GE Nuclear Energy

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Supplemental Reload Licensing Report
for
Browns Ferry Nuclear Plant Unit 2
Reload 8 Cycle 9

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Important Notice Regarding

Contents of This Report

Please Read Carefully

This report was prepared by General Electric Company (GE) solely for Tennessee Valley Authority for TVA's use in defining operating limits for the Browns Ferry Unit 2. The information contained in this report is believed by GE to be an accurate and true representation of the facts known or obtained or provided to GE at the time this report was prepared.

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Acknowledgement

The engineering and reload licensing analyses, which form the technical basis of this Supplemental Reload Licensing Report, were performed by B.R. Fischer and H.M. Schrum. The Supplemental Reload Licensing Report was prepared by B.R. Fischer. This document has been verified by W.E. Russell. Revision 1 has been verified by M.R. Morris. Revision 2 has been verified by F.T. Bolger. Revision 3 has been verified by A.F. Alzaben.

The basis for this report is *General Electric Standard Application for Reactor Fuel*, NEDE-24011-P-A-11, November 1995; and the U.S. Supplement, NEDE-24011-P-A-11-US, November 1995.

1. Plant-unique Items

Appendix A: Analysis Conditions
Appendix B: Alternate Analyses For Feedwater Temperature Reduction

2. Reload Fuel Bundles

Fuel Type	Cycle Loaded	Number
Irradiated:		
P8DRB284L (P8x8R)	6	64
BP8DRB299 (BP8x8R)	7	24
BP8DRB301L (BP8x8R)	7	112
GE9B-P8DWB326-7GZ-80M-150-T (GE8x8NB)	7	48
GE9B-P8DWB325-10GZ-80M-150-T (GE8x8NB)[1]	7	72
BP8DRB299 (BP8x8R)	8	144
BP8DRB301L (BP8x8R)	8	4
GE9B-P8DWB319-9GZ-80M-150-T (GE8x8NB)	8	96
New:		
GE11-P9HUB367-14GZ-100T-146-T (GE11)	9	88
GE11-P9HUB366-12G4.0-100T-146-T (GE11)	9	112
Total		764

3. Reference Core Loading Pattern

Nominal previous cycle core average exposure at end of cycle:	22959 MWd/MT (20828 MWd/ST)
Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations:	22723 MWd/MT (20614 MWd/ST)
Assumed reload cycle core average exposure at beginning of cycle:	14118 MWd/MT (12808 MWd/ST)
Assumed reload cycle core average exposure at end of cycle:	25251 MWd/MT (22908 MWd/ST)
Reference core loading pattern:	Figure 1

1. Includes 40 bundles reinserted in Cycle 9 from Cycle 7.

4. Calculated Core Effective Multiplication and Control System Worth – No Voids, 20°C

Beginning of Cycle, $k_{effective}$	
Uncontrolled	1.096
Fully controlled	0.955
Strongest control rod out	0.981
R, Maximum increase in cold core reactivity with exposure into cycle, Δk	0.005

5. Standby Liquid Control System Shutdown Capability

Boron (ppm)	Shutdown Margin (Δk) (20°C, Xenon Free)
660	0.046

6. Reload Unique GETAB Anticipated Operational Occurrences (AOO) Analysis Initial Condition Parameters

Exposure: BOC9 to EOC9 STANDARD – HARD BOTTOM BURN							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE11	1.45	1.45	1.52	1.035	6.091	114.6	1.28
GE8x8NB	1.20	1.67	1.40	1.000	7.027	107.3	1.25
BP8x8R	1.20	1.60	1.40	1.051	6.732	113.4	1.23

Exposure: BOC9 to EOC9 STANDARD – HALING							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE11	1.45	1.59	1.19	1.035	6.658	108.4	1.27
GE8x8NB	1.20	1.73	1.40	1.000	7.273	105.8	1.20
BP8x8R	1.20	1.65	1.40	1.051	6.950	112.0	1.18

Exposure: BOC9 to EOC9 FFWTR – HARD BOTTOM BURN							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE11	1.45	1.50	1.53	1.035	6.295	113.6	1.26
GE8x8NB	1.20	1.70	1.40	1.000	7.119	106.7	1.24
BP8x8R	1.20	1.62	1.40	1.051	6.802	112.9	1.23

Exposure: BOC9 to EOC9 FFWTR – HALING							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE11	1.45	1.64	1.20	1.035	6.875	107.2	1.24
GE8x8NB	1.20	1.74	1.40	1.000	7.309	105.5	1.21
BP8x8R	1.20	1.66	1.40	1.051	6.988	111.7	1.19

Exposure: BOC9 to EOC9 ELLLA – HARD BOTTOM BURN							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE11	1.45	1.41	1.47	1.035	5.915	94.2	1.28
GE8x8NB	1.20	1.57	1.40	1.000	6.610	89.2	1.25
BP8x8R	1.20	1.54	1.40	1.051	6.474	93.5	1.21

Exposure: BOC9 to EOC9 ELLLA – HALING							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE11	1.45	1.53	1.18	1.035	6.393	89.0	1.28
GE8x8NB	1.20	1.67	1.40	1.000	7.014	87.0	1.16
BP8x8R	1.20	1.61	1.40	1.051	6.771	91.8	1.15

Exposure: BOC9 to EOC9 ELLLA-FFWTR - HARD BOTTOM BURN							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE11	1.45	1.45	1.47	1.035	6.062	93.5	1.27
GE8x8NB	1.20	1.60	1.40	1.000	6.728	88.5	1.24
BP8x8R	1.20	1.54	1.40	1.051	6.477	93.4	1.23

Exposure: BOC9 to EOC9 ELLLA-FFWTR - HALING							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE11	1.45	1.57	1.16	1.035	6.568	88.1	1.25
GE8x8NB	1.20	1.67	1.40	1.000	6.989	87.0	1.18
BP8x8R	1.20	1.61	1.40	1.051	6.748	91.9	1.17

7. Selected Margin Improvement Options

Recirculation pump trip:	Yes
Rod withdrawal limiter:	No
Thermal power monitor:	Yes[2]
Improved scram time:	Yes (ODYN Option B)
Measured scram time:	No
Exposure dependent limits:	No
Exposure points analyzed:	1

8. Operating Flexibility Options

Single-loop operation:	No
Load line limit:	Yes
Extended load line limit:	Yes
Maximum extended load line limit:	No

2. No credit taken for thermal power monitor.

Increased core flow throughout cycle:	Yes
Flow point analyzed:	105.0 %
Increased core flow at EOC:	Yes
Feedwater temperature reduction throughout cycle:	Yes
Temperature reduction:	47.0°F
Final feedwater temperature reduction:	Yes
ARTS Program:	No
Maximum extended operating domain:	No
Moisture separator reheater OOS:	No
Turbine bypass system OOS:	No
Safety/relief valves OOS: (credit taken for 12 of 13 valves)	Yes[3]
ADS OOS:	No
EOC RPT OOS:	No
Main steam isolation valves OOS:	No

9. Core-wide AOO Analysis Results

Methods used: GEMINI; GEXL-PLUS

Exposure range: BOC9 to EOC9 STANDARD – HARD BOTTOM BURN						
			Uncorrected ΔCPR			
Event	**Flux (%NBR)**	**Q/A (%NBR)**	**GE11**	**GE8x8NB**	**BP8x8R**	**Fig.**
FW Controller Failure	499	125	0.20	0.18	0.16	2
Load Reject w/o Bypass	626	124	0.21	0.18	0.16	3

Exposure range: BOC9 to EOC9 STANDARD – HALING						
			Uncorrected ΔCPR			
Event	**Flux (%NBR)**	**Q/A (%NBR)**	**GE11**	**GE8x8NB**	**BP8x8R**	**Fig.**
FW Controller Failure	314	118	0.17	0.13	0.11	4
Load Reject w/o Bypass	427	118	0.20	0.13	0.11	5

3. The transient analyses assume one S/RV is inoperable; however, other analyses supporting S/RVs out of service have not been performed

Exposure range: BOC9 to EOC9 FFWTR – HARD BOTTOM BURN						
			Uncorrected ΔCPR			
Event	Flux (%NBR)	Q/A (%NBR)	GE11	GE8x8NB	BP8x8R	Fig.
FW Controller Failure	460	126	0.19	0.18	0.16	6

Exposure range: BOC9 to EOC9 FFWTR – HALING						
			Uncorrected ΔCPR			
Event	Flux (%NBR)	Q/A (%NBR)	GE11	GE8x8NB	BP8x8R	Fig.
FW Controller Failure	312	119	0.17	0.14	0.12	7

Exposure range: BOC9 to EOC9 ELLLA – HARD BOTTOM BURN						
			Uncorrected ΔCPR			
Event	Flux (%NBR)	Q/A (%NBR)	GE11	GE8x8NB	BP8x8R	Fig.
FW Controller Failure	481	125	0.20	0.16	0.15	8
Load Reject w/o Bypass	594	124	0.22	0.18	0.15	9

Exposure range: BOC9 to EOC9 ELLLA – HALING						
			Uncorrected ΔCPR			
Event	Flux (%NBR)	Q/A (%NBR)	GE11	GE8x8NB	BP8x8R	Fig.
FW Controller Failure	237	113	0.17	0.09	0.09	10
Load Reject w/o Bypass	324	114	0.20	0.09	0.08	11

Exposure range: BOC9 to EOC9 ELLLA–FFWTR – HARD BOTTOM BURN						
			Uncorrected ΔCPR			
Event	Flux (%NBR)	Q/A (%NBR)	GE11	GE8x8NB	BP8x8R	Fig.
FW Controller Failure	466	126	0.20	0.17	0.16	12

Exposure range: BOC9 to EOC9 ELLLA–FFWTR – HALING						
			Uncorrected ΔCPR			
Event	Flux (%NBR)	Q/A (%NBR)	GE11	GE8x8NB	BP8x8R	Fig.
FW Controller Failure	258	116	0.18	0.11	0.10	13

10. Local Rod Withdrawal Error (With Limiting Instrument Failure) AOO Summary[4]

Rod Block	Rod Position	ΔCPR		
Reading, %	(ft withdrawn)	GE11	GE8x8NB	BP8x8R/P8x8R
104	3.0	0.06	0.06	0.07
105	3.5	0.10	0.11	0.11
106	4.0	0.15	0.15	0.15
107	4.5	0.15	0.16	0.16
108	4.5	0.15	0.16	0.16
109	5.0	0.16	0.16	0.16
110	5.5	0.17	0.17	0.17

Setpoint selected: 110%

Limiting rod pattern: Figure 14

11. Cycle MCPR Values

Safety limit: 1.09

In agreement with commitments to the NRC (letter from M.A. Smith to the Document Control Desk, *10CFR Part 21, Reportable Condition, Safety Limit MCPR Evaluation*, May 24, 1996) a cycle–specific Safety Limit MCPR calculation was performed, and has been reported in both the Safety Limit MCPR and the Operating Limit MCPR shown below. This cycle specific SLMCPR was determined using the analysis basis documented in GESTAR with the following exceptions:

1. The actual core loading was analyzed.
2. The actual bundle parameters (e.g. local peaking) were used.
3. The full cycle exposure range was analyzed.

