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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL FOR DUANE ARNOLD ATOMIC ENERGY CENTER RELOAD 6

GENERAL ELECTRIC

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Revision 1
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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL
FOR
DUANE ARNOLD ATOMIC ENERGY CENTER
RELOAD 6

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GENERAL ELECTRIC

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

Appendix A: Operating Flexibility Options

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

		CYCLE LOADED	NUMBER	NUMBER DRILLED
Irradiated	8DB274H	4	68	68
Irradiated	P8DPB289	5	88	88
Irradiated	P8DPB289	6	84	84
New	P8DRB284H	7	88	88
New	P8DRB299	7	40	40
TOTAL			368	368

3. REFERENCE CORE LOADING PATTERN (3.3.1)

Nominal previous cycle core average exposure at end of cycle: 17,045 MWd/t
Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations: 16,845 MWd/t
Assumed reload cycle core average exposure at end of cycle: 17,443 MWd/t
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)

BOC k_{eff}	
Uncontrolled	1.112
Fully Controlled	0.954
Strongest Control Rod Out	0.988
R, Maximum Increase in Cold Core Reactivity with Exposure Into Cycle, Δk	0.001

*( ) refers to areas of discussion in "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-4, January 1982.

5. STANDBY LIQUID CONTROL SYSTEM SHUTDOWN CAPABILITY (3.3.2.1.3)

ppm	Shutdown Margin (Δk) (20°C, Xenon Free)
600	0.029

6. RELOAD-UNIQUE TRANSIENT ANALYSIS INPUTS (3.3.2.1.5 AND S.2)

(REDY Events Only)	EOC7
Void fraction (%)	41.8
Average Fuel Temperature (°F)	1289
Void Coefficient N/A* (¢/% Rg)	-8.82/-11.02
Doppler Coefficient N/A (¢/°F)	-0.232/-0.220
Scram Worth N/A ($)	-46.31/-37.05

7. RELOAD-UNIQUE GETAB TRANSIENT ANALYSIS INITIAL CONDITION PARAMETERS (S.2)

Fuel Design	Peaking Factors			R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
	Local	Radial	Axial				
BOC 7 to EOC 7							
P8x8R	1.20	1.56	1.40	1.051	6.598	110.3	1.22
8x8	1.22	1.43	1.40	1.098	6.062	109.3	1.20

8. SELECTED MARGIN IMPROVEMENT OPTIONS (S.2.2.2)

Transient Recategorization: No

Recirculation Pump Trip: Yes

Rod Withdrawal Limiter: No

Thermal Power Monitor: No

Measured Scram Time: Yes

Number of Exposure Points: 1

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

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

Transient	Flux (%NBR)	Q/A (%NBR)	ΔCPR P8x8R	ΔCPR 8x8	Figure
Exposure: BOC 7 to EOC 7 Load Rejection w/o Bypass	434	117	0.17	0.15	2
Exposure: BOC to EOC Loss of Feedwater Heater	125	124	0.15	0.15	3
Exposure: BOC 7 to EOC 7 Feedwater Controller Failure	326	114	0.11	0.10	4

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

(Generic Bounding Analysis Results)

Rod Block Reading	ΔCPR (All Fuel Types)
104	0.13
105	0.16
106	0.19
107	0.22
108	0.28
109	0.32
110	0.36

Set Point Selected: 105

11. OPERATING MCPR LIMIT (S.2.2)

ODYN (Option A)

8x8	P8x8R
1.27	1.29

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12. OVERPRESSURIZATION ANALYSIS SUMMARY (S.2.3)

Transient	P_{sl} (psig)	P_v (psig)	Plant Response
MSIV Closure (Flux Scram)	1232	1257	Figure 5

13. STABILITY ANALYSIS RESULTS (S.2.4)

Rod Line Analyzed: Extrapolated Rod Block Line

Decay Ratio: Figure 6

Reactor Core Stability Decay Ratio, x_2/x_0 0.85

Channel Hydrodynamic Performance Decay Ratio, x_2/x_0

Channel Type

P8x8R	0.31
8x8	0.39

14. 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	1.20	1.07

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

Bounding Analysis Results:

Doppler Reactivity Coefficients: Figure 7

Accident Reactivity Shape Functions: Figures 8 and 9

Scram Reactivity Functions: Figures 10 and 11

Plant Specific Analysis Results:

Parameters not Bounded, Cold: Accident Reactivity
Scram Reactivity

Resultant Peak Enthalpy, Cold (cal/gm): 236.6

Parameters not Bounded, HSB: None

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

See "Loss-of-Coolant Accident Analysis Report for Duane Arnold Energy Center (Lead Plant)", July 1977 (NEDO-21082-02-1A).

