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Supplemental Reload Licensing Report

for
River Bend Station

Reload 5 Cycle 6

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Important Notice Regarding

Contents of This Report

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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 P. K. Wu of Advanced Engineering. The Supplemental Reload Licensing Report was prepared by M. E. Harding of Nuclear Fuel – Europe. This document has been verified by C. W. Smith of Fuel Licensing.

The basis for this report is *General Electric Standard Application for Reactor Fuel*, NEDE-24011-P-A-10, February 1991; and the U.S. Supplement, NEDE-24011-P-A-10-US, March 1991.

1. Plant-unique Items

Appendix A: Analysis Conditions
Appendix B: Basis for Analysis of Loss-of-feedwater Heater Event

2. Reload Fuel Bundles

Fuel Type	Cycle Loaded	Number
Irradiated:		
GE8B-P8SQB322-8GZ-120M-4WR-150-T (BS322B) (GE8x8EB)	3	36
GE8B-P8SQB322-9GZ-120M-4WR-150-T (BS322C) (GE8x8EB)	3	20
GE8B-P8SQB333-10GZ-120M-4WR-150-T (GE8x8EB)	4	160
GE8B-P8SQB331-11GZ-120M-4WR-150-T (GE8x8EB)	4	16
GE8B-P8SQB334-10GZ-120M-4WR-150-T (GE8x8EB)	5	200
New:		
GE8B-P8SQB334-11GZ-120M-4WR-150-T (GE8x8EB)	6	56
GE8B-P8SQB334-10GZ2-120M-4WR-150-T (GE8x8EB)	6	136
Total		624

3. Reference Core Loading Pattern

Nominal previous cycle core average exposure at end of cycle:	23494 MWd/MT (21314 MWd/ST)
Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations:	22494 MWd/MT (20406 MWd/ST)
Assumed reload cycle core average exposure at beginning of cycle:	13423 MWd/MT (12177 MWd/ST)
Assumed reload cycle core average exposure at end of cycle:	24343 MWd/MT (22083 MWd/ST)
Reference core loading pattern:	Figure 1

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

Beginning of Cycle, $k_{effective}$	
Uncontrolled	1.125
Fully controlled	0.9568
Strongest control rod out	0.988
R, Maximum increase in cold core reactivity with exposure into cycle, Δk	0.000

5. Standby Liquid Control System Shutdown Capability

Boron (ppm)	Shutdown Margin (Δk) (20°C, Xenon Free)
660	0.028

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

Exposure: BOC6 to EOC6							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE8x8EB	1.20	1.55	1.40	1.051	7.004	108.5	1.14

Exposure: BOC6 to EOC6 FEEDWATER HEATER OUT OF SERVICE							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE8x8EB	1.20	1.57	1.40	1.051	7.074	107.4	1.16

7. Selected Margin Improvement Options

Recirculation pump trip:	Yes
Rod withdrawal limiter:	Yes
Thermal power monitor:	Yes
Improved scram time:	No
Measured scram time:	No
Exposure dependent limits:	No
Exposure points analyzed:	1

8. Operating Flexibility Options

Single-loop operation:	Yes
Load line limit:	No
Extended load line limit:	No
Maximum extended load line limit:	No
Increased core flow throughout cycle:	No
Flow point analyzed:	N/A
Increased core flow at EOC:	No
Feedwater Heater OOS:	Yes
Final feedwater temperature reduction:	No
ARTS Program:	No
Maximum extended operating domain:	No
Moisture separator reheater OOS:	No
Turbine bypass system OOS:	No
Safety/relief valves OOS:	No
ADS OOS:	No
EOC RPT OOS:	No
Main steam isolation valves OOS:	No

9. Core-wide AOO Analysis Results[1]

Methods used: GEMINI; GEXL-PLUS

Exposure range: BOC6 to EOC6				
			Uncorrected ΔCPR	
Event	Flux (%NBR)	Q/A (%NBR)	GE8x8EB	Fig.
FW Controller Failure	228	109	0.06	2
Load Reject w/o Bypass	312	110	0.07	3
Press. Regulator Failure	145	103	0.03	4
Loss of 100° Feedwater Heating	(1)	(1)	0.12	(1)

Exposure range: BOC6 to EOC6 FEEDWATER HEATER OUT OF SERVICE				
			Uncorrected ΔCPR	
Event	Flux (%NBR)	Q/A (%NBR)	GE8x8EB	Fig.
FW Controller Failure	260	113	0.09	5

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

The generic bounding BWR/6 rod withdrawal error analysis described in NEDE-24011-P-A-US is applied.