<u>Non–pressurization events:</u>

Exposure range: BOC9 to EOC9			
	GE11	GE8x8NB	BP8x8R
Rod Withdrawal Error (for RBM Setpoint to 110%)	1.26	1.26	1.26
Fuel Loading Error	1.25	1.30	1.24

4. A Technical Specification (TS) allowable value of 112% is supported by this analysis with one RBM channel operable and 5% CPR margin, or both RBM channels operable.

Pressurization events:

Exposure range: BOC9 to EOC9 STANDARD – HARD BOTTOM BURN Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.33	1.33	1.31	1.30	1.29	1.27
Load Reject w/o Bypass	1.34	1.32	1.30	1.31	1.28	1.26

Exposure range: BOC9 to EOC9 STANDARD – HALING Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.30	1.27	1.26	1.27	1.23	1.22
Load Reject w/o Bypass	1.33	1.27	1.26	1.30	1.23	1.22

Exposure range: BOC9 to EOC9 FFWTR – HARD BOTTOM BURN Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.32	1.32	1.31	1.29	1.28	1.27

Exposure range: BOC9 to EOC9 FFWTR – HALING Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.31	1.29	1.27	1.28	1.25	1.23

Exposure range: BOC9 to EOC9 ELLLA – HARD BOTTOM BURN Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.33	1.31	1.30	1.30	1.27	1.26
Load Reject w/o Bypass	1.35	1.32	1.29	1.32	1.28	1.25

Exposure range: BOC9 to EOC9 ELLLA – HALING Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.30	1.24	1.23	1.27	1.20	1.19
Load Reject w/o Bypass	1.34	1.23	1.22	1.31	1.19	1.18

Exposure range: BOC9 to EOC9 ELLLA–FFWTR – HARD BOTTOM BURN Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.33	1.31	1.31	1.30	1.27	1.27

Exposure range: BOC9 to EOC9 ELLLA–FFWTR – HALING Exposure point: EOC9						
	Option A			Option B		
	GE11	GE8x8NB	BP8x8R	GE11	GE8x8NB	BP8x8R
FW Controller Failure	1.31	1.26	1.25	1.28	1.22	1.21

12. Overpressurization Analysis Summary

Event	Psl (psig)	Pv (psig)	Plant Response
MSIV Closure (Flux Scram)	1224	1257	Figure 15

13. Loading Error Results

Variable water gap misoriented bundle analysis: Yes[5]

Misoriented Fuel Bundle	ΔCPR
GE11–P9HUB366–12G4.0–100T–146–T	0.16
GE11–P9HUB367–14GZ–100T–146–T	0.16
GE9B–P9DWB319–9GZ–80M–150–T	0.21
BP8DRB299	0.13

Mislocated Fuel Bundle	0.15

14. Control Rod Drop Analysis Results

This is a banked position withdrawal sequence plant, therefore, the control rod drop accident analysis is not required. NRC approval is documented in NEDE–24011–P–A–US.

5. Includes a 0.02 penalty due to variable water gap R–factor uncertainty.

15. Stability Analysis Results

GE SIL-380 recommendations have been included in the operating procedures; therefore, no stability analysis is required. NRC approval for deletion of a cycle-specific stability analysis is documented in NEDE-24011-P-A-US. Browns Ferry Nuclear Plant Unit 2 recognizes the issuance of NRC Bulletin No. 88-07, Supplement 1, *Power Oscillations in Boiling Water Reactors (BWRs)*, and will comply with the recommendations contained therein.

16. Loss-of-Coolant Accident Results

LOCA method used: SAFER/GESTR-LOCA

Reference LOCA Analyses: *Browns Ferry Nuclear Plant Units 1, 2 and 3 Safer/GESTR-LOCA Loss-of-Coolant Accident Analysis*, S.K. Rhow and C.T. Young, NEDC-32484P, Rev. 1, February 1996, and *Relaxation of Emergency Core Cooling System Parameters for Browns Ferry Nuclear Plant Units 1, 2, and 3 (Perform Program Phase I)*, S.K. Rhow and T.H. Chuang, GE-NE-B13-01755-2, Rev. 1, February 1996.

An analysis consistent with *Browns Ferry Nuclear Plant Units 1, 2 and 3 Single Loop Operation*, NEDO-24236, resulted in a single loop operation MAPLHGR multiplier of 0.90 for all of the fuel designs in the current cycle. The MAPLHGR limits for the lattices of each of the new fuel bundles are provided in *Lattice-Dependent MAPLHGR Report for Browns Ferry Nuclear Plant Unit 2*, January 1996, J11-02761MAPL. The least limiting and the most limiting MAPLHGRs for the new fuel is provided in the table on the next page. The core-wide metal water reaction is <0.1%.

16. Loss-of-Coolant Accident Results (cont)

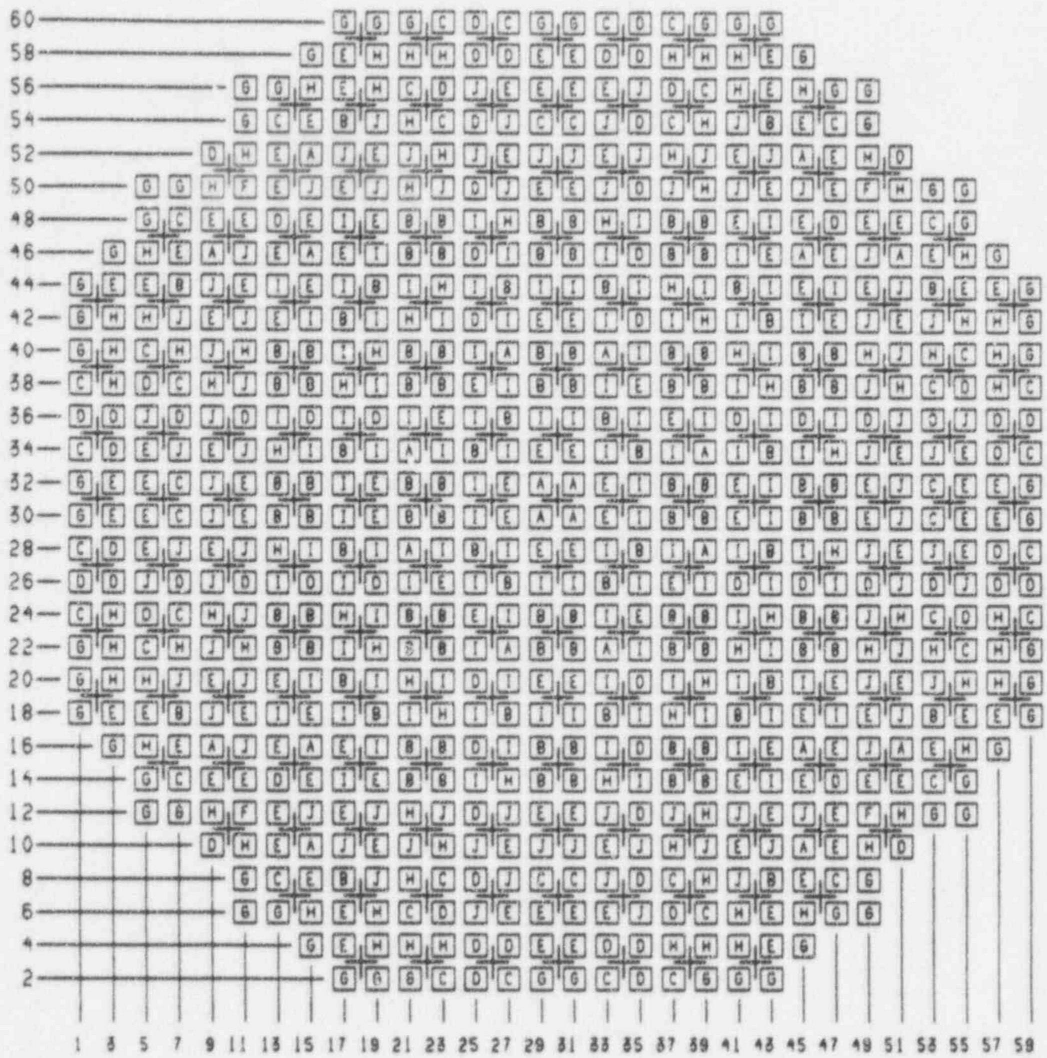
Bundle Type: GE11-P9HUB366-12G4.0-100T-146-T

Average Planar Exposure		MAPLHGR(kW/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	9.55	9.64
0.20	0.22	9.62	9.72
1.00	1.10	9.80	9.88
2.00	2.20	10.05	10.10
3.00	3.31	10.32	10.34
4.00	4.41	10.58	10.61
5.00	5.51	10.84	10.91
6.00	6.61	11.11	11.22
7.00	7.72	11.39	11.55
8.00	8.82	11.67	11.87
9.00	9.92	11.81	12.04
10.00	11.02	11.95	12.19
12.50	13.78	11.92	12.16
15.00	16.53	11.72	11.93
17.50	19.29	11.48	11.68
20.00	22.05	11.20	11.38
25.00	27.56	10.51	10.66
30.00	33.07	9.84	9.97
35.00	38.58	9.19	9.31
40.00	44.09	8.55	8.69
45.00	49.60	7.91	8.07
50.00	55.12	7.26	7.46
55.00	60.63	6.59	6.81
56.17	61.92	6.42	6.65
56.94	62.77	—	6.55

