

**BSEP 05-0024
Enclosure 2**

**0000-0028-0680-SRLR, Revision 0,
Supplemental Reload Licensing Report
for Brunswick Steam Electric Plant Unit 2
Reload 16 Cycle 17,
January 2005**



Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

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Revision 0

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Supplemental Reload Licensing Report
for
Brunswick Steam Electric Plant Unit 2
Reload 16 Cycle 17

Approved:

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C. P. Collins
Customer Account Leader

Important Notice Regarding the Contents of This Report

Please Read Carefully

This report was prepared by Global Nuclear Fuel - Americas, LLC (GNF-A) solely for Progress Energy Carolinas, Inc. (PGN) for PGN's use in defining operating limits for the Brunswick Steam Electric Plant Unit 2 (BSEP-2). The information contained in this report is believed by GNF-A to be an accurate and true representation of the facts known or obtained or provided to GNF-A at the time this report was prepared.

The only undertakings of GNF-A respecting information in this document are contained in the contract between PGN and GNF-A for nuclear fuel and related services for the nuclear system for Brunswick Steam Electric Plant Unit 2 and nothing contained in this document shall be construed as changing said contract. The use of this information except as defined by said contract, or for any purpose other than that for which it is intended, is not authorized; and with respect to any such unauthorized use, neither GNF-A nor any of the contributors to this document makes any representation or warranty (expressed or implied) as to the completeness, accuracy or usefulness of the information contained in this document or that such use of such information may not infringe privately owned rights; nor do they assume any responsibility for liability or damage of any kind which may result from such use of such information.

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 GENE - Nuclear and Safety Analysis personnel. The Supplemental Reload Licensing Report was prepared by G. M. Baka. This document has been verified by E. W. Gibbs.

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: Implementation of TRACG AOO Methodology
- Appendix E: MELLLA+ Implementation
- Appendix F: List of Acronyms

2. Reload Fuel Bundles

| Fuel Type | Cycle Loaded | Number |
|--|-----------------|--------|
| <u>Irradiated:</u> | | |
| GE14-P10DNAB399-16GZ-100T-150-T-2418 (GE14C) | 15 | 38 |
| GE14-P10DNAB398-13GZ-100T-150-T-2417 (GE14C) | 15 | 37 |
| GE14-P10DNAB420-18GZ-100T-150-T-2572 (GE14C) | 16 | 119 |
| GE14-P10DNAB419-6G7.0/7G6.0/3G2.0-100T-150-T-2573 (GE14C) | 16 | 40 |
| GE14-P10DNAB425-3G7.0/14G6.0/1G2.0-100T-150-T-2574 (GE14C) | 16 | 40 |
| GE14-P10DNAB439-12G6.0-100T-150-T-2575 (GE14C) | 16 | 38 |
| <u>New:</u> | | |
| GE14-P10DNAB439-12G6.0-100T-150-T-2575 (GE14C) | 17 | 40 |
| GE14-P10DNAB425-3G7.0/14G6.0/1G2.0-100T-150-T-2574 (GE14C) | 17 | 64 |
| GE14-P10DNAB413-16GZ-100T-150-T-2660 (GE14C) | 17 | 144 |
| <u>Total:</u> | | 560 |

3. Reference Core Loading Pattern ¹

| | |
|---|---------------------------------|
| Nominal previous cycle core average exposure at end of cycle: | 34102 MWd/MT (30936 MWd/ST) |
| Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations: | 33676 MWd/MT (30550 MWd/ST) |
| Assumed reload cycle core average exposure at beginning of cycle: | 14561 MWd/MT (13209 MWd/ST) |
| Assumed reload cycle core average exposure at end of cycle (full power): | 32751 MWd/MT (29711 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_{eff} | |
| Uncontrolled | 1.128 |
| Fully controlled | 0.959 |
| Strongest control rod out | 0.990 |
| R, Maximum increase in cold core reactivity with exposure into cycle, Δk | 0.000 |

5. Standby Liquid Control System Shutdown Capability

| | |
|--------------------------|--|
| Boron (ppm) (at 20°C) | Shutdown Margin (Δk) (at 160°C, Xenon Free) |
| 720 | 0.013 |

¹ The previous cycle core average exposure at beginning of cycle was 14798 MWd/MT (13424 MWd/ST).

