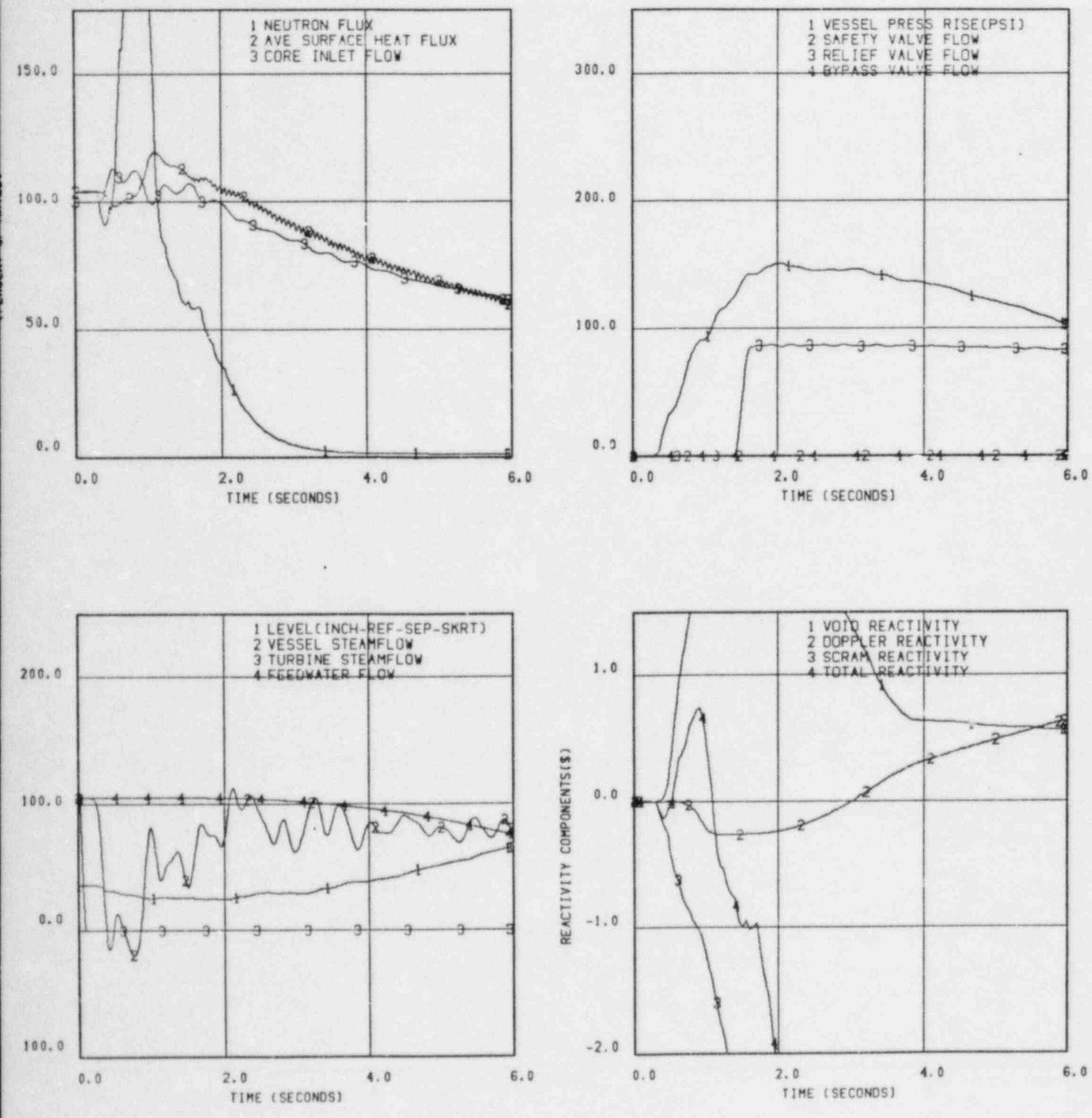


Figure 2a. Plant Response to Generator Load Rejection Without Bypass (EOC-2000)