1. See Appendix B.

11. Cycle MCPR Values[2,3]

Safety limit: 1.07

Single loop operation safety limit: 1.08

Non-pressurization events:

Exposure Range: BOC6 to EOC6	
	GE8x8EB
Rod Withdrawal Error	1.18
Loss of 100° F Feedwater Heating	1.19
Fuel Loading Error	1.22

Pressurization events:[4,5]

Exposure range: BOC6 to EOC6 Exposure point: EOC6	
	GE8x8EB
FW Controller Failure	1.14
Load Reject w/o Bypass	1.14
Press. Regulator Failure	1.11
Exposure range: BOC6 to EOC6 Feedwater Heaters Out of Service **Exposure point: EOC6**	
	GE8x8EB
FW Controller Failure	1.17

12. Overpressurization Analysis Summary

Event	Psl (psig)	Pv (psig)	Plant Response
MSIV Closure (Flux Scram)	1215	1257	Figure 6

2. GEMINI ODYN adjustment factors are provided in the letter from J.S. Charnley (GE) to M. W. Hodges (NRC), GEMINI ODYN Adjustment Factors for BWR/6, dated July 6, 1987. The limiting transients for River Bend Station, Cycle 6, are rod withdrawal error and loss of 100° F feedwater heating.

3. See letter, J. F. Klapproth (GE) tor R. C. Jones, Jr. (NRC), Rotated Bundle Evaluation, July 20, 1992.

4. ECCS MCPR value is 1.17

5. The FWCF with Feedwater Heaters Out of Service is reported here for information only.

13. Loading Error Results[6]

Variable water gap misoriented bundle analysis: Yes[7]

Misoriented Fuel Bundle	ΔCPR
GE8B–P8SQB334–10GZ2–120M–4WR–150–T (GE8x8EB)	0.15

14. Control Rod Drop Analysis Results

River Bend Station 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–10–US, March 1991.

15. Stability Analysis Results

GE SIL–380 recommendations have been included in the River Bend Station operating procedures and Technical Specifications; therefore, the stability analysis is not required. NRC approval for deletion of a cycle–specific stability analysis is documented in Amendment 8 to NEDE–24011–P–A–US. River Bend Station 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.

6. See letter, J. F. Klapproth (GE) to R. C. Jones, Jr. (NRC), Rotated Bundle Evaluation, July 20, 1992.

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

16. Loss-of-coolant Accident Results[8]

LOCA method used: SAFE/REFLOOD (See River Bend Station Final Safety Analysis Report)

Bundle Type: GE8B-P8SQB334-10GZ2-120M-4WR-150-T

Average Planar Exposure		MAPLHGR(kw/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	11.36	11.88
0.20	0.22	11.42	11.91
1.00	1.10	11.54	12.00
2.00	2.20	11.71	12.13
3.00	3.31	11.89	12.28
4.00	4.41	12.08	12.43
5.00	5.51	12.28	12.60
6.00	6.61	12.48	12.76
7.00	7.72	12.69	12.94
8.00	8.82	12.91	13.11
9.00	9.92	13.13	13.29
10.00	11.02	13.34	13.48
12.50	13.78	13.57	13.63
15.00	16.53	13.30	13.31
20.00	22.05	12.63	12.64
25.00	27.56	11.95	11.96
35.00	38.58	10.46	10.52
45.00	49.60	9.08	9.21
50.00	55.12	6.95	7.03

The peak clad temperature (PCT) is ≤ 2150 °F at all exposures; the local oxidation (fraction) is ≤ 0.073 at all exposures. The MAPLHGR multiplier for single-loop operation (SLO) is 0.84.

8. For format explanation, see letter J.S. Charnley (GE) to M. W. Hodges (NRC), Recommended MAPLHGR Technical Specifications for Multiple Lattice Fuel Designs, March 9, 1987. Most Limiting and Least Limiting refer to the lowest and highest limits, respectively, of any enriched lattice in the bundle.

