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Supplemental Reload Licensing Report
for Brunswick Steam Electric Plant Unit 1
Reload 15 Cycle 16, December 2005

Global Nuclear Fuel
A Joint Venture of GE, Toshiba, & Hitachi

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Supplemental Reload Licensing Report
for
Brunswick Steam Electric Plant Unit 1
Reload 15 Cycle 16

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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 GNF - Fuel Engineering Services and GEEN - Nuclear and Safety Analysis personnel. The Supplemental Reload Licensing Report was prepared by G. M. Baka and C. F. Lamb. This document has been verified by R. D. McCord and M. A. Holmes.

The basis for this report is *General Electric Standard Application for Reactor Fuel*, NEDE-24011-P-A-14, June 2000; and the U.S. Supplement, NEDE-24011-P-A-14-US, June 2000.

1. Plant-unique Items

Appendix A: Analysis Conditions
Appendix B: Decrease in Core Coolant Temperature Events
Appendix C: Operating Flexibility Options
Appendix D: TRACG AOO Methodology
Appendix E: MELLLA+ Implementation
Appendix F: Normal and Reduced Feedwater Temperature Limits
Appendix G: List of Acronyms

2. Reload Fuel Bundles

Fuel Type	Cycle Loaded	Number
Irradiated:		
GE14-P10DNAB416-17GZ-100T-150-T-2496 (GE14C)	14	3
GE14-P10DNAB425-16GZ-100T-150-T-2497 (GE14C)	14	16
GE14-P10DNAB438-12G6.0-100T-150-T-2498 (GE14C)	14	45
GE14-P10DNAB413-16GZ-100T-150-T-2660 (GE14C)	15	144
GE14-P10DNAB429-18GZ-100T-150-T-2661 (GE14C)	15	64
GE14-P10DNAB437-12G6.0-100T-150-T-2662 (GE14C)	15	38
New:		
GE14-P10DNAB437-12G6.0-100T-150-T-2662 (GE14C)	16	40
GE14-P10DNAB425-18GZ-100T-150-T-2854 (GE14C)	16	60
GE14-P10DNAB407-16GZ-100T-150-T-2853 (GE14C)	16	150
Total:		**560**

3. Reference Core Loading Pattern

	Core Average Exposure	Cycle Average Exposure
Nominal previous end-of-cycle exposure:	33609 MWd/MT (30489 MWd/ST)	19476 MWd/MT (17669 MWd/ST)
Minimum previous end-of-cycle exposure (for cold shutdown considerations):	33170 MWd/MT (30091 MWd/ST)	19037 MWd/MT (17270 MWd/ST)
Assumed reload beginning-of-cycle exposure:	13709 MWd/MT (12436 MWd/ST)	0 MWd/MT (0 MWd/ST)
Assumed reload end-of-cycle exposure (rated conditions):	31839 MWd/MT (28884 MWd/ST)	18130 MWd/MT (16447 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	1.126
Fully controlled	0.956
Strongest control rod out	0.986
R, Maximum increase in strongest rod out reactivity during the cycle (Δk)	0.000
Cycle average exposure at which R occurs	0 MWd/MT (0 MWd/ST)

5. Standby Liquid Control System Shutdown Capability

Boron (ppm) (at 20°C)	Shutdown Margin (Δk) (at 160°C, Xenon Free)	
	Analytical Requirement	Achieved
720	≥0.011	0.015

6. Reload Unique TRACG Anticipated Operational Occurrences (AOO) Analysis Initial Condition Parameters [1]

Operating domain: ICF (HBB)
Exposure range : BOC to MOC (Application Condition: 1)

	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE14C	1.0	1.47	1.35	1.040	7.674	118.7	1.34

Operating domain: ICF (HBB)
Exposure range : MOC to EOC (Application Condition: 1)

	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE14C	1.0	1.33	1.34	1.040	6.955	124.3	1.45

Operating domain: ICF with TBVOOS and NFWT (HBB)
Exposure range : BOC to EOC (Application Condition: 2)

	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE14C	1.0	1.33	1.34	1.040	6.955	124.3	1.45

Operating domain: ICF with TBVOOS and RFWT (UB)
Exposure range : BOC to EOC (Application Condition: 2)

	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GE14C	1.0	1.24	1.38	1.040	6.448	127.8	1.77

[1] Exposure range designation is defined in Table 7-1. Application condition number is defined in Section 11.

7. Selected Margin Improvement Options [2]

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

Table 7-1 Cycle Exposure Range Designation

Name	Exposure Range [3]
BOC to MOC	BOC16 to EOR16-4130 MWd/MT (3747 MWd/ST)
MOC to EOC	EOR16-4130 MWd/MT (3747 MWd/ST) to EOC16
BOC to EOC	BOC16 to EOC16

[2] Refer to GESTAR for those margin improvement options that are referenced and supported within GESTAR.
[3] End of Rated (EOR) is defined as the cycle average exposure corresponding to all rods out, 100% power/100% flow, and normal feedwater temperature.

8. Operating Flexibility Options [4]

The following information presents the operational domains and flexibility options which are supported by the reload licensing analysis. Inclusion of these results in this report is not meant to imply that these domains and options have been fully licensed and approved for operation.

Extended Operating Domain (EOD):	Yes
EOD type: Maximum Extended Load Line Limit (MELLLA)	
Minimum core flow at rated power:	99.0 %
EOD type: Maximum Extended Load Line Limit Plus (MELLLA+) [5]	
Minimum core flow at rated power:	85.0 %
Increased Core Flow:	Yes
Flow point analyzed throughout cycle:	104.5 %
Feedwater Temperature Reduction:	Yes (MELLLA) No (MELLLA+)
Feedwater temperature reduction during cycle:	110.3°F
Final feedwater temperature reduction:	110.3°F
ARTS Program:	Yes
Single Loop Operation:	Yes (MELLLA) No (MELLLA+)
Equipment Out of Service:	
One Safety/relief valves Out of Service:	Yes (MELLLA) No (MELLLA+)
ADS Out of Service:	Yes (1 Valve OOS)
MSIVOOS (w/ zero SRVs OOS)	Yes (MELLLA) No (MELLLA+)
TBVOOS (w/ one SRV OOS) [6]	Yes

[4] Refer to GESTAR for those operating flexibility options that are referenced and supported within GESTAR.
[5] MELLLA+ operation is not allowed until approved by the U.S. Nuclear Regulatory Commission. See Appendix E.
[6] When the Turbine Bypass System is credited, 3 of 4 valves are assumed operable in the analysis.

9. Core-wide AOO Analysis Results [7]

Methods used: GEMINI (TRACG), GEXL-PLUS

Operating domain: ICF (HBB) Exposure range : BOC to MOC (Application Condition: 1)				
			Uncorrected ΔCPR/ICPR [8]	
Event	**Flux (%rated)**	**Q/A [9] (%rated)**	**GE14C**	**Fig.**
Load Rejection w/o Bypass	315	-	0.158	2
FW Controller Failure	265	-	0.143	3

Operating domain: ICF (HBB) Exposure range : MOC to EOC (Application Condition: 1)				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (%rated)**	**Q/A (%rated)**	**GE14C**	**Fig.**
Load Rejection w/o Bypass	434	-	0.185	4
FW Controller Failure	381	-	0.181	5

Operating domain: ICF with TBVOOS and NFWT (HBB) Exposure range : BOC to EOC (Application Condition: 2)				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (%rated)**	**Q/A (%rated)**	**GE14C**	**Fig.**
FW Controller Failure	458	-	0.204	6

Operating domain: ICF with TBVOOS and RFWT (UB) Exposure range : BOC to EOC (Application Condition: 2)				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (%rated)**	**Q/A (%rated)**	**GE14C**	**Fig.**
FW Controller Failure	394	-	0.241	7

[7] Exposure range designation is defined in Table 7-1. Application condition number is defined in Section 11.
[8] Uncorrected ΔCPR/ICPR is being reported since this is the term used in developing the operating limit for TRACG-based analyses.
[9] Not available from the TRACG transient output.

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

The rod withdrawal error (RWE) event in the maximum extended operating domain was originally analyzed in the GE BWR Licensing Report, *Maximum Extended Operating Domain Analysis for Brunswick Steam Electric Plant*, NEDC-31654P, February 1989. The MCPRs for Brunswick Unit 1 Cycle 16 RWE are not generally bounded by the safety limit adjusted operating limit MCPRs in Table 10-5(a) or 10-5(b) of NEDC-31654P. The limiting results are shown in the table below for the RBM System setpoints shown in Table 10-5(c) of NEDC-31654P. The RBM operability requirements specified in Section 10.5 of NEDC-31654P (for RBM inoperable: OLMCPR ≥ 1.40 for power ≥ 90% and OLMCPR ≥ 1.70 for power < 90%) have been evaluated and shown to be sufficient to ensure that the Safety Limit MCPR will not be exceeded in the event of an unblocked RWE event. In addition, the cladding 1% plastic strain criteria have been met.