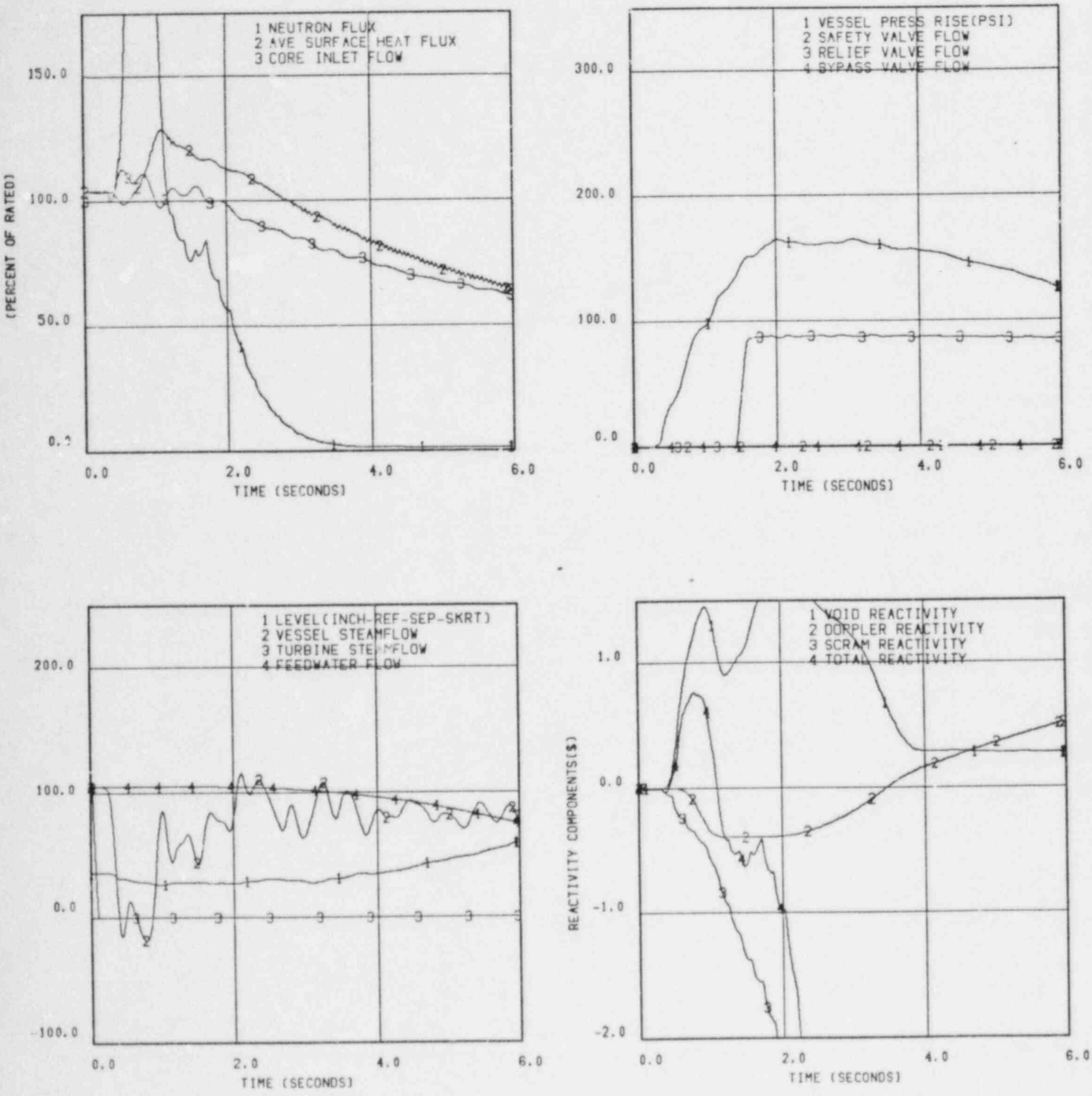


Figure 2b. Plant Response to Generator Load Rejection Without Bypass (EOC)