16. Loss-of-coolant Accident Results (continued)[9]

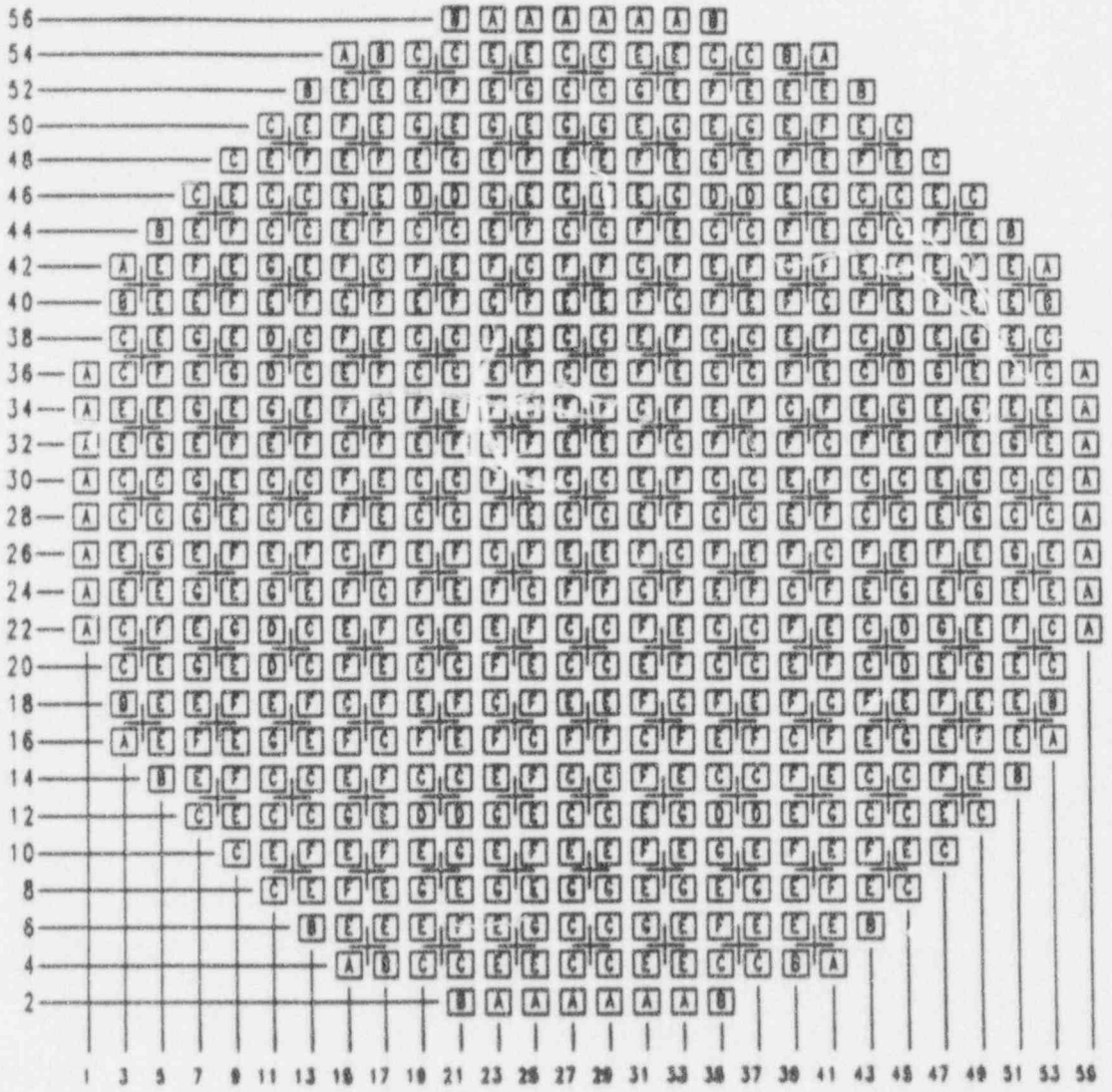
LOCA method used: SAFE/REFLOOD (See River Bend Station Final Safety Analysis Report)

Bundle Type: GE8B-P8SQB334-11GZ-120M-4WR-150-T

Average Planar Exposure		MAPLHGR(kw/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	10.86	11.24
0.20	0.22	10.93	11.30
1.00	1.10	11.09	11.44
2.00	2.20	11.30	11.63
3.00	3.31	11.53	11.83
4.00	4.41	11.76	12.05
5.00	5.51	12.01	12.27
6.00	6.61	12.27	12.50
7.00	7.72	12.53	12.74
8.00	8.82	12.81	12.98
9.00	9.92	13.09	13.22
10.00	11.02	13.36	13.46
12.50	13.78	13.58	13.61
15.00	16.53	13.29	13.31
20.00	22.05	12.63	12.63
25.00	27.56	11.95	11.96
35.00	38.58	10.46	10.52
45.00	49.60	9.08	9.20
50.00	55.12	6.95	7.02

The peak clad temperature (PCT) is ≤ 2150 °F at all exposures; the local oxidation (fraction) is ≤ 0.073 at all exposures. The MAPLHGR multiplier for single-loop operation (SLO) is 0.84.