RBM Setpoint All HTSP Without RBM Filter	Cycle 16 Results ΔCPR
108.0	0.18
111.0	0.22
114.0	0.27
117.0	0.29

11. Cycle MCPR Values [10,11]

Two loop operation safety limit: 1.11

Single loop operation safety limit: 1.12

Stability MCPR Design Basis: See Section 15

ECCS MCPR Design Basis: See Section 16 (Initial MCPR)

Non-pressurization events:

Exposure range: BOC to EOC	
	GE14C
Control Rod Withdrawal Error (RBM setpoint at 108%)	1.29
Loss of Feedwater Heating [12]	1.26
Fuel Loading Error (mislocated)	Not limiting [13]
Fuel Loading Error (misoriented)	1.17

Limiting Pressurization Events OLMCPR Summary Table: [14]

Appl. Cond.	**Exposure Range**	**Option A**	**Option B**
		GE14C	**GE14C**
1	**Normal Operation (w/ Equipment-in-Service)**		
	BOC to MOC	1.52	1.34
	MOC to EOC	1.56	1.38
2	**TBVOOS (w/ one SRV OOS)**		
	BOC to EOC, NFWT	1.61	1.43
	BOC to EOC, RFWT	1.70	1.52

[10] Exposure range designation is defined in Table 7-1.
[11] The Operating Limit MCPRs for Two Loop Operation (TLO) bound the Operating Limit MCPRs for Single Loop Operation (SLO); therefore, the Operating Limit MCPRs need not be changed for SLO.
[12] See Appendix B.
[13] The mislocated bundle fuel loading error OLMCPR is bounded by the pressurization event OLMCPR.
[14] Each application condition (Appl. Cond.) covers the entire range of licensed flow and feedwater temperature unless specified otherwise. The OLMCPR values presented apply to rated power operation based on the two loop operation safety limit MCPR.

Pressurization events: [15]

Operating domain: ICF (HBB) **Exposure range : BOC to MOC (Application Condition: 1)**		
	Option A	**Option B**
	GE14C	**GE14C**
Load Rejection w/o Bypass	1.52	1.34
FW Controller Failure	Not Limiting[16]	Not Limiting[16]

Operating domain: ICF (HBB) **Exposure range : MOC to EOC (Application Condition: 1)**		
	Option A	**Option B**
	GE14C	**GE14C**
Load Rejection w/o Bypass	1.56	1.38
FW Controller Failure	Not Limiting[16]	Not Limiting[16]

Operating domain: ICF with TBVOOS and NFWT (HBB) **Exposure range : BOC to EOC (Application Condition: 2)**		
	Option A	**Option B**
	GE14C	**GE14C**
FW Controller Failure	1.61	1.43

Operating domain: ICF with TBVOOS and RFWT (UB) **Exposure range : BOC to EOC (Application Condition: 2)**		
	Option A	**Option B**
	GE14C	**GE14C**
FW Controller Failure	1.70	1.52

12. Overpressurization Analysis Summary

Event	**Psl (psig)**	**Pdome (psig)**	**Pv (psig)**	**Plant Response**
MSIV Closure (Flux Scram) – ICF (HBB)	1270	1279	1316	Figure 8

[15] Application condition numbers shown for each of the following pressurization events represent the application conditions for which this event contributed in the determination of the limiting OLMCPR value.
[16] The FW Controller Failure OLMCPR is bounded by the Load Rejection w/o Bypass event OLMCPR.

13. Loading Error Results

Variable water gap misoriented bundle analysis: Yes [17]

Misoriented Fuel Bundle	ΔCPR
GE14-P10DNAB416-17GZ-100T-150-T-2496 (GE14C)	0.06
GE14-P10DNAB413-16GZ-100T-150-T-2660 (GE14C)	0.06
GE14-P10DNAB429-18GZ-100T-150-T-2661 (GE14C)	0.06
GE14-P10DNAB437-12G6.0-100T-150-T-2662 (GE14C)	0.05
GE14-P10DNAB407-16GZ-100T-150-T-2853 (GE14C)	0.06
GE14-P10DNAB425-18GZ-100T-150-T-2854 (GE14C)	0.06

14. Control Rod Drop Analysis Results

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

15. Stability Analysis Results

15.1 Introduction

The BWROG Regional Mode DIVOM Guideline recommends that a plant specific DIVOM slope be used for Option III OPRM setpoint determination (Reference 1 in Section 15.4).

However, since Brunswick Unit 1 will be implementing the Detect and Suppress Solution – Confirmation Density (DSS-CD) solution in the near future, the interim DIVOM approach as a function of Figure of Merit will be applied until DSS-CD is implemented (Reference 2 in Section 15.4).

Should the Option III OPRM system be declared inoperable, the BWROG Interim Corrective Action will constitute the stability licensing basis for Brunswick Unit 1 Cycle 16.

15.2 Stability Option III

Brunswick Unit 1 has implemented BWROG Long Term Stability Solution Option III (Oscillation Power Range Monitor-OPRM) as described in Reference 3 in Section 15.4. Plant specific analysis incorporating the Option III hardware is described in Reference 4 in Section 15.4. Reload validation has been

[17] Includes a 0.02 penalty due to variable water gap R-factor uncertainty.

performed in accordance with the licensing basis methodology described in Reference 5 in Section 15.4. The stability based MCPR Operating Limit is provided for two conditions as a function of OPRM amplitude setpoint in the following table. The two conditions evaluated are for a postulated oscillation at 45% rated core flow steady state operation (SS) and following a two recirculation pump trip (2PT) from the limiting full power operation state point. Current power and flow dependent limits provide adequate protection against violation of the Safety Limit MCPR for postulated reactor instability as long as the operating limit is greater than or equal to the specified value for the selected OPRM setpoint.

The stability-based OLMCPR was calculated for Cycle 16. The reload validation calculation demonstrated that reactor stability does not produce the limiting OLMCPR for Cycle 16 as long as the selected OPRM setpoint produces values for OLMCPR(SS) and OLMCPR(2PT) that are less than the corresponding acceptance criteria.

OPRM Setpoint	OLMCPR(SS)	OLMCPR(2PT)
1.05	1.2093	1.0914
1.06	1.2302	1.1103
1.07	1.2519	1.1298
1.08	1.2743	1.1501
1.09	1.2975	1.1711
1.10	1.3216	1.1928
1.11	1.3455	1.2144
1.12	1.3702	1.2367
1.13	1.3959	1.2598
1.14	1.4225	1.2839
1.15	1.4502	1.3089
Acceptance Criteria	**Off-rated OLMCPR @ 45% Flow [18]**	**Rated Power OLMCPR as described in SRLR Section 11**

15.3 Interim Corrective Action Stability

GE SIL-380 recommendations and the BWROG Interim Corrective Actions in Reference 6 in Section 15.4 have been included in the Brunswick Unit 1 Cycle 16 operating procedures. Regions of restricted operation defined in Attachment 1 of Reference 7 in Section 15.4 and expanded in Reference 6 in Section 15.4, are applicable to Brunswick Unit 1. The standard ICA stability regions are expanded as appropriate to offer stability protection for Brunswick Unit 1 Cycle 16 in accordance with Reference 8 in Section 15.4.

[18] The off-rated OLMCPR is the maximum of the K_p adjusted MCPR or the $MCPR_f$ at 45% core flow.

15.4 References

1. *Plant-Specific Regional Mode DIVOM Procedure Guideline,* GE-NE-0000-0028-9714-R1, June 2, 2005.
2. *Determination of Figure of Merit for Stability DIVOM Curve Applicability,* OG01-0228-001, July 16, 2001.
3. *BWR Owners' Group Long-Term Stability Solutions Licensing Methodology,* NEDO-31960-A, November 1995.
4. *Licensing Basis Hot Bundle Oscillation Magnitude for Brunswick 1 and 2,* GE-NE-C51-00251-00-01, Revision 0, March 2001.
5. *Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications,* NEDO-32465-A, August 1996.
6. *BWR Owners' Group Guideline for Stability Interim Corrective Action,* BWROG-94079, June 6, 1994.
7. *Power Oscillations in Boiling Water Reactors,* NRC Bulletin 88-07, Supplement 1, December 30, 1988.
8. *Review of BWR Owners' Group Guidelines for Stability Interim Corrective Action,* BWROG-02072, November 20, 2002.

16. Loss-of-Coolant Accident Results

16.1 10CFR50.46 Licensing Results

The ECCS-LOCA analysis is based on the SAFER/GESTR-LOCA methodology. The licensing results applicable to all fuel types in the new cycle are summarized in the following table:

Table 16.1-1 Licensing Results

Fuel Type	Licensing Basis PCT (°F)	Local Oxidation (%)	Core-Wide Metal-Water Reaction (%)
GE14C	1557	< 1.00	< 0.10

The SAFER/GESTR-LOCA analysis results are documented in Reference 1 for GE14C in Section 16.4.

16.2 10CFR50.46 Error Evaluation

The 10CFR50.46 errors applicable to the Licensing Basis PCT are shown in the table below.

Table 16.2-1 Impact on Licensing Basis Peak Cladding Temperature for GE14C

10CFR50.46 Error Notifications		
Number	**Subject**	**PCT Impact (°F)**
2002-01	Error in core spray injection elevation	+5
2002-02	Error in SAFER initial bulk water level	+10
2002-05	Error in WEVOL calculation of downcomer free volume	0
2003-01	Impact of SAFER level/volume table error on PCT	-5
2003-05	Impact of Postulated Hydrogen-Oxygen Recombination	0
	Total PCT Adder (°F)	+10

The GE14C Licensing Basis PCT remains below the 10CFR50.46 limit of 2200°F.

16.3 ECCS-LOCA Operating Limits

The ECCS MAPLHGR operating limits have been merged with the thermal-hydraulic MAPLHGR operating limits to produce a set of fuel type dependant composite MAPLHGR limits representing the most restrictive values of both. The most and least limiting values of these composite MAPLHGRs for each of the new fuel bundles in this cycle are shown in the tables below. The MAPLHGR operating limits for the remaining fuel bundles are documented in References 2 and 3 for GE14C in Section 16.4.