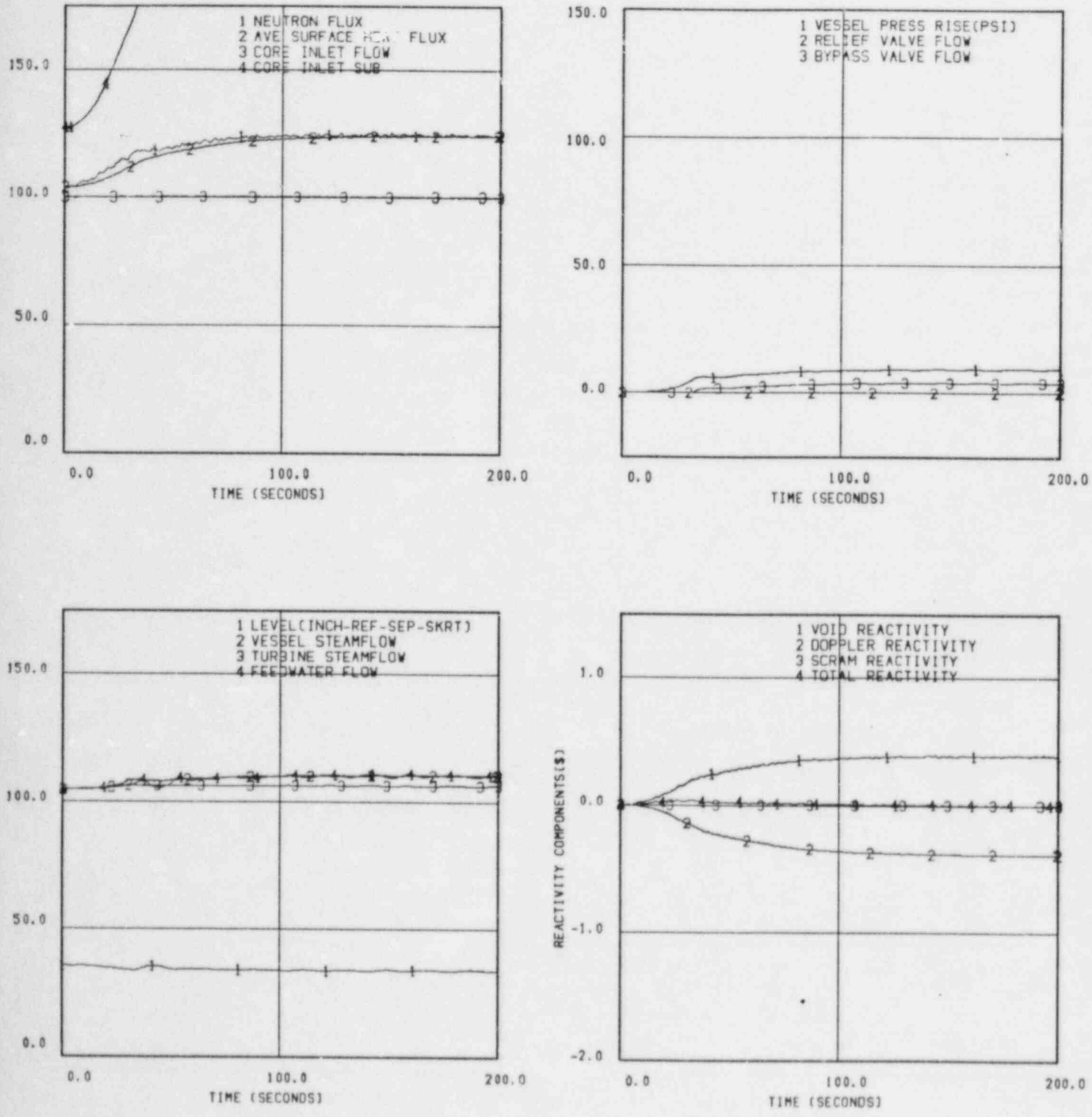


Figure 3. Plant Response to Loss of 100°F Feedwater Heating

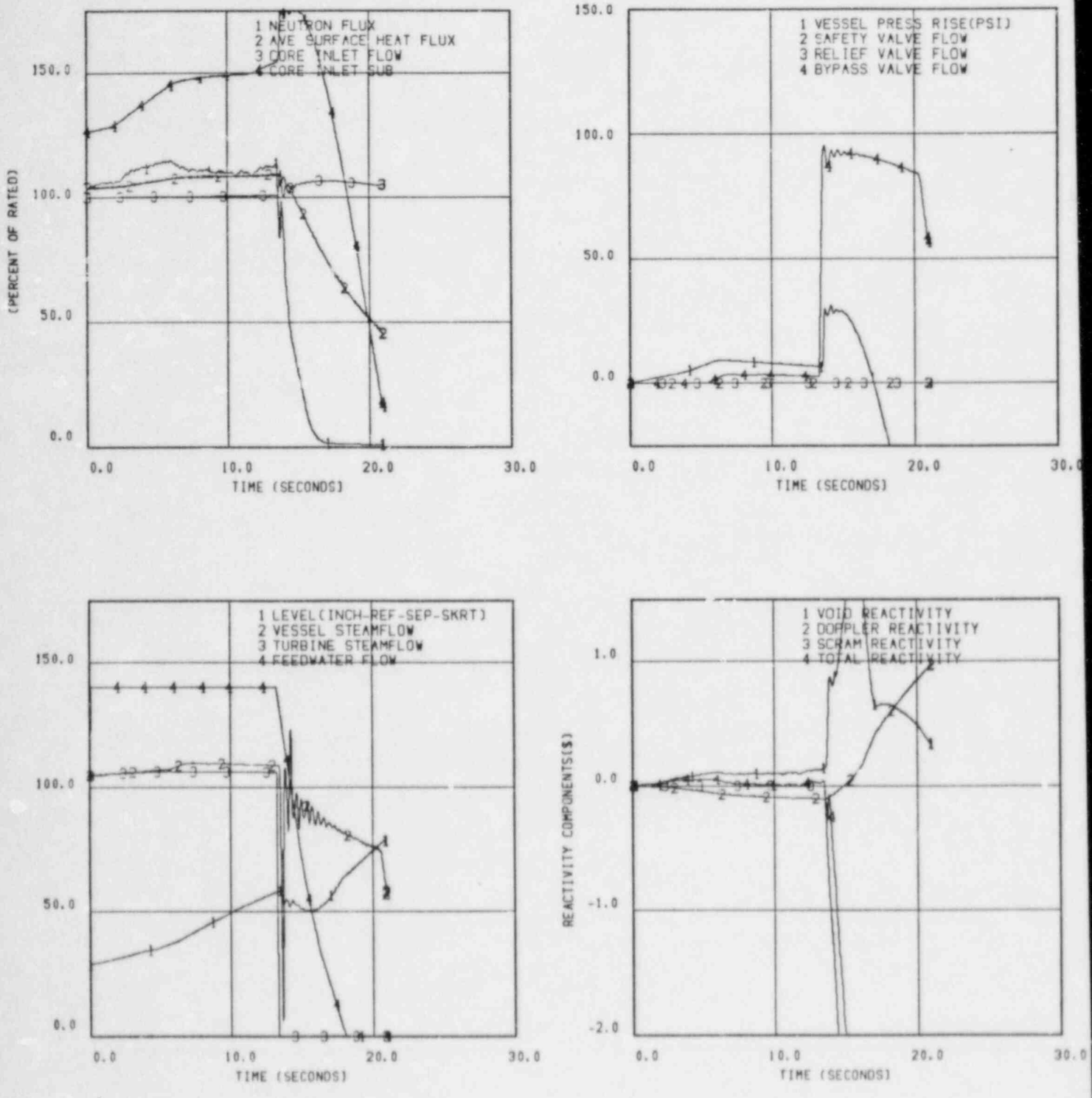


Figure 4a. Plant Response to Feedwater Controller Failure, Maximum Demand (EOC-2000)

