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# SUPPLEMENTAL RELOAD LICENSING SUBMITTAL FOR JAMES A. FITZPATRICK NUCLEAR POWER PLANT RELOAD 5



GENERAL ELECTRIC

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# SUPPLEMENTAL RELOAD LICENSING SUBMITTAL
# FOR
# JAMES A. FITZPATRICK NUCLEAR POWER PLANT
# RELOAD 5

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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: GETAB Analysis Initial Conditions

Appendix B: Verification of Operating Flexibility Options

Appendix C: Full Arc Operation

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

| Fuel Type | Cycle Loaded | Number | Number Drilled |
|---|---|---|---|
| Irradiated | | | |
| 8DRB283 | 3 | 12 | 12 |
| P8DRB265L | 4 | 24 | 24 |
| P8DRB283 | 4 | 136 | 136 |
| P8DRB284H | 5 | 128 | 128 |
| P8DRB299 | 5 | 60 | 60 |
| New | | | |
| P8DRB299 | 6 | 200 | 200 |
| Total | | 560 | 560 |

3. REFERENCE CORE LOADING PATTERN (3.3.1)

Nominal previous cycle core average exposure at end of cycle: 17232 MWd/st
Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations: 17050 MWd/st
Assumed reload cycle core average exposure at end of cycle: 17509 MWd/st
Core loading pattern: Figure 1

*( ) Refers to area of discussion in "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-4, January 1982; a letter "S" preceding the number refers to the United States supplement.

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-effective | |
| Uncontrolled | 1.112 |
| Fully Controlled | 0.957 |
| Strongest Control Rod Out | 0.989 |
| 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 | 0.026 |

6. RELOAD UNIQUE TRANSIENT ANALYSIS INPUT (3.3.2.1.5 and S.2.2) (REDY EVENTS ONLY)

| | EOC | EOC-1000 MWd/st | EOC-2000 MWd/st |
|---|---|---|---|
| Void Fraction (%) | 41.7 | 41.7 | 41.7 |
| Average Fuel Temperature (°F) | 1271 | 1271 | 1271 |
| Void Coefficient N/A* (¢/% Rg) | -9.19/-11.49 | -9.99/-12.49 | -10.37/-12.96 |
| Doppler Coefficient N/A (¢/°F) | -0.234/-0.222 | -0.229/-0.218 | -0.224/-0.213 |
| 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-4, January 1982.

## 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: EOC | | | | | | | |
| 8x8R | 1.20 | 1.45 | 1.40 | 1.051 | 6.193 | 116.8 | 1.31 |
| P8x8R | 1.20 | 1.42 | 1.40 | 1.051 | 6.059 | 117.7 | 1.34 |
| Exposure: EOC-1000 MWd/st | | | | | | | |
| 8x8R | 1.20 | [illegible] | 1.40 | 1.051 | 6.338 | 116.0 | 1.28 |
| P8x8R | 1.20 | [illegible]45 | 1.40 | 1.051 | 6.194 | 116.9 | 1.31 |
| Exposure: EOC-2000 MWd/st | | | | | | | |
| 8x8R | 1.20 | 1.54 | 1.40 | 1.051 | 6.550 | 114.8 | 1.24 |
| P8x8R | 1.20 | 1.51 | 1.40 | 1.051 | 6.424 | 115.6 | 1.26 |

## 8. SELECTED MARGIN IMPROVEMENT OPTIONS (S.2.2.2)

Transient Recategorization: No

Recirculation Pump Trip : No

Rod Withdrawal Limiter : No

Thermal Power Monitor : Yes

ODYN Option B

Improved Scram Time : Yes

Exposure Dependent Limits . Yes

Exposure Points Analyzed : EOC, EOC-1000 MWd/st, EOC-2000 MWd/st

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

| Transient | Exposure (MWd/st) | Flux (% NBR) | Q/A (% NBR) | ΔCPR 8x8R | ΔCPR P8x8R | Figure |
|---|---|---|---|---|---|---|
| Load Rejection Without Bypass | EOC | 615 | 128 | 0.24 | 0.27 | 2a |
| | EOC-1000 | 550 | 125 | 0.21 | 0.24 | 2b |
| | EOC-2000 | 484 | 121 | 0.17 | 0.19 | 2c |
| Loss of 80°F Feedwater Heating | EOC | 122 | 121 | 0.13 | 0.13 | 3 |
| Feedwater Controller Failure | EOC | 442 | 126 | 0.21 | 0.23 | 4a |
| | EOC-1000 | 309 | 122 | 0.17 | 0.19 | 4b |
| | EOC-2000 | 248 | 118 | 0.13 | 0.14 | 4c |

10. 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 (ft withdrawn) | ΔCPR 8x8R/P8x8R | MLHGR (kW/ft) 8x8R/P8x8R |
|---|---|---|---|
| 104 | 3.5 | 0.12 | 14.17 |
| 105 | 4.0 | 0.14 | 14.72 |
| 106 | 4.5 | 0.15 | 14.84 |
| 107 | 5.0 | 0.17 | 14.84 |
| 108 | 5.5 | 0.18 | 14.84 |
| 109 | 6.0 | 0.20 | 14.84 |
| 110 | 9.0 | 0.26 | 16.23 |

Set Point Selected: 108

11. CYCLE MCPR VALUES (S.2.2)

Non-Pressurization Events

| Exposure Range: BOC to EOC | P8x8R | 8x8R |
|---|---|---|
| Loss of 80°F Feedwater Heating | 1.20 | 1.20 |
| Fuel Loading Error | 1.20 | -- |
| Rod Withdrawal Error | 1.25 | 1.25 |

Pressurization Events

| | Option A P8x8R | Option A 8x8R | Option B P8x8R | Option B 8x8R |
|---|---|---|---|---|
| Exposure Range: | | | | |
| BOC to EOC-2000 MWd/st | | | | |
| Load Rejection Without Bypass | 1.32 | 1.29 | 1.11 | 1.10 |
| Feedwater Controller Failure | 1.26 | 1.25 | 1.20 | 1.19 |
| Exposure Range: | | | | |
| EOC-2000 MWd/st to EOC-1000 MWd/st | | | | |
| Load Rejection Without Bypass | 1.37 | 1.34 | 1.15 | 1.13 |
| Feedwater Controller Failure | 1.32 | 1.29 | 1.25 | 1.23 |
| Exposure Range: | | | | |
| EOC-1000 MWd/st to EOC | | | | |
| Load Rejection Without Bypass | 1.40 | 1.37 | 1.28 | 1.25 |
| Feedwater Controller Failure | 1.36 | 1.34 | 1.29 | 1.27 |

12. OVERPRESSURIZATION ANALYSIS SUMMARY (S.2.3)

| Transient | $P_{sl}$ (psig) | $P_v$ (psig) | Plant Response |
|---|---|---|---|
| MSIV Closure (Flux Scram) | 1218 | 1256 | Figure 6 |

13. STABILITY ANALYSIS RESULT (S.2.4)

Rod Line Analyzed: Extrapolated Rod Block

| | |
|---|---|
| Decay Ratio: | Figure 7 |
| Reactor Core Stability Decay Ratio, $x_2/x_0$ | 0.93 |
| Channel Hydrodynamic Performance Decay Ratio, $x_2/x_0$ | |
| Channel Type | |
| 8x8R/P8x8R | 0.30 |

14. LOADING ERROR RESULTS (S.2.5.4)

Variable Water Gap Misoriented Bundle Analysis: Yes

| Event | Initial CPR | Resulting CPR |
|---|---|---|
| Misoriented | 1.18 | 1.07 |

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

Bounding Analysis Results:

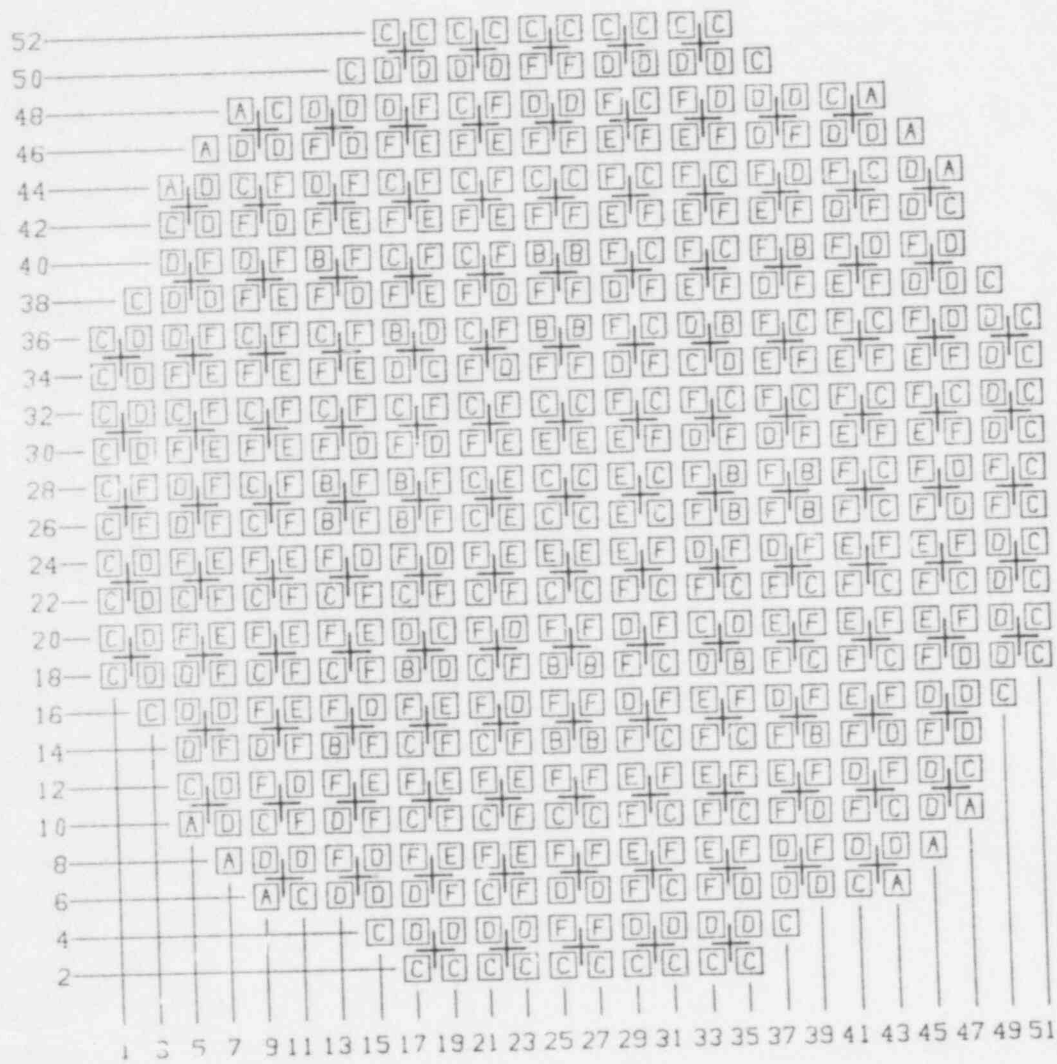
| | |
|---|---|
| Doppler Reactivity Coefficient: | Figure 8 |
| Accident Reactivity Shape Functions: | Figures 9 and 10 |
| Scram Reactivity Functions: | Figures 11 and 12 |