16. Loss–of–Coolant Accident Results (cont)

Bundle Type: GE11–P9HUB367–14GZ–100T–146–T

Average Planar Exposure		MAPLHGR(kW/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	9.18	9.64
0.20	0.22	9.27	9.72
1.00	1.10	9.45	9.88
2.00	2.20	9.72	10.10
3.00	3.31	10.00	10.34
4.00	4.41	10.30	10.61
5.00	5.51	10.62	10.91
6.00	6.61	10.95	11.22
7.00	7.72	11.31	11.55
8.00	8.82	11.67	11.87
9.00	9.92	11.81	12.04
10.00	11.02	11.95	12.19
12.50	13.78	11.92	12.16
15.00	16.53	11.72	11.93
17.50	19.29	11.48	11.68
20.00	22.05	11.20	11.38
25.00	27.56	10.51	10.66
30.00	33.07	9.84	9.97
35.00	38.58	9.19	9.31
40.00	44.09	8.55	8.69
45.00	49.60	7.91	8.07
50.00	55.12	7.26	7.46
55.00	60.63	6.59	6.81
56.17	61.92	6.42	6.65
56.89	62.71	—	6.56
56.94	62.77	—	6.55



Fuel Type	
A=BP8DRB299 (BP8x8R - Cycle 7)	F=BP8DRB301L (BP8x8R - Cycle 8)
B=BP8DRB301L (BP8x8R - Cycle 7)	G=P8DRB284L (P8x8R - Cycle 6)
C=GE9B-P8DWB326-7GZ-80M-150-T (Cycle 7)	H=GE9B-P8DWB319-9GZ-80M-150-T (Cycle 8)
D=GE9B-P8DWB325-10GZ-80M-150-T (Cycle 7)	I=GE11-P9HUB366-12G4.0-100T-146-T (Cycle 9)
E=BPDRB299L (BP8x8R - Cycle 8)	J=GE11-P9HUB367-14GZ-100T-146-T (Cycle 9)

Figure 1 Reference Core Loading Pattern

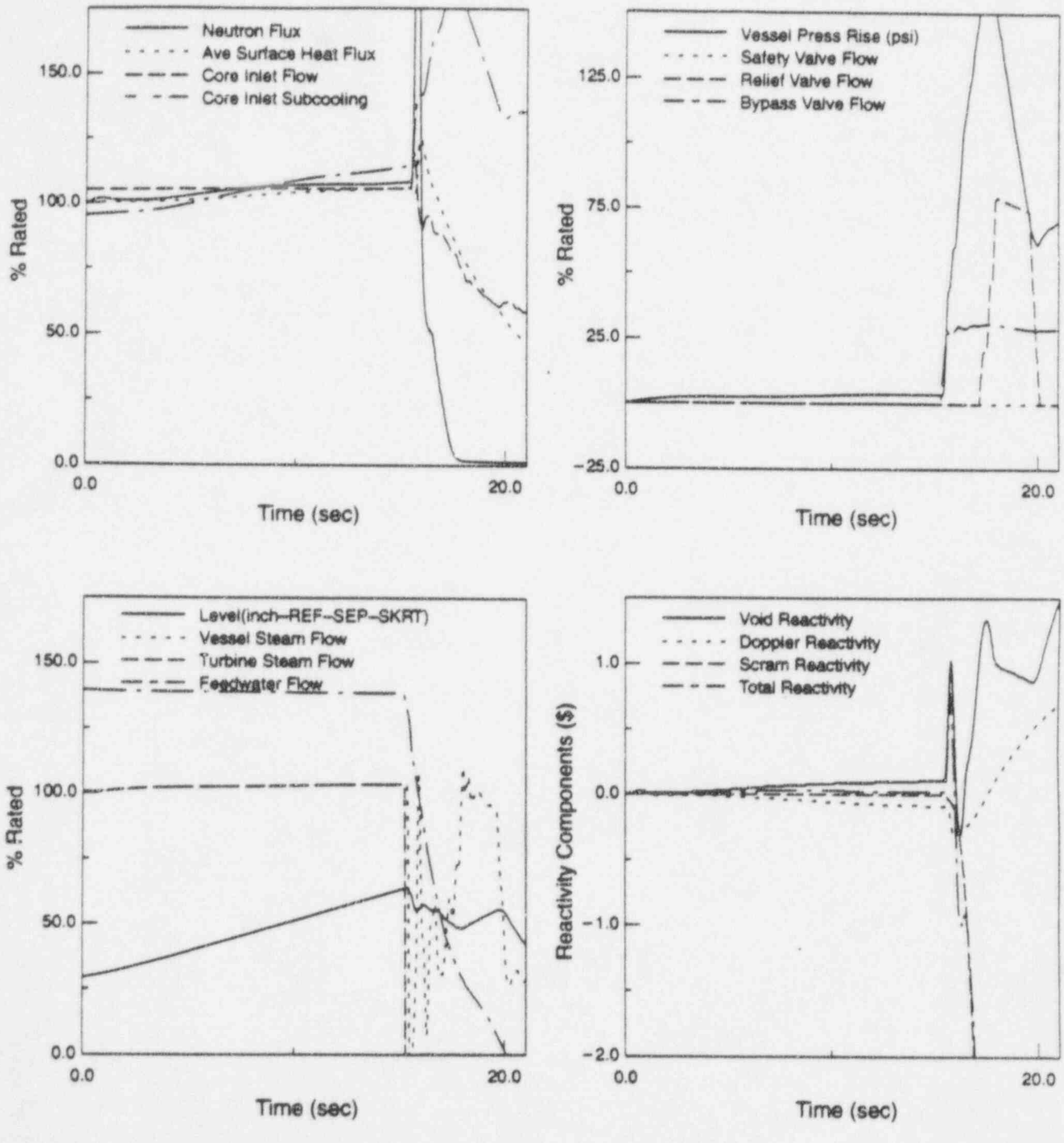


Figure 2 Plant Response to FW Controller Failure (BOC9 to EOC9 STANDARD – HARD BOTTOM BURN)

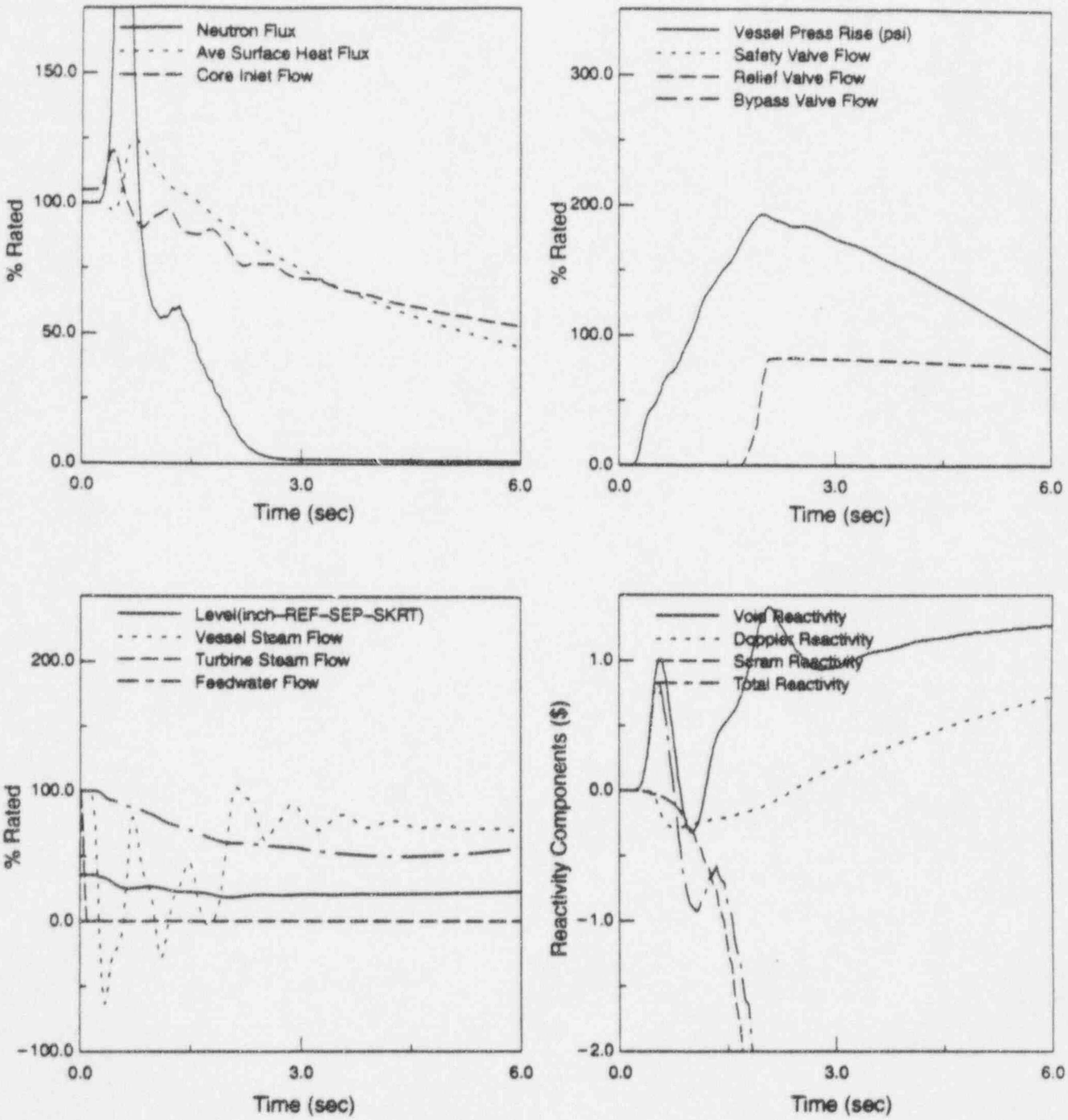


Figure 3 Plant Response to Load Reject w/o Bypass (BOC9 to EOC9 STANDARD – HARD BOTTOM BURN)