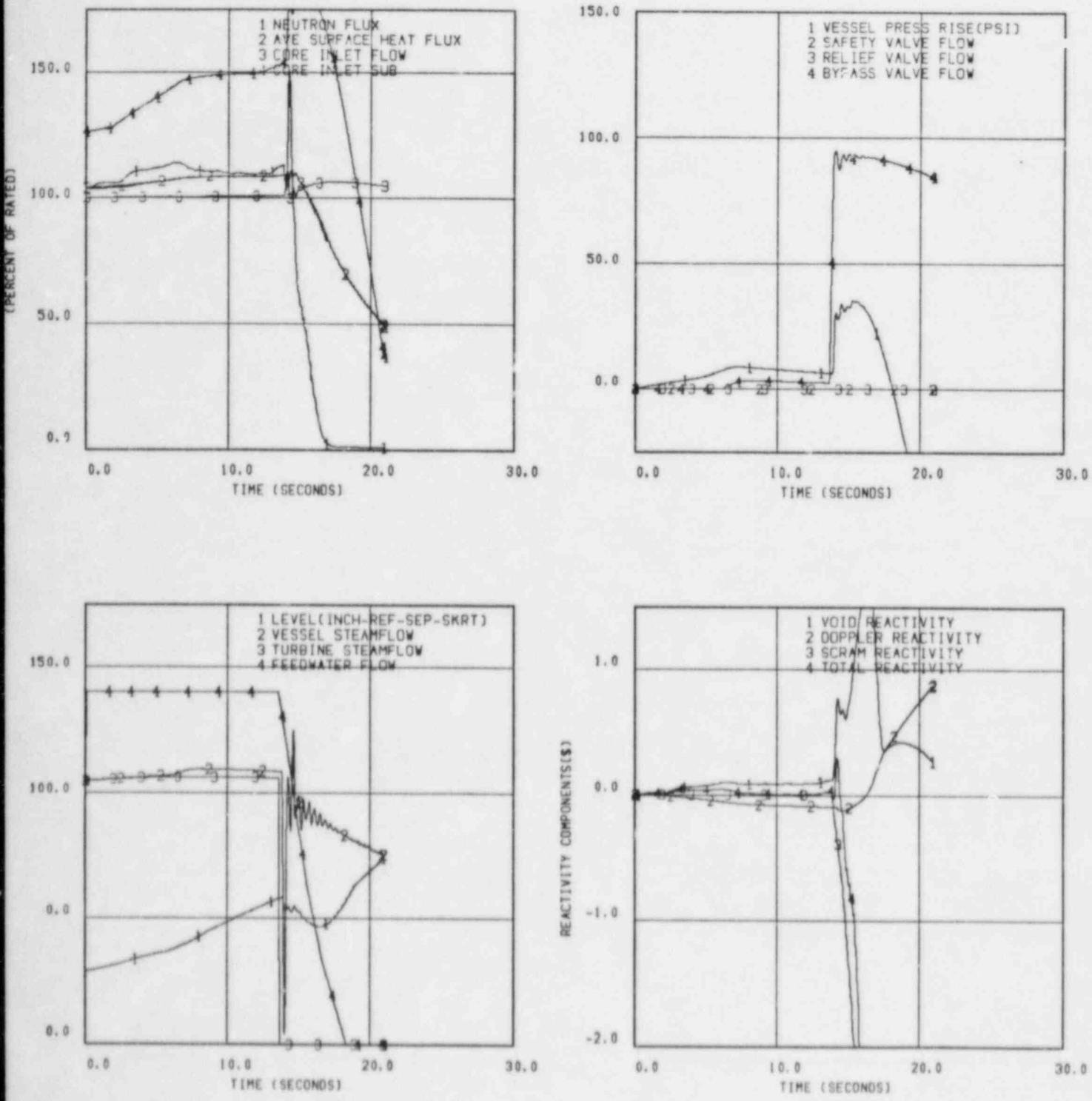


Figure 4b. Plant Response to Feedwater Controller Failure, Maximum Demand (EOC)

NOTES:
1. ROD PATTERN IS 1/4 CORE MIRROR SYMMETRIC.
2. NO. INDICATES NUMBER OF NOTCHES WITHDRAWN OUT OF 48. BLANK IS A WITHDRAWN ROD.
3. ERROR ROD IS (22, 31).

	2	6	10	14	18	22	26
51					32		32
47				2		6	
43			32		36		36
39		2		6		14	
35	32		36		44		44
31		6		14		0	
27	32		36		44		44

Figure 5. Limiting Rod Withdrawal Error Rod Pattern

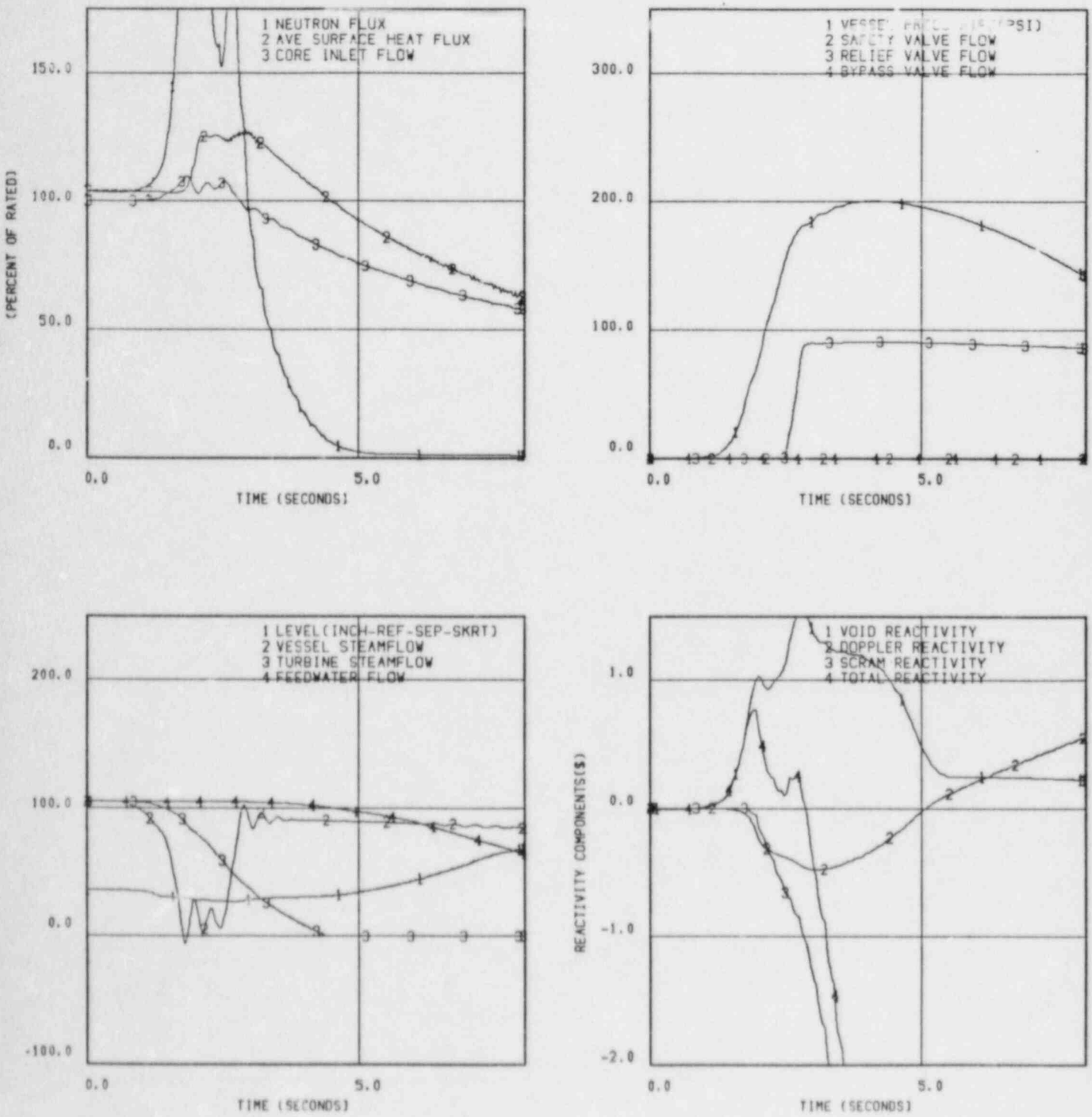


Figure 6. Plant Response to MSIV Closure (Flux Scram)