6. Reload Unique TRACG Anticipated Operational Occurrences (AOO) Analysis
 Initial Condition Parameters ²

| Operating domain: ICF-HBB Exposure range: BOC17 to EOFPC17-3145 MWd/MT (2853 MWd/ST) | | | | | | | |
|---|-------|--------|-------|----------|--------------------|--------------------------|--------------|
| Peaking Factors | | | | | | | |
| Fuel Design | Local | Radial | Axial | R-Factor | Bundle Power (MWt) | Bundle Flow (1000 lb/hr) | Initial MCPR |
| GE14C | 1.0 | 1.39 | 1.33 | 1.040 | 7.243 | 123.0 | 1.45 |

| Operating domain: ICF-HBB Exposure range: EOFPC17-3145 MWd/MT (2853 MWd/ST) to EEOC17 | | | | | | | |
|--|-------|--------|-------|----------|--------------------|--------------------------|--------------|
| Peaking Factors | | | | | | | |
| Fuel Design | Local | Radial | Axial | R-Factor | Bundle Power (MWt) | Bundle Flow (1000 lb/hr) | Initial MCPR |
| GE14C | 1.0 | 1.33 | 1.32 | 1.040 | 6.957 | 125.2 | 1.48 |

| Operating domain: ICF-FWTR-TBVOOS-UB Exposure range: BOC17 to EEOC17 | | | | | | | |
|---|-------|--------|-------|----------|--------------------|--------------------------|--------------|
| Peaking Factors | | | | | | | |
| Fuel Design | Local | Radial | Axial | R-Factor | Bundle Power (MWt) | Bundle Flow (1000 lb/hr) | Initial MCPR |
| GE14C | 1.0 | 1.27 | 1.27 | 1.040 | 6.634 | 127.6 | 1.69 |

² End of Full Power Capability (EOFPC) is defined as end-of-cycle all rods out, 100% power / 104.5% flow, and normal feedwater temperature (NFWT).

7. Selected Margin Improvement Options³

| | |
|----------------------------|--------------------------------------|
| 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 (EOFP17-3145 MWd/MT and EEOC17) |

³ Refer to GESTAR for those margin improvement options that are referenced and supported within GESTAR.

8. Operating Flexibility Options ⁴

| | |
|--|------------------------------|
| 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 valve 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, 8 of 10 valves are assumed operable in the analysis.

9. Core-wide AOO Analysis Results

Methods used: GEMINI (TRACG); GEXL-PLUS

| Operating domain: ICF-HBB Exposure range: BOC17 to EOFPC17-3145 MWd/MT (2853 MWd/ST) | | | | |
|---|-------------|-------------------------|--|------|
| | | | Uncorrected Δ CPR/ICPR ⁷ | |
| Event | Flux (%NBR) | Q/A ⁸ (%NBR) | GE14C | Fig. |
| Load Reject w/o Bypass | 314 | - | 0.147 | 2 |
| FW Controller Failure | 139 | - | 0.061 | 3 |

| Operating domain: ICF-HBB Exposure range: EOFPC17-3145 MWd/MT (2853 MWd/ST) to EEOC17 | | | | |
|--|-------------|------------|-------------------------------|------|
| | | | Uncorrected Δ CPR/ICPR | |
| Event | Flux (%NBR) | Q/A (%NBR) | GE14C | Fig. |
| Load Reject w/o Bypass | 408 | - | 0.169 | 4 |
| FW Controller Failure | 203 | - | 0.130 | 5 |

| Operating domain: ICF-FWTR-TBVOOS-UB Exposure range: BOC17 to EEOC17 | | | | |
|---|-------------|------------|-------------------------------|------|
| | | | Uncorrected Δ CPR/ICPR | |
| Event | Flux (%NBR) | Q/A (%NBR) | GE14C | Fig. |
| FW Controller Failure | 376 | - | 0.218 | 6 |

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 2 Cycle 17 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 \geq 1.40 for power \geq 90% and

⁷ Uncorrected Δ CPR/ICPR is being reported since this is the term used in developing the operating limit for TRACG-based analyses.

⁸ Not available from the TRACG transient output.

OLMCPR \geq 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 17 Results Δ CPR |
|--|-------------------------------------|
| 108.0 | 0.15 |
| 111.0 | 0.20 |
| 114.0 | 0.24 |
| 117.0 | 0.29 |

11. Cycle MCPR Values⁹

- Safety limit: 1.11
- Single loop operation safety limit: 1.13
- ECCS OLMCPR Design Basis: See Section 16

Non-pressurization events:

| Exposure range: BOC17 to EOC17 | |
|---|----------------------------|
| | GE14C |
| Control Rod Withdrawal Error (RBM setpoint at 108%) | 1.26 |
| Loss of Feedwater Heating ¹⁰ | 1.25 |
| Fuel Loading Error (mislocated) | Not limiting ¹¹ |
| Fuel Loading Error (misoriented) | 1.25 |

⁹ 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.