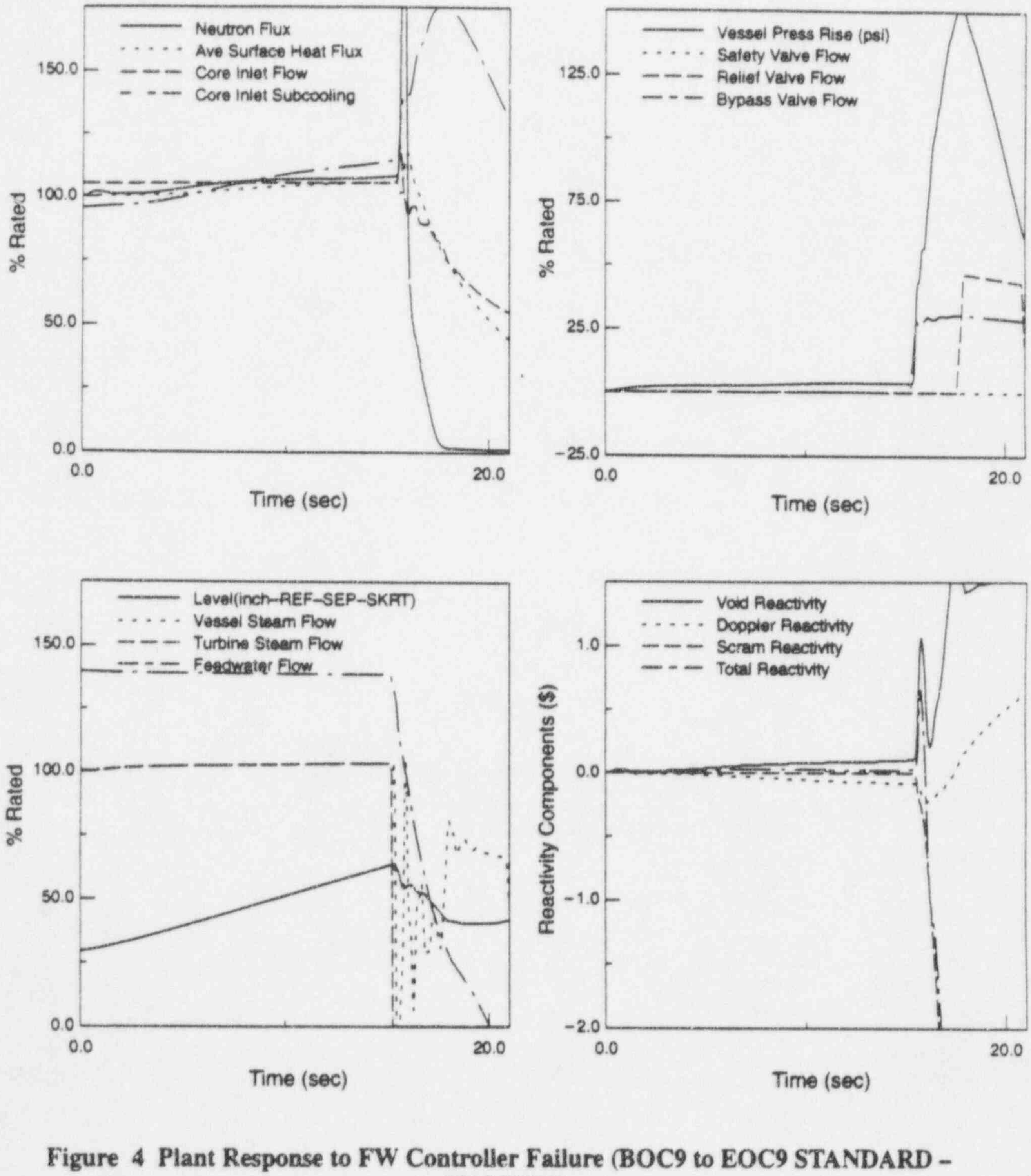


Figure 4 Plant Response to FW Controller Failure (BOC9 to EOC9 STANDARD – HALING)

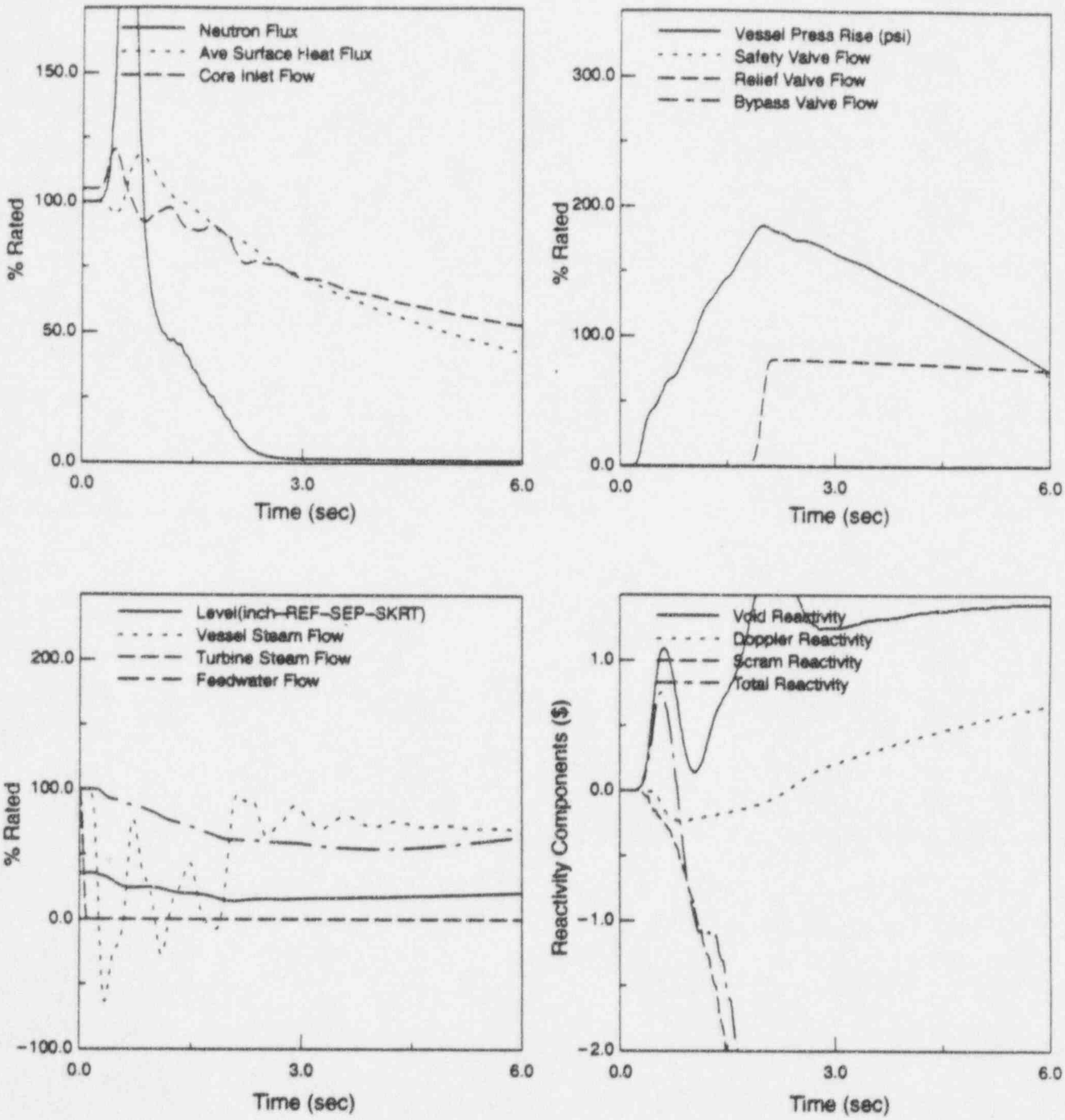


Figure 5 Plant Response to Load Reject w/o Bypass (BOC9 to EOC9 STANDARD – HALING)