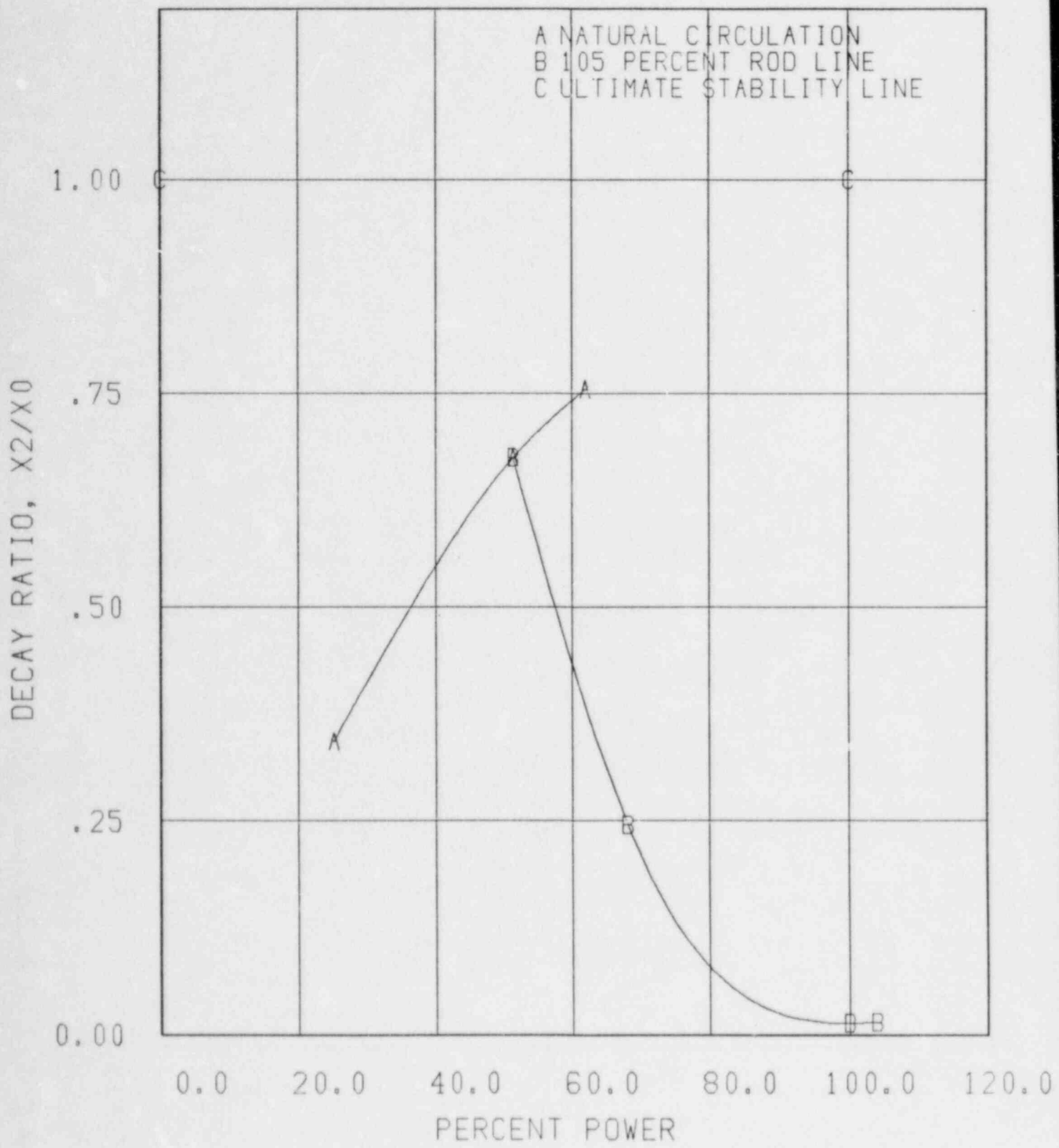


Figure 7. Reactor Core Decay Ratio

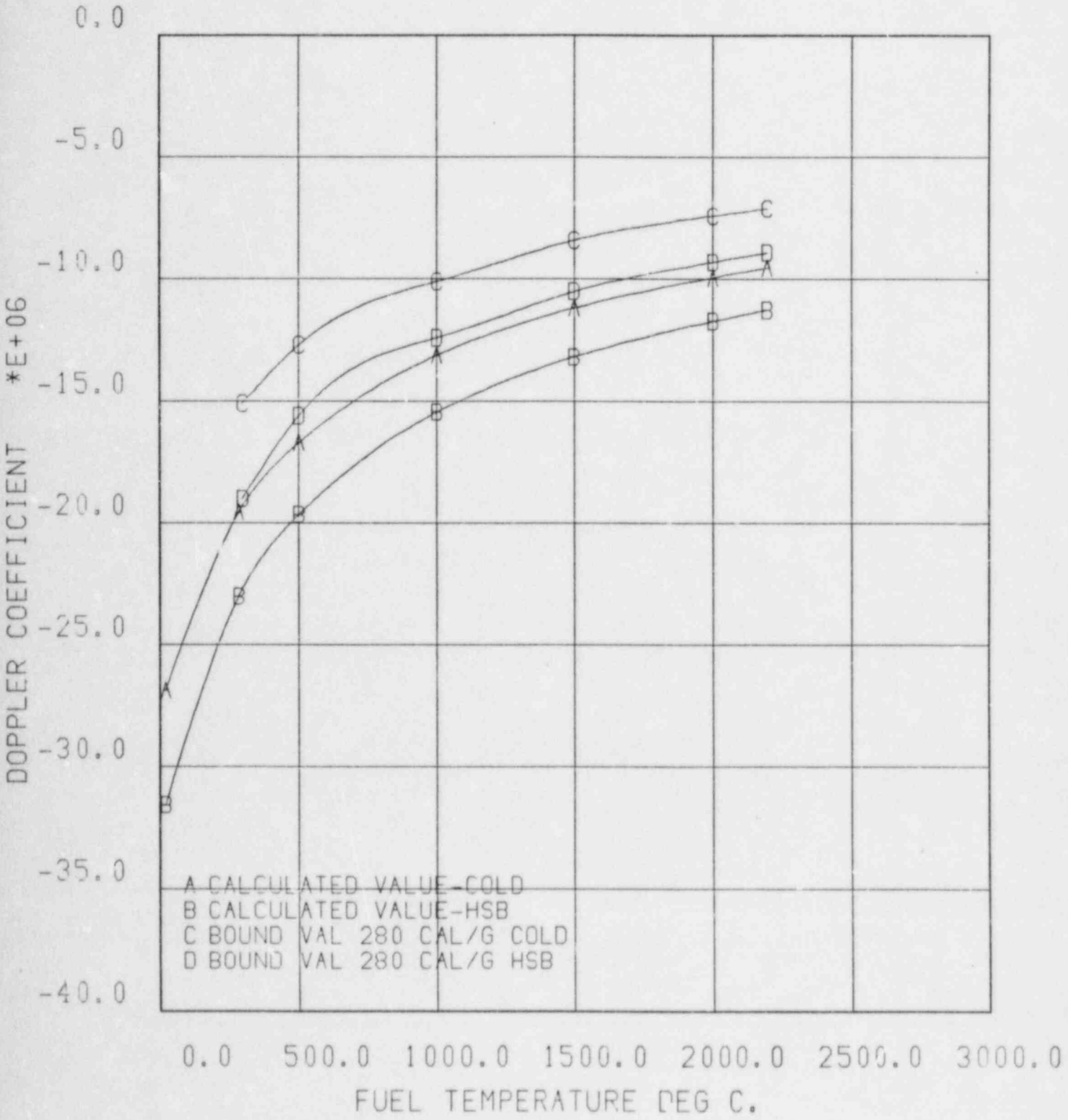


Figure 8. Fuel Doppler Coefficient in 1/Δ°C

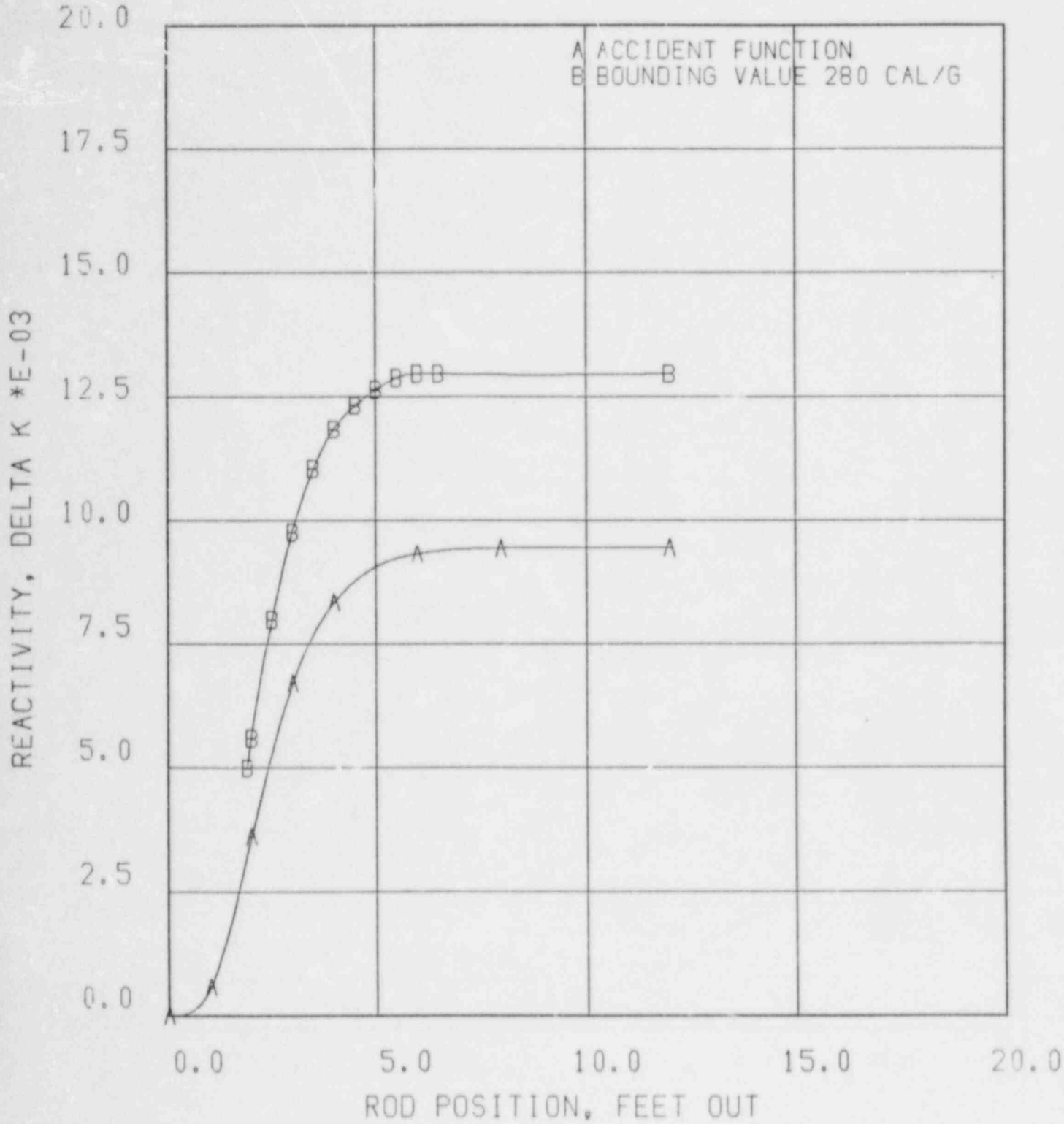