Plant Specific Analysis Results:

| | |
|---|---|
| Parameter(s) not Bounded, Cold: | Accident Reactivity |
| Resultant Peak Enthalpy, Cold: | 225.5 cal/gm |
| Parameter(s) not Bounded, HSB : | Accident Reactivity |
| Resultant Peak Enthalpy, HSB : | 272.2 cal/gm |

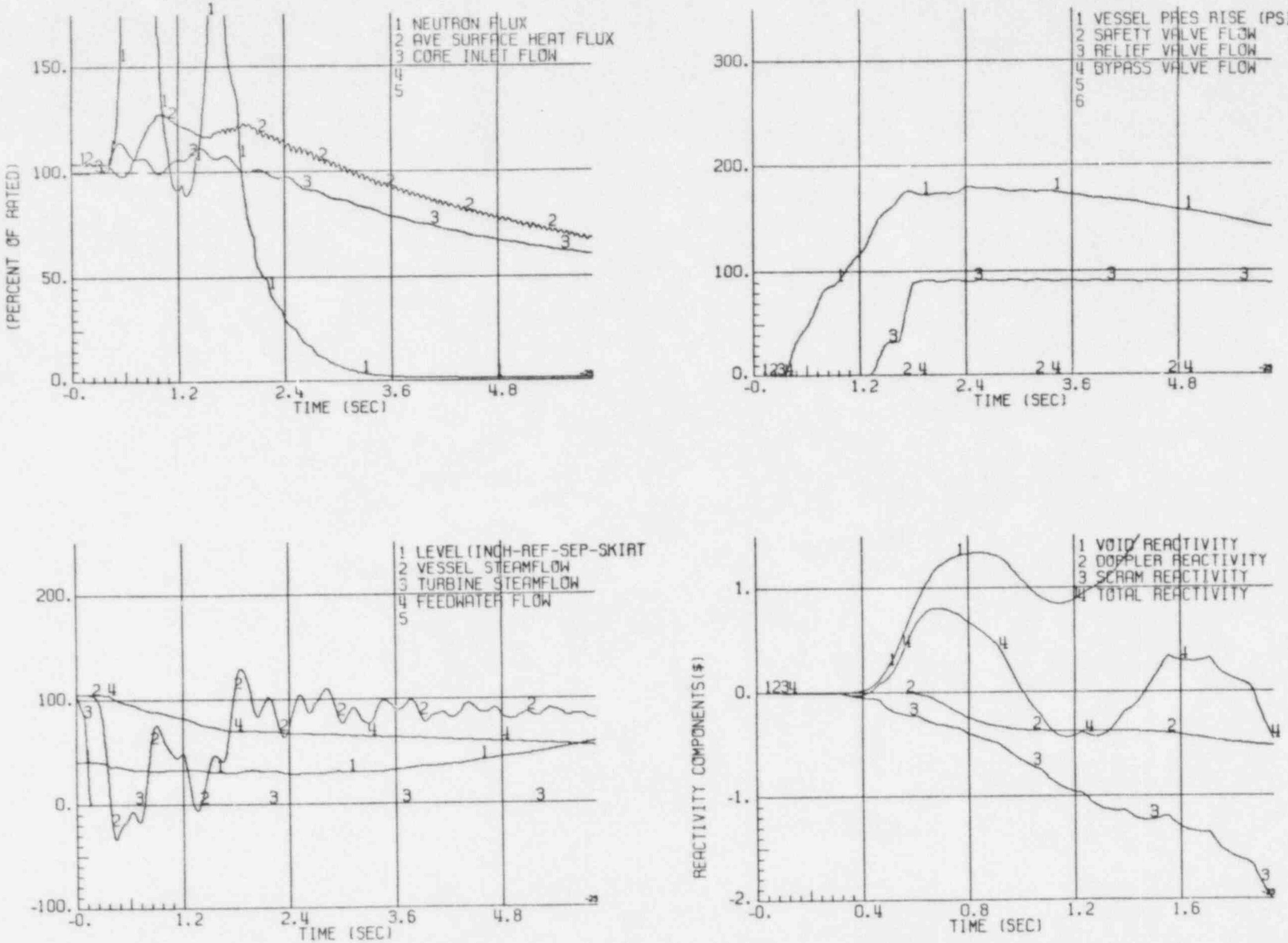
16. LOSS-OF-COOLANT ACCIDENT RESULT (S.2.5.2)

See "Loss-of-Coolant Accident Analysis Report for James A. FitzPatrick Nuclear Power Plant (Lead Plant)," July 1977, NEDO-21662 (as amended).



| FUEL TYPE | |
|---|---|
| A = 8DRB283 | D = P8DRB284H |
| B = P8DRB265L | E = P8DRB299 |
| C = P8DRB283 | F = P8DRB299 |

Figure 1. Reference Core Loading Pattern




F'gure 2a. Plant Response to Load Rejection Without Bypass (EOC)

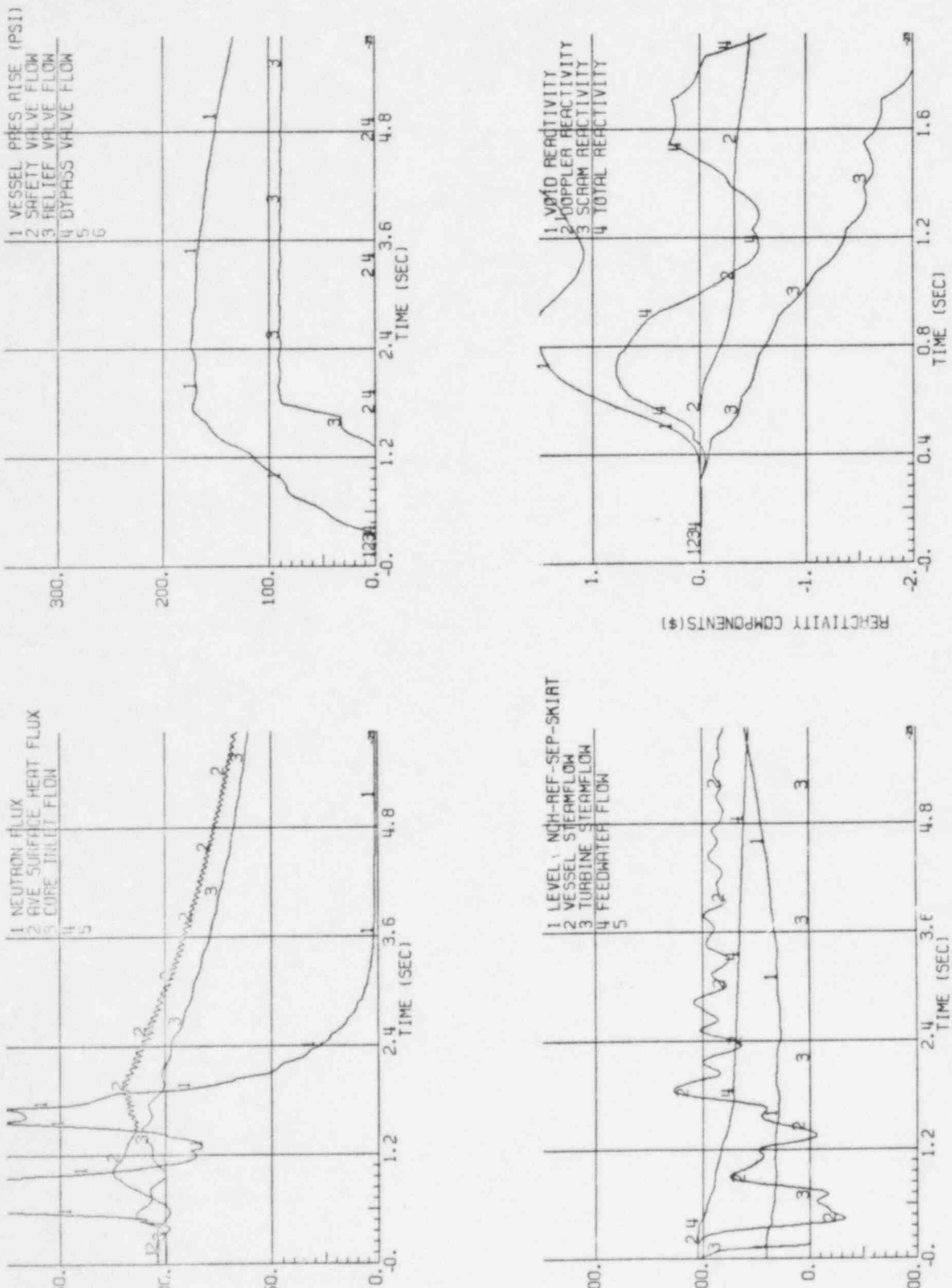



Figure 2b. Plan Response to Load Rejection Without Bypass (EOC-1000 MWd/st)