¹⁰ See Appendix B.

¹¹ The mislocated bundle fuel loading error OLMCPR is bounded by the pressurization event OLMCPR.

Pressurization events:

| | | |
|---|----------------------------|----------------------------|
| Operating domain: ICF-HBB ¹² | | |
| Exposure range: BOC17 to EOFPC17-3145 MWd/MT (2853 MWd/ST) | | |
| | Option A | Option B |
| | GE14C | GE14C |
| Load Reject w/o Bypass | 1.51 | 1.33 |
| FW Controller Failure | Not limiting ¹³ | Not limiting ¹⁴ |

| | | |
|--|----------------------------|----------------------------|
| Operating domain: ICF-HBB ¹⁴ | | |
| Exposure range: EOFPC17-3145 MWd/MT (2853 MWd/ST) to EEOC17 | | |
| | Option A | Option B |
| | GE14C | GE14C |
| Load Reject w/o Bypass | 1.55 | 1.37 |
| FW Controller Failure | Not limiting ¹⁴ | Not limiting ¹⁴ |

| | | |
|---|-----------------|-----------------|
| Operating domain: ICF-FWTR-TBVOOS-UB ¹⁵ | | |
| Exposure range: BOC17 to EEOC17 | | |
| | Option A | Option B |
| | GE14C | GE14C |
| FW Controller Failure | 1.66 | 1.48 |

12. Overpressurization Analysis Summary

| Event | Psl (psig) | Pdome (psig) | Pv (psig) | Plant Response |
|---------------------------|-----------------------|-------------------------|----------------------|---------------------------|
| MSIV Closure (Flux Scram) | 1268 | 1277 | 1320 | Figure 7 |

¹² The ICF Operating Limits for the exposure range of BOC17 to EOFPC17-3145 MWd/MT (2853 MWd/ST) bound the Operating Limits for the following domains: MELLLA+, MELLLA, ICF and FWTR, MSIVOOS and ICF.

¹³ The FW Controller Failure OLMCPR is bounded by the Load Rejection w/o Bypass event OLMCPR.

¹⁴ The ICF Operating Limits for the exposure range of EOFPC17-3145 MWd/MT (2853 MWd/ST) to EEOC17 bound the Operating Limits for the following domains: MELLLA+, MELLLA, ICF and FWTR, MSIVOOS and ICF.

¹⁵ The TBVOOS ICF-FWTR Operating Limits for the exposure range of BOC17 to EEOC17 bound the Operating Limits for all domains with TBVOOS. The corresponding Option A and B limits for NFWT are 1.58 and 1.40, respectively.

13. Loading Error Results

Variable water gap misoriented bundle analysis: Yes ¹⁶

| Misoriented Fuel Bundle | Δ CPR |
|--|--------------|
| GE14-P10DNAB420-18GZ-100T-150-T-2572 (GE14C) | 0.12 |
| GE14-P10DNAB419-6G7.0/7G6.0/3G2.0-100T-150-T-2573 (GE14C) | 0.12 |
| GE14-P10DNAB425-3G7.0/14G6.0/1G2.0-100T-150-T-2574 (GE14C) | 0.13 |
| GE14-P10DNAB439-12G6.0-100T-150-T-2575 (GE14C) | 0.14 |
| GE14-P10DNAB413-16GZ-100T-150-T-2660 (GE14C) | 0.06 |

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.

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 2 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 (FOM) 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 2 Cycle 17.

15.2 Stability Option III

Brunswick Unit 2 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 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

¹⁶ Includes a 0.02 penalty due to variable water gap R-factor uncertainty.

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 17. The reload validation calculation demonstrated that reactor stability does not produce the limiting OLMCPR for Cycle 17 as long as the selected OPRM setpoint produces values for OLMCPR(SS) and OLMCPR(2PT) which are less than the corresponding acceptance criteria.

| OPRM Setpoint | OLMCPR(SS) | OLMCPR(2PT) |
|---------------------|---|--|
| 1.05 | 1.2265 | 1.1105 |
| 1.06 | 1.2515 | 1.1331 |
| 1.07 | 1.2775 | 1.1566 |
| 1.08 | 1.3046 | 1.1812 |
| 1.09 | 1.3329 | 1.2068 |
| 1.10 | 1.3624 | 1.2335 |
| 1.11 | 1.3918 | 1.2601 |
| 1.12 | 1.4226 | 1.2880 |
| 1.13 | 1.4547 | 1.3170 |
| 1.14 | 1.4883 | 1.3475 |
| 1.15 | 1.5235 | 1.3793 |
| Acceptance Criteria | Off-rated OLMCPR @ 45% Flow ¹⁷ | 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 2 Cycle 17 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 2. The standard ICA stability regions are expanded as appropriate to offer stability protection for Brunswick Unit 2 Cycle 17 in accordance with Reference 8 in Section 15.4.