Table 16.3-1 MAPLHGR Limits

Bundle Type: GE14-P10DNAB437-12G6.0-100T-150-T-2662

Average Planar Exposure		MAPLHGR (kW/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	9.06	9.21
0.20	0.22	9.11	9.27
1.00	1.10	9.20	9.36
2.00	2.20	9.31	9.48
3.00	3.31	9.43	9.62
4.00	4.41	9.55	9.76
5.00	5.51	9.68	9.90
6.00	6.61	9.81	10.05
7.00	7.72	9.95	10.21
8.00	8.82	10.09	10.37
9.00	9.92	10.23	10.53
10.00	11.02	10.38	10.71
11.00	12.13	10.45	10.84
12.00	13.23	10.48	10.91
13.00	14.33	10.51	10.98
14.00	15.43	10.54	11.03
14.51	16.00	10.55	11.05
15.00	16.53	10.56	11.06
17.00	18.74	10.56	11.03
19.13	21.09	10.49	10.94
20.00	22.05	10.47	10.89
25.00	27.56	10.20	10.62
30.00	33.07	9.87	10.28
35.00	38.58	9.42	9.80
40.00	44.09	8.95	9.32
45.00	49.60	8.45	8.82
50.00	55.12	7.91	8.29
55.00	60.63	5.56	6.58
56.27	62.02	4.91	5.93
57.61	63.50	--	5.23
58.05	63.99	--	5.00
58.14	64.09	--	4.96

Table 16.3-2 MAPLHGR Limits

Bundle Type: GE14-P10DNAB407-16GZ-100T-150-T-2853

Average Planar Exposure		MAPLHGR (kW/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	9.47	9.91
0.20	0.22	9.57	9.98
1.00	1.10	9.71	10.10
2.00	2.20	9.87	10.25
3.00	3.31	10.02	10.41
4.00	4.41	10.17	10.58
5.00	5.51	10.31	10.74
6.00	6.61	10.45	10.88
7.00	7.72	10.57	11.02
8.00	8.82	10.70	11.17
9.00	9.92	10.82	11.31
10.00	11.02	10.93	11.46
11.00	12.13	11.05	11.60
12.00	13.23	11.06	11.70
13.00	14.33	11.05	11.68
14.00	15.43	11.05	11.66
14.51	16.00	11.05	11.63
15.00	16.53	11.05	11.61
17.00	18.74	11.02	11.48
19.13	21.09	10.91	11.27
20.00	22.05	10.87	11.19
25.00	27.56	10.49	10.65
30.00	33.07	10.08	10.12
35.00	38.58	9.58	9.61
40.00	44.09	9.07	9.10
45.00	49.60	8.54	8.59
50.00	55.12	7.99	8.06
55.00	60.63	6.34	6.49
57.61	63.50	5.03	5.18
57.91	63.84	4.88	5.03
58.17	64.12	--	4.91
58.19	64.14	--	4.90

Table 16.3-3 MAPLHGR Limits

Bundle Type: GE14-P10DNAB425-18GZ-100T-150-T-2854

Average Planar Exposure		MAPLHGR (kW/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	8.85	9.20
0.20	0.22	8.91	9.25
1.00	1.10	9.01	9.34
2.00	2.20	9.14	9.46
3.00	3.31	9.27	9.59
4.00	4.41	9.41	9.73
5.00	5.51	9.54	9.86
6.00	6.61	9.68	9.99
7.00	7.72	9.82	10.12
8.00	8.82	9.95	10.25
9.00	9.92	10.09	10.38
10.00	11.02	10.23	10.51
11.00	12.13	10.27	10.60
12.00	13.23	10.29	10.62
13.00	14.33	10.31	10.65
14.00	15.43	10.34	10.70
14.51	16.00	10.35	10.74
15.00	16.53	10.37	10.77
17.00	18.74	10.44	10.88
19.13	21.09	10.47	10.90
20.00	22.05	10.48	10.90
25.00	27.56	10.28	10.52
30.00	33.07	9.84	10.06
35.00	38.58	9.38	9.60
40.00	44.09	8.91	9.14
45.00	49.60	8.41	8.65
50.00	55.12	7.88	8.12
55.00	60.63	5.70	6.47
56.45	62.23	4.96	5.74
56.61	62.40	--	5.66
57.61	63.50	--	5.16
57.77	63.68	--	5.08
58.04	63.98	--	4.95

The single-loop operation multiplier on LHGR and MAPLHGR, and the ECCS analytical initial MCPR values applicable to each fuel type in the new cycle core are shown in the table below.

Table 16.3-4 Initial MCPR and Single Loop Operation LHGR and MAPLHGR Multiplier

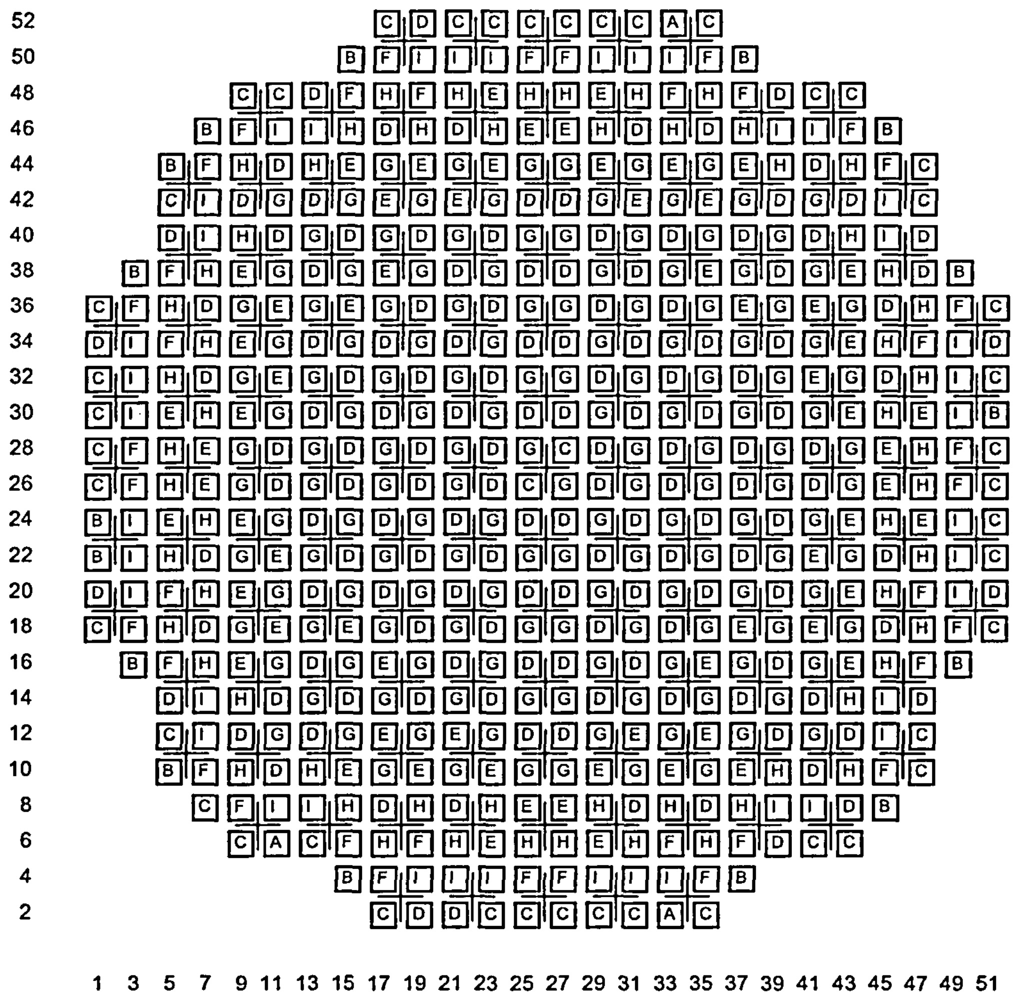
Fuel Type	Initial MCPR	Single Loop Operation LHGR and MAPLHGR Multiplier
GE14C	1.275	0.80

16.4 References

The SAFER/GESTR-LOCA analysis base reports applicable to the new cycle core are listed below.

References for GE14C

1. *Brunswick Nuclear Plant Unit 1 and 2 Extended Power Uprate Task 0407 ECCS-LOCA SAFER/GESTR Project Task Report*, GE-NE-A22-00113-27-01, Revision 0, June 2001.
2. *Supplemental Reload Licensing Report for Brunswick Steam Electric Plant Unit 1 Reload 14 Cycle 15*, 0000-0016-6502-SRLR, Revision 1, June 2005.
3. *Supplemental Reload Licensing Report for Brunswick Steam Electric Plant Unit 1 Reload 13 Cycle 14*, J11-03936SRLR, Revision 2, March 2002.