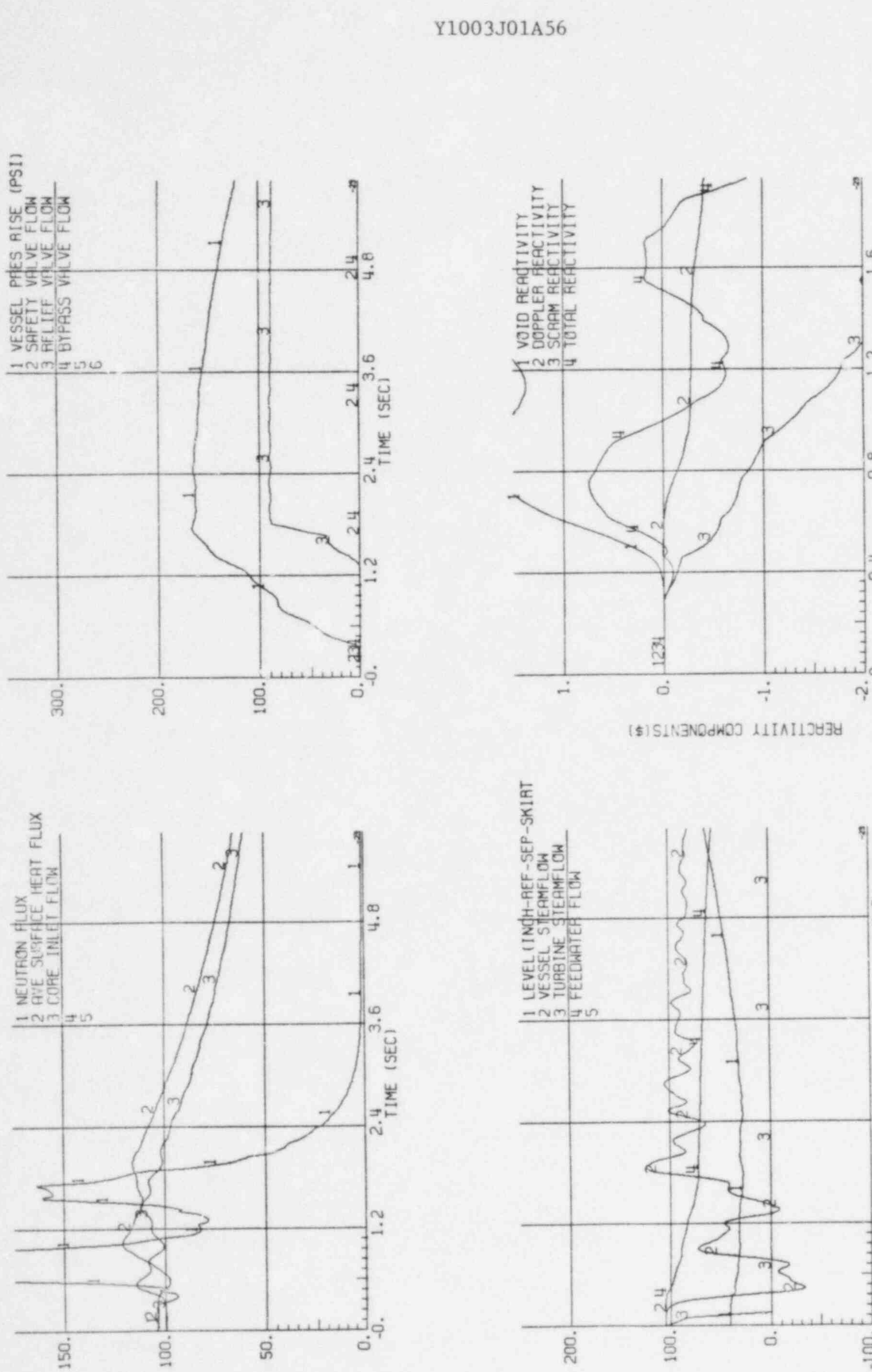



Figure 2c. Plant Response to Load Rejection Without Bypass (EOC-2000 MWd/st)