¹⁷ 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. *BWROG Regional Mode DIVOM Guideline*, GE-NE-0000-0028-9714-R0, June 2004.
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 Application*, 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 each fuel type 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 for the GE14C fuel type 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-mechanical MAPLHGR operating limits to produce a set of fuel type dependent 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-P10DNAB425-3G7.0/14G6.0/1G2.0-100T-150-T-2574

| Average Planar Exposure | | MAPLHGR (kW/ft) | |
|-------------------------|----------|-----------------|----------------|
| (GWd/ST) | (GWd/MT) | Most Limiting | Least Limiting |
| 0.00 | 0.00 | 9.37 | 9.48 |
| 0.20 | 0.22 | 9.44 | 9.54 |
| 1.00 | 1.10 | 9.55 | 9.65 |
| 2.00 | 2.20 | 9.70 | 9.79 |
| 3.00 | 3.31 | 9.85 | 9.94 |
| 4.00 | 4.41 | 10.01 | 10.10 |
| 5.00 | 5.51 | 10.16 | 10.26 |
| 6.00 | 6.61 | 10.30 | 10.43 |
| 7.00 | 7.72 | 10.45 | 10.60 |
| 8.00 | 8.82 | 10.60 | 10.72 |
| 9.00 | 9.92 | 10.70 | 10.85 |
| 10.00 | 11.02 | 10.79 | 10.95 |
| 11.00 | 12.13 | 10.87 | 11.07 |
| 12.00 | 13.23 | 10.87 | 11.13 |
| 13.00 | 14.33 | 10.85 | 11.17 |
| 14.00 | 15.43 | 10.84 | 11.21 |
| 14.51 | 16.00 | 10.84 | 11.23 |
| 15.00 | 16.53 | 10.84 | 11.25 |
| 17.00 | 18.74 | 10.82 | 11.23 |
| 19.13 | 21.09 | 10.72 | 11.08 |
| 20.00 | 22.05 | 10.68 | 11.02 |
| 25.00 | 27.56 | 10.26 | 10.51 |
| 30.00 | 33.07 | 9.82 | 10.05 |
| 35.00 | 38.58 | 9.33 | 9.52 |
| 40.00 | 44.09 | 8.83 | 8.95 |
| 45.00 | 49.60 | 8.35 | 8.41 |
| 50.00 | 55.12 | 7.85 | 7.90 |
| 55.00 | 60.63 | 5.72 | 6.49 |
| 56.66 | 62.46 | 4.90 | 5.66 |
| 57.61 | 63.50 | -- | 5.19 |
| 57.77 | 63.68 | -- | 5.11 |
| 58.04 | 63.98 | -- | 4.97 |

Table 16.3-2 MAPLHGR Limits

Bundle Type: GE14-P10DNAB439-12G6.0-100T-150-T-2575

| Average Planar Exposure | | MAPLHGR (kW/ft) | |
|-------------------------|----------|-----------------|----------------|
| (GWd/ST) | (GWd/MT) | Most Limiting | Least Limiting |
| 0.00 | 0.00 | 9.68 | 9.82 |
| 0.20 | 0.22 | 9.72 | 9.87 |
| 1.00 | 1.10 | 9.79 | 9.95 |
| 2.00 | 2.20 | 9.89 | 10.06 |
| 3.00 | 3.31 | 9.99 | 10.17 |
| 4.00 | 4.41 | 10.09 | 10.29 |
| 5.00 | 5.51 | 10.20 | 10.42 |
| 6.00 | 6.61 | 10.31 | 10.55 |
| 7.00 | 7.72 | 10.43 | 10.68 |
| 8.00 | 8.82 | 10.55 | 10.82 |
| 9.00 | 9.92 | 10.67 | 10.96 |
| 10.00 | 11.02 | 10.79 | 11.10 |
| 11.00 | 12.13 | 10.92 | 11.23 |
| 12.00 | 13.23 | 10.93 | 11.28 |
| 13.00 | 14.33 | 10.92 | 11.30 |
| 14.00 | 15.43 | 10.90 | 11.30 |
| 14.51 | 16.00 | 10.89 | 11.30 |
| 15.00 | 16.53 | 10.88 | 11.29 |
| 17.00 | 18.74 | 10.81 | 11.19 |
| 19.13 | 21.09 | 10.66 | 11.02 |
| 20.00 | 22.05 | 10.60 | 10.95 |
| 25.00 | 27.56 | 10.18 | 10.51 |
| 30.00 | 33.07 | 9.76 | 10.08 |
| 35.00 | 38.58 | 9.32 | 9.62 |
| 40.00 | 44.09 | 8.87 | 9.17 |
| 45.00 | 49.60 | 8.37 | 8.63 |
| 50.00 | 55.12 | 7.83 | 8.09 |
| 55.00 | 60.63 | 5.54 | 6.37 |
| 56.30 | 62.06 | 4.88 | 5.71 |
| 57.61 | 63.50 | -- | 5.05 |
| 57.74 | 63.65 | -- | 4.98 |
| 57.79 | 63.70 | -- | 4.95 |