9. For format explanation, see letter J.S. Charnley (GE) to M. W. Hodges (NRC), Recommended MAPLHGR Technical Specifications for Multiple Lattice Fuel Designs, March 9, 1987. Most Limiting and Least Limiting refer to the lowest and highest limits, respectively, of any enriched lattice in the bundle.



Fuel Type	
A=GE8B-P8SQB322-8GZ-120M-4WR-150-T B=GE8B-P8SQB322-9GZ-120M-4WR-150-T C=GE8B-P8SQB333-10GZ-120M-4WR-150-T D=GE8B-P8SQB331-11GZ-120M-4WR-150-T	E=GE8B-P8SQB334-10GZ-120M-4WR-150-T F=GE8B-P8SQB334-10GZ2-120M-4WR-150-T G=GE8B-P8SQB334-11GZ-120M-4WR-150-T

Figure 1 Reference Core Loading Pattern

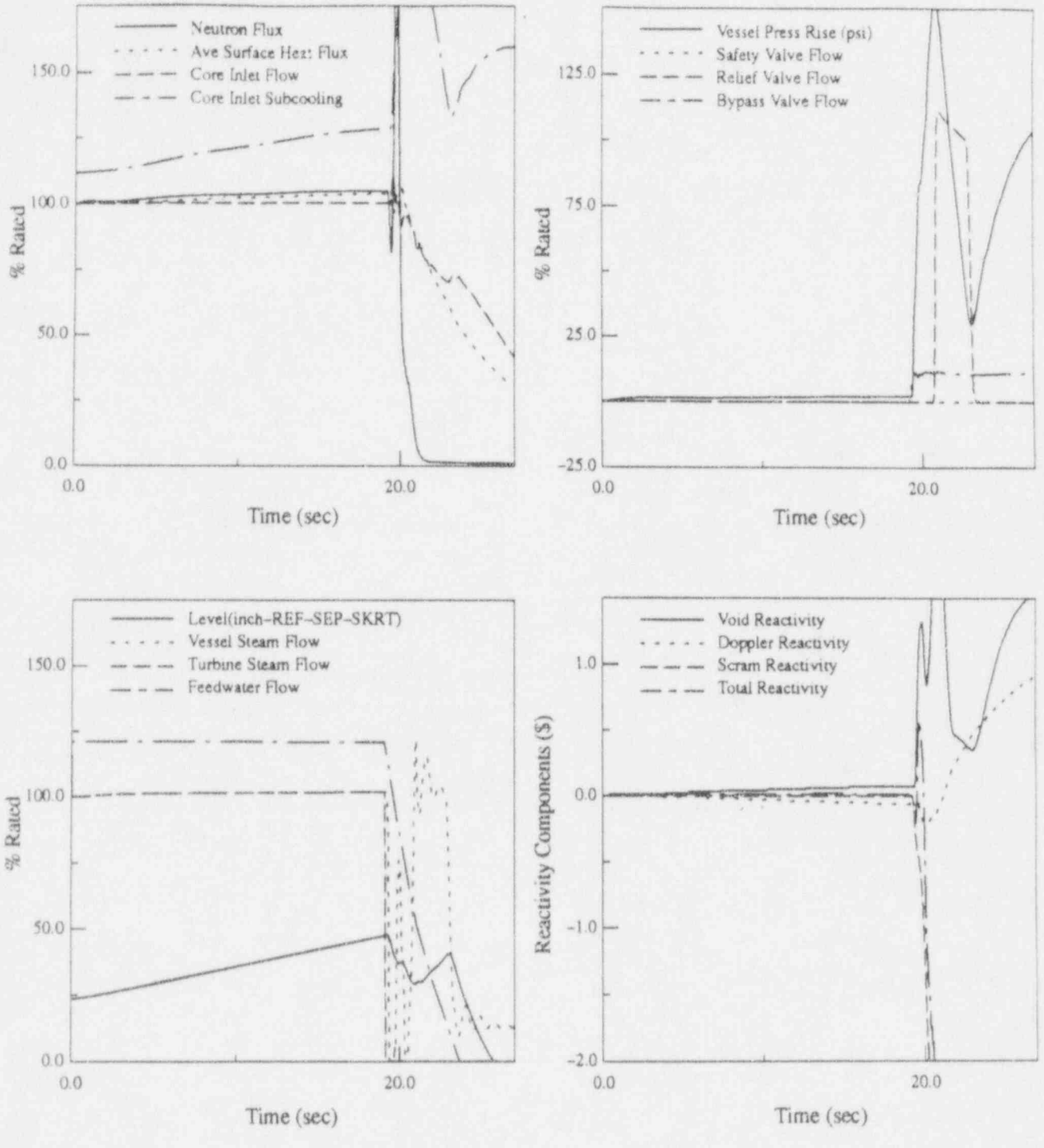


Figure 2 Plant Response to FW Controller Failure (BOC6 to EOC6)