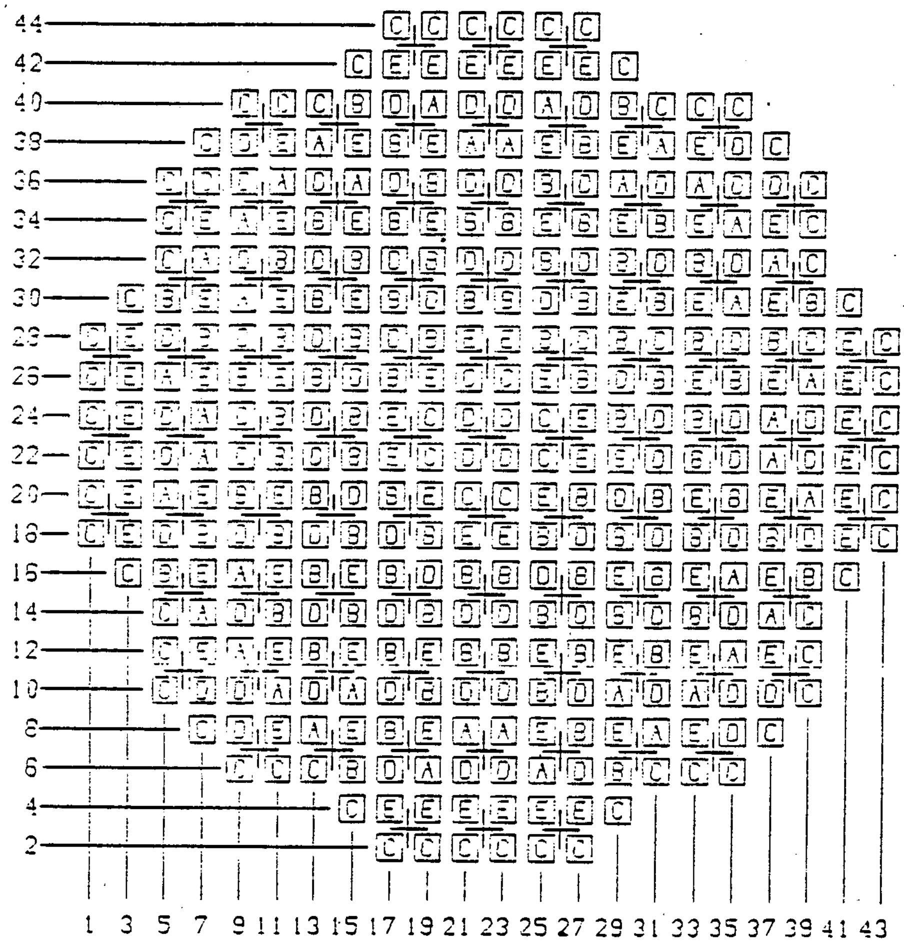
Fuel Type: P8DRB299

Exposure (GWd/t)	Exposure (GWd/MT)	MAPLHGR (kW/ft)	PCT (°F)	Local Oxidation (Fraction)
0.20	0.22	10.90	2080.0	0.023
1.0	1.1	11.00	2082.0	0.023
5.0	5.5	11.50	2114.0	0.025
10.0	11.0	12.20	2191.0	0.031
15.0	17.0	12.20	2198.0	0.032
20.0	22.0	12.10	2199.0	0.032
25.0	28.0	11.80	2153.0	0.027
30.0	33.0	11.30	2118.0	0.059
35.0	39.0	10.90	2048.0	0.047
40.0	44.0	10.50	1978.0	0.037
45.0	50.0	10.00	1911.0	0.028

Fuel Type: P8DRB284H

Exposure (GWd/t)	Exposure (GWd/MT)	MAPLHGR (kW/ft)	PCT (°F)	Local Oxidation (Fraction)
0.20	0.22	11.20	2119.0	0.026
1.0	1.1	11.20	2115.0	0.026
5.0	5.5	11.70	2148.0	0.028
10.0	11.0	12.00	2177.0	0.030
15.0	17.0	12.00	2182.0	0.030
20.0	22.0	11.90	2176.0	0.030
25.0	28.0	11.30	2098.0	0.023
30.0	33.0	10.80	2034.0	0.044
35.0	39.0	10.40	1963.0	0.034
40.0	44.0	10.00	1894.0	0.026
45.0	50.0	9.50	1827.0	0.018