Figure 9. Accident Reactivity Shape Function Cold Startup

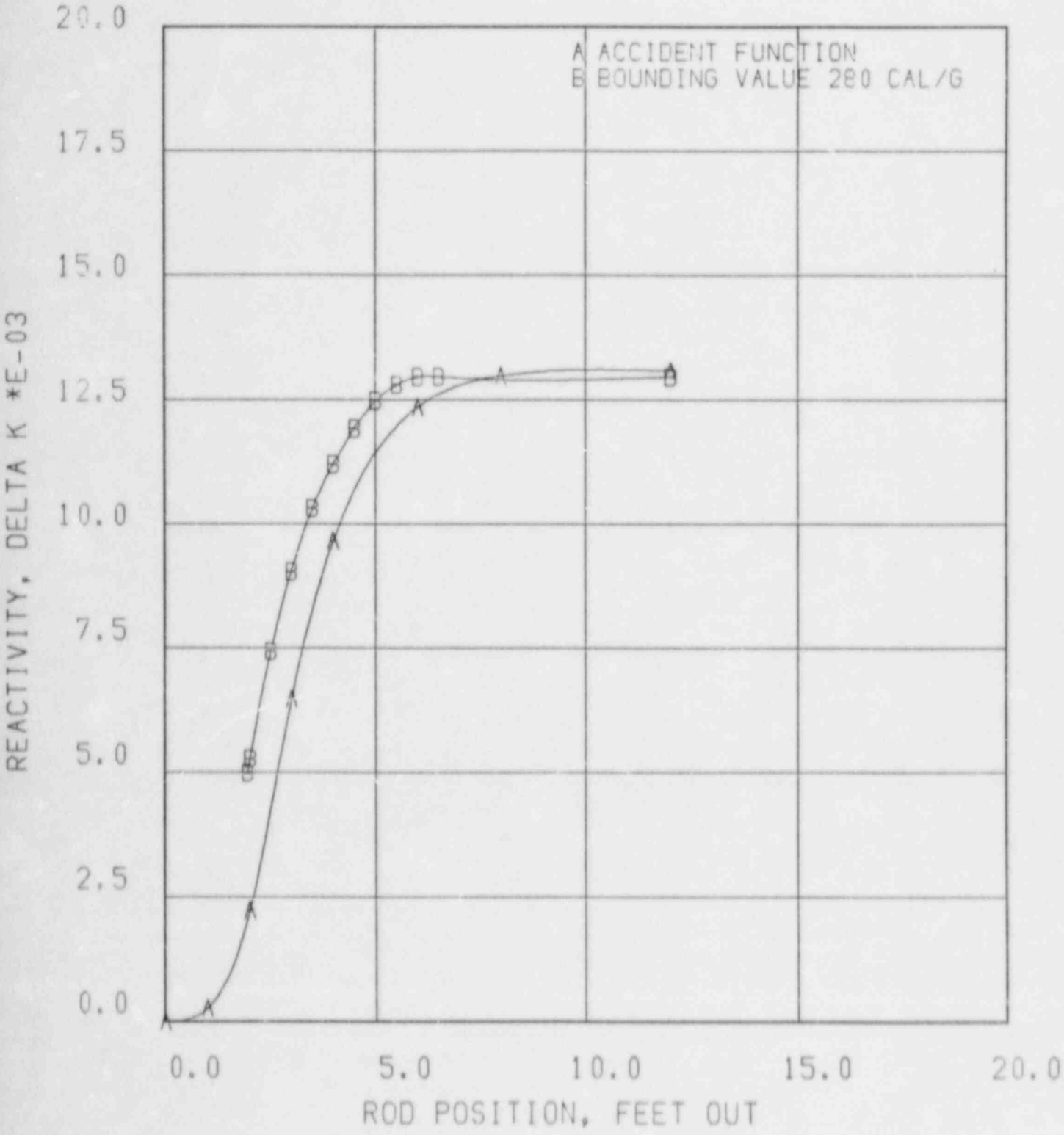


Figure 10. Accident Reactivity Shape Function Hot Startup

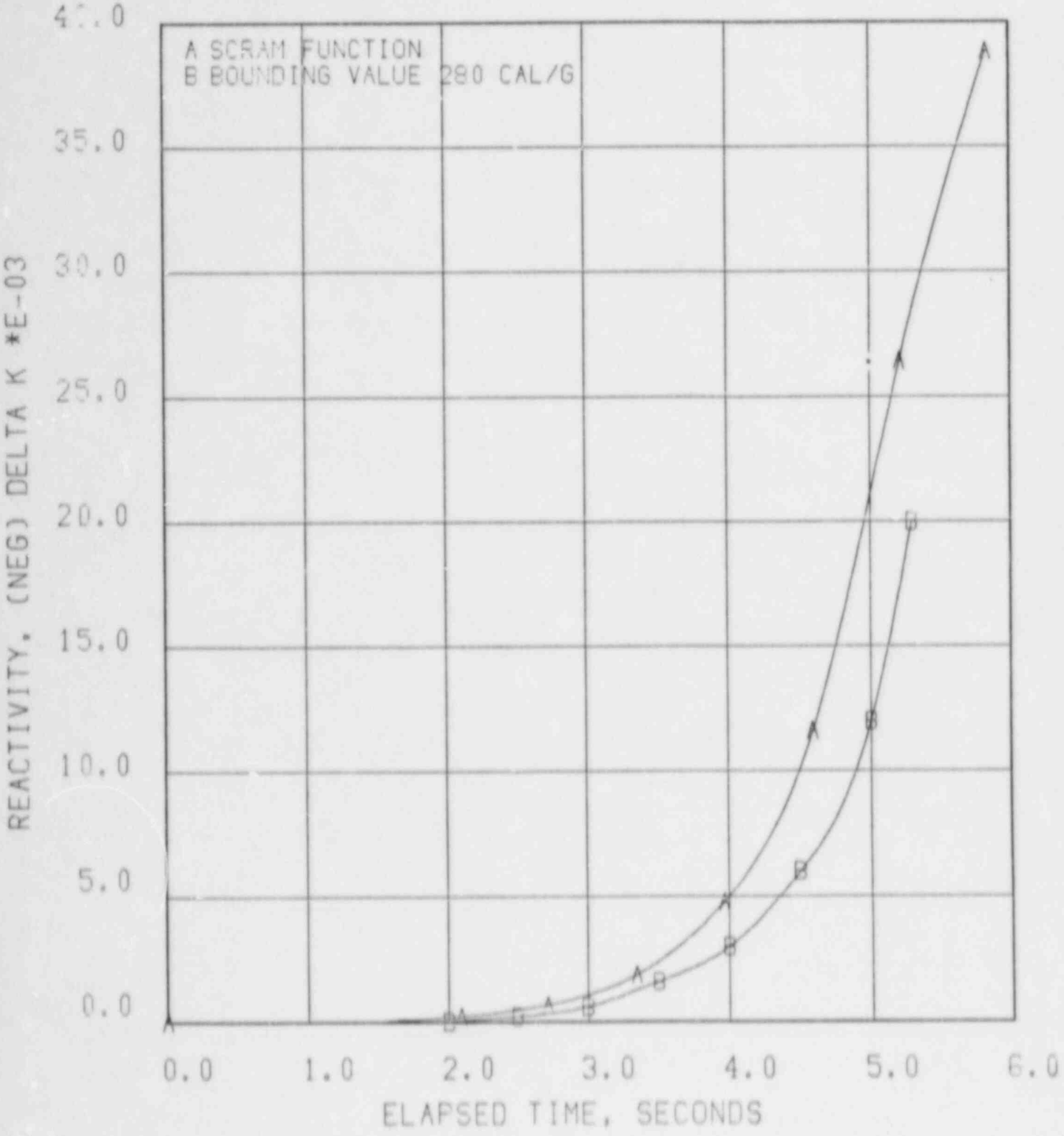