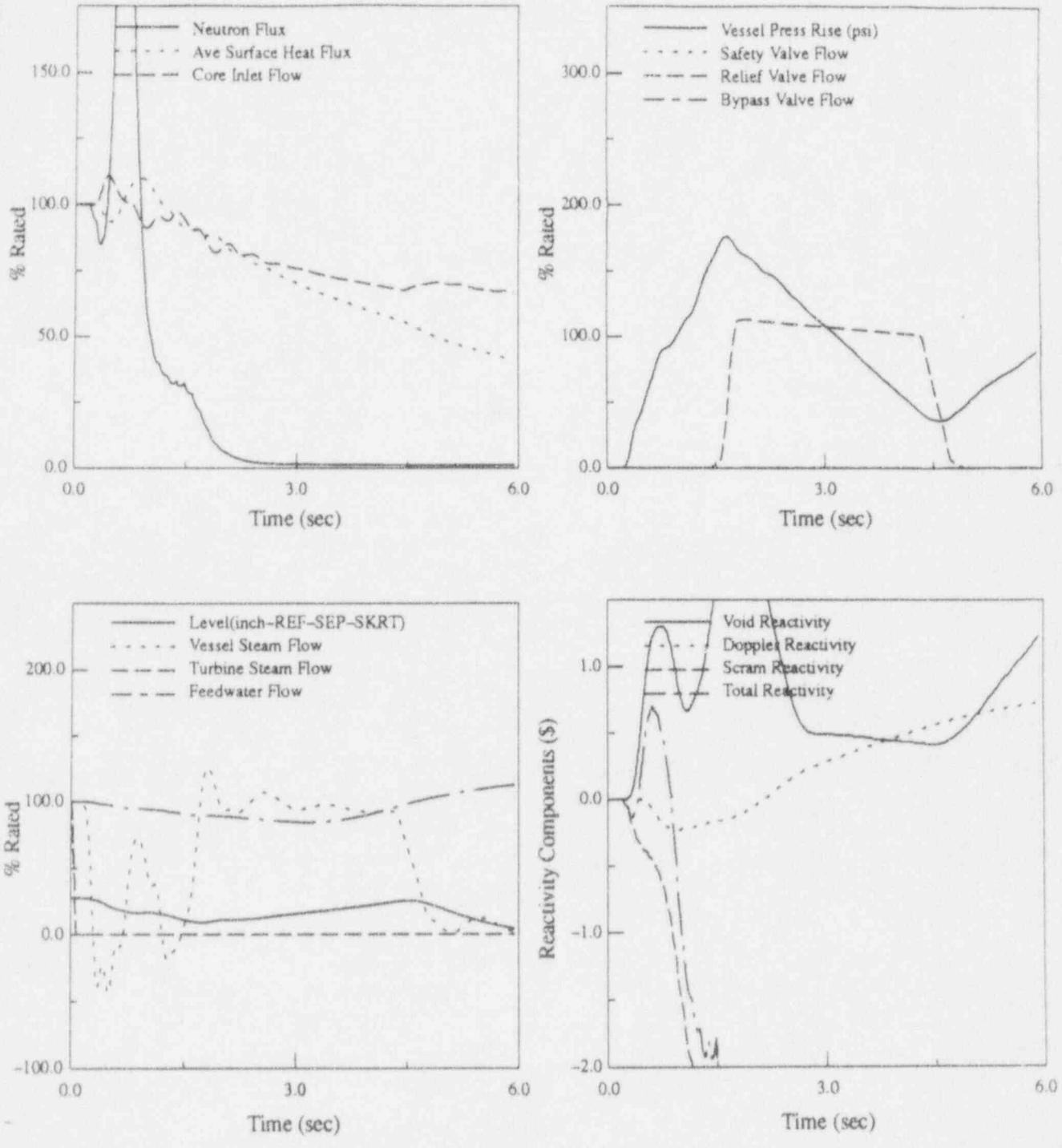


Figure 3 Plant Response to Load Reject w/o Bypass (BOC6 to EOC6)