Table 16.3-3 MAPLHGR Limits

Bundle Type: GE14-P10DNAB413-16GZ-100T-150-T-2660

| Average Planar Exposure | | MAPLHGR (kW/ft) | |
|-------------------------|----------|-----------------|----------------|
| (GWd/ST) | (GWd/MT) | Most Limiting | Least Limiting |
| 0.00 | 0.00 | 9.57 | 9.68 |
| 0.20 | 0.22 | 9.60 | 9.70 |
| 1.00 | 1.10 | 9.66 | 9.78 |
| 2.00 | 2.20 | 9.77 | 9.91 |
| 3.00 | 3.31 | 9.92 | 10.06 |
| 4.00 | 4.41 | 10.08 | 10.22 |
| 5.00 | 5.51 | 10.26 | 10.38 |
| 6.00 | 6.61 | 10.44 | 10.55 |
| 7.00 | 7.72 | 10.59 | 10.73 |
| 8.00 | 8.82 | 10.74 | 10.91 |
| 9.00 | 9.92 | 10.87 | 11.11 |
| 10.00 | 11.02 | 11.00 | 11.31 |
| 11.00 | 12.13 | 11.12 | 11.52 |
| 12.00 | 13.23 | 11.15 | 11.66 |
| 13.00 | 14.33 | 11.16 | 11.75 |
| 14.00 | 15.43 | 11.16 | 11.74 |
| 14.51 | 16.00 | 11.16 | 11.73 |
| 15.00 | 16.53 | 11.16 | 11.71 |
| 17.00 | 18.74 | 11.13 | 11.58 |
| 19.13 | 21.09 | 11.02 | 11.38 |
| 20.00 | 22.05 | 10.98 | 11.30 |
| 25.00 | 27.56 | 10.57 | 10.75 |
| 30.00 | 33.07 | 10.15 | 10.21 |
| 35.00 | 38.58 | 9.65 | 9.69 |
| 40.00 | 44.09 | 9.12 | 9.17 |
| 45.00 | 49.60 | 8.59 | 8.65 |
| 50.00 | 55.12 | 8.04 | 8.11 |
| 55.00 | 60.63 | 6.48 | 6.64 |
| 57.61 | 63.50 | 5.18 | 5.34 |
| 58.20 | 64.16 | 4.88 | 5.05 |
| 58.23 | 64.19 | -- | 5.03 |
| 58.48 | 64.46 | -- | 4.91 |
| 58.50 | 64.48 | -- | 4.90 |

The single-loop operation multiplier on LHGR and MAPLHGR, and the ECCS 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 PLHGR and MAPLHGR Multiplier