LIST OF FIGURES



FUEL TYPE	
A = P8DRB299	D = P8DPB289
B = P8DRB284H	E = P8DPB289
C = 8DB274H	

Figure 1. Reference Core Loading Pattern

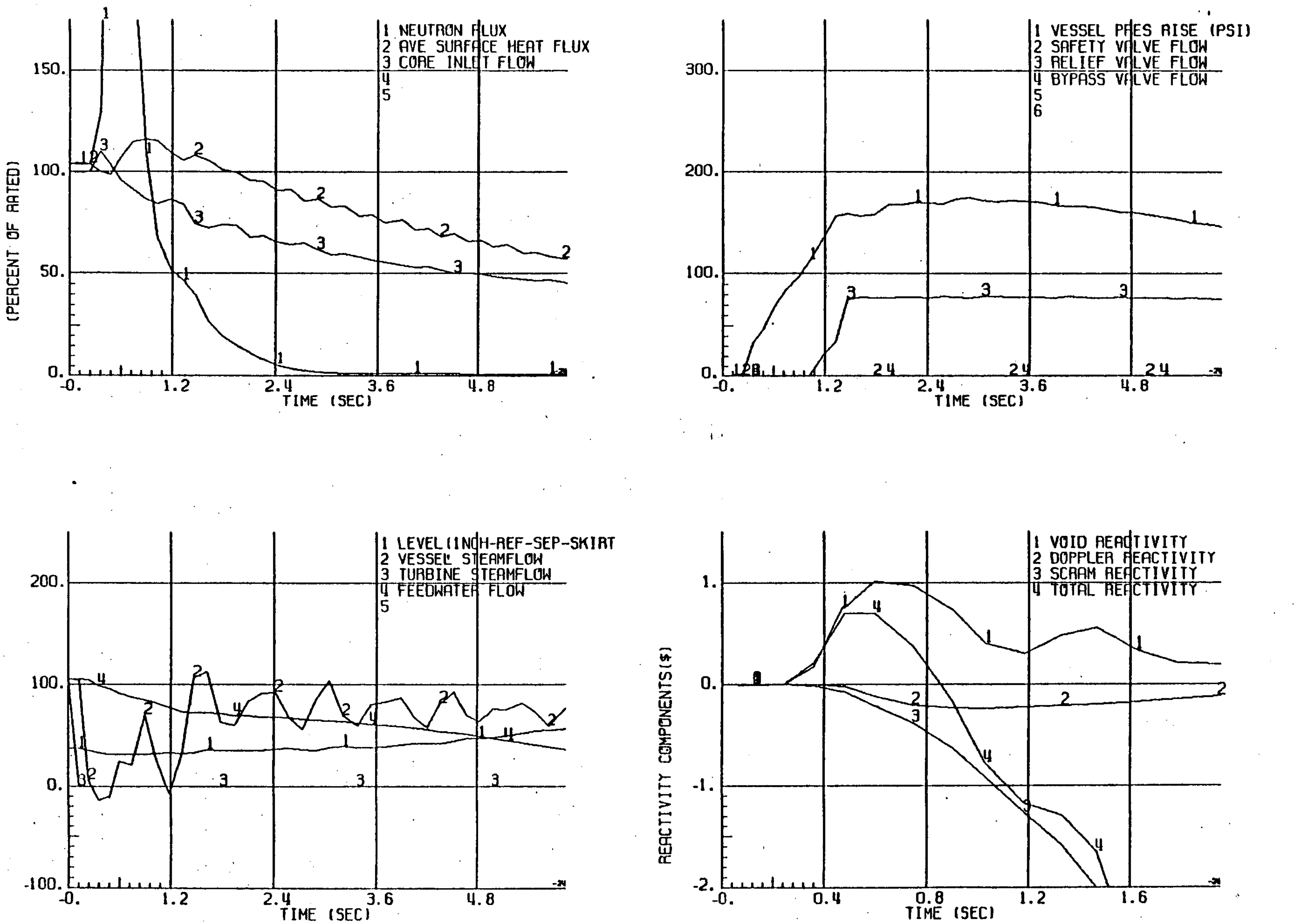


Figure 2. Plant Response to Load Rejection, Without Bypass (104% Power/100% Flow)

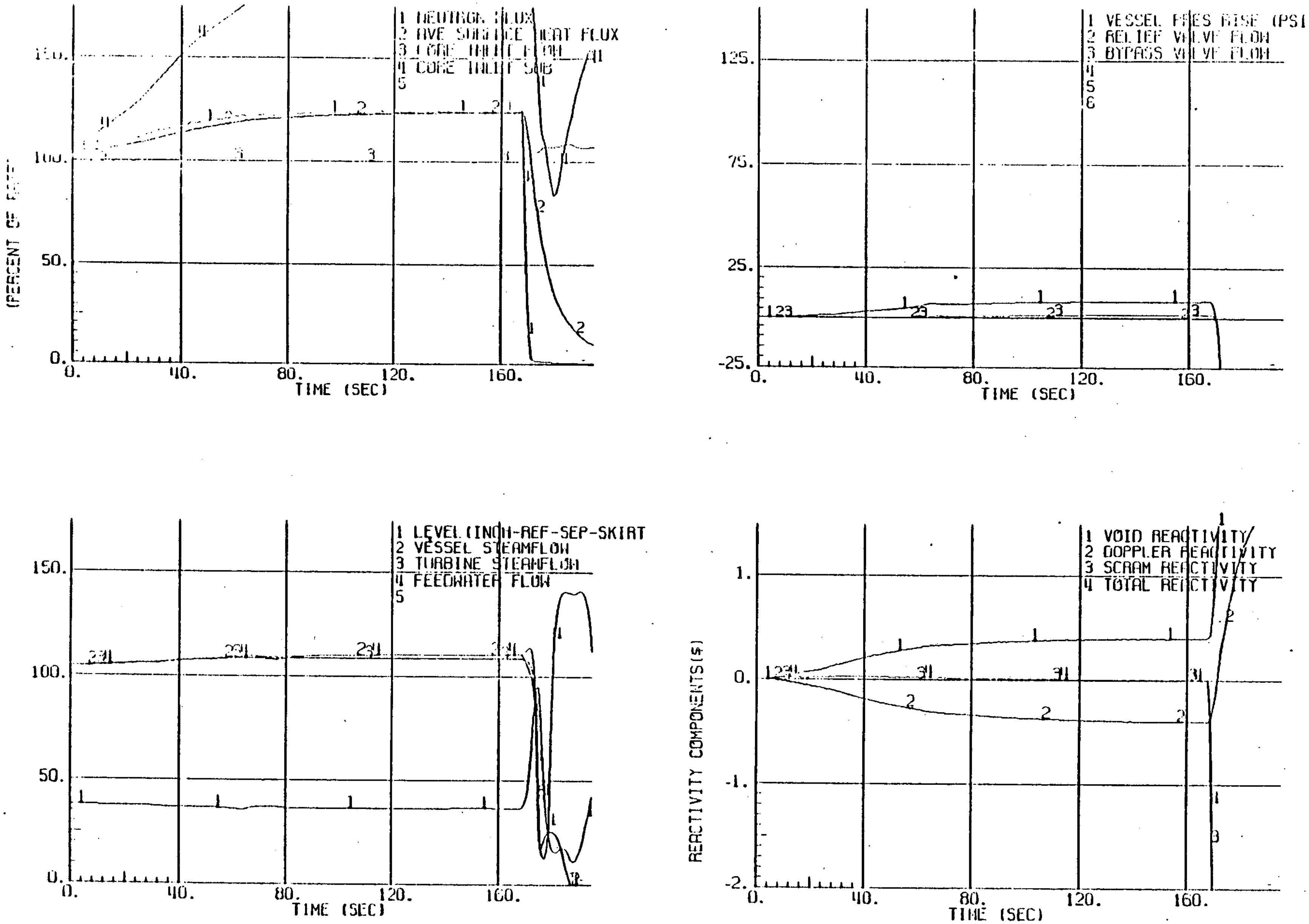


Figure 3. Plant Response to Loss of Feedwater Heating (104% Power/100% Flow)