Fuel Type			
A=GE14-P10DNAB416-17GZ-100T-150-T-2496	(Cycle 14)	F=GE14-P10DNAB437-12G6.0-100T-150-T-2662	(Cycle 15)
B=GE14-P10DNAB425-16GZ-100T-150-T-2497	(Cycle 14)	G=GE14-P10DNAB407-16GZ-100T-150-T-2853	(Cycle 16)
C=GE14-P10DNAB438-12G6.0-100T-150-T-2498	(Cycle 14)	H=GE14-P10DNAB425-18GZ-100T-150-T-2854	(Cycle 16)
D=GE14-P10DNAB413-16GZ-100T-150-T-2660	(Cycle 15)	I=GE14-P10DNAB437-12G6.0-100T-150-T-2662	(Cycle 16)
E=GE14-P10DNAB429-18GZ-100T-150-T-2661	(Cycle 15)		

Figure 1 Reference Core Loading Pattern

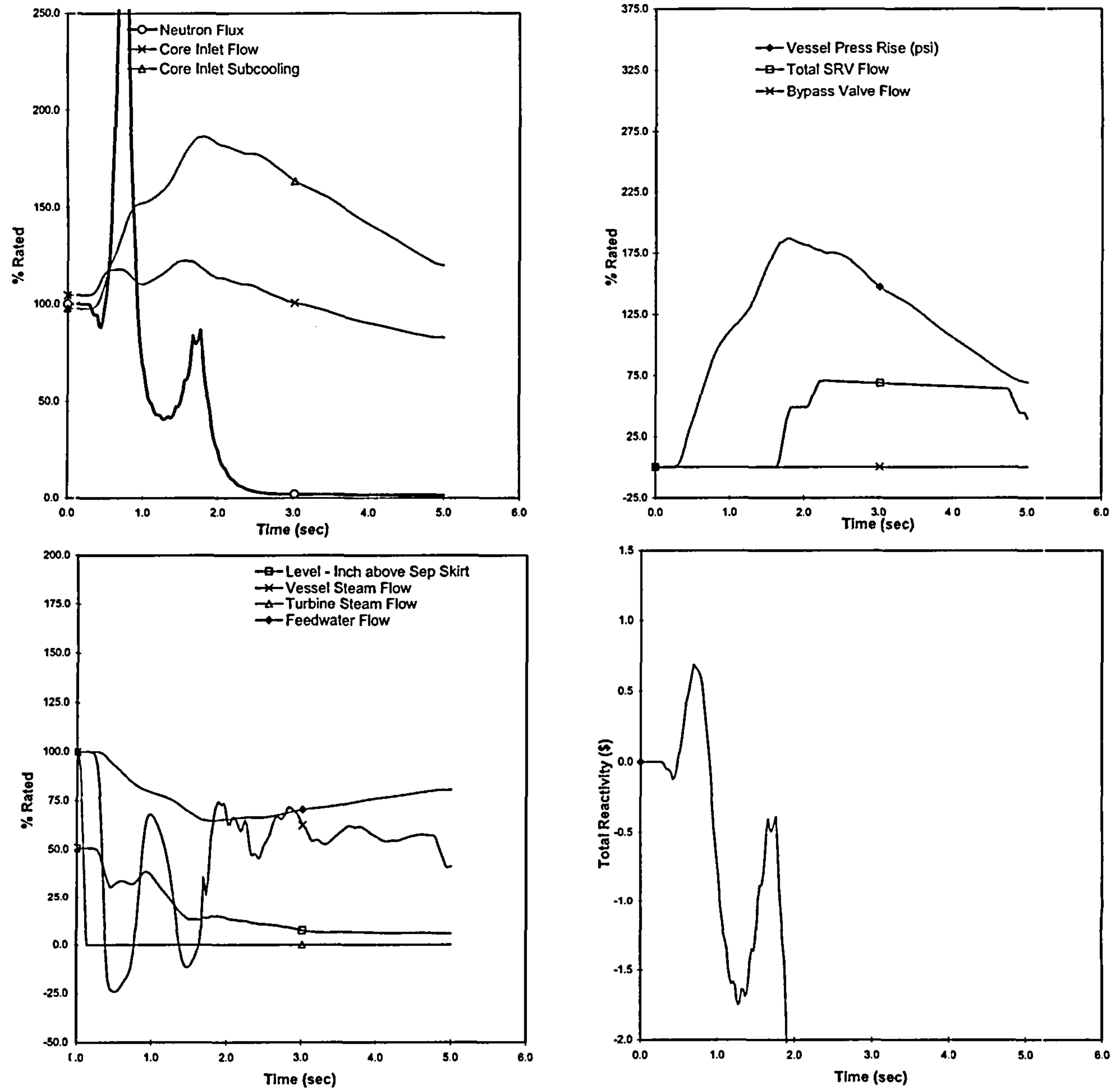


Figure 2 Plant Response to Load Rejection w/o Bypass
(MOC ICF (HBB))

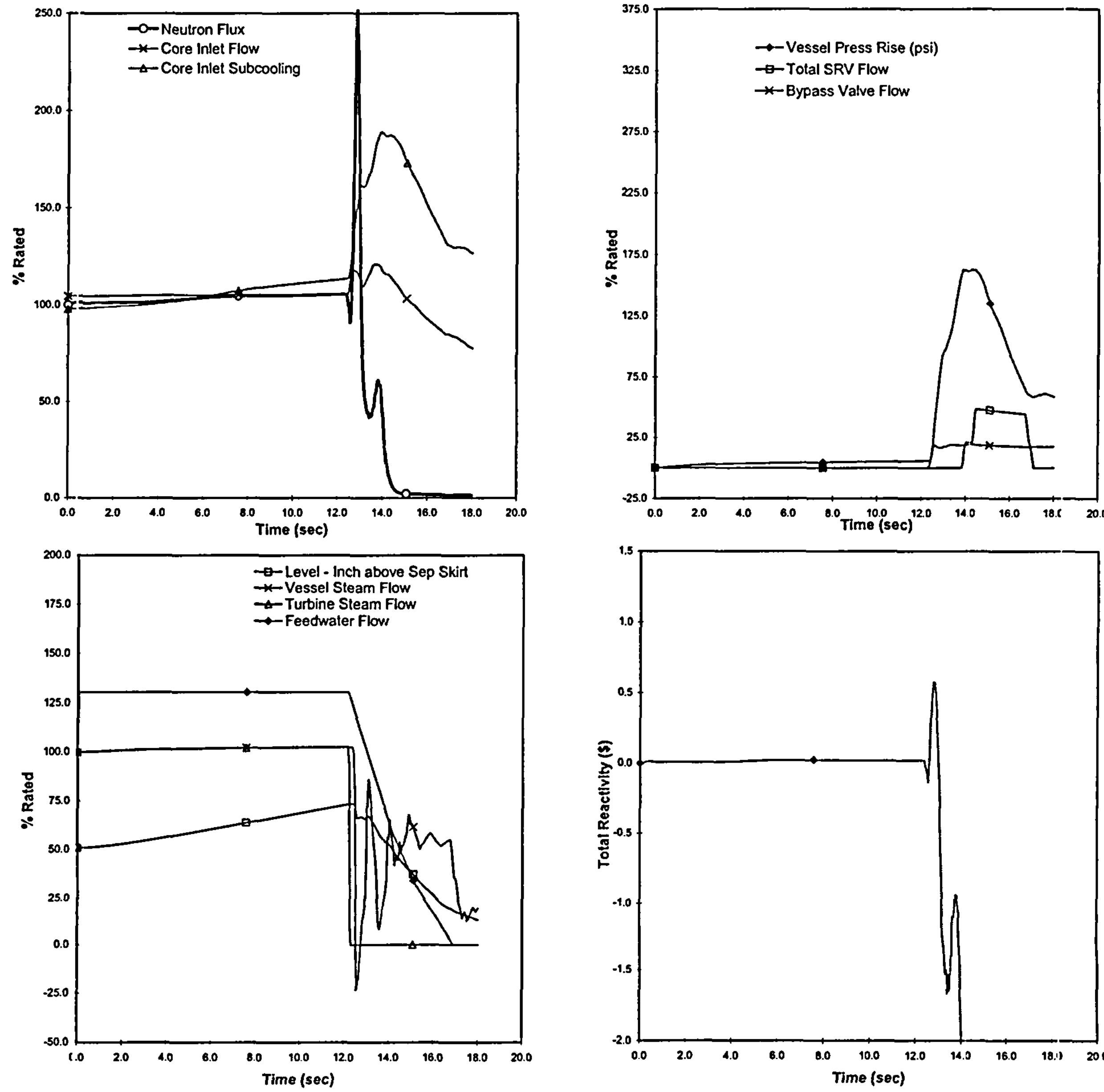


Figure 3 Plant Response to FW Controller Failure
(MOC ICF (HBB))