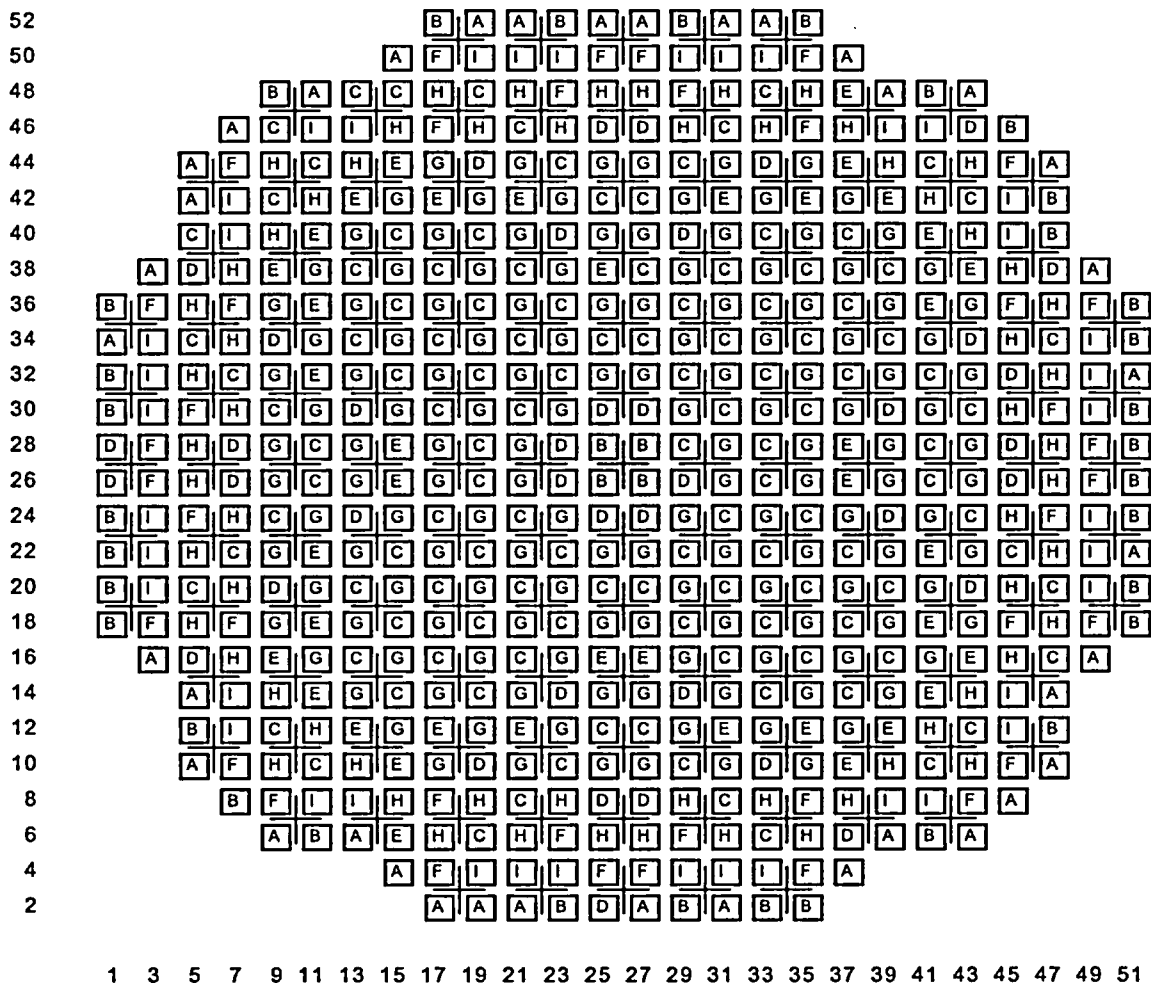
| Fuel Type | Initial MCPR | Single Loop Operation PLHGR and MAPLHGR Multiplier |
|-----------|--------------|--|
| GE14C | 1.275 | 0.80 |