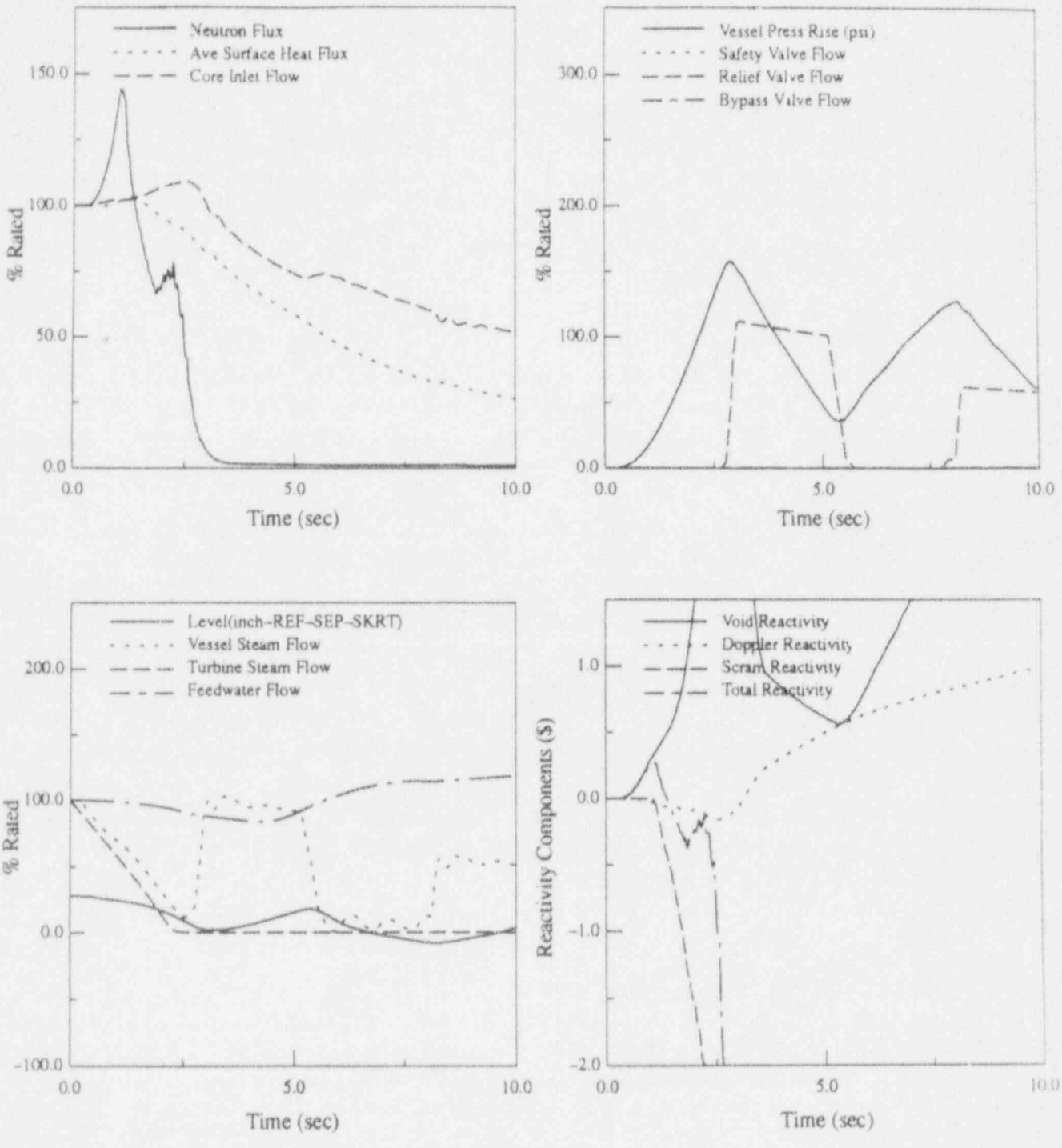


Figure 4 Plant Response to Pressure Regulator Failure (BOC6 to EOC6)