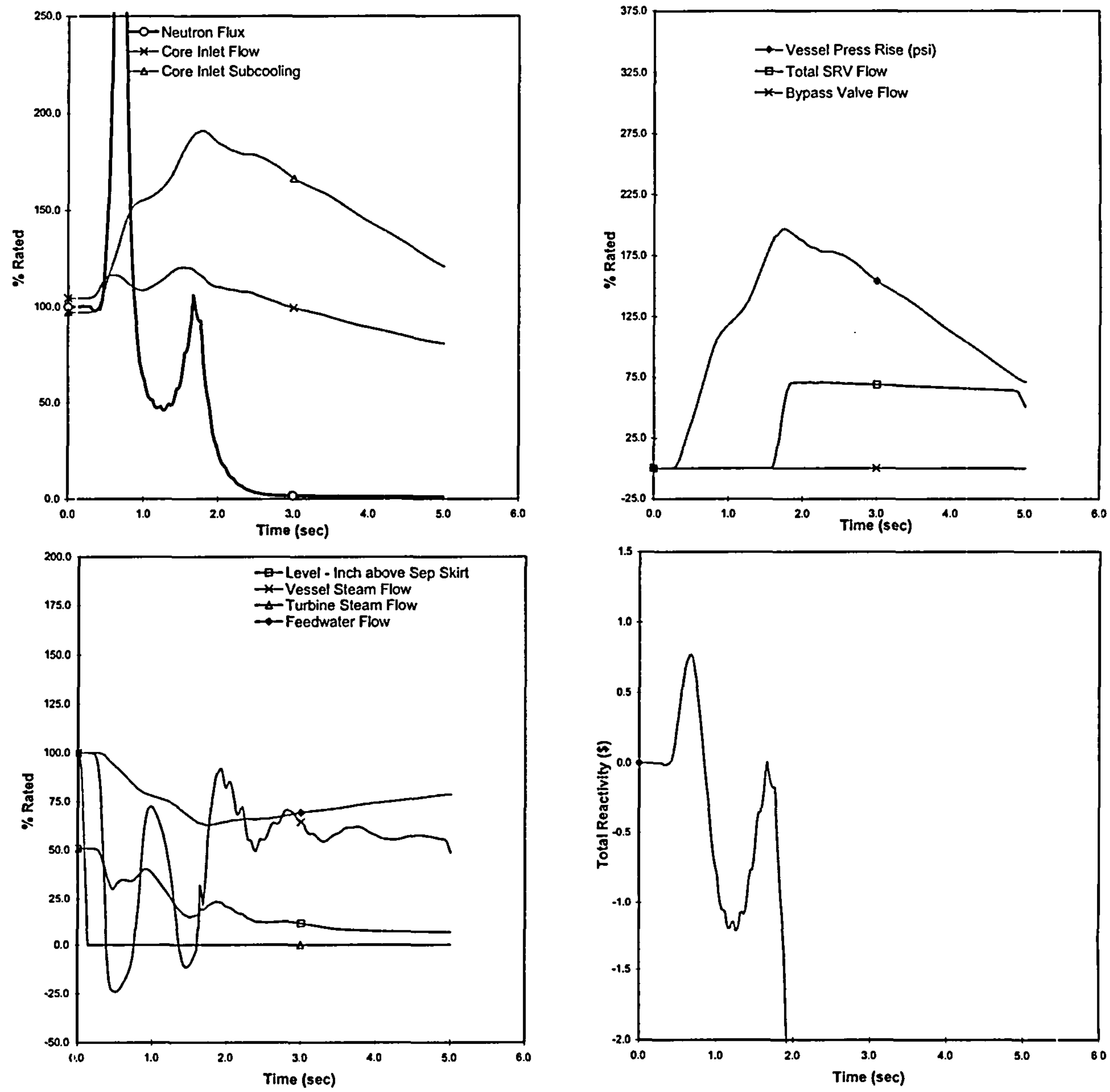


Figure 4 Plant Response to Load Rejection w/o Bypass
(EOC ICF (HBB))

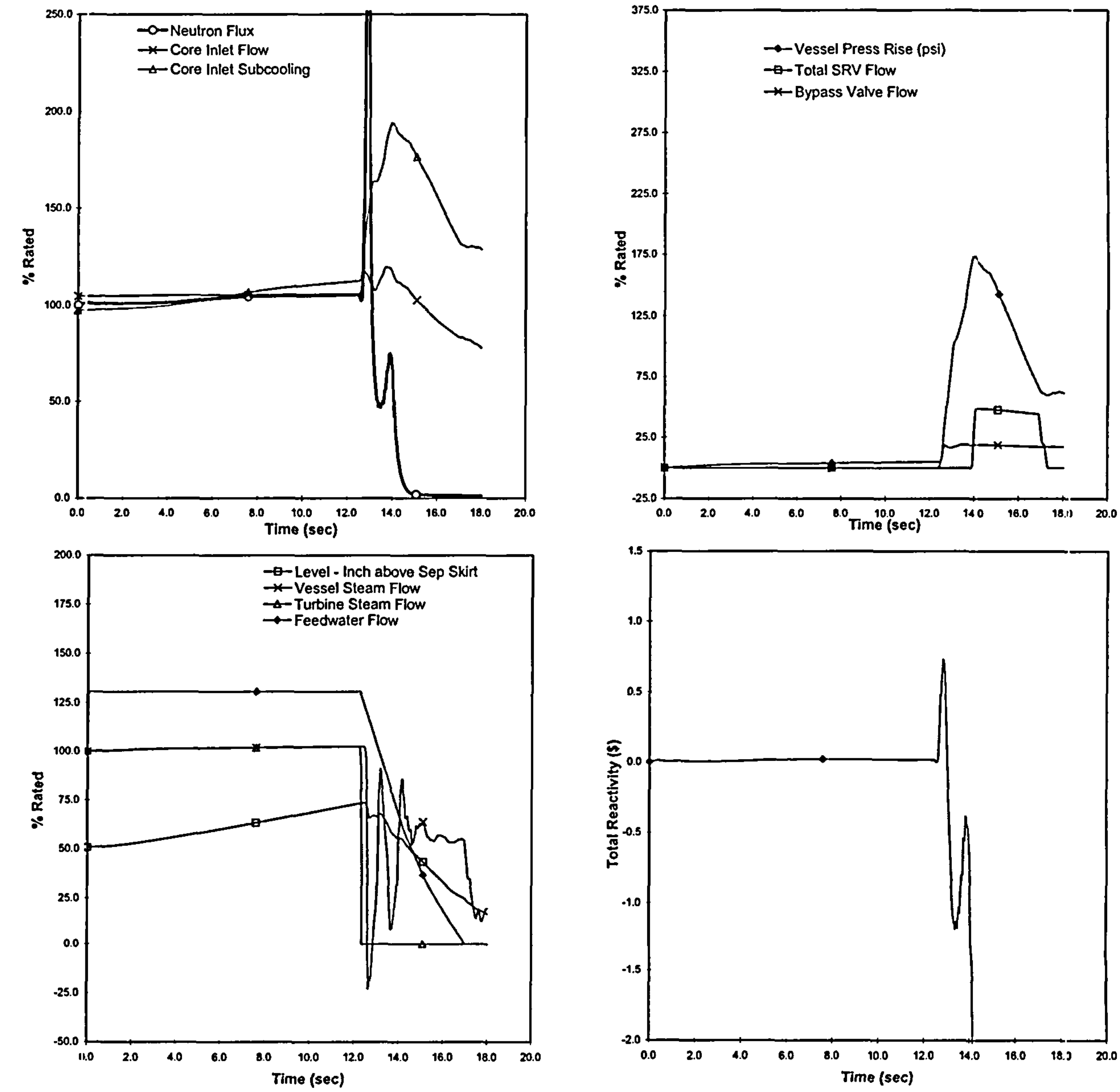


Figure 5 Plant Response to FW Controller Failure
(EOC ICF (HBB))

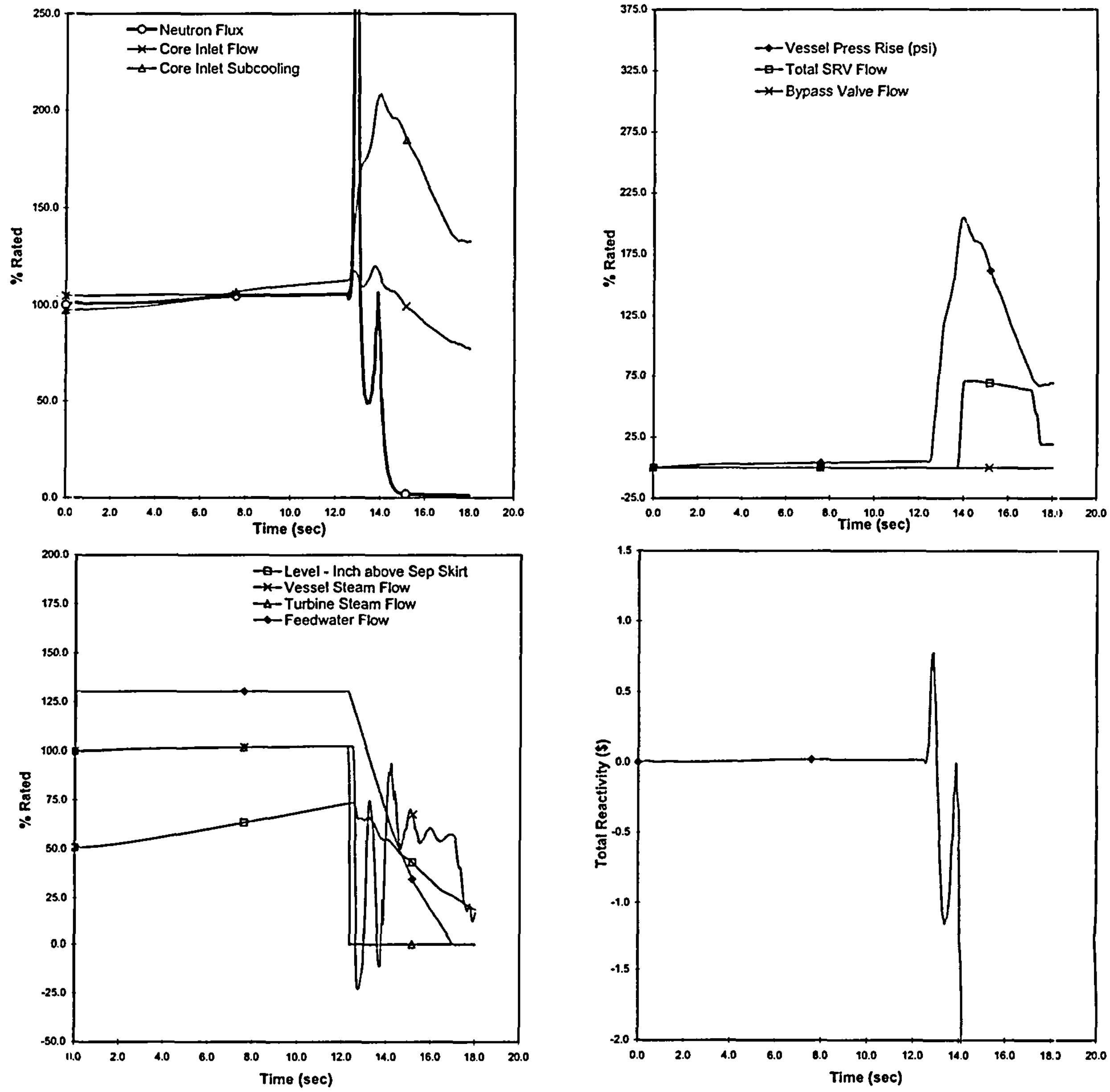


Figure 6 Plant Response to FW Controller Failure
(EOC NFWT ICF (HBB) with TBVOOS)