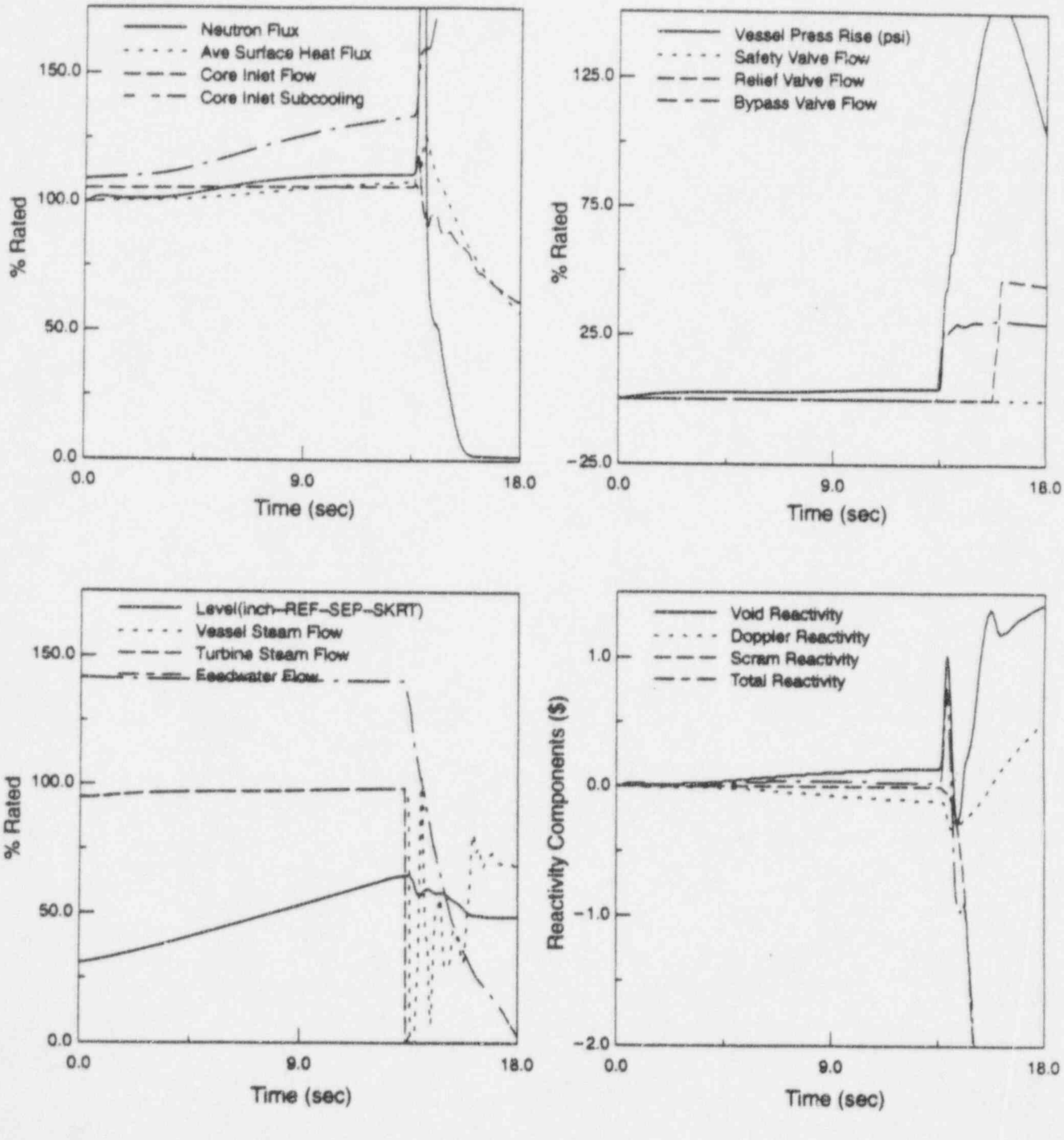


Figure 6 Plant Response to FW Controller Failure (BOC9 to EOC9 FFWTR – HARD BOTTOM BURN)

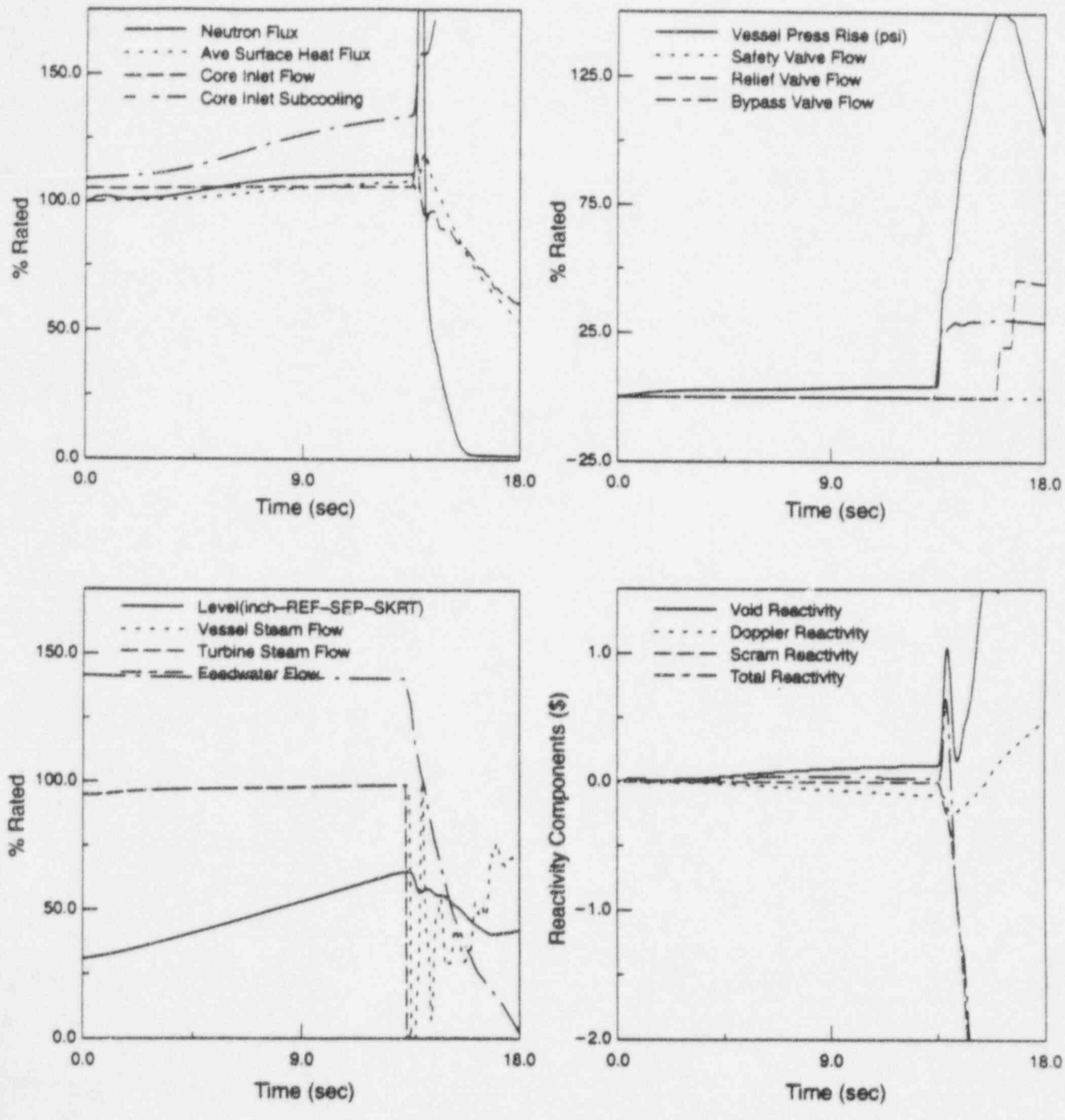


Figure 7 Plant Response to FW Controller Failure (BOC9 to EOC9 FFWTR – HALING)

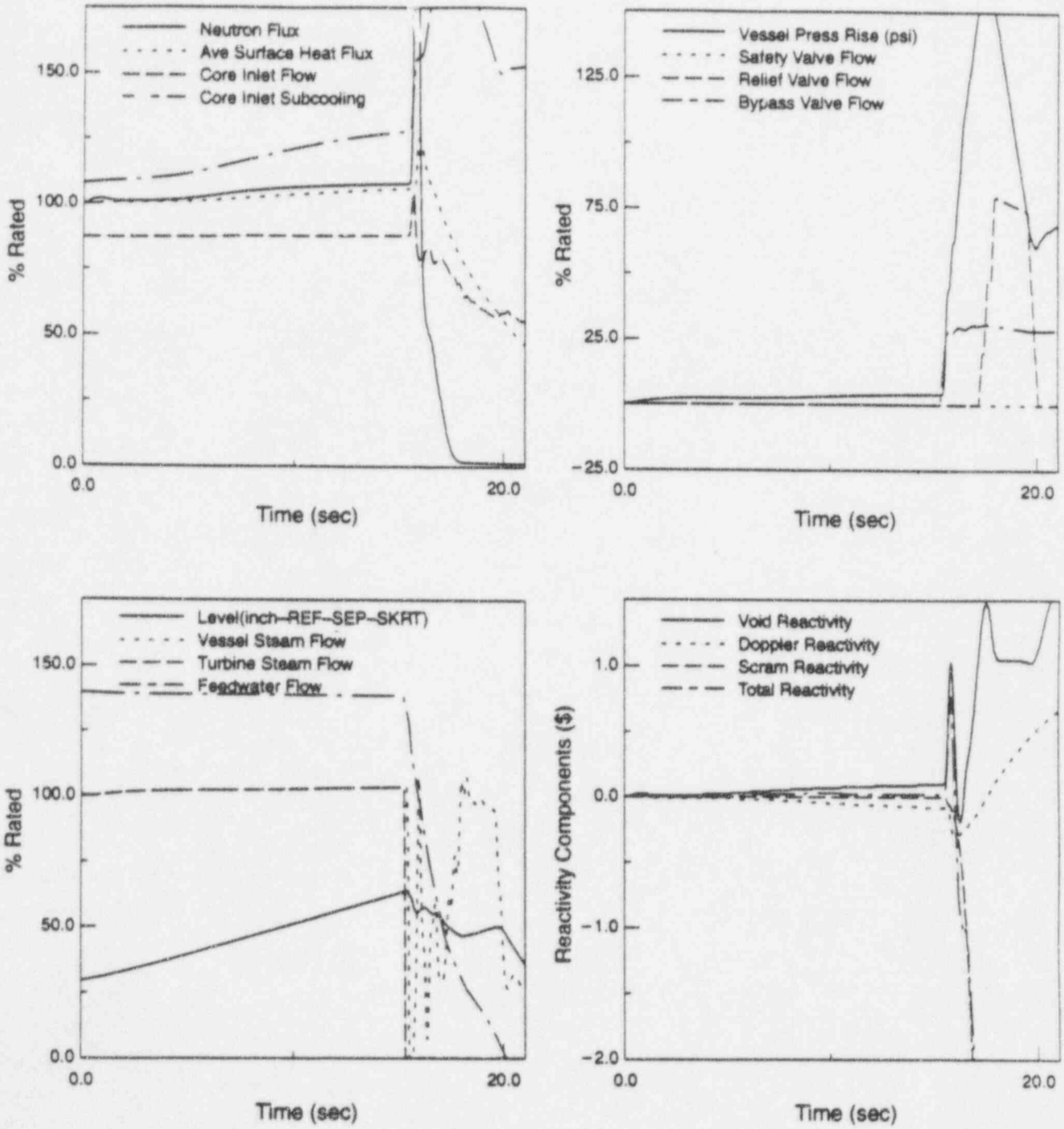


Figure 8 Plant Response to FW Controller Failure (BOC9 to EOC9 ELLLA – HARD BOTTOM BURN)