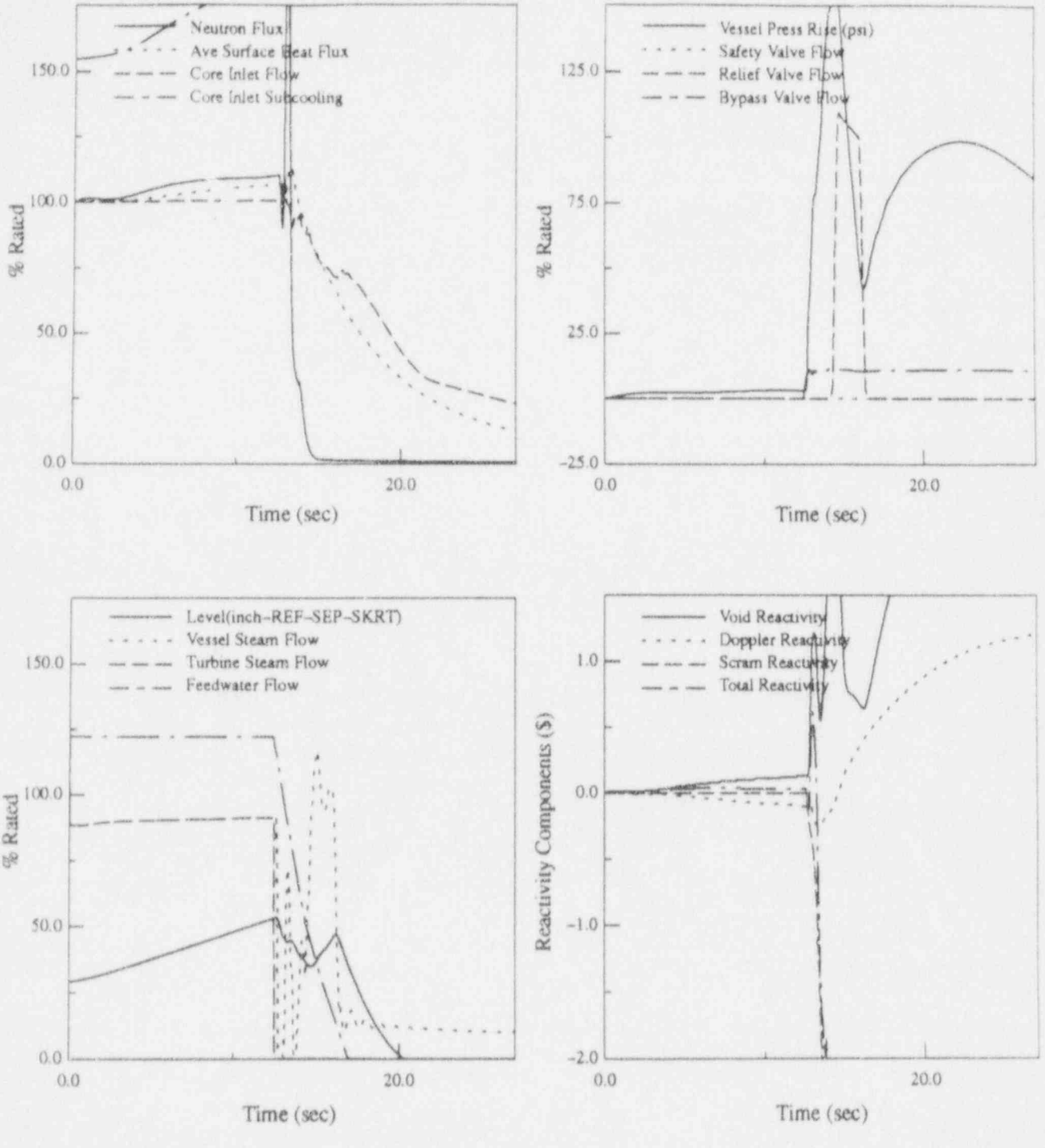


Figure 5 Plant Response to FW Controller Failure (BOC6 to EOC6 Feedwater Heater Out of Service)