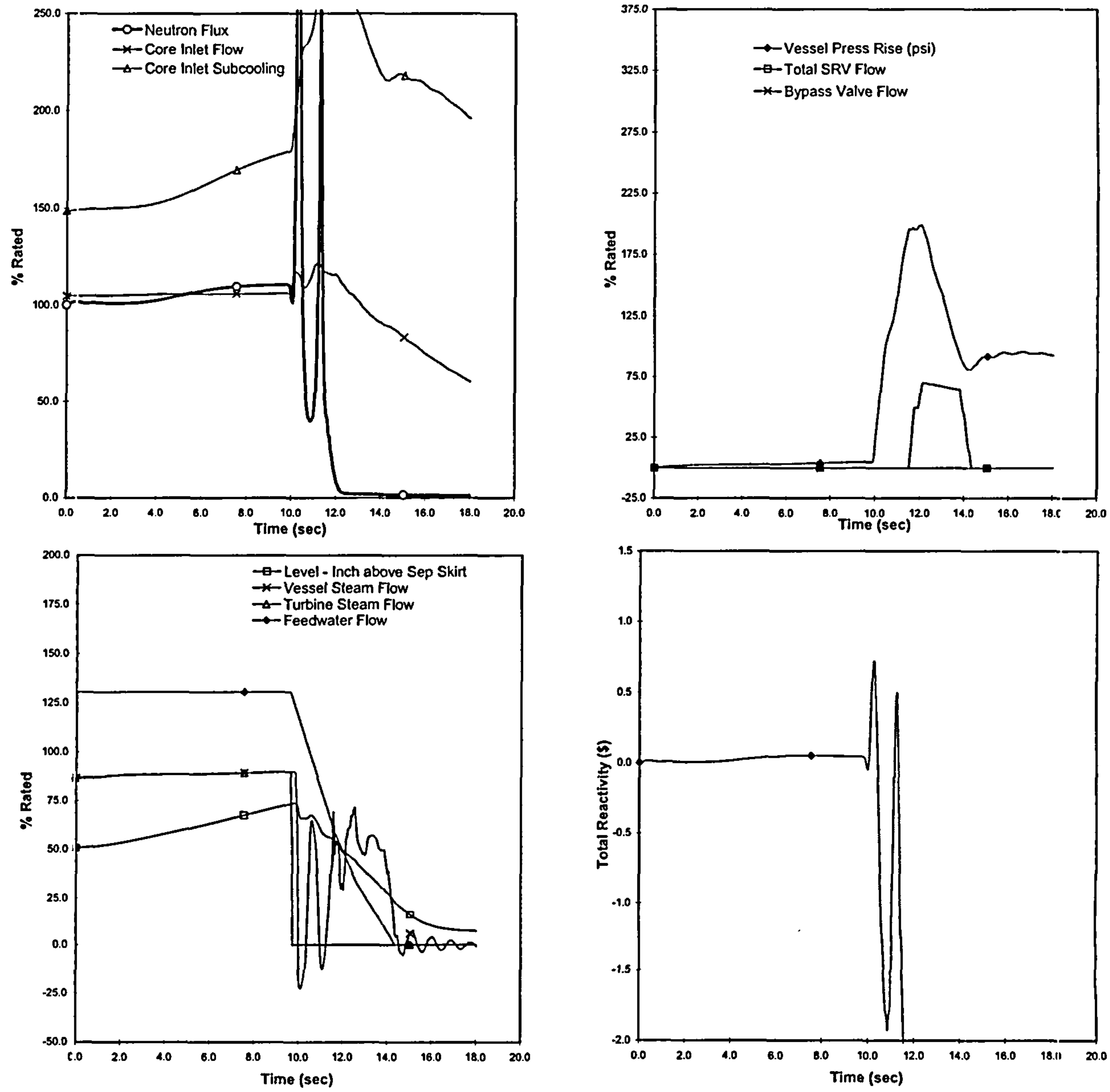


Figure 7 Plant Response to FW Controller Failure
(EOC RFWT ICF (UB) with TBVOOS)

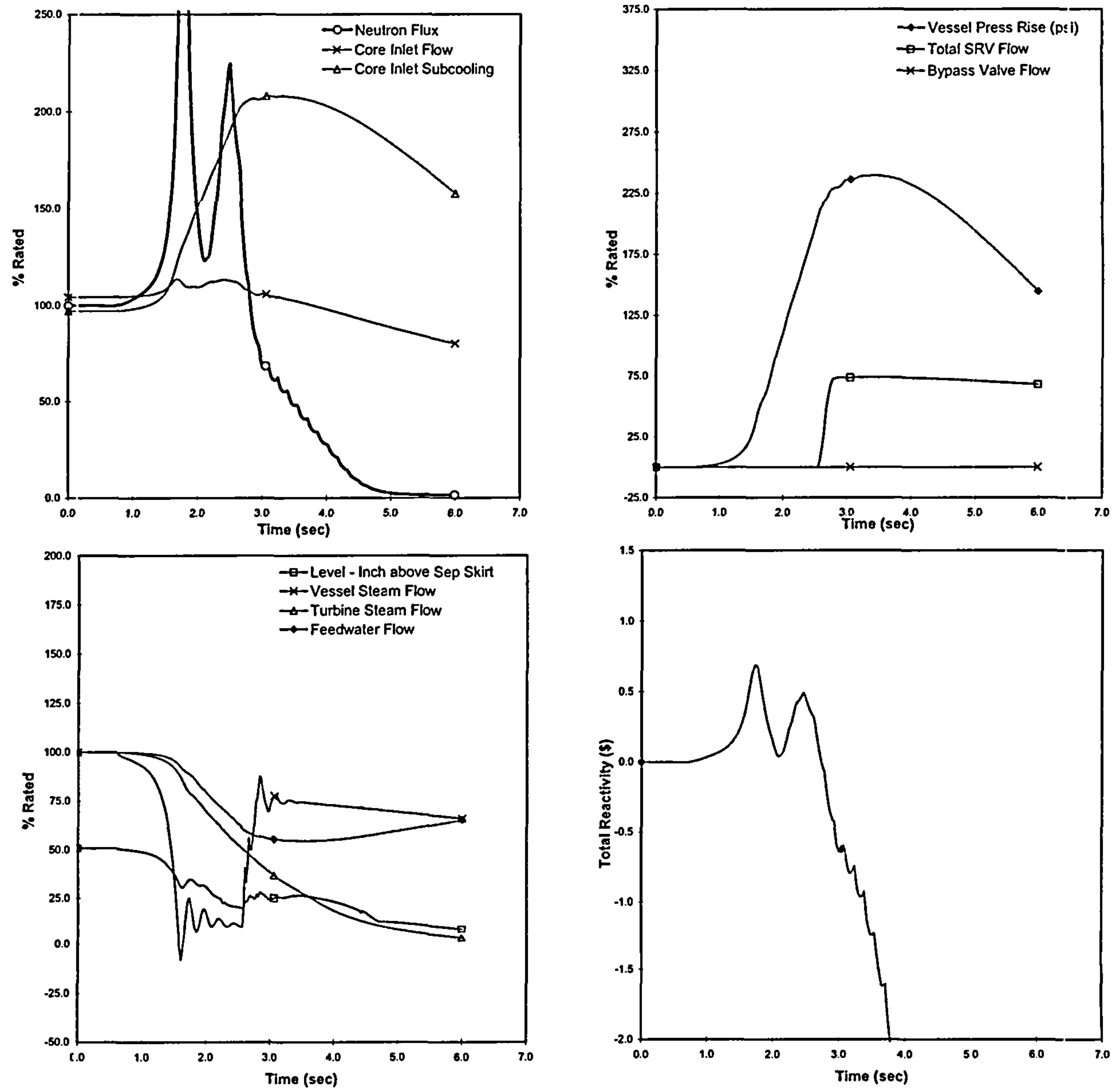


Figure 8 - Plant Response to MSIV Closure (Flux Scram) – ICF (HBB)

Appendix A
Analysis Conditions

The reactor operating conditions and the pressure relief and safety valve configuration used in the reload licensing analysis for this plant and cycle are presented in Tables A-1 and A-2 below.