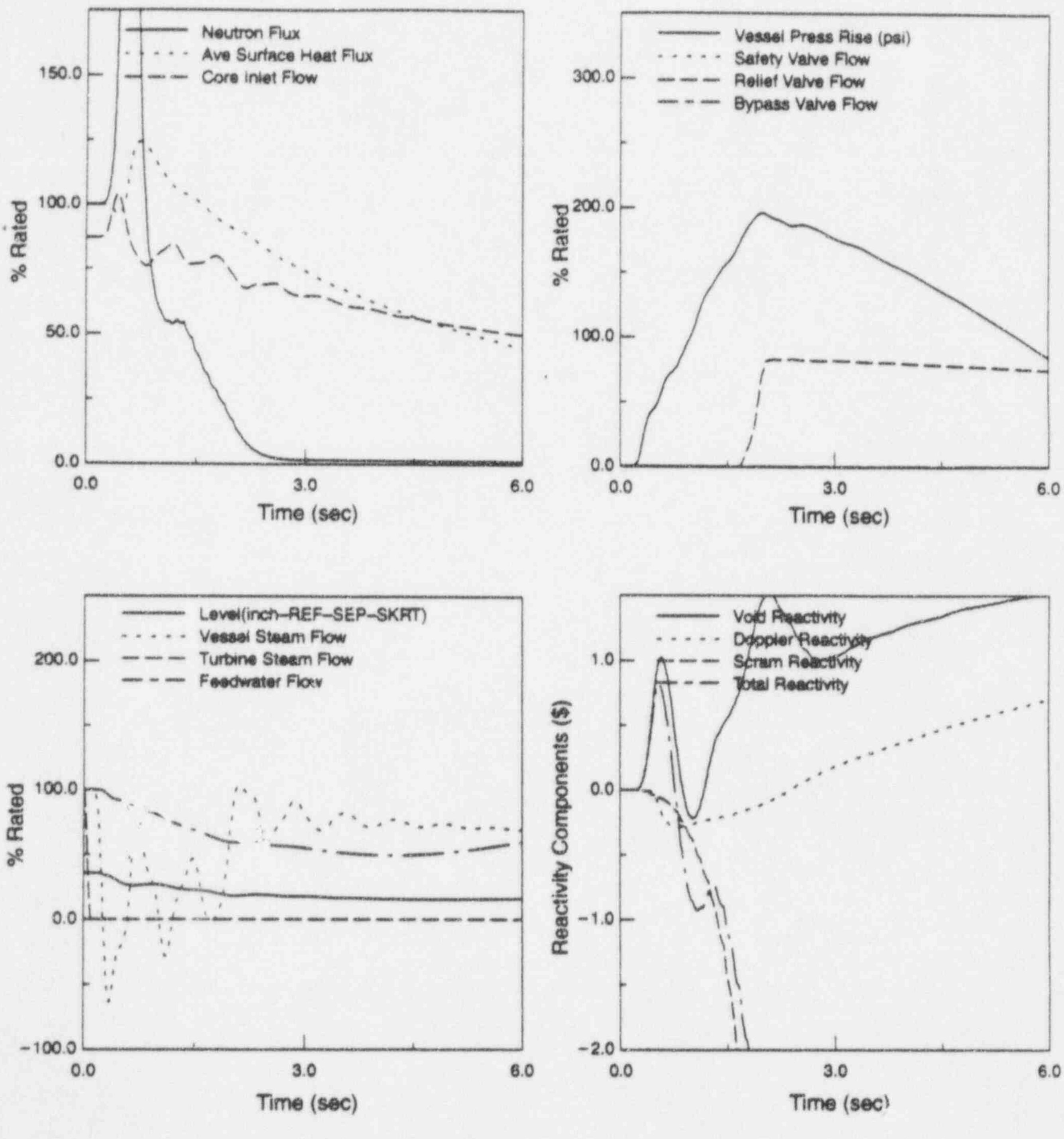


Figure 9 Plant Response to Load Reject w/o Bypass (BOC9 to EOC9 ELLLA – HARD BOTTOM BURN)

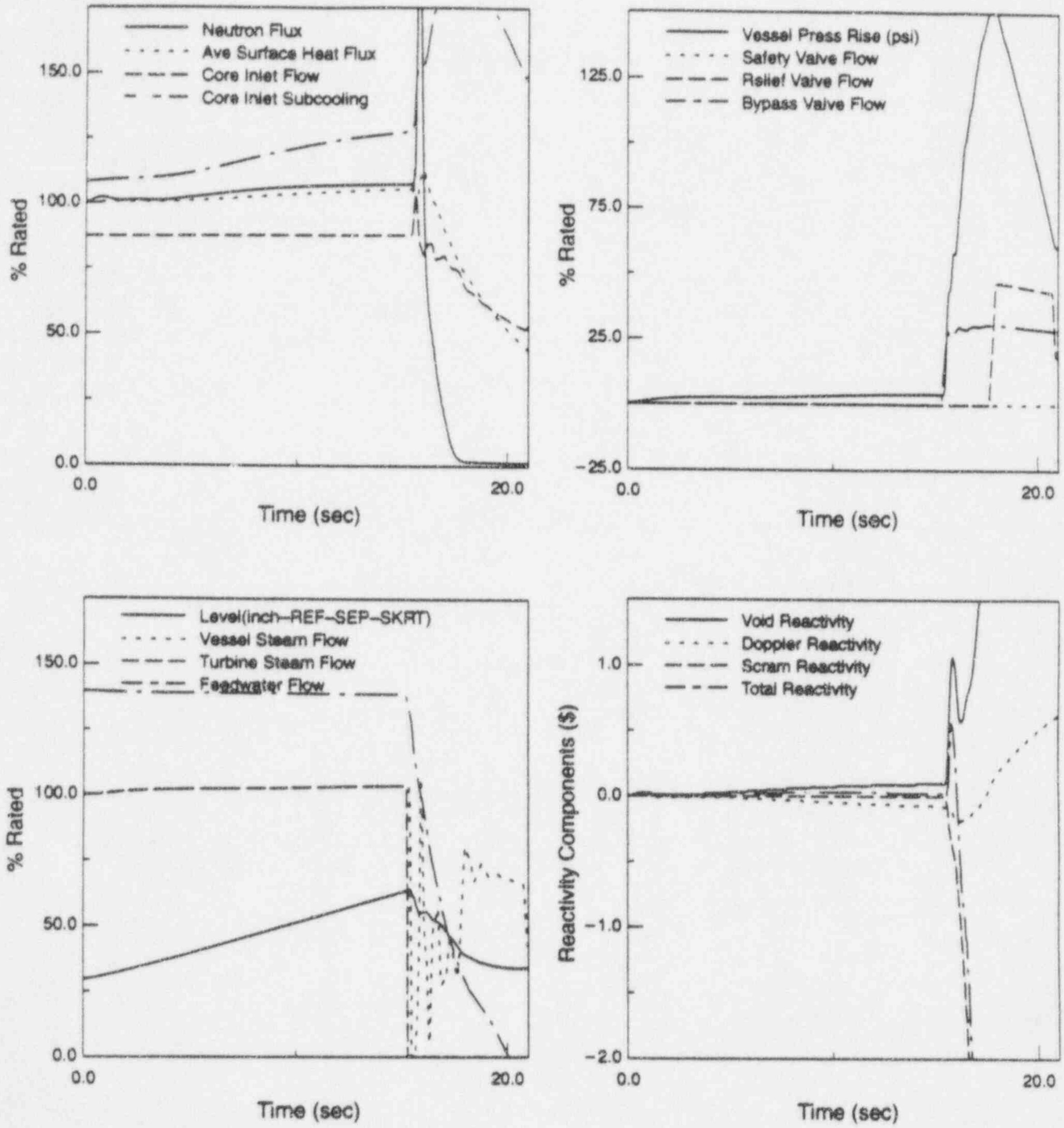


Figure 10 Plant Response to FW Controller Failure (BOC9 to EOC9 ELLLA – HALING)