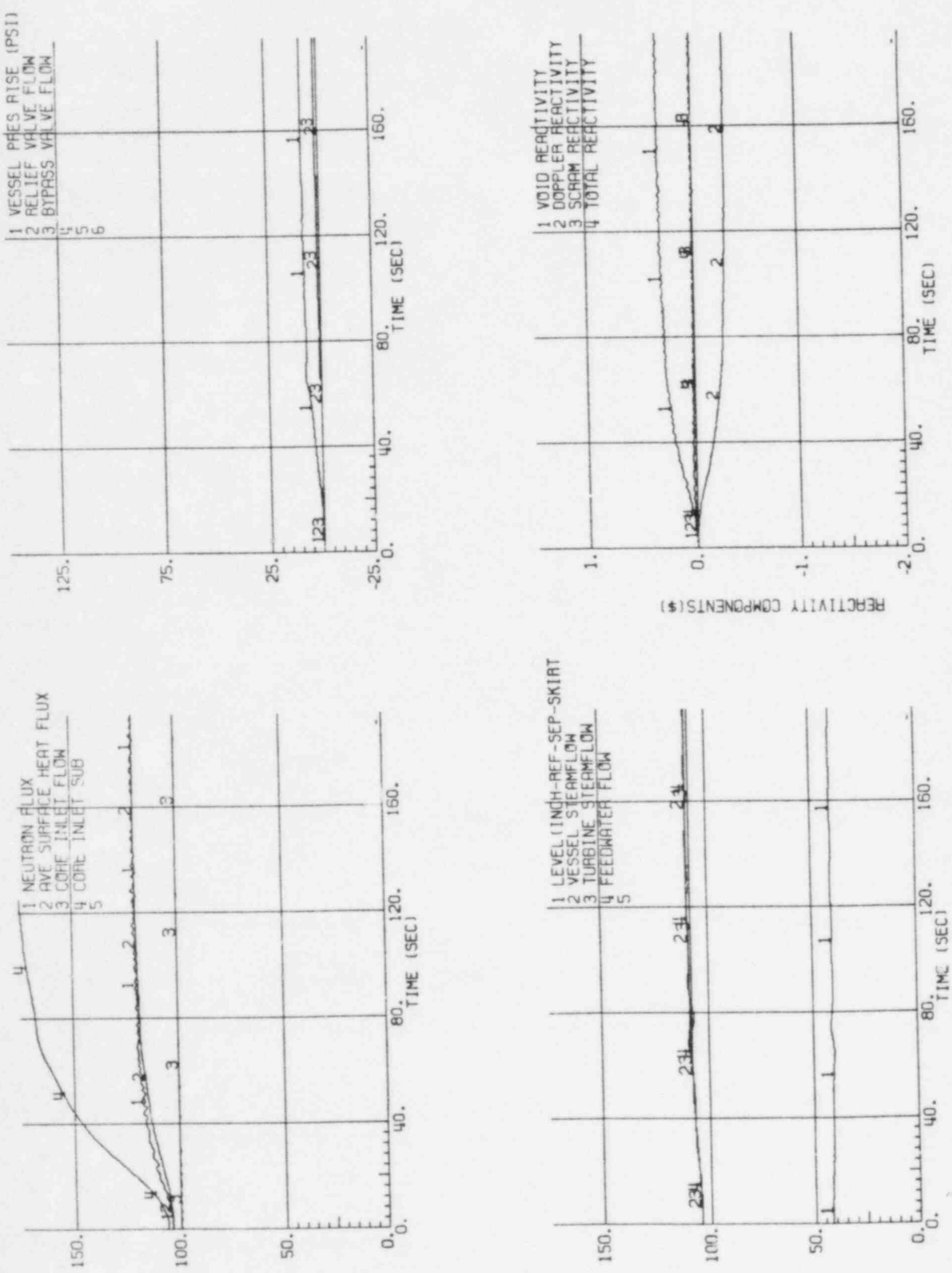



Figure 3. Plant Response to Loss of 80°F Feedwater Heating

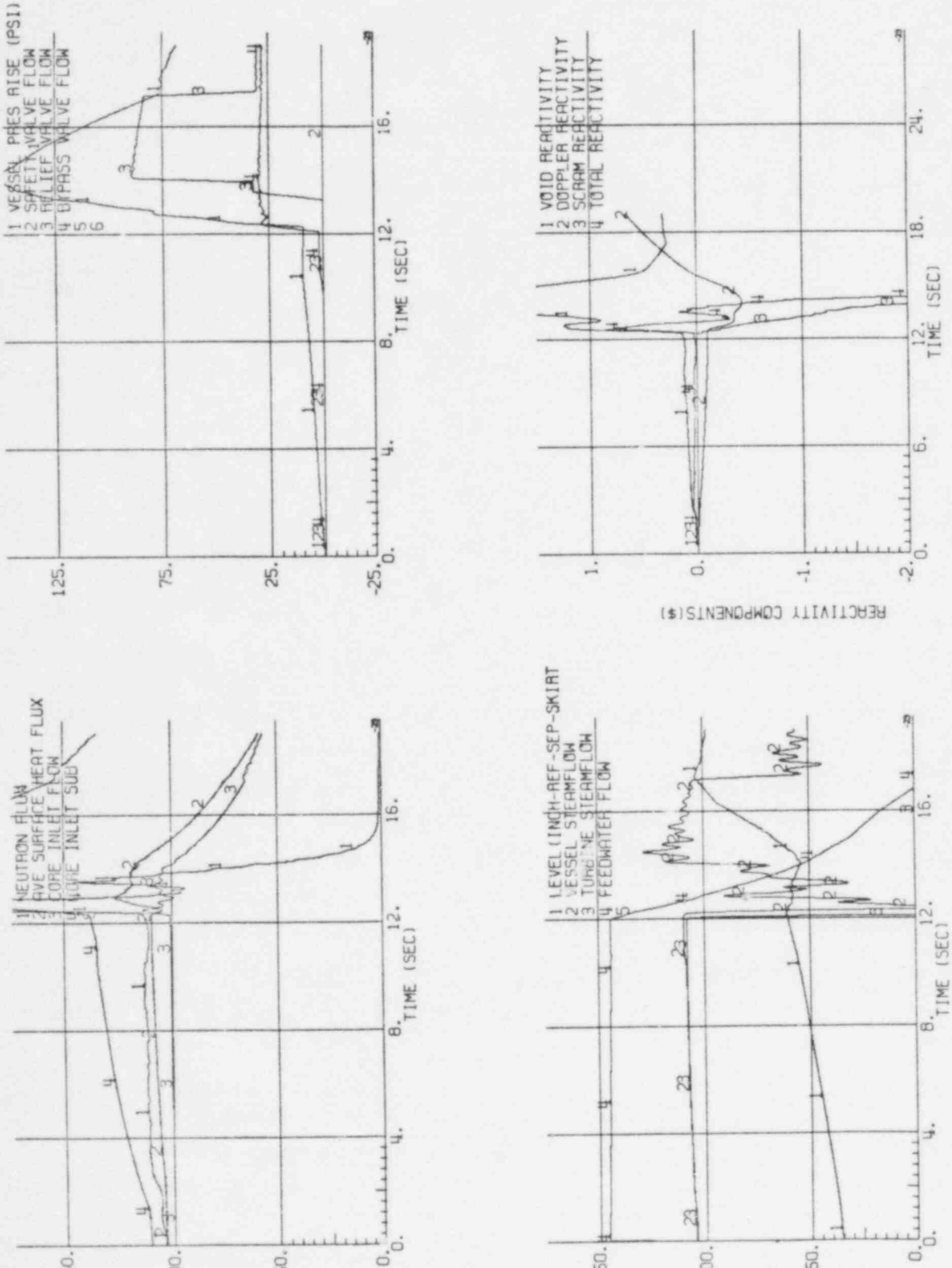



Figure 4a. Plant Response to Feedwater Controller Failure (EOC)

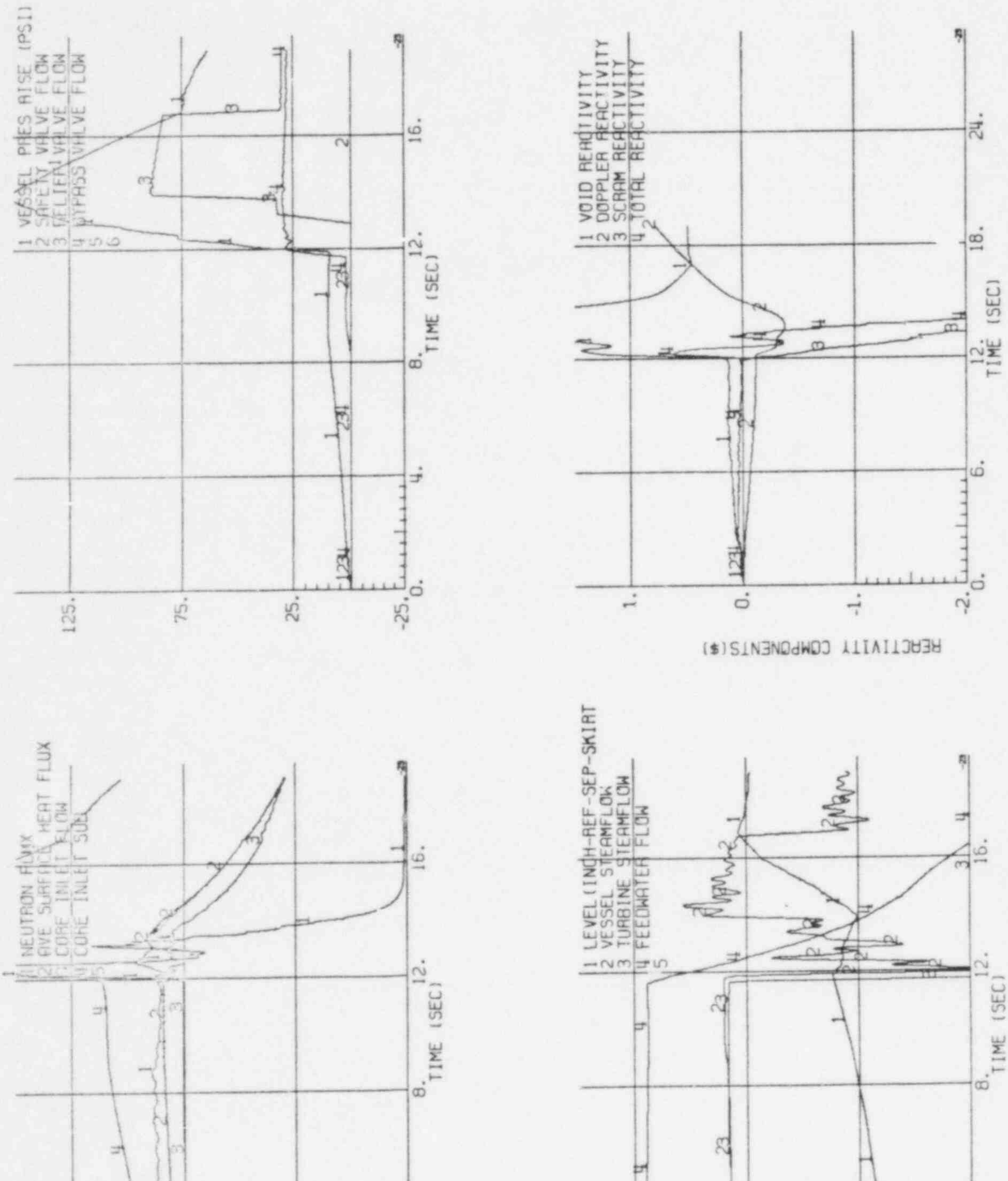



Figure 4b. Plant Response to Feedwater Controller Failure (EOC-1000 MWd/st)

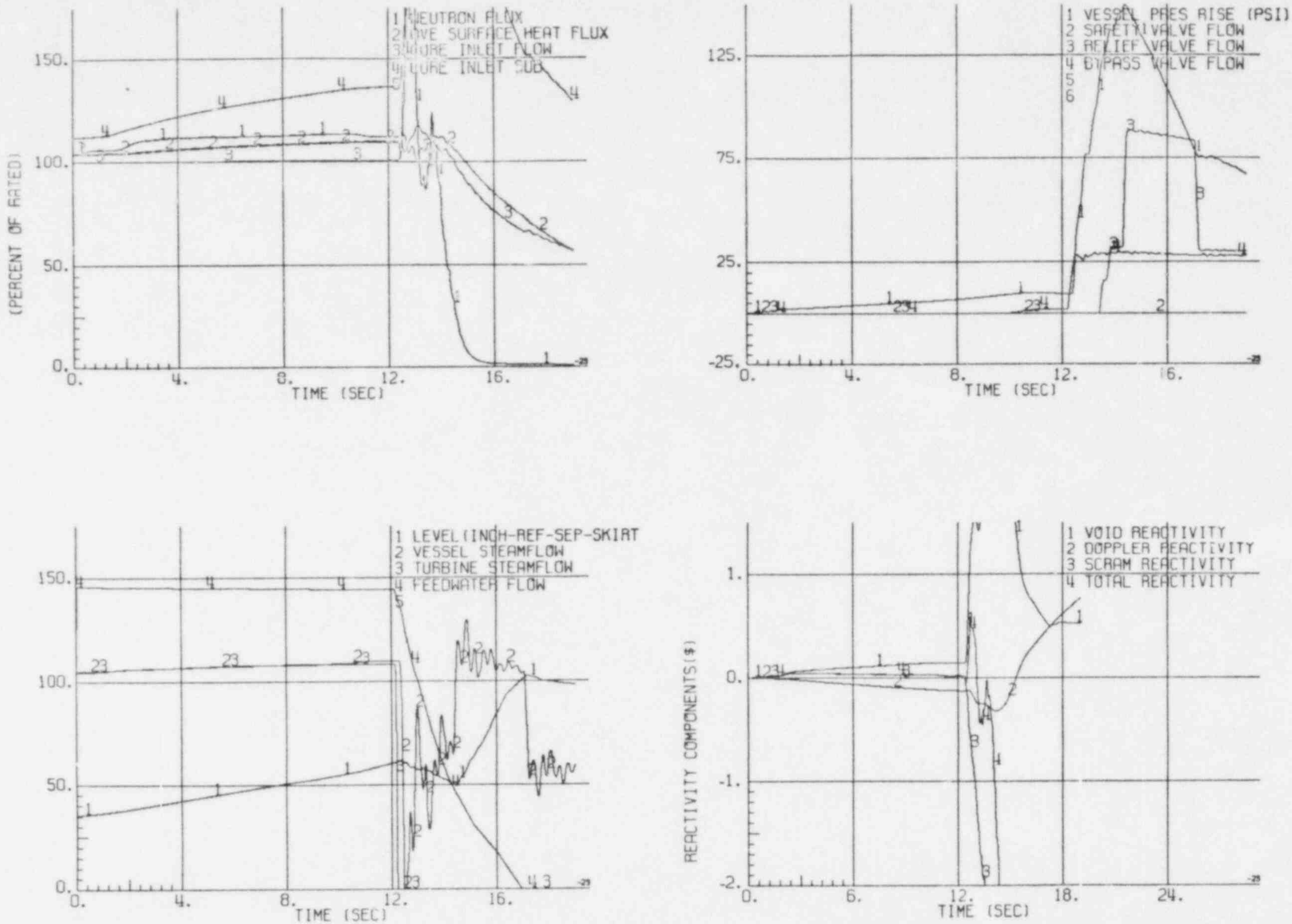



Figure 4c. Plant Response to Feedwater Controller Failure (EOC-2000 MWd/st)

| | 2 | 6 | 10 | 14 | 18 | 22 | 26 | 30 | 34 | 38 | 42 | 46 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | | | | | 36 | | 36 | | 36 | | | | |
| 47 | | | | 6 | | 6 | | 6 | | 6 | | | |
| 43 | | | 36 | | 36 | | 36 | | 36 | | 36 | | |
| 39 | | 6 | | 6 | | 12 | | 12 | | 6 | | 6 | |
| 35 | 36 | | 36 | | 40 | | 44 | | 40 | | 36 | | 36 |
| 31 | | 6 | | 12 | | 0 | | 0 | | 12 | | 6 | |
| 27 | 36 | | 36 | | 44 | | 40 | | 44 | | 36 | | 36 |
| 23 | | 0 | | 12 | | 0 | | 0 | | 12 | | 6 | |
| 19 | 36 | | 36 | | 40 | | 44 | | 40 | | 36 | | 36 |
| 15 | | 6 | | 6 | | 12 | | 12 | | 6 | | 6 | |
| 11 | | | 36 | | 36 | | 36 | | 36 | | 36 | | |
| 7 | | | | 6 | | 6 | | 6 | | 6 | | | |
| 3 | | | | | 36 | | 36 | | 36 | | | | |

NOTES: 1. NUMBER INDICATES NUMBER OF NOTCHES WITHDRAWN OUT OF 48. BLANK IS A WITHDRAWN ROD
2. ERROR ROD IS (22,31).