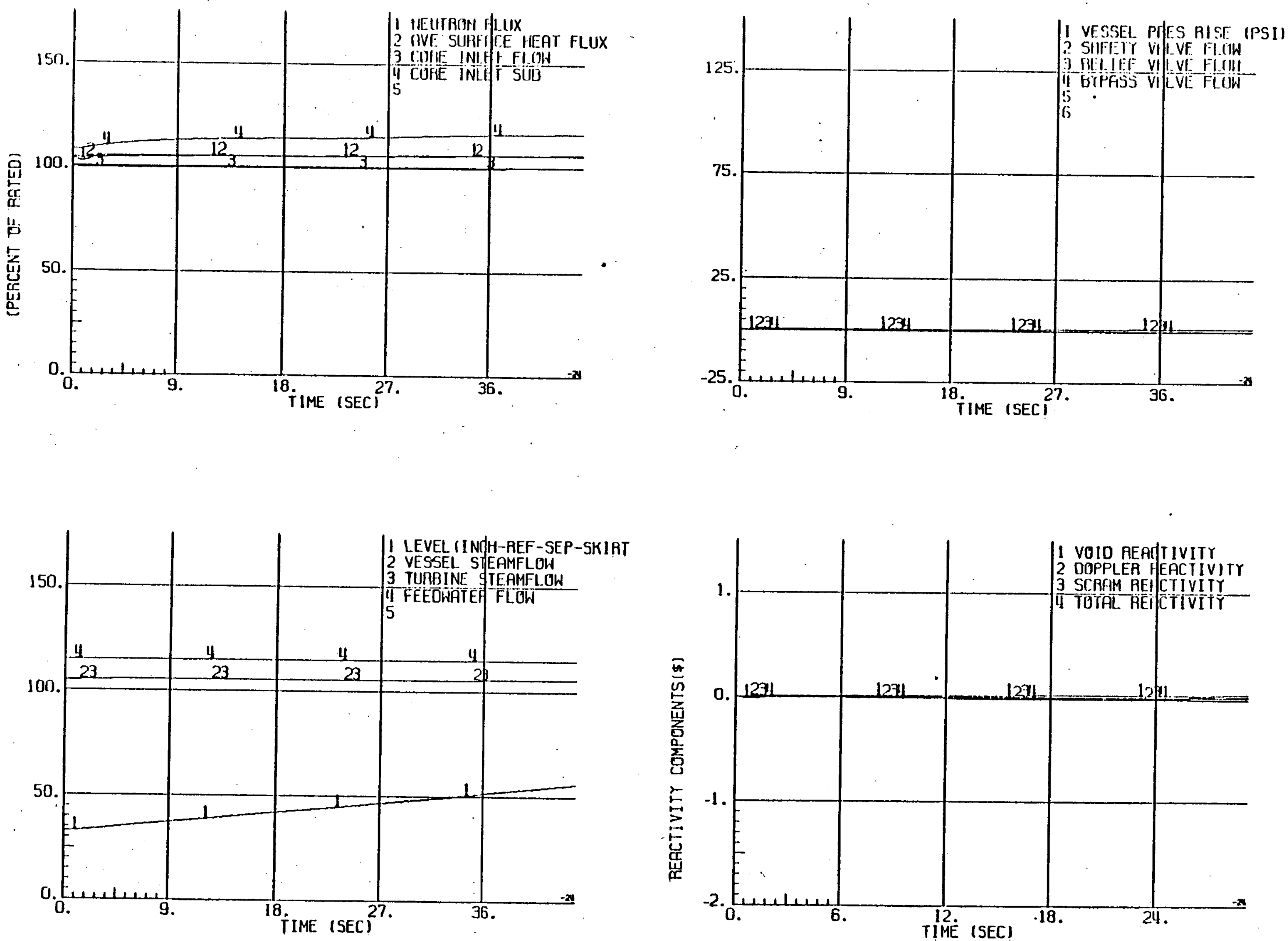


Figure 4. Plant Response to Feedwater Controller Failure (104% Power/100% Flow)

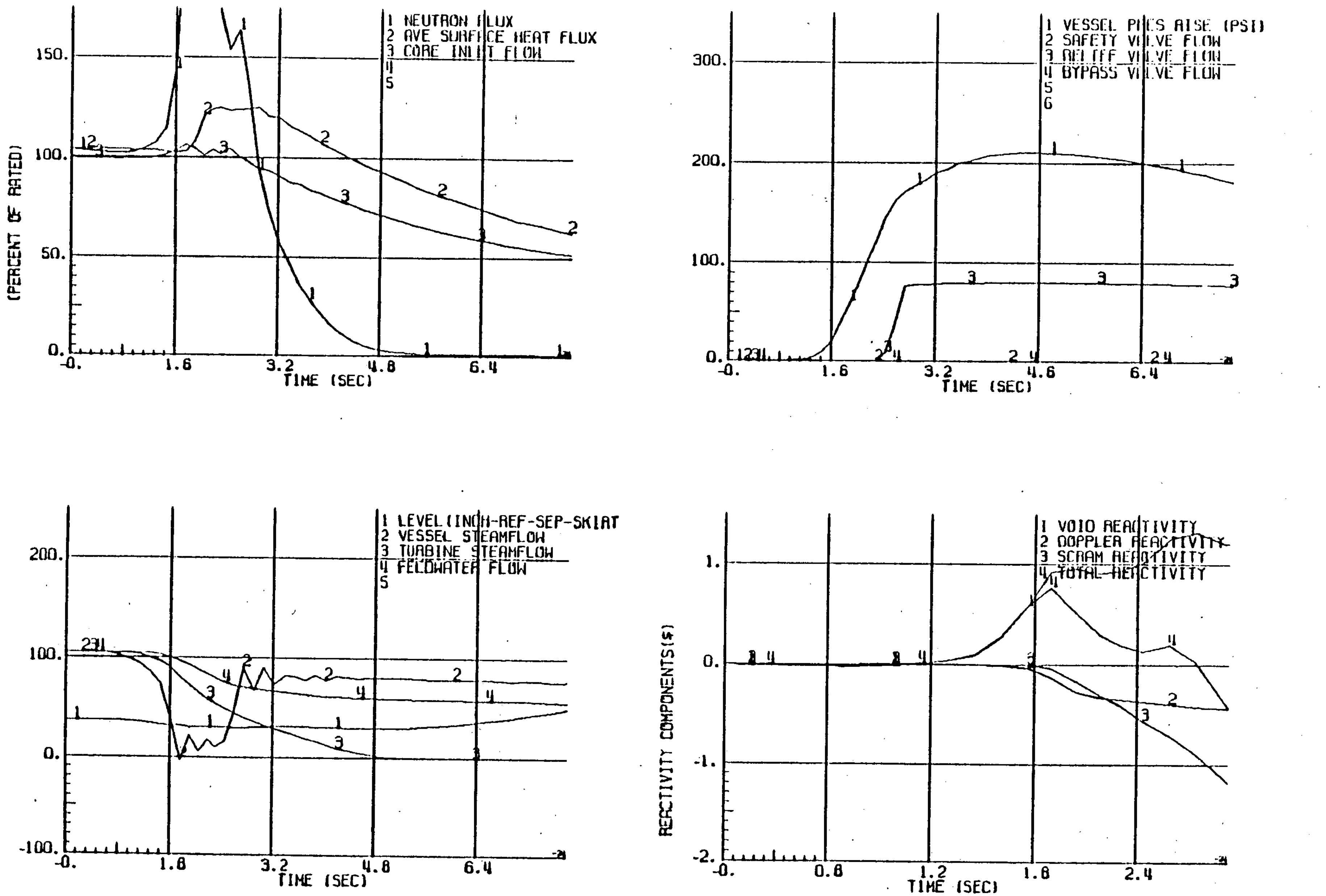


Figure 5. Plant Response to MSIV Closure, Flux Scram (104% Power/100% Flow)