Table A-1 Reactor Operating Conditions

	Analysis Value	
Parameter	**NFWT**	**RFWT**
Thermal power, MWt	2923.0	2923.0
Core flow, Mlb/hr	80.5	80.5
Reactor pressure (core mid-plane), psia	1059.3	1035.3
Inlet enthalpy, Btu/lb	529.1	512.2
Non-fuel power fraction [19]	-	-
Steam flow, Mlb/hr	12.78	11.06
Dome pressure, psig	1030.1	1007.2
Turbine pressure, psig	963.9	956.9

Table A-2 Pressure Relief and Safety Valve Configuration

Valve Type	Number of Valves	Lowest Setpoint (psig)
Safety/Relief Valve	10	1163.9

[19] Not available in the TRACG output files.

Appendix B
Decrease in Core Coolant Temperature Events

The Loss of Feedwater Heating (LFWH) event was analyzed for Brunswick Unit 1 Cycle 16 using the BWR Simulator Code. The use of this code is permitted in GESTAR II. The transient plots, neutron flux and heat flux values normally reported in Section 9 are not an output of the BWR Simulator Code; therefore, those items are not included in this document. The OLMCPR result is shown in Section 11.

In addition, the Inadvertent HPCI start-up event was shown to be bounded by the LFWH event in Brunswick Unit 1 Cycle 16 in accordance with Reference B-1.

Reference

B-1. *Determination of Limiting Cold Water Event*, NEDC-32538P-A, February 1996.

Appendix C
Operating Flexibility Options

Reference C-1 provides a basis for operation of the Brunswick Steam Electric Plant (BSEP) with one Main Steamline Isolation Valve Out of Service (MSIVOOS) (three steamline operation) and all S/RVs in service. For MSIVOOS, the OLMCPRs presented in Section 11 and peak overpressure results in Section 12 are bounding. MSIVOOS will not be allowed while operating in the MELLLA+ domain (See Appendix E).

Reference C-2 provides a basis for operation of the Brunswick Steam Electric Plant (BSEP) with Feedwater Temperature Reduction (FWTR). The required OLMCPRs are provided in Section 11. FWTR and FWHOOS will not be allowed while operating in the MELLLA+ domain (See Appendix E).

Reference C-3 provides a basis for operation of the Brunswick Steam Electric Plant (BSEP) with Maximum Extended Operating Domain (MEOD). The required OLMCPRs are provided in Section 11.

Reference C-4 provides a basis for operation of the Brunswick Steam Electric Plant (BSEP) with all Turbine Bypass Valves Out of Service (TBVOOS). The required OLMCPRs are provided in Section 11.

The impact of GE14 fuel on the operating flexibility options is addressed in Reference C-5.

The ARTS power and flow dependent operating limits for all operating flexibility options are provided in References C-9, C-3, and C-6. The ARTS power and flow dependent MCPR limits apply to two recirculation pump system operation and SLO without modification for Brunswick Unit 1 Cycle 16.

The ARTS power dependent limits in Reference C-9 include an adjustment to the limits provided in References C-3 and C-5 to address the 10 CFR Part 21 Communication in Reference C-8. The power dependent MCPR limits in Reference C-9 also include an adjustment to the K(p) above P-bypass due to the implementation of TRACG (Reference C-7). The MCPR(p) limits provided in Reference C-9 are based on a Safety Limit of 1.11. The Reference C-9 power dependent limits are not altered for Brunswick Unit 1 Cycle 16.

The ARTS flow dependent limits provided in Reference C-3 are based on a Safety Limit of 1.07. Due to the safety limit change for Brunswick Unit 1 Cycle 16, there will be a required adjustment to the MCPR(f) limits and a validation of the required minimum GE14 OLMCPR for the recirculation pump seizure event. The Reference C-3 MCPR(f) limits are increased for a Safety Limit of 1.11 by the ratio of (1.11/1.07). The following coefficients apply:

Maximum Core Flow (% of Rated)	A(f)	B(f)	Flow Intercept (% of Rated)	MCPR
102.5	-0.592	1.717	80.51	1.24
107.0	-0.608	1.760	85.61	1.24
112.0	-0.625	1.812	91.64	1.24
117.0	-0.656	1.877	97.10	1.24

The flow dependent MAPLHGR limit multiplier, MAPFAC(f), is not altered for Brunswick Unit 1 Cycle 16.

From Reference C-5, the SLO OLMCPR was determined to be 1.40 with a SLO SLMCPR of 1.12. The initial power for the licensing basis pump seizure event is 2143 MW_{th}, which was about 83.8% of the plant licensed thermal power at the time of the analysis. Consequently, the K(P) for this power level from Reference C-5 was approximately 1.06, resulting in a minimum TLO OLMCPR of 1.32 to cover the pump seizure event for GE14 fuel for a SLO SLMCPR of 1.12. After EPU, the licensing basis GE14 pump seizure initial power in MW_{th} is unchanged, but represents about 73.3% of licensed thermal power, resulting in a K(P) of about 1.12. Since the SLO SLMCPR is 1.12 for Brunswick Unit 1 Cycle 16, the SLO OLMCPR must be greater than or equal to 1.40 for the pump seizure event. Therefore, the minimum GE14 OLMCPR of 1.34 (See Section 11) is conservative for the SLO pump seizure event (1.34*K(73.3) = 1.34*1.12 = 1.50 > 1.40).

References

C-1. *Main Steamline Isolation Valve Out of Service for the Brunswick Steam Electric Plant*, EAS-117-0987, GE Nuclear Energy (Proprietary), April 1988.

C-2. *Feedwater Temperature Reduction with Maximum Extended Load Line Limit and Increased Core Flow for Brunswick Steam Electric Plants Units 1 and 2*, NEDC-32457P, Revision 1, GE Nuclear Energy (Proprietary), December 1995.

C-3. *Maximum Extended Operating Domain Analysis for Brunswick Steam Electric Plant*, NEDC-31654P, GE Nuclear Energy (Proprietary), February 1989.

C-4. *Turbine Bypass Out of Service Analysis for Carolina Power & Light Company's Brunswick Nuclear Plants Units 1 and 2*, NEDC-32813, Revision 3, GE Nuclear Energy (Proprietary), June 1998.

C-5. *GE14 Fuel Design Cycle-Independent Analyses For Brunswick Steam Electric Plant Units 1 and 2*, GE-NE-L12-00876-00-01P, Revision 1, GE Nuclear Energy (Proprietary), February 2001.

C-6. *Safety Analysis Report for Brunswick Steam Electric Plant Units 1 and 2 Extended Power Uprate*, NEDC-33039P, GE Nuclear Energy (Proprietary), August 2001.

C-7. *Brunswick Nuclear Station TRACG Implementation for Reload Licensing Transient Analysis*, GE-NE-0000-0022-8180-R0, GE Nuclear Energy (Proprietary), February 2004.

C-8. SC04-15, "Turbine Control System Impact in Transient Analyses," 10 CFR Part 21 Communication, October 31, 2004.

C-9. *Brunswick 1 and 2 Off-Rated Analyses Below the PLU Power Level*, GE-NE-0000-0036-9469-R0, Revision 0, GE Nuclear Energy (Proprietary), June 2005.

Appendix D
TRACG AOO Methodology

Reference D-1 provides the results of the analyses and evaluations supporting the application of TRACG for AOO analyses for the Brunswick Steam Electric Plant Units 1 and 2. The report requires the increase of K(P) from 1.15 to 1.18 at 60% power (See Appendix C). Additionally, the report specifies a scram speed adjustment factor (SSAF) of 0.18 for GE14 fuel. Section 11 of this report presents the MCPR limits based on the methodology of References D-2 and D-3.

References

D-1. *Brunswick Nuclear Station TRACG Implementation for Reload Licensing Transient Analysis*, GE-NE-0000-0022-8180-R0, GE Nuclear Energy (Proprietary), February 2004.

D-2. *TRACG Application for Anticipated Operational Occurrences Transient Analysis*, NEDE-32906P-A, Revision 1, April 2003.

D-3. *Final Safety Evaluation Report by the Office of Nuclear Reactor Regulation for NEDE-32906P, Supplement 2, "TRACG Application for Anticipated Operational Occurrences Transient Analyses"*, March 2005.

Appendix E
MELLLA+ Implementation

Brunswick is seeking approval to operate in the MELLLA+ domain (Reference E-1), which would provide greater core flow flexibility, particularly as power approaches 120% of the original licensed thermal power (OLTP). Approval is not expected prior to startup of Brunswick Unit 1 Cycle 16. However, the cycle-specific reload licensing analyses were performed to support operation with or without the MELLLA+ domain. Special consideration of MELLLA+ was given during performance of the transient analyses, stability analyses, and LOCA analyses.

The pressurization transients are generally limiting at high flow conditions. However, the transients were performed at both the minimum MELLLA+ flow (85%) and the maximum ICF flow (104.5%). This ensures that the pressurization transient results bound both MELLLA and MELLLA+. Additionally, the loss of feedwater heating (LFWH) transient, which is more limiting at low flow, was performed at the minimum MELLLA+ flow. Therefore, the limiting subcooling transient bounds both MELLLA and MELLLA+. Reduced feedwater temperature (FFWTR and FWHOOS) and single loop operation (SLO) will not be allowed in conjunction with operation in the MELLLA+ domain. Further, no SRVs will be allowed to be out of service in the MELLLA+ domain. However, the pressurization transients were performed at MELLLA+ with 1 SRV out of service to ensure that both MELLLA and MELLLA+ are bounded. Finally, TBVOOS will be allowed in the MELLLA+ domain, but MSIVOOS will not.