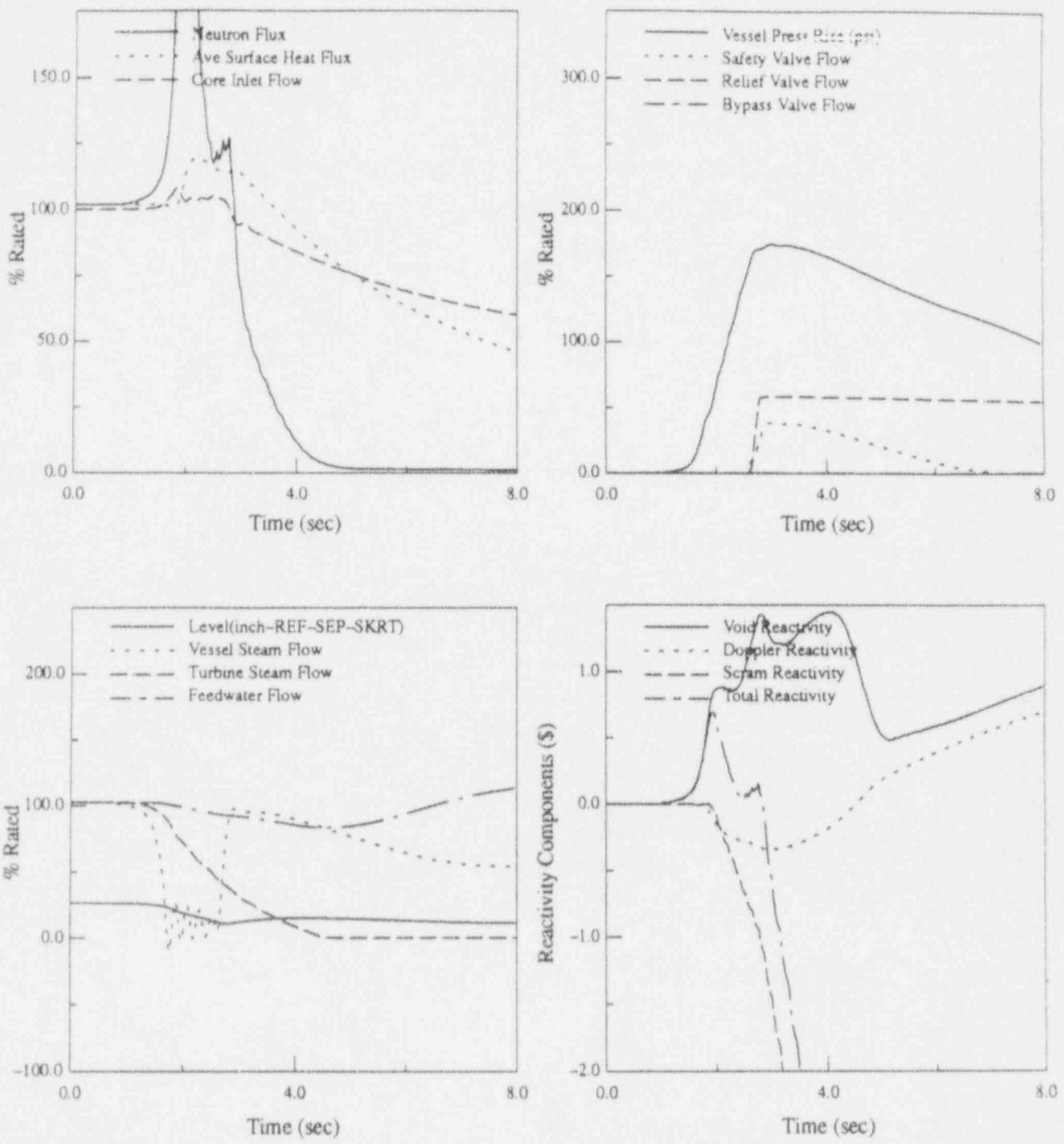


Figure 6 Plant Response to MSIV Closure (Flux Scram)

Appendix A
Analysis Conditions

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

Table A-1

	Analysis Value	
Parameter	STANDARD	FWHOOS
Thermal power, MWt	2894.0	2894.0
Core flow, Mlb/hr	84.5	84.5
Reactor pressure, psia	1055.0	1055.0
Inlet enthalpy, BTU/lb	527.9	514.2
Non-fuel power fraction	0.041	0.041
Steam flow analysis, Mlb/hr	12.45	12.45
Dome pressure, psig	1025.0	1025.0
Turbine pressure, psig	986.0	986.0
No. of Dual Mode S/R Valves	16	16
Relief mode lowest setpoint, psig	1133.0	1133.0
Safety mode lowest setpoint, psig	1177.0	1177.0
Safety/Relief Valve Capacity, lb/hr	831,000	831,000
Reference Pressure, psig	1080	1080

Appendix B
Basis for Analysis of Loss–of–feedwater Heater Event

The loss–of–feedwater heating event was analyzed at 102% rated power using the BWR Simulator Code (Reference B–1). The use of this code is permitted in GESTAR II (Reference B–2). The transient plots, neutron flux and heat flux values normally reported in Section 9 are not an output of the BWR Simulator Code; therefore, these items are not included in this document.

References

B–1. *Steady–State Nuclear Methods*, NEDE–30130–P–A, and NEDO–30130–A, April 1985

B–2. *General Electric Standard Application for Reactor Fuel*, NEDE–24011–P–A (latest approved version)