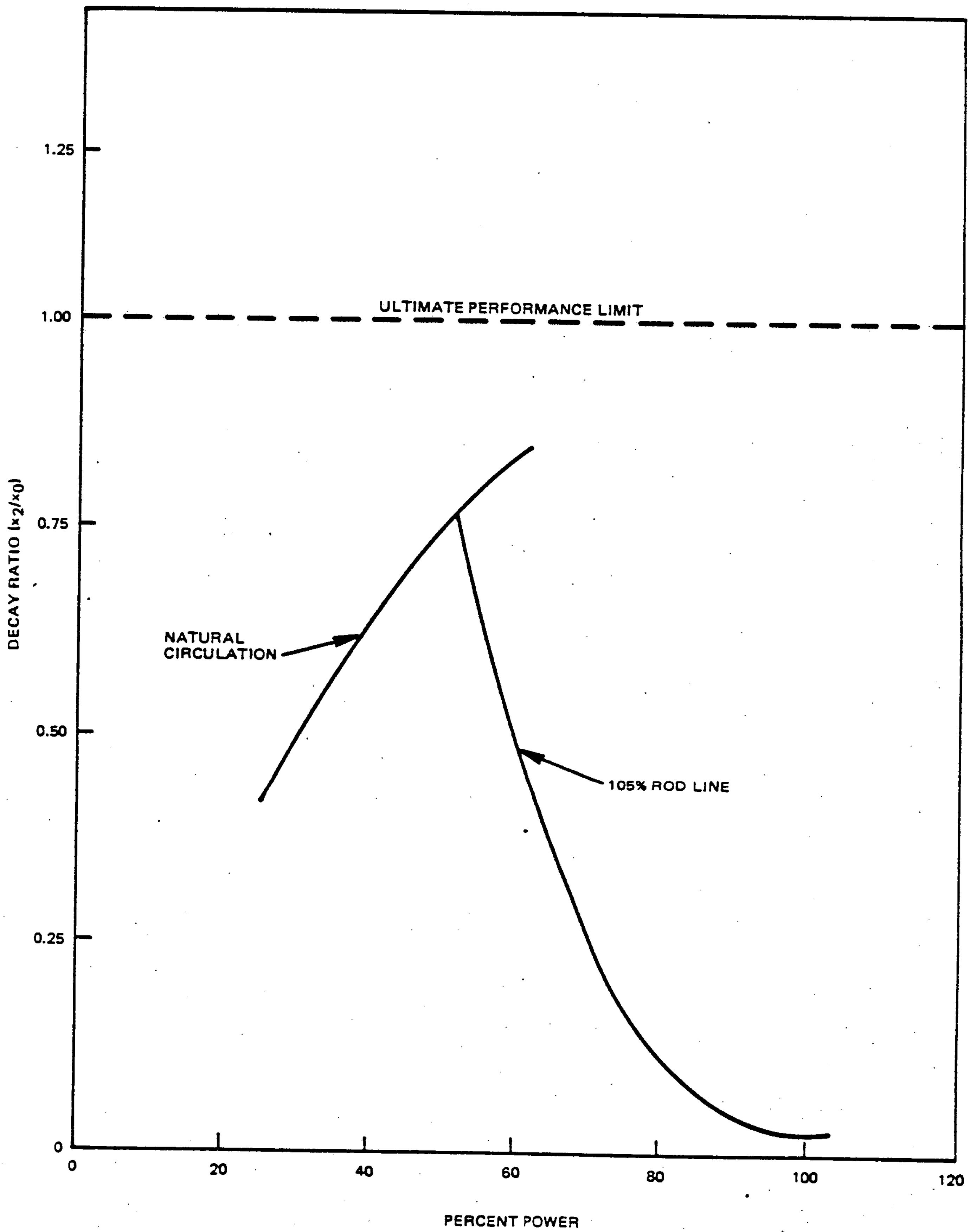


Figure 6. Reactor Core Decay Ratio

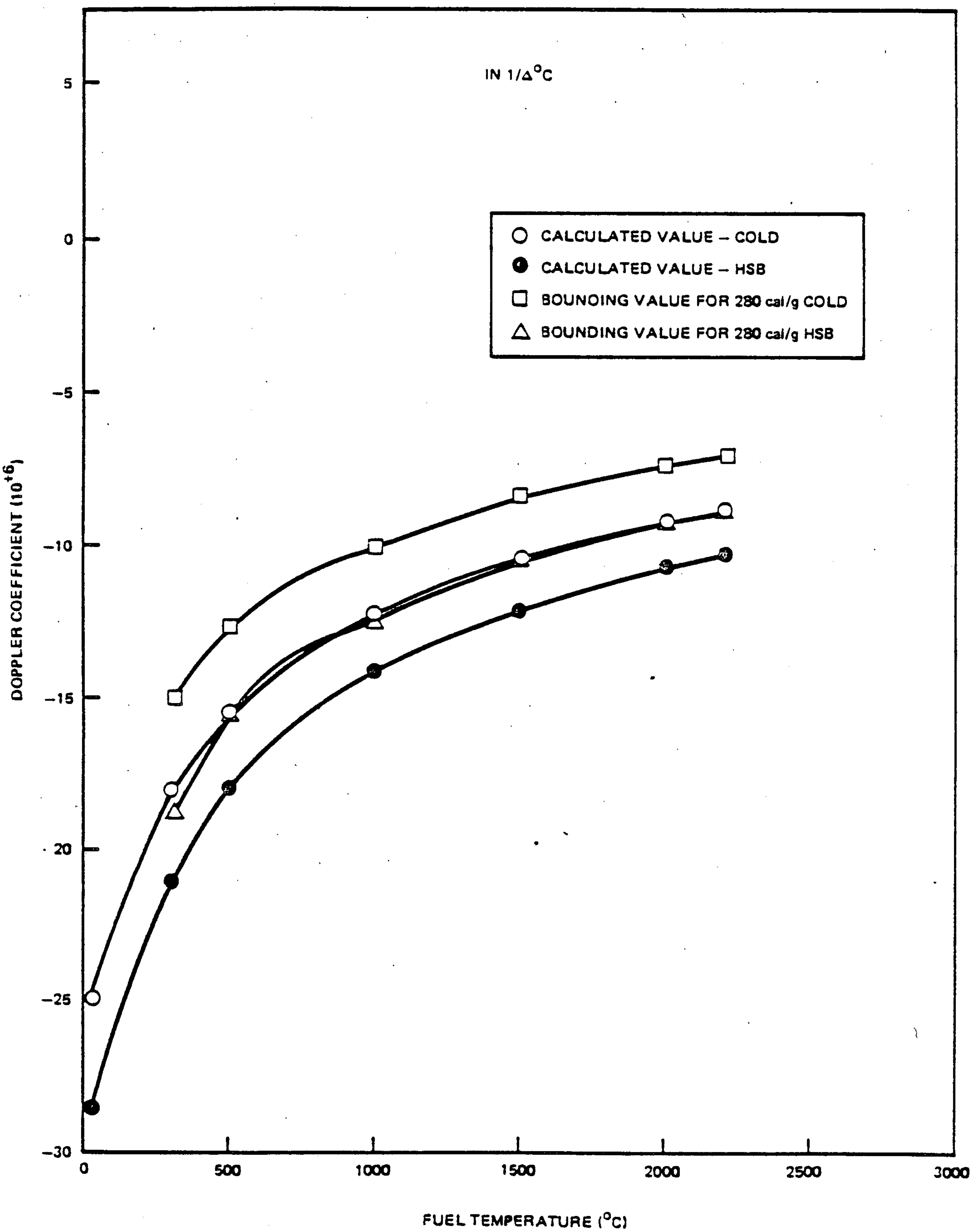


Figure 7. Doppler Reactivity Coefficient Comparison for RDA

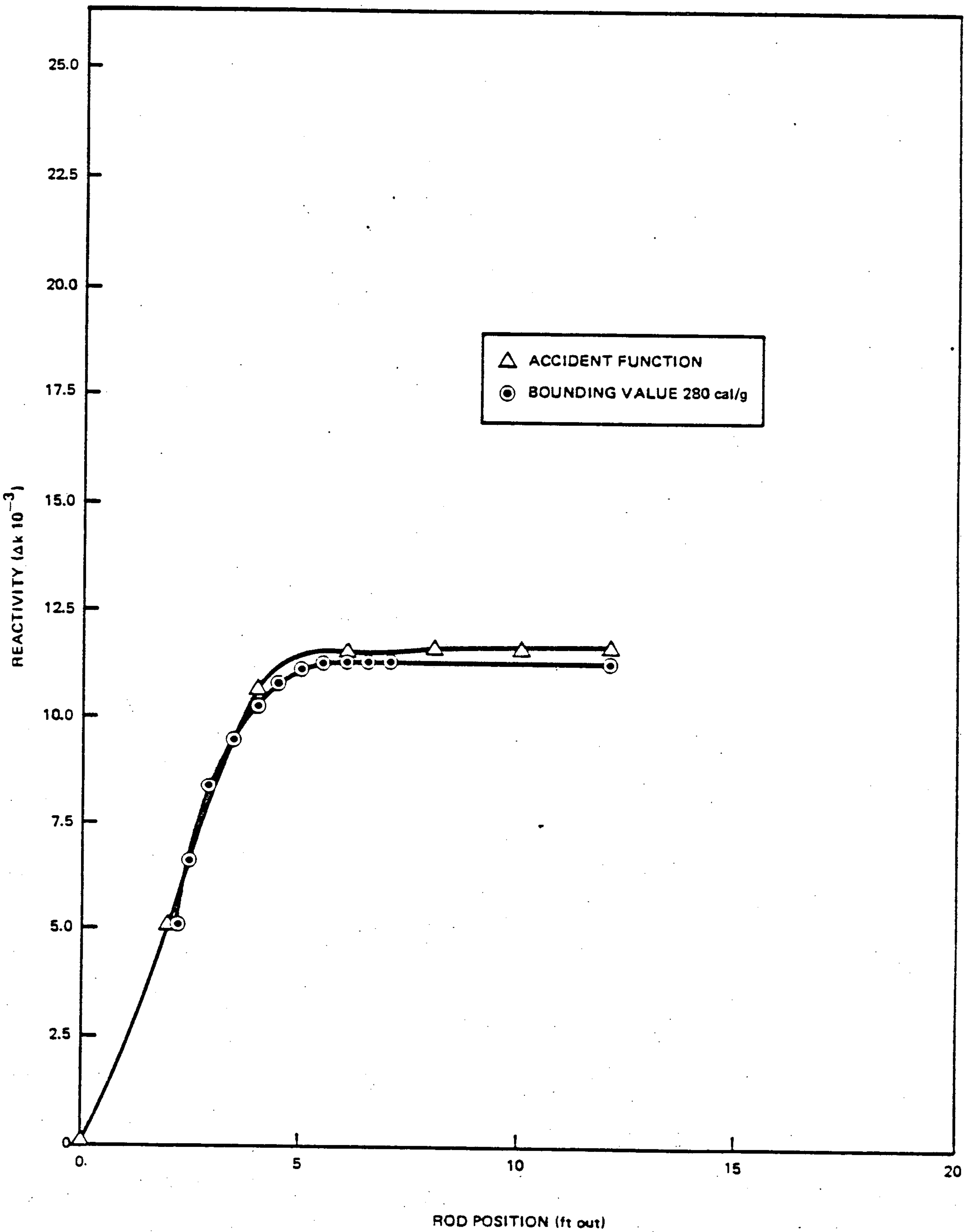