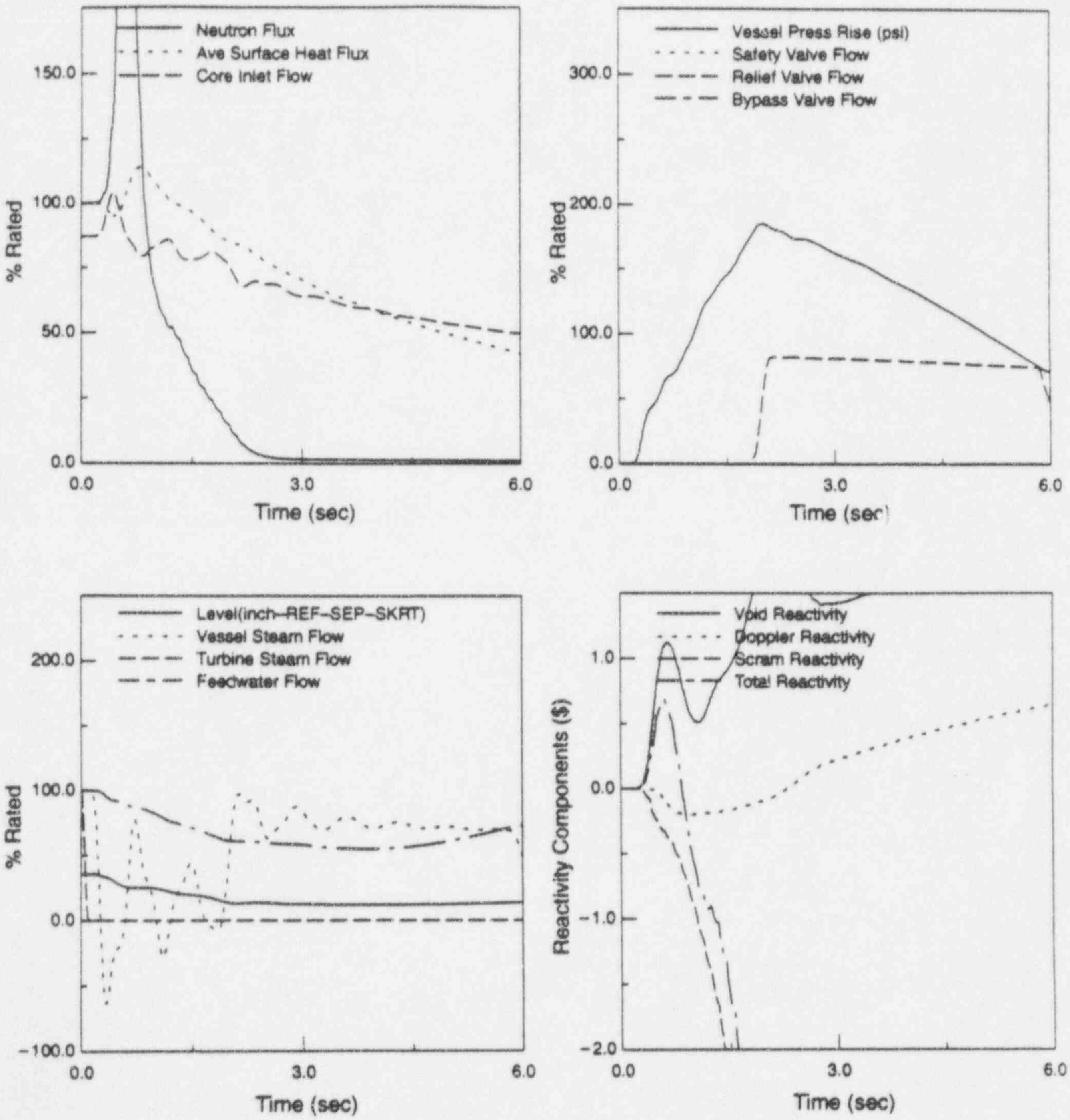


Figure 11 Plant Response to Load Reject w/o Bypass (BOC9 to EOC9 ELLLA – HALING)

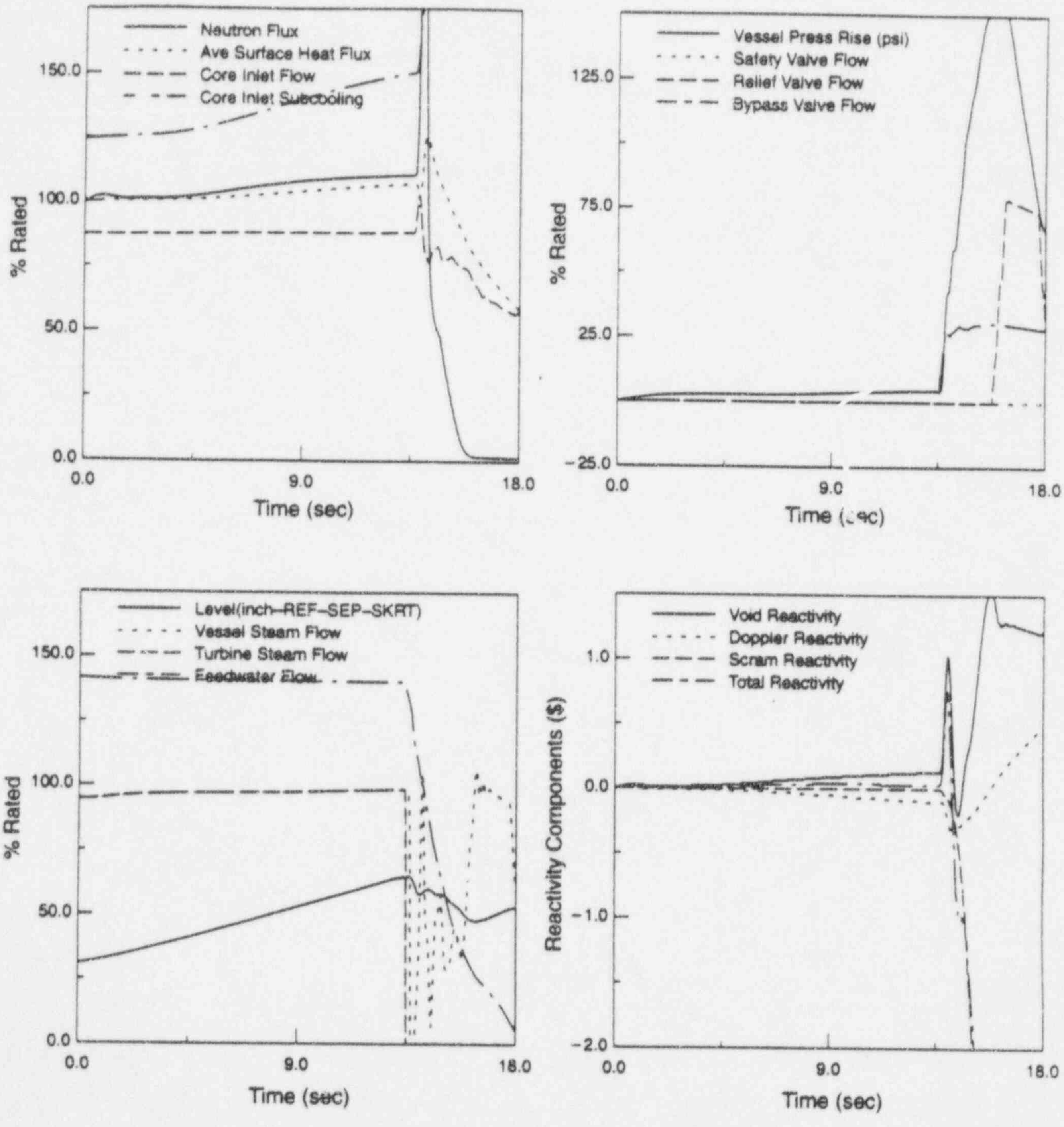


Figure 12 Plant Response to FW Controller Failure (BOC9 to EOC9 ELLLA-FFWTR – HARD BOTTOM BURN)

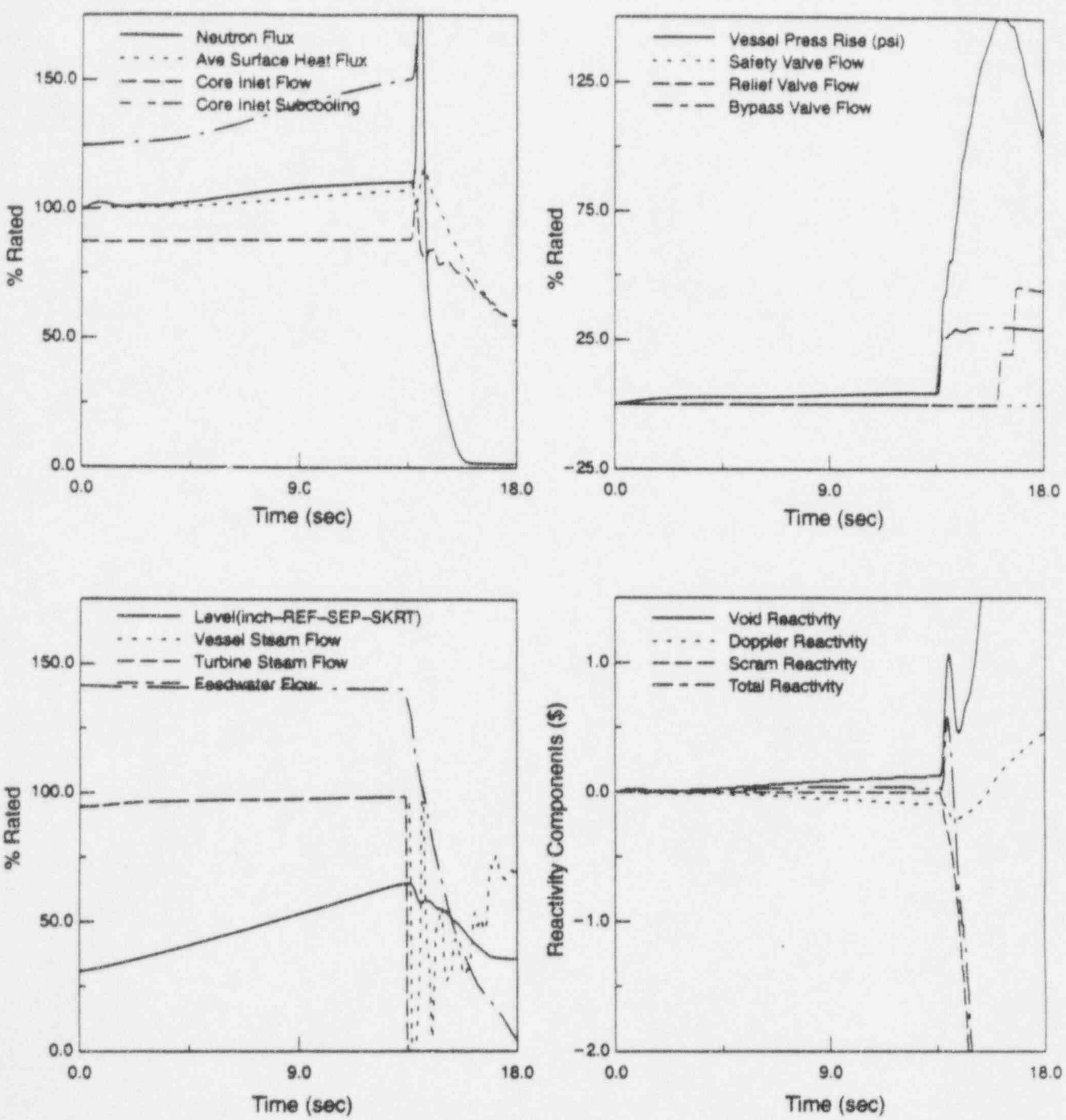


Figure 13 Plant Response to FW Controller Failure (BOC9 to EOC9 ELLLA-FFWTR – HALING)

	2	6	10	14	18	22	26	30	34	38	42	46	50	54	58
59															
55							**0**		**0**						
51						**38**		**0**		**38**					
47					**12**		**0**		**0**		**12**				
43								**0**							
39			**12**		**0**		**16**		**16**		**0**		**12**		
35		**38**						**0**						**38**	
31			**0**		**16**		**0**		**0**		**16**		**0**		
27		**38**						**0**						**38**	
23			**12**		**0**		**16**		**16**		**0**		**12**		
19								**0**							
15					**12**		**0**		**0**		**12**				
11						**38**		**0**		**38**					
7							**0**		**0**						
3															

Notes: 1. Number indicates number of notches withdrawn out of 48. Blank is a fully withdrawn rod.
2. Error rod is (18,39).