Figure 11. Scram Reactivity Function Cold Startup

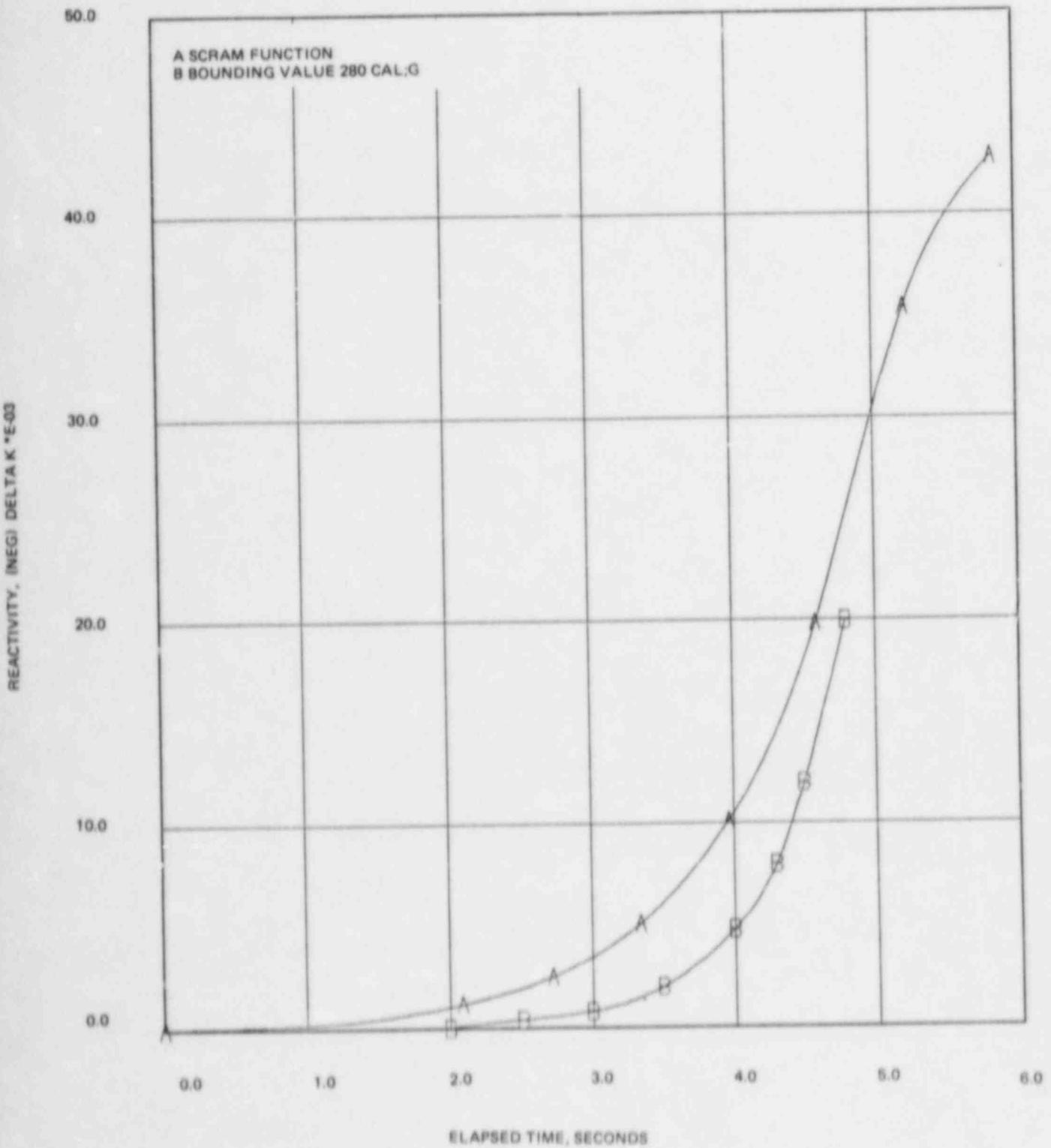


Figure 12. Scram Reactivity Function Hot Startup

APPENDIX A

Plant Parameter Changes:

Pressure Relief Systems (Table S.2-4.1, pg. US.2-93, NEDO-24011)

Safety/Relief Valve Type: (i.e., capacity at reference pressure of 1080 +3% psig is 789,000 lb/hr for each S/RV)	E

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