Figure 8. RDA Reactivity Shape Function at 20°C

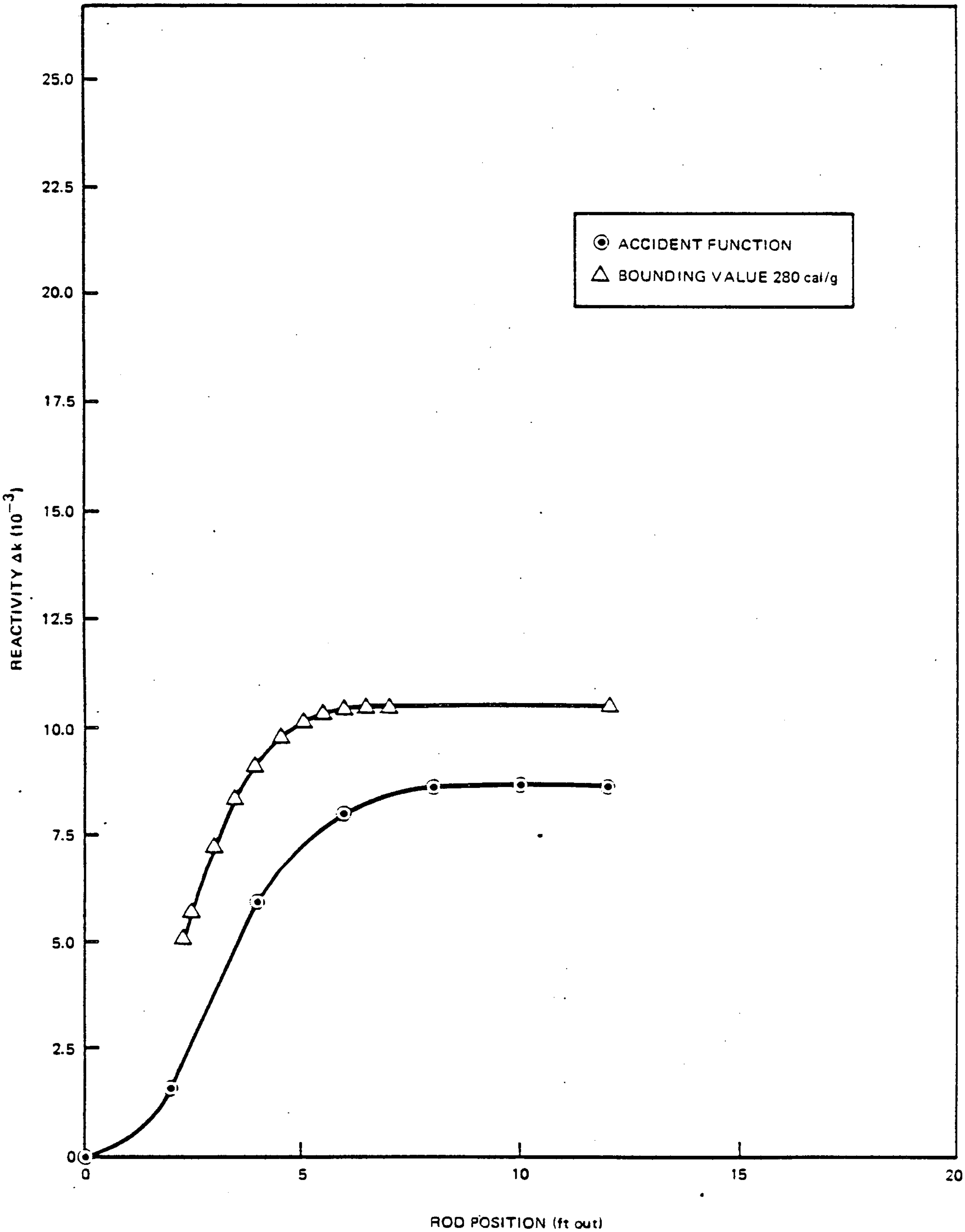


Figure 9. RDA Reactivity Shape Function at 286°C

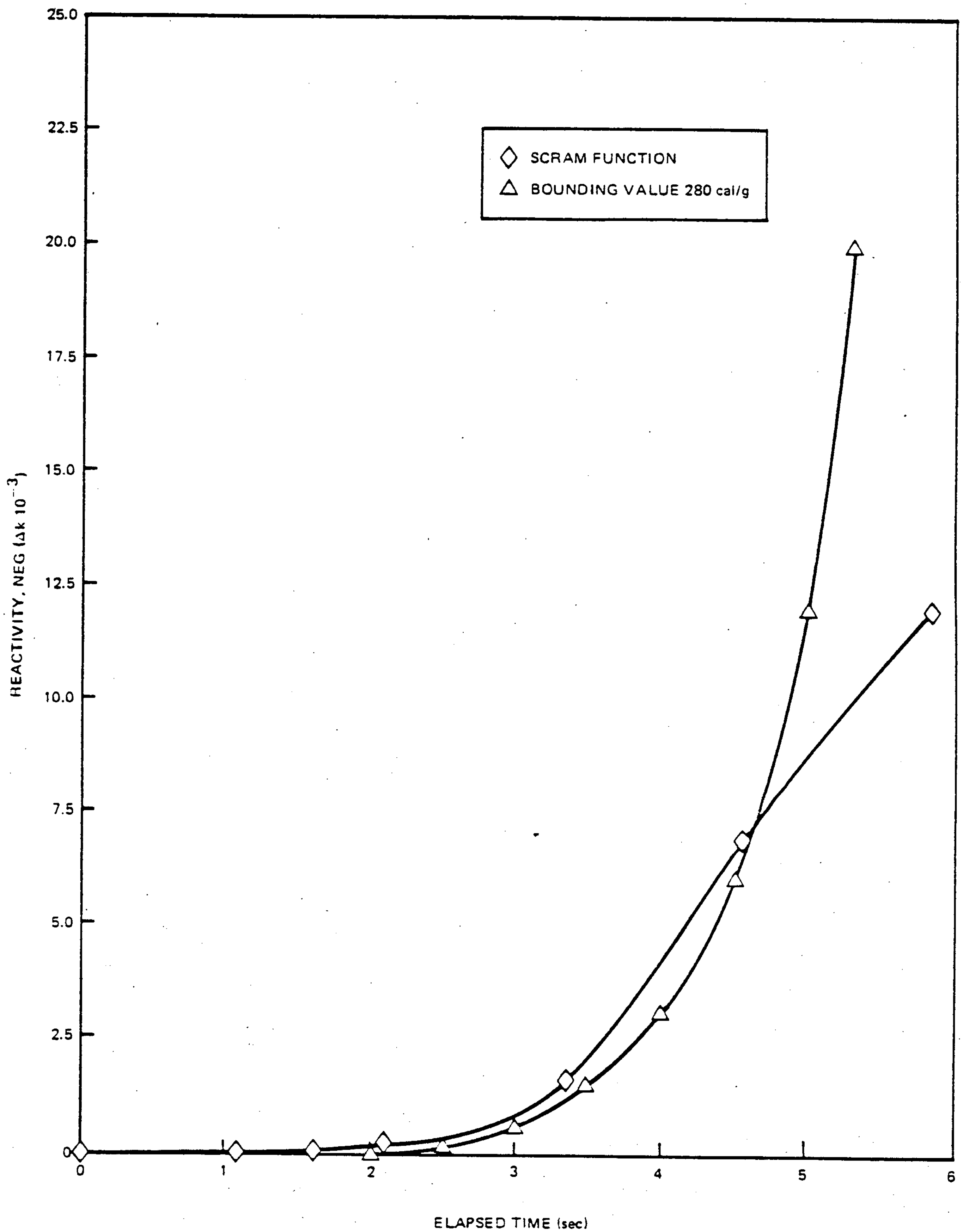


Figure 10. RDA Scram Reactivity Function at 20°C