Figure 14 Limiting Rod Pattern

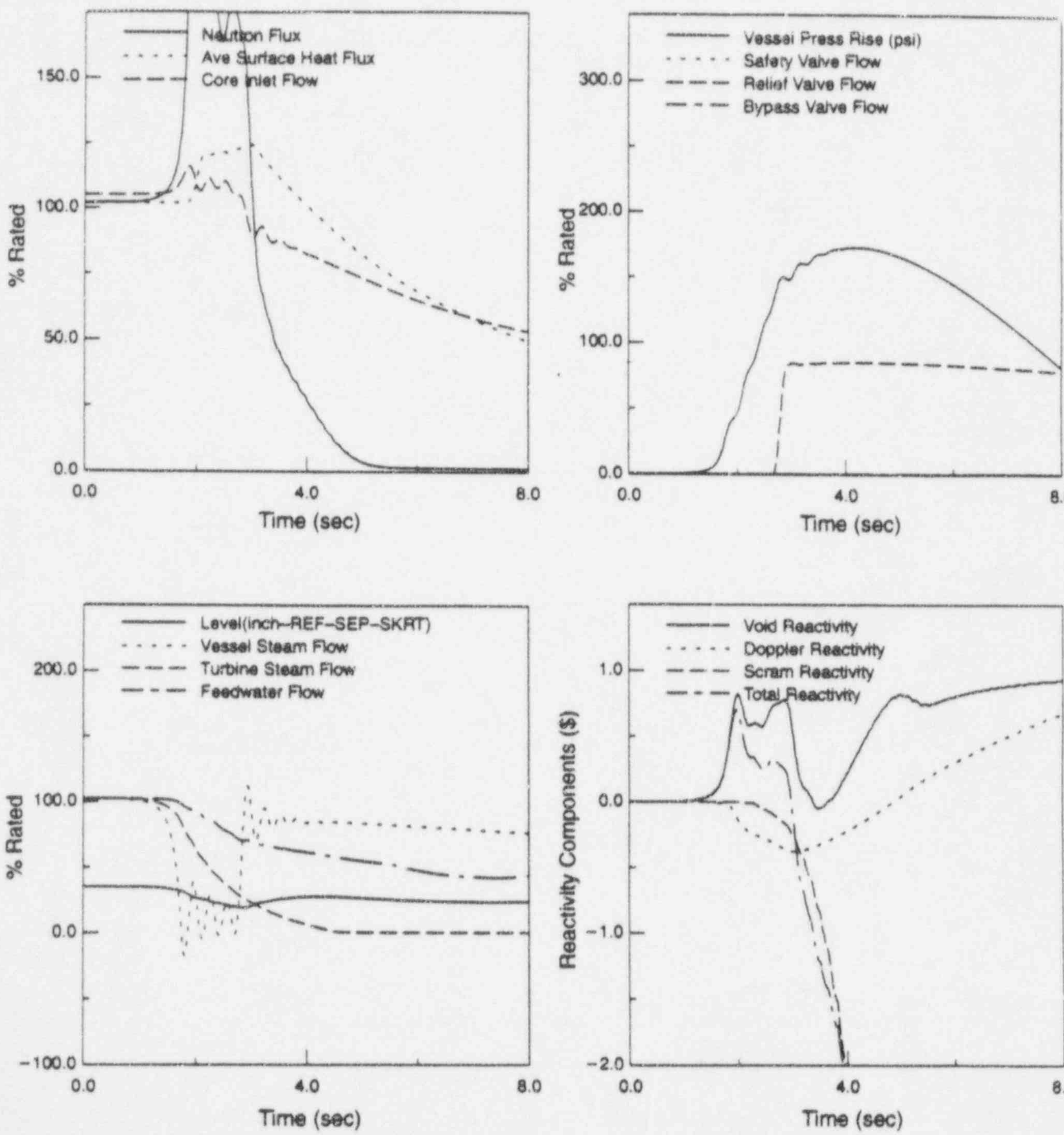


Figure 15 Plant Response to MSIV Closure (Flux Scram)

Appendix A
Analysis Conditions

To reflect actual plant parameters accurately, the values shown in Table A-1 were used this cycle.

Table A-1

STANDARD - HARD BOTTOM BURN	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	107.6
Reactor pressure, psia	1036.0
Inlet enthalpy, BTU/lb	522.9
Non-fuel power fraction	0.038
Steam flow analysis, Mlb/hr	13.39
Dome pressure, psig	1005.0
Turbine pressure, psig	962.9
Number of Safety/Relief Valves (Analysis assumes one S/RV is out-of-service, or 12 values in-service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	-

STANDARD - HALING	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	107.6
Reactor pressure, psia	1036.0
Inlet enthalpy, BTU/lb	522.9
Non-fuel power fraction	0.038
Steam flow analysis, Mlb/hr	13.39
Dome pressure, psig	1005.0
Turbine pressure, psig	962.9
Number of Safety/Relief Valves (Analysis assumes one S/RV is out-of-service, or 12 values in-service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	-

FFWTR – HARD BOTTOM BURN	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	107.6
Reactor pressure, psia	1029.0
Inlet enthalpy, BTU/lb	517.5
Non–fuel power fraction	0.038
Steam flow analysis, Mlb/hr	12.65
Dome pressure, psig	998.0
Turbine pressure, psig	960.2
Number of Safety/Relief Valves (Analysis assumes one S/RV is out–of–service, or 12 values in–service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	–

FFWTR – HALING	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	107.6
Reactor pressure, psia	1029.0
Inlet enthalpy, BTU/lb	517.5
Non–fuel power fraction	0.038
Steam flow analysis, Mlb/hr	12.65
Dome pressure, psig	998.0
Turbine pressure, psig	960.2
Number of Safety/Relief Valves (Analysis assumes one S/RV is out–of–service, or 12 values in–service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	–

ELLLA – HARD BOTTOM BURN	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	89.2
Reactor pressure, psia	1032.6
Inlet enthalpy, BTU/lb	517.7
Non–fuel power fraction	0.038
Steam flow analysis, Mlb/hr	13.37
Dome pressure, psig	1005.0
Turbine pressure, psig	963.0
Number of Safety/Relief Valves (Analysis assumes one S/RV is out–of–service, or 12 values in–service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	–

ELLLA – HALING	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	89.2
Reactor pressure, psia	1032.6
Inlet enthalpy, BTU/lb	517.7
Non–fuel power fraction	0.038
Steam flow analysis, Mlb/hr	13.37
Dome pressure, psig	1005.0
Turbine pressure, psig	963.0
Number of Safety/Relief Valves (Analysis assumes one S/RV is out–of–service, or 12 values in–service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	–

ELLLA–FFWTR – HARD BOTTOM BURN	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	89.2
Reactor pressure, psia	1025.6
Inlet enthalpy, BTU/lb	511.5
Non–fuel power fraction	0.038
Steam flow analysis, Mlb/hr	12.63
Dome pressure, psig	998.0
Turbine pressure, psig	960.3
Number of Safety/Relief Valves (Analysis assumes one S/RV is out–of–service, or 12 values in–service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	–

ELLLA–FFWTR – HALING	
Parameter	**Analysis Value**
Thermal power, MWt	3293.0
Core flow, Mlb/hr	89.2
Reactor pressure, psia	1025.6
Inlet enthalpy, BTU/lb	511.5
Non–fuel power fraction	0.038
Steam flow analysis, Mlb/hr	12.63
Dome pressure, psig	998.0
Turbine pressure, psig	960.3
Number of Safety/Relief Valves (Analysis assumes one S/RV is out–of–service, or 12 values in–service)	13
Relief mode lowest setpoint, psig	1138.2
Safety mode lowest setpoint, psig	–

Appendix B
Alternate Analyses for Feedwater Temperature Reduction

To provide for improved operating flexibility and cycle extension for Cycle 9, expanded operating domain analyses were performed for increased core flow (ICF) at 105% rated and intermittent use of final feedwater temperature reduction (FFWTR) to a temperature (at full power) of 330°F. The analyses for cycle extension with ICF were performed at the EOC9[6] exposure point achieved with ICF using appropriate thermal hydraulic conditions. The analyses for cycle extension with ICF and FFWTR were performed at the extended EOC9 (EEOC)[7] exposure point achieved with ICF and FFWTR using appropriate thermal hydraulic conditions.

For cycle extension operation with ICF and FFWTR, the transient MCPR values are given in Section 11. The MCPR operating limits for ODYN option A will be fuel dependent and are 1.35 (GE11), 1.33 (GE8x8NB), and 1.31 (BP8x8R) and for ODYN Option B they are 1.32 (GE11), 1.30 (GE8x8NB), and 1.27 (BP8x8R)[8]. These limits are applicable for the exposure range BOC8 throught EEOC8. The analyses for ICF and FFWTR bound the intermittent concurrent use of FFWTR from BOC to the EEOC operation with ICF and FFWTR.

6. EOC is the assumed reload cycle core average exposure used for licensing the nominal Cycle 9 and is specified in Section 3.
7. EEOC identifies the rated power operation point attainable, using ICF and FFWTR. For Cycle 9, the EEOC exposure = 25527 MWd/MT.
8. Based on a safety limit of 1.09.

ENCLOSURE 5

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

ENGINEERING JUSTIFICATION