For EPU/MELLLA+ operation, the Detect and Suppress Solution – Confirmation Density (DSS-CD) is the licensing basis for Brunswick Unit 1 Cycle 16. The reload checklist as outlined in Reference E-2 and shown in Table E-1 is used to confirm that the DSS-CD is applicable to Brunswick Unit 1 Cycle 16 EPU/MELLLA+ operation.

Table E-1 DSS-CD Plant Specific Applicability Checklist

Parameter	Criterion	Acceptance
BWR Product Line	BWR/3-6 design as of July 2002	Yes (BWR/4)
Fuel Product Line	GE14 and earlier GE designs	Yes (GE14)
Operating Domain	≤ EPU/MELLLA+ including BWR/3-6 licensed operational flexibility features as of July 2002	Yes
Rated T_{FW} Reduction	≤ 120°F (EPU/MELLLA) No T_{FW} Reduction (MELLLA+ extension)	Yes (110°F)
MCPR Margin	$\frac{OLMCPR_{Rated} - SLMCPR}{OLMCPR_{Rated}} \geq 0.067$	Yes (0.165)

Should the DSS-CD OPRM system be declared inoperable, either the BSP Option 1 or the BSP Option 2 is the backup stability solution for Brunswick Unit 1 Cycle 16 operation. The appropriate BSP Option may be implemented based on the information provided in Reference E-3.

The application of the ECCS-LOCA analysis to operation in the MELLLA+ power/flow region was addressed in Reference E-4. Elimination of the 1600°F Upper Bound peak cladding temperature limit has been incorporated as defined in Reference E-5.

References

E-1. *Safety Analysis Report for Brunswick Steam Electric Plant Units 1 and 2 Maximum Extended Load Line Limit Analysis Plus,* NEDC-33063P, GE Nuclear Energy (Proprietary), November 2002.

E-2. *General Electric Boiling Water Reactor Detect and Suppress Solution – Confirmation Density Licensing Topical Report*, NEDC-33075P, Revision 4, July 2004.

E-3. *DSS-CD Backup Stability Protection Evaluation for Brunswick Unit 1 Cycle 16*, GE-NE-0000-0044-3728-R0, November 2005.

E-4. *Brunswick Nuclear Plant Unit 1 and 2 MELLLA+ Task 0407 ECCS-LOCA SAFER/GESTR Project Task Report*, GE-NE-A22-00113-83-01, Revision 0, September 2002.

E-5. *GESTR-LOCA and SAFER Models for Evaluation of Loss-of-Coolant Accident Volume III, Supplement 1, Additional Information for Upper Bound PCT Calculation*, NEDE-23785P-A, Volume III, Supplement 1, Revision 1, March 2002.

Appendix F
Normal and Reduced Feedwater Temperature Limits

In some cases, a distinction is made between the OLMCPR values for the normal feedwater temperature (NFWT) and reduced feedwater temperature (RFWT) domains. Specifically, the NFWT and RFWT limits are separated at any cycle exposure for which the TBPOOS operating flexibility option is employed. The RFWT limits apply to both feedwater temperature reduction and feedwater heater out of service. The results of the analyses are insensitive to feedwater temperature deviations of less than 10°F.

Appendix G
List of Acronyms

Acronym	Description
ΔCPR	Delta Critical Power Ratio
Δk	Delta k-effective
2PT	Two Recirculation Pump Trip
ADS	Automatic Depressurization System
ADSOOS	Automatic Depressurization System Out of Service
AOO	Anticipated Operational Occurrence
APRM	Average Power Range Monitor
ARTS	APRM, Rod Block and Technical Specification Improvement Program
BOC	Beginning of Cycle
BSP	Backup Stability Protection
Btu	British thermal unit
BWROG	Boiling Water Reactor Owners Group
COLR	Core Operating Limits Report
CPR	Critical Power Ratio
DIVOM	Delta CPR over Initial MCPR vs. Oscillation Magnitude
DR	Decay Ratio
DS/RV	Dual Mode Safety/Relief Valve
ECCS	Emergency Core Cooling System
ELLLA	Extended Load Line Limit Analysis
EOC	End of Cycle (including all planned cycle extensions)
EOR	End of Rated (All Rods Out 100%Power / 100%Flow / NFWT)
ER	Exclusion Region
FFWTR	Final Feedwater Temperature Reduction
FMCPR	Final MCPR
FOM	Figure of Merit
FWCF	Feedwater Controller Failure
FWTR	Feedwater Temperature Reduction
GDC	General Design Criterion
GESTAR	General Electric Standard Application for Reactor Fuel
GETAB	General Electric Thermal Analysis Basis
GSF	General Shape Function
HAL	Haling Burn
HBB	Hard Bottom Burn
HBOM	Hot Bundle Oscillation Magnitude
HCOM	Hot Channel Oscillation Magnitude
HFCL	High Flow Control Line
HPCI	High Pressure Coolant Injection
ICA	Interim Corrective Action

Acronym	Description
ICF	Increased Core Flow
IMCPR	Initial MCPR
IVM	Initial Validation Matrix
L8	Turbine Trip on high water level (Level 8)
LCF	Low Core Flow
LHGR	Linear Heat Generation Rate
LOCA	Loss of Coolant Accident
LPRM	Local Power Range Monitor
LRHBP	Load Rejection with Half Bypass
LRNBP	Load Rejection without Bypass
LTR	Licensing Topical Report
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MELLLA	Maximum Extended Load Line Limit Analysis
MELLLA+	MELLLA Plus
MEOD	Maximum Extended Operating Domain
MOC	Middle of Cycle
MRB	Maximal Region Boundaries
MSIV	Main Steam Isolation Valve
MSIVOOS	Main Steam Isolation Valve Out of Service
MTU	Metric Ton Uranium
MWd	Megawatt day
MWd/ST	Megawatt days per Standard Ton
MWd/MT	Megawatt days per Metric Ton
MWt	Megawatt Thermal
NBP	No Bypass
NCL	Natural Circulation Line
NFWT	Normal Feedwater Temperature
NOM	Nominal Burn
NTR	Normal Trip Reference
OLMCPR	Operating Limit MCPR
OOS	Out of Service
OPRM	Oscillation Power Range Monitor
Pdome	Peak Dome Pressure
Psl	Peak Steam Line Pressure
Pv	Peak Vessel Pressure
PCT	Peak Clad Temperature
PHE	Peak Hot Excess
PLHGR	Peak Linear Heat Generation Rate
PLUOOS	Power Load Unbalance Out of Service
PRFDS	Pressure Regulator Failure Downscale
PROOS	Pressure Regulator Out of Service
Q/A	Heat Flux
RBM	Rod Block Monitor
RC	Reference Cycle

Acronym	Description
RCF	Rated Core Flow
RFWT	Reduced Feedwater Temperature
RPS	Reactor Protection System
RPT	Recirculation Pump Trip
RPTOOS	Recirculation Pump Trip Out of Service
RV	Relief Valve
RVM	Reload Validation Matrix
RWE	Rod Withdrawal Error
SC	Standard Cycle
SL	Safety Limit
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
SRLR	Supplemental Reload Licensing Report
S/RV	Safety/Relief Valve
SRVOOS	Safety/Relief Valve(s) Out of Service
SS	Steady State
SSV	Spring Safety Valve
STU	Short Tons (or Standard Tons) of Uranium
TBV	Turbine Bypass Valve
TBVOOS	Turbine Bypass Valves Out of Service
TCV	Turbine Control Valve
TCVOOS	Turbine Control Valve Out of Service
TCVSC	Turbine Control Valve Slow Closure
TLO	Two Loop Operation
TRF	Trip Reference Function
TSIP	Technical Specifications Improvement Program
TTHBP	Turbine Trip with Half Bypass
TTNBP	Turbine Trip without Bypass
UB	Under Burn

Global Nuclear Fuels Affidavit
Regarding Withholding
NEDC-31624P, Supplement 1, Revision 9,
From Public Disclosure

Affidavit

I, Andrew A. Lingenfelter, state as follows:

(1) I am Manager, Fuel Engineering Services, Global Nuclear Fuel – Americas, L.L.C. ("GNF-A") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in the attachment, "NEDC-31624P, Supplement 1, Revision 9, Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 1 Reload 15 Cycle 16," December 2005. GNF proprietary information is indicated by enclosing it in double brackets. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GNF-A relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4) and 2.390(a)(4) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information," and some portions also qualify under the narrower definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, <u>Critical Mass Energy Project v. Nuclear Regulatory Commission</u>, 975F2d871 (DC Cir. 1992), and <u>Public Citizen Health Research Group v. FDA</u>, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GNF-A's competitors without license from GNF-A constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of GNF-A, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future GNF-A customer–funded development plans and programs, of potential commercial value to GNF-A;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b., above.

(5) To address the 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GNF-A, and is in fact so held. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in (6) and (7) following. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GNF-A, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GNF-A. Access to such documents within GNF-A is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GNF-A are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GNF-A's fuel design and licensing methodology.

The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost, on the order of several million dollars, to GNF-A or its licensor.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GNF-A's competitive position and foreclose or reduce the availability of profit-making opportunities. The fuel design and licensing methodology is part of GNF-A's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical, and NRC review costs comprise a substantial investment of time and money by GNF-A or its licensor.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GNF-A's competitive advantage will be lost if its competitors are able to use the results of the GNF-A experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GNF-A would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GNF-A of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed at Wilmington, North Carolina, this 16 day of December, 2005.

Andrew A. Lingenfelter

Andrew A. Lingenfelter
Global Nuclear Fuel – Americas, LLC