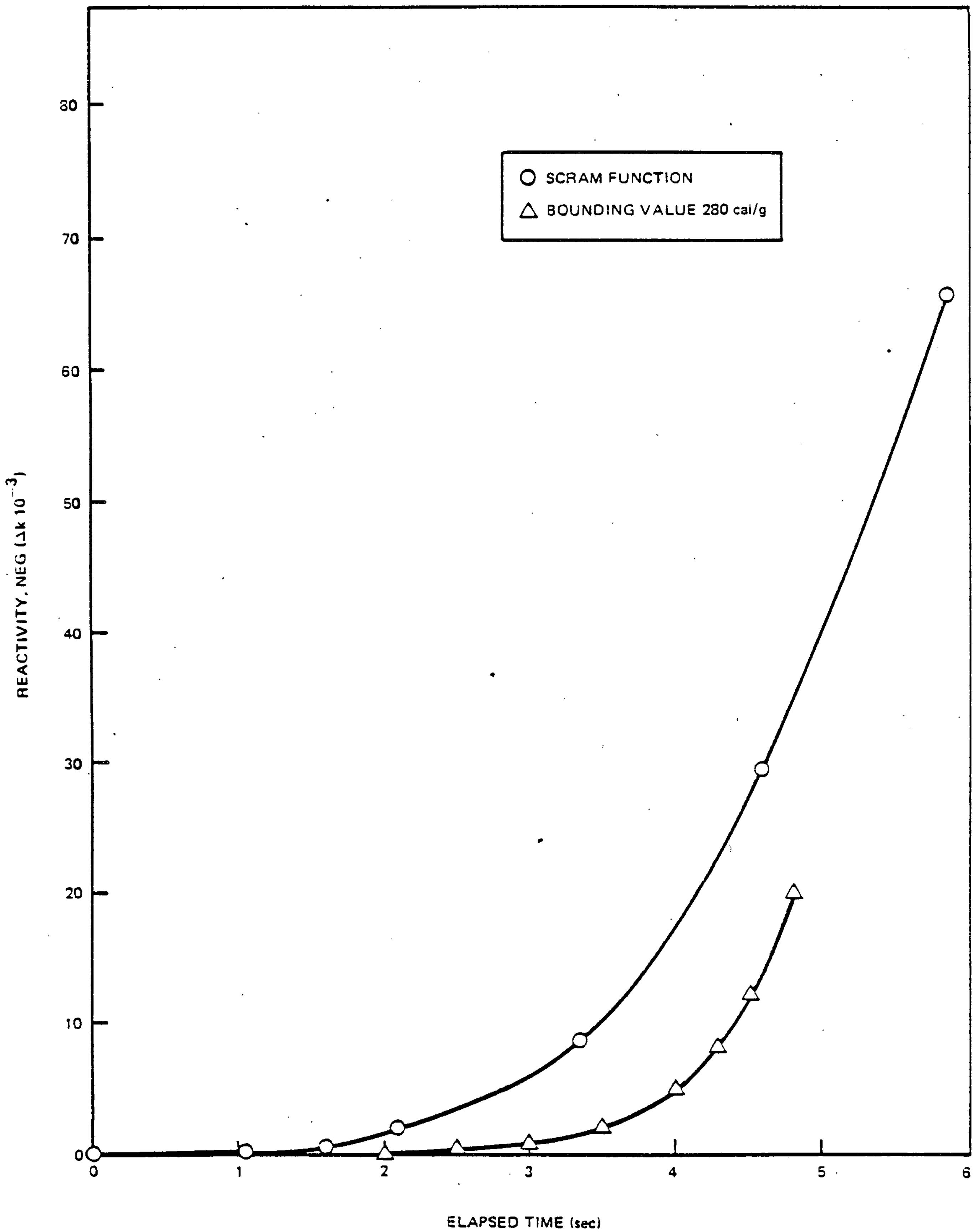


Figure 11. RDA Scram Reactivity Function at 286°C

APPENDIX A

OPERATING FLEXIBILITY OPTIONS

The following operating flexibility options have been developed for BWRs. A "Yes" indicates that the option has been verified as being applicable to Cycle 7.

a. Single Loop Operation: Yes

b. Load Line Limit: Yes

c. Extended Load Line Limit: No

d. Increased Core Flow: No

e. Feedwater Temperature Reduction: No