Figure 5. Limiting RWE Rod Pattern

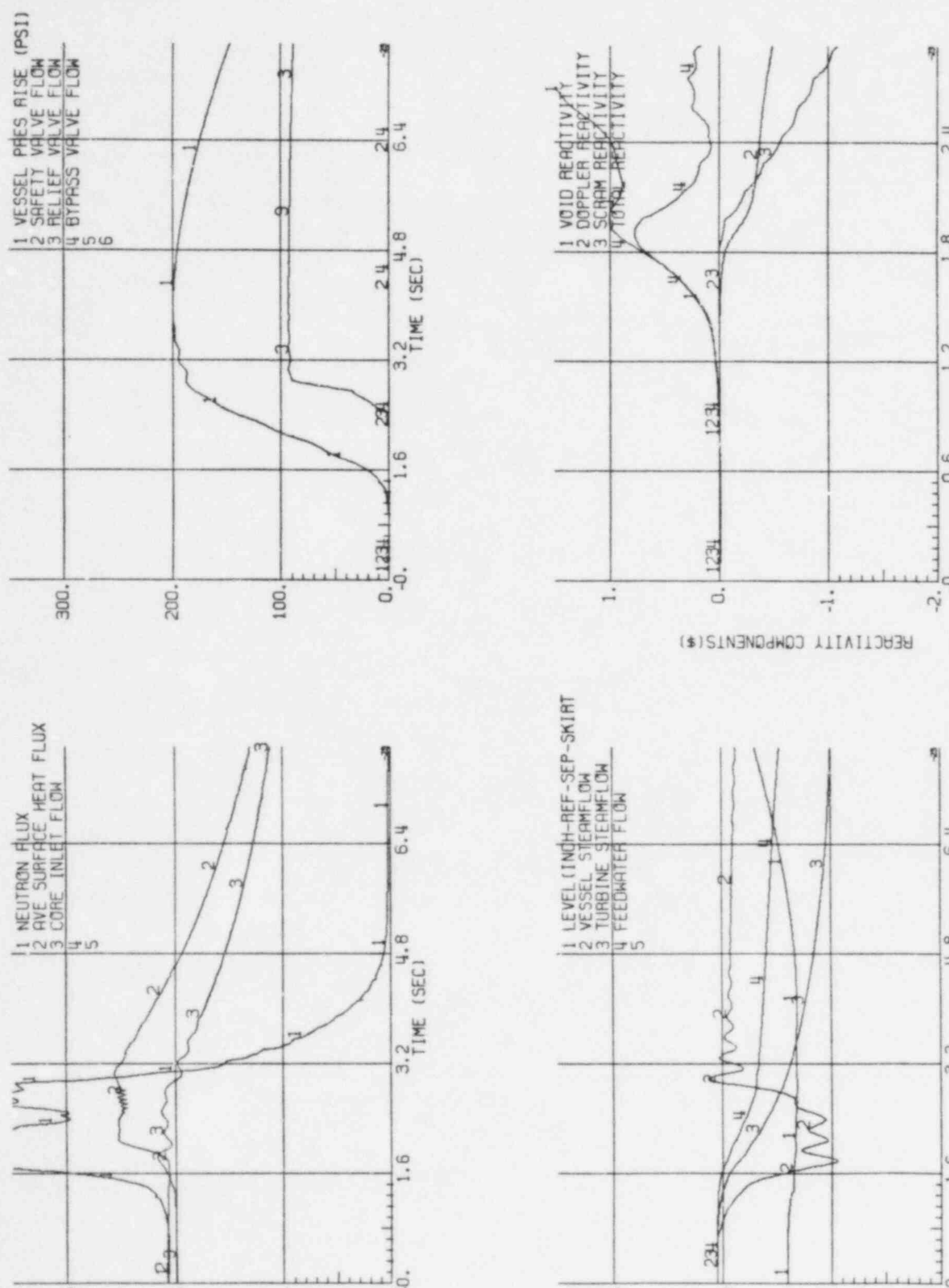



Figure 6. Plant Response to MSIV Closure (Flux Scram)