16.4 References

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

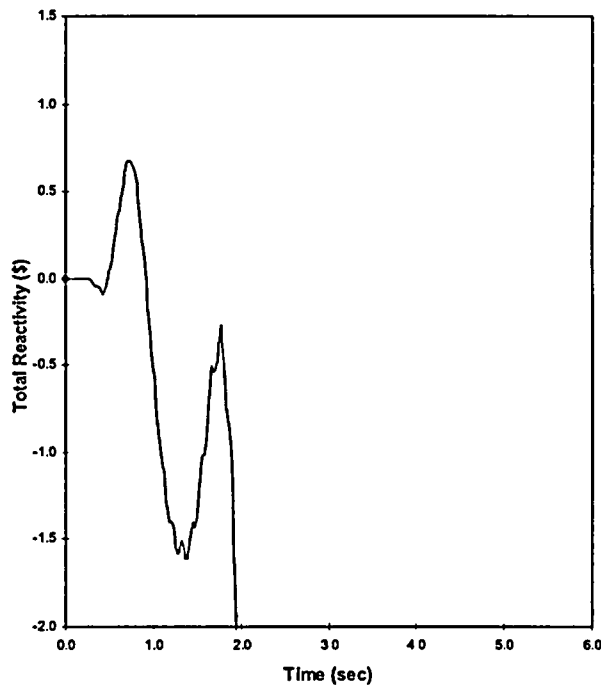
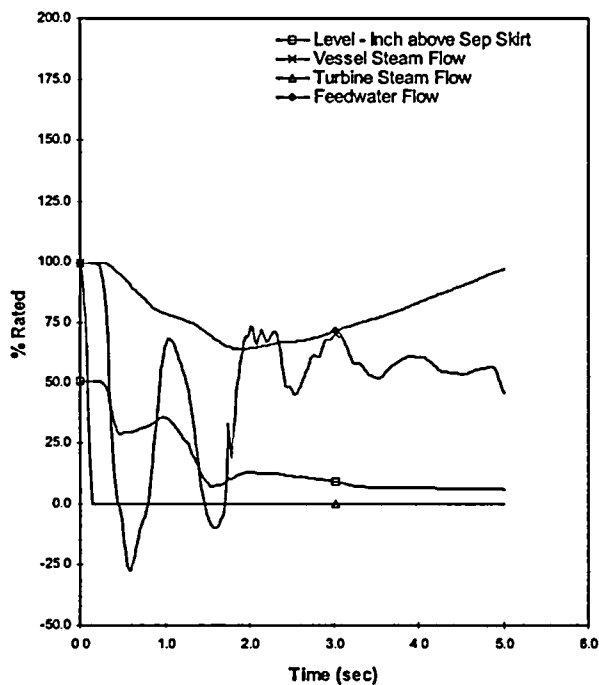
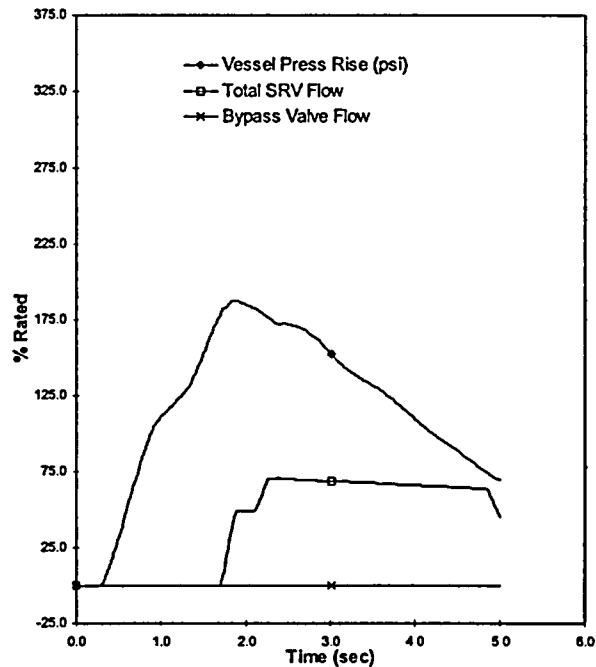
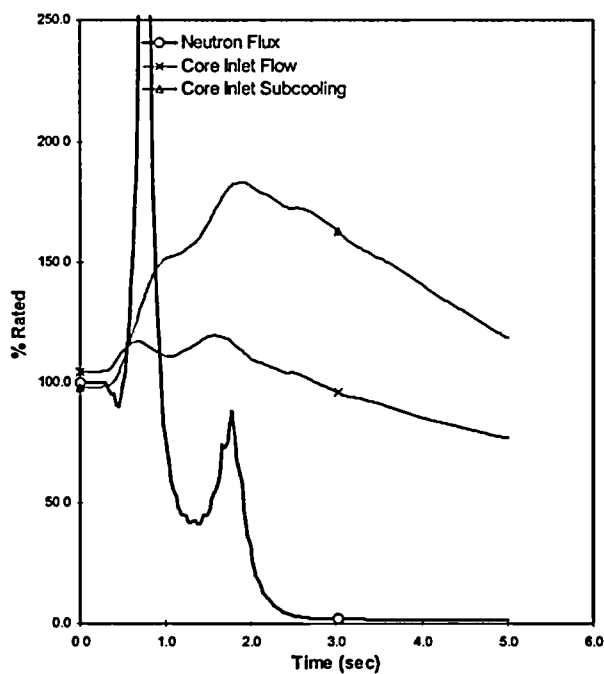
References for GE14C

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 2 Reload 15 Cycle 16*, 0000-0005-1282-SRLR, Revision 0, January 2003.
3. *Supplemental Reload Licensing Report for Brunswick Steam Electric Plant Unit 2 Reload 14 Cycle 15*, J11-03781SRLR, Revision 0, February 2001.



| Fuel Type | |
|---|---|
| A=GE14-P10DNAB399-16GZ-100T-150-T-2418 (Cycle 15) | F=GE14-P10DNAB439-12G6.0-100T-150-T-2575 (Cycle 16) |
| B=GE14-P10DNAB398-13GZ-100T-150-T-2417 (Cycle 15) | G=GE14-P10DNAB413-16GZ-100T-150-T-2660 (Cycle 17) |
| C=GE14-P10DNAB420-18GZ-100T-150-T-2572 (Cycle 16) | H=GE14-P10DNAB425-3G7.0/14G6.0/1G2.0-100T-150-T-2574 (Cycle 17) |
| D=GE14-P10DNAB419-6G7.0/7G6.0/3G2.0-100T-150-T-2573 (Cycle 16) | I=GE14-P10DNAB439-12G6.0-100T-150-T-2575 (Cycle 17) |
| E=GE14-P10DNAB425-3G7.0/14G6.0/1G2.0-100T-150-T-2574 (Cycle 16) | |