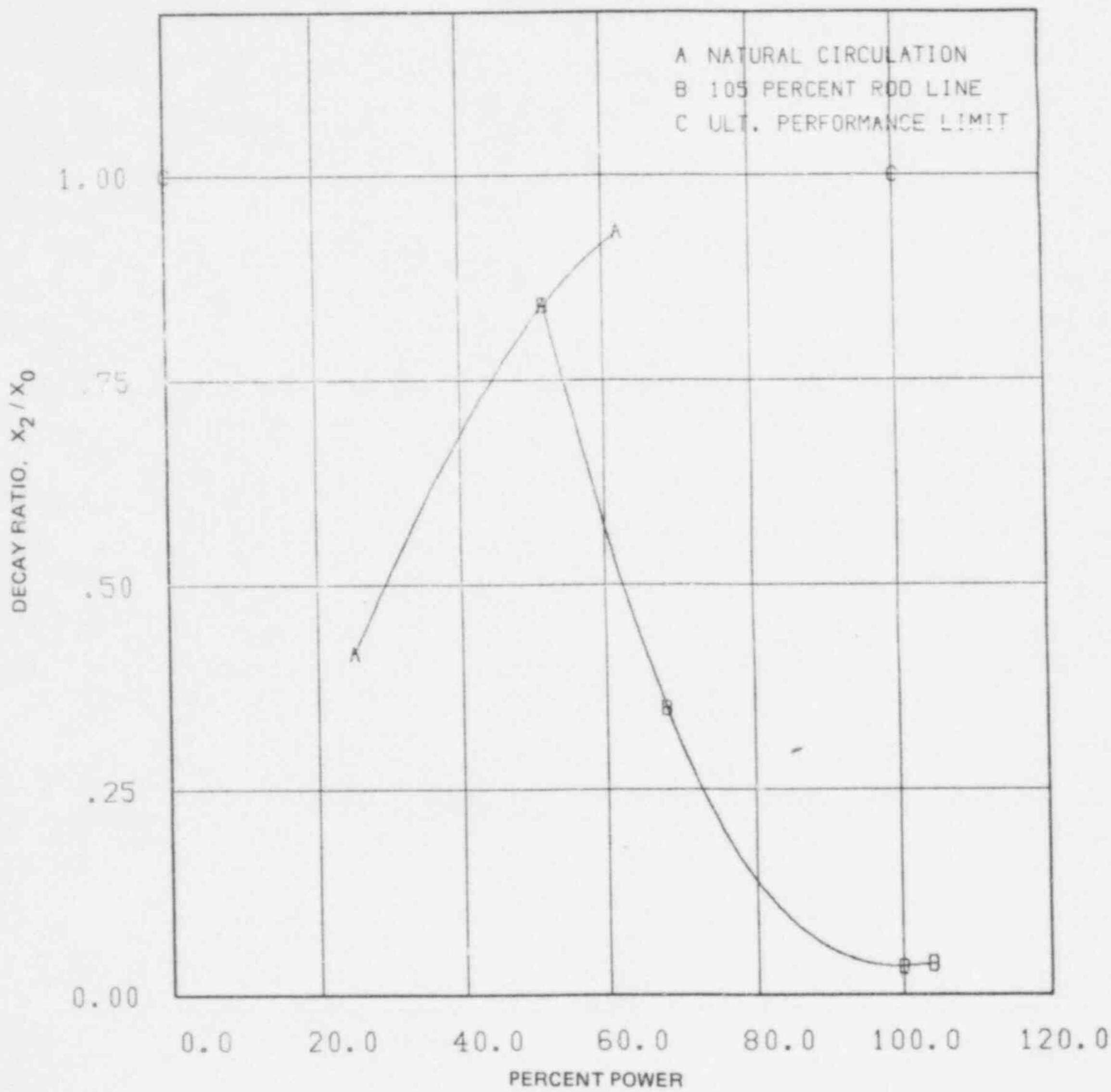



Figure 7. Reactor Core Decay Ratio versus Power

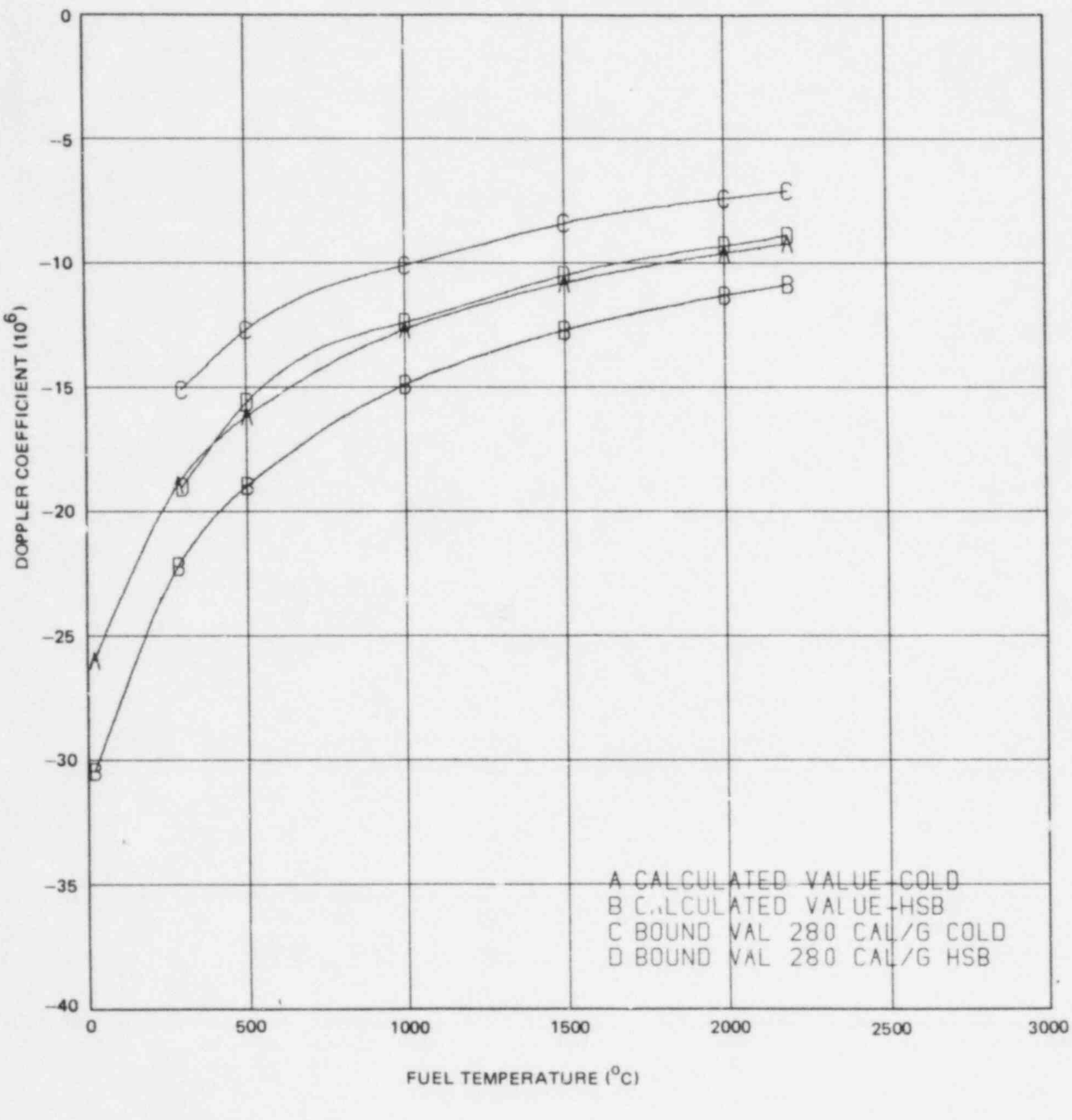



Figure 8. Doppler Reactivity Coefficient in 1/Δ °C

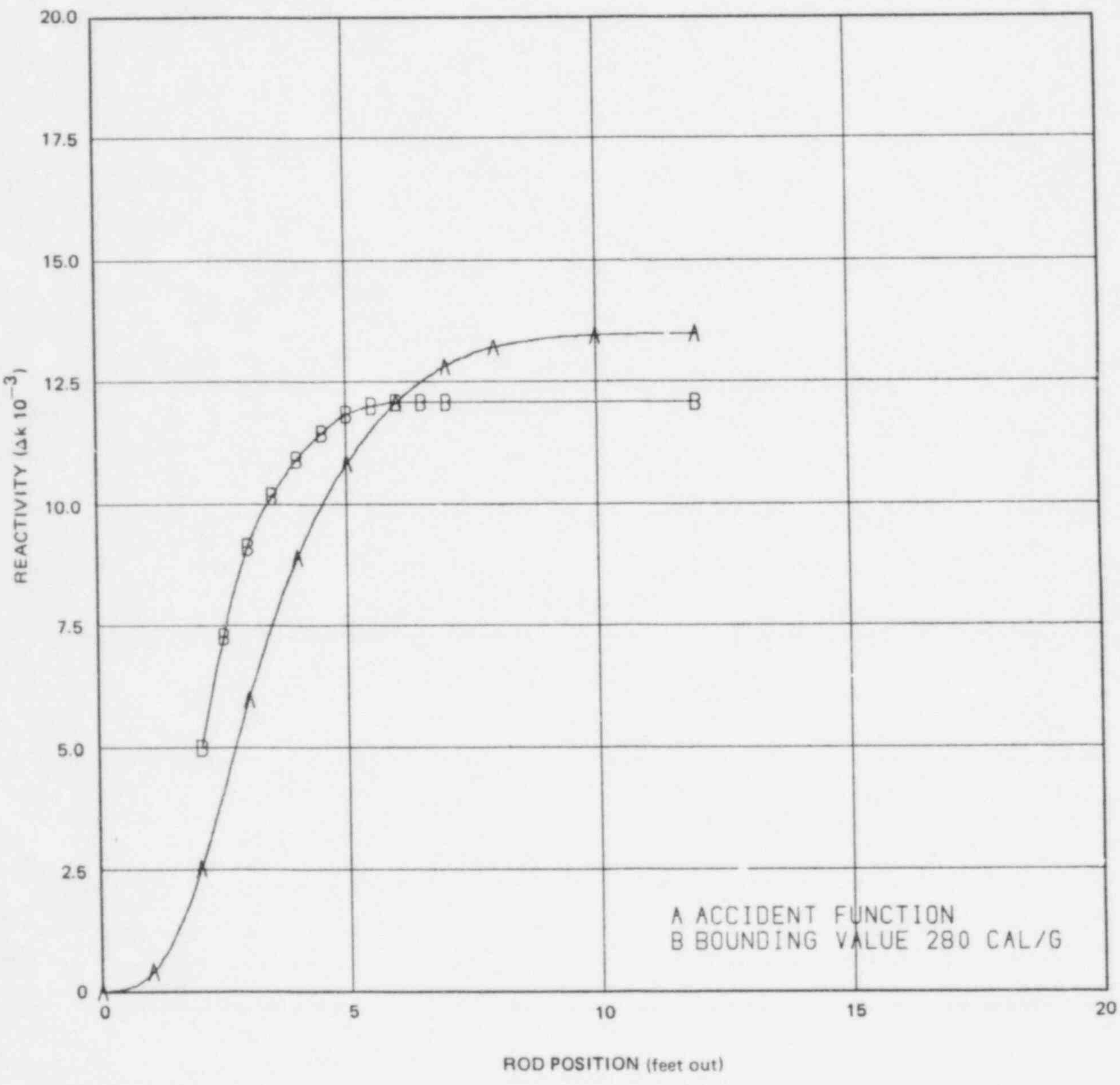



Figure 9. Accident Reactivity Shape Function, Cold Startup

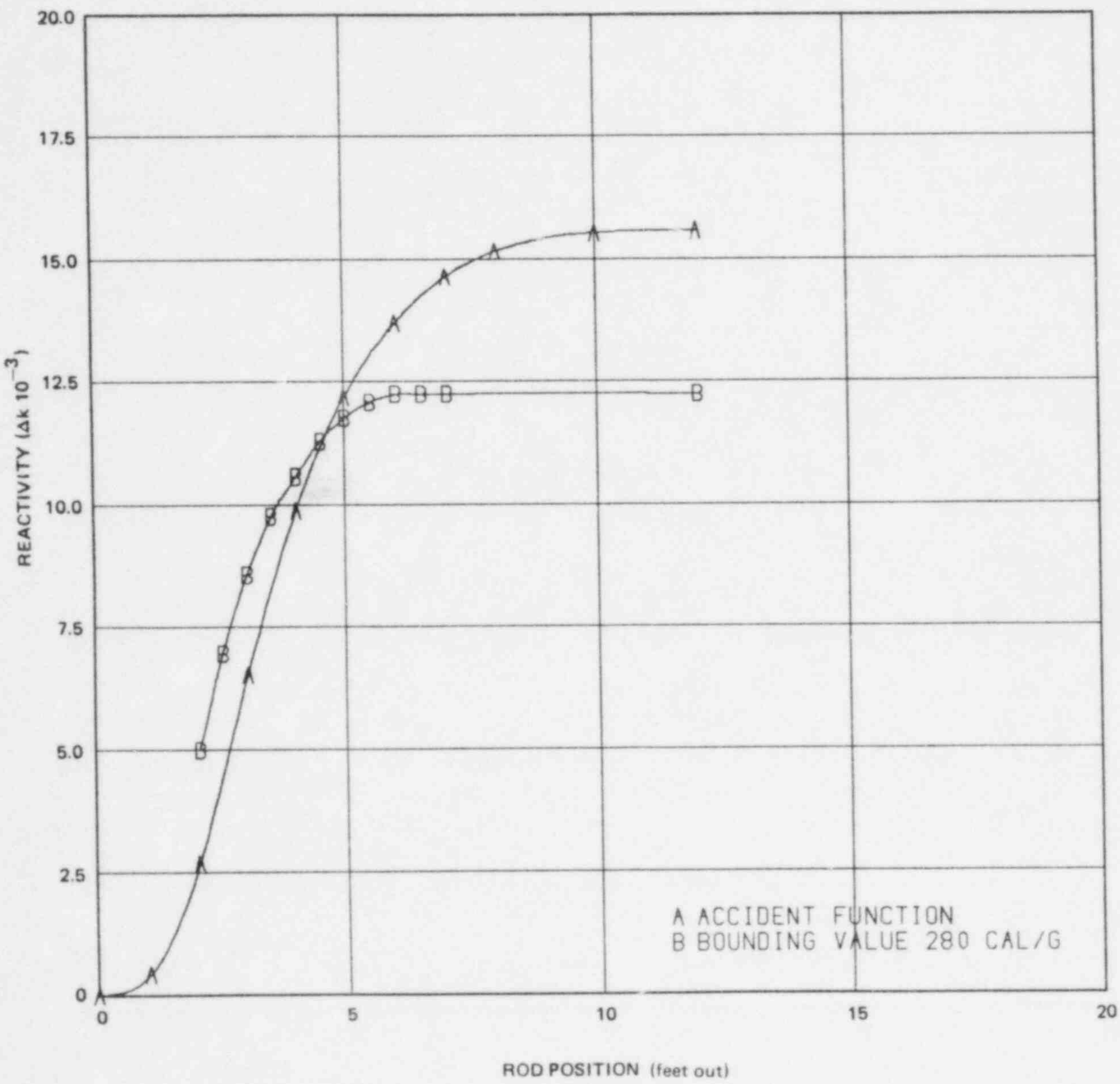



Figure 10. Accident Reactivity Shape Function, Hot Standby

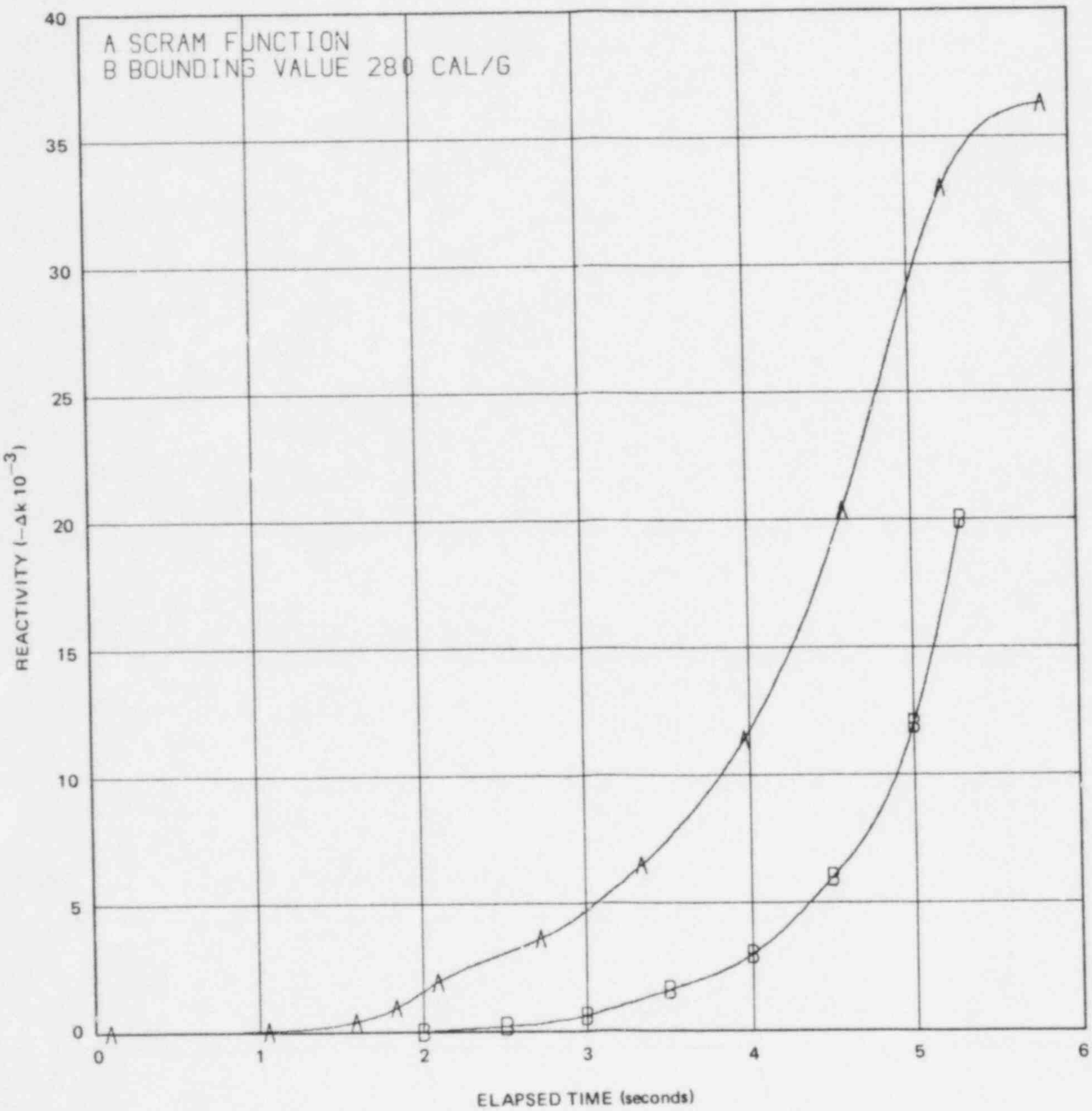



Figure 11. Scram Reactivity Function, Cold Startup

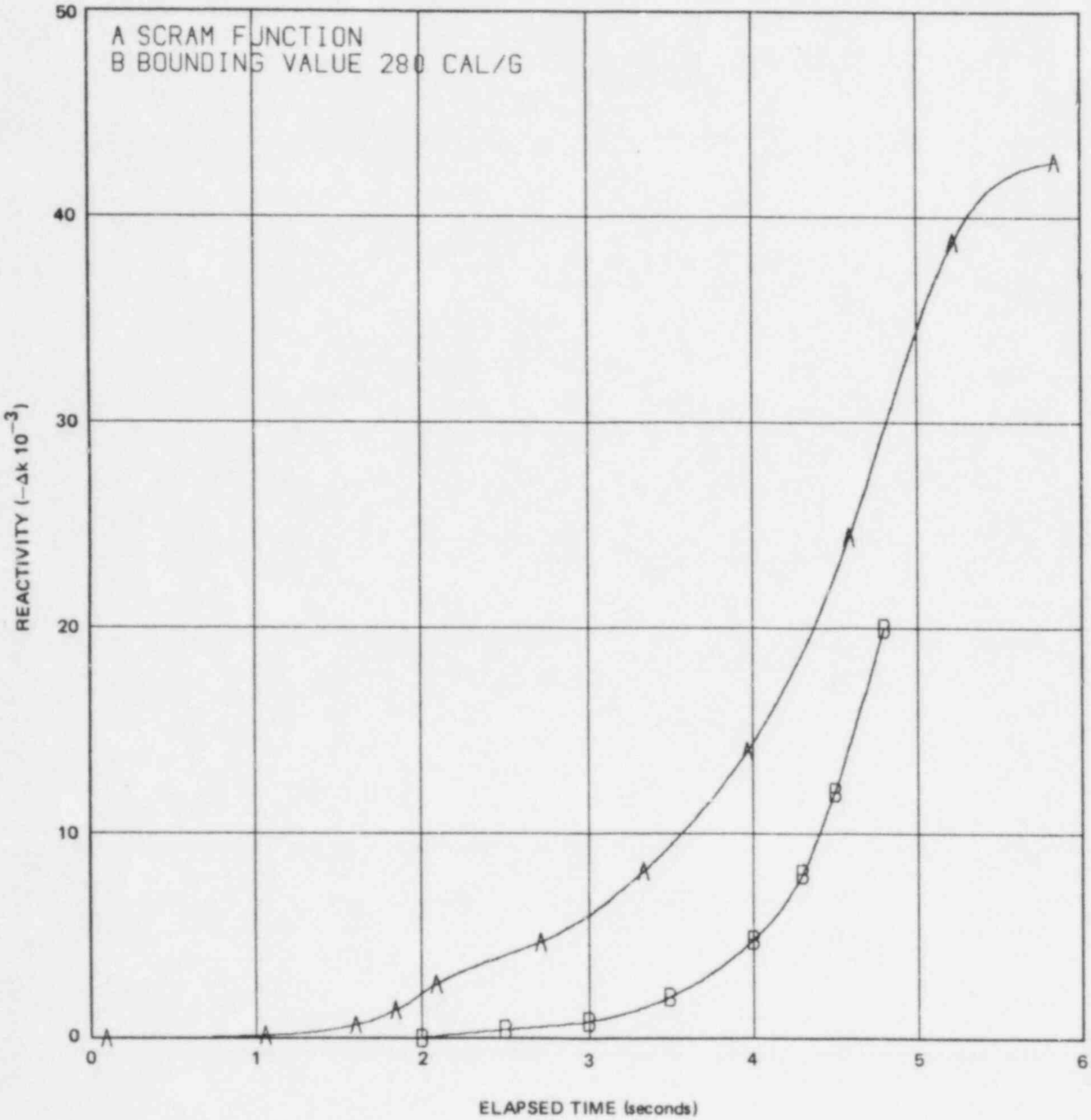



Figure 12. Scram Reactivity Function, Hot Standby

# APPENDIX A
## GETAB ANALYSIS INITIAL CONDITIONS

The values listed below were used in the GETAB analysis for this reload rather than the values given in Reference A-1, to more nearly reflect actual plant data.

| | |
|---|---|
| Reactor Pressure (psia) | 1035 |
| Inlet Enthalpy (Btu/lb) | 527.0 |

REFERENCE

A-1. "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-4, January 1982.

# APPENDIX B

## VERIFICATION OF 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 6.

1. Single Loop Operation: Yes
2. Load Line Limit: Yes
3. Extended Load Line Limit: No
4. Increased Core Flow: No
5. Feedwater Temperature Reduction: No

# APPENDIX C
# FULL ARC OPERATION

The analysis results summarized in the body of this document were performed assuming a partial arc turbine control valve configuration. The change from a partial arc configuration to a full arc configuration impacts only the Load Rejection Without Bypass event, since for this event it is the closure of the turbine control valves that causes a reduction in steam flow that results in a nuclear system pressure increase. For the Turbine Trip Without Bypass and the Feedwater Controller Failure events, the steam pressure increases as the result of closure of the turbine stop valves, so these events are not impacted by the change in turbine control valve configuration. Non-pressurization events are also not affected.

This appendix summarizes the results of the reanalysis of the Load Rejection Without Bypass event assuming full arc turbine control valve configuration. The reload unique GETAB transient analysis initial condition parameters are listed in Table C-1. The core-wide transient analysis results are shown in Table C-2, and the cycle MCPR values are provided in Table C-3. Although other events are not affected by the change in turbine control valve configuration, they are included in Table C-3 in order to determine operating limits.

The results of this appendix supercede the results reported in the body of this submittal if a full arc turbine control valve configuration is used.