Figure 1 - Reference Core Loading Pattern



**Figure 2 - Plant Response to Load Reject w/o Bypass
 BOC17 to EOFPC17-3145 MWd/MT (2853 MWd/ST)
 ICF-HBB**

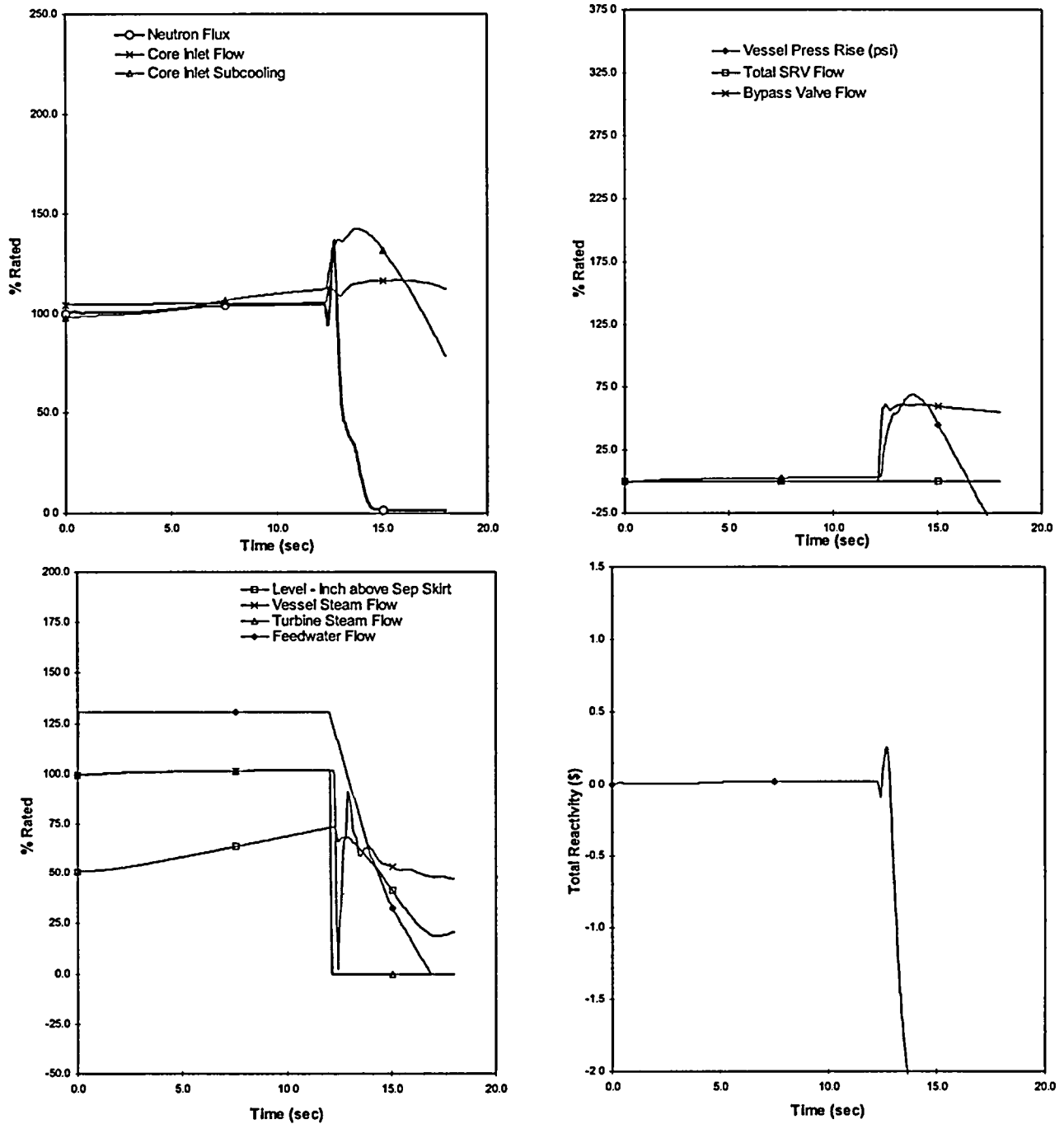