Table C-1

RELOAD UNIQUE GETAB TRANSIENT ANALYSIS INITIAL CONDITION PARAMETERS

| Fuel Design | Peaking Factors Local | Radial | Axial | R-Factor | Bundle Power (MWt) | Bundle Flow (1000 lb/hr) | Initial MCPR |
|---|---|---|---|---|---|---|---|
| Exposure: EOC | | | | | | | |
| 8X8R | 1.20 | 1.44 | 1.40 | 1.051 | 6.148 | 117.1 | 1.32 |
| P8X8R | 1.20 | 1.41 | 1.40 | 1.051 | 5.990 | 118.1 | 1.36 |
| Exposure: EOC - 1000 MWd/st | | | | | | | |
| 8X8R | 1.20 | 1.48 | 1.40 | 1.051 | 6.304 | 116.2 | 1.29 |
| P8X8R | 1.20 | 1.45 | 1.40 | 1.051 | 6.178 | 117.0 | 1.32 |

Table C-2

CORE WIDE TRANSIENT ANALYSIS RESULTS

| Transient | Exposure (MWd/st) | Flux (% NBR) | Q/A (% NBR) | ΔCPR 8X8R | ΔCPR P8X8R | Figure |
|---|---|---|---|---|---|---|
| Load Rejection Without Bypass | EOC | 678 | 128 | 0.25 | 0.29 | C-1 |
| | EOC-1000 | 590 | 125 | 0.22 | 0.24 | C-2 |

Table C-3
CYCLE MCPR VALUES

Non-Pressurization Events

Exposure Range: BOC to EOC

| | P8X8R | 8X8R |
|---|---|---|
| Loss of 80°F Feedwater Heating | 1.20 | 1.20 |
| Fuel Loading Error | 1.20 | -- |
| Rod Withdrawal Error | 1.25 | 1.25 |

Pressurization Events

| | Option A | | Option B | |
|---|---|---|---|---|
| | P8X8R | 8X8R | P8X8R | 8X8R |
| Exposure Range: BOC to EOC 1000 MWd/st | | | | |
| Load Rejection Without Bypass | 1.37 | 1.35 | 1.15 | 1.14 |
| Feedwater Controller Failure | 1.32 | 1.29 | 1.25 | 1.23 |
| Exposure Range: EOC-1000 MWd/st to EOC | | | | |
| Load Rejection Without Bypass | 1.42 | 1.38 | 1.30 | 1.26 |
| Feedwater Controller Failure | 1.36 | 1.34 | 1.29 | 1.27 |

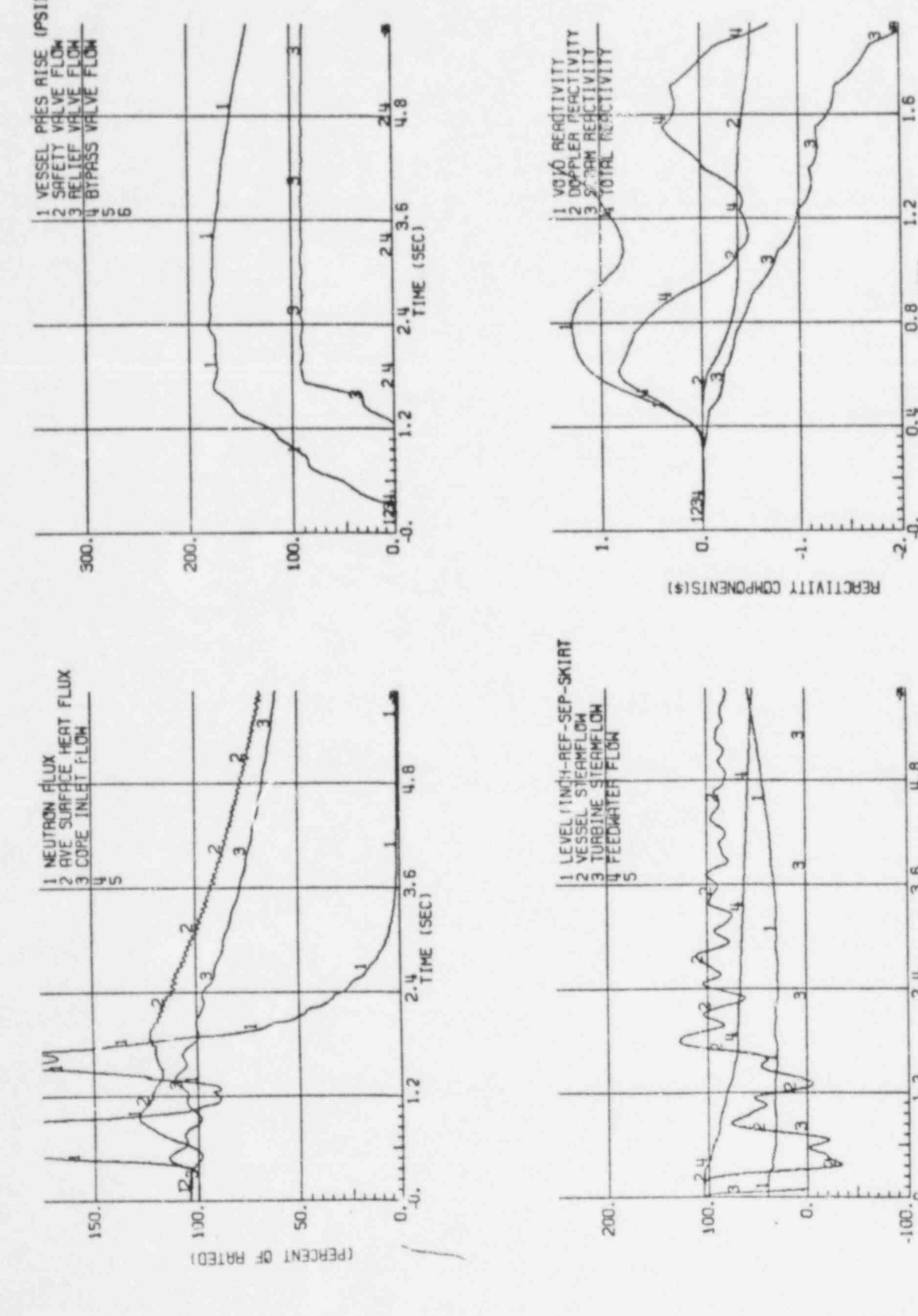



Figure C-1. Plant Response to Load Rejection Without Bypass (EOC)

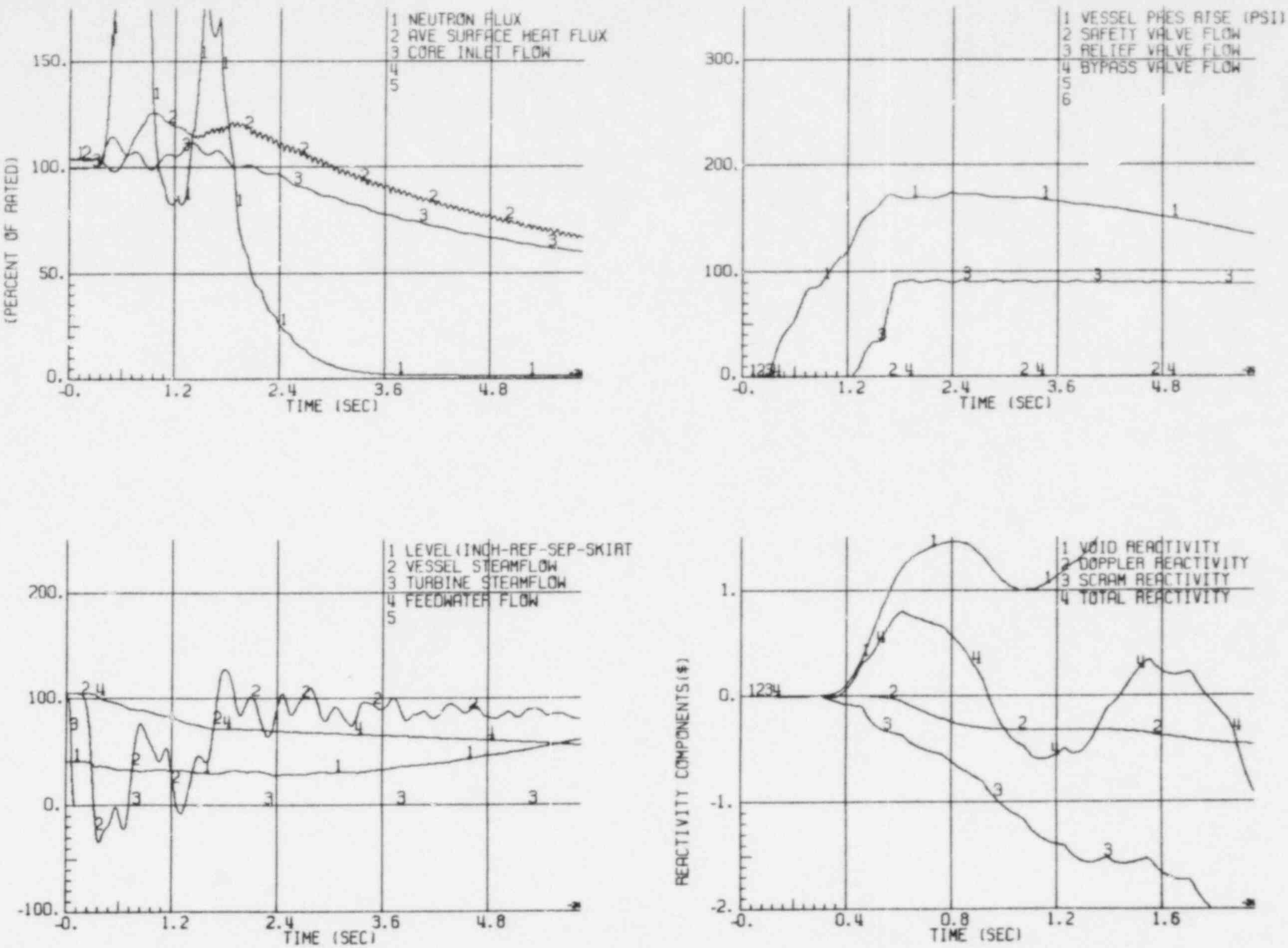



Figure C-2. Plant Response to Load Rejection Without Bypass (EOC-1000 MWd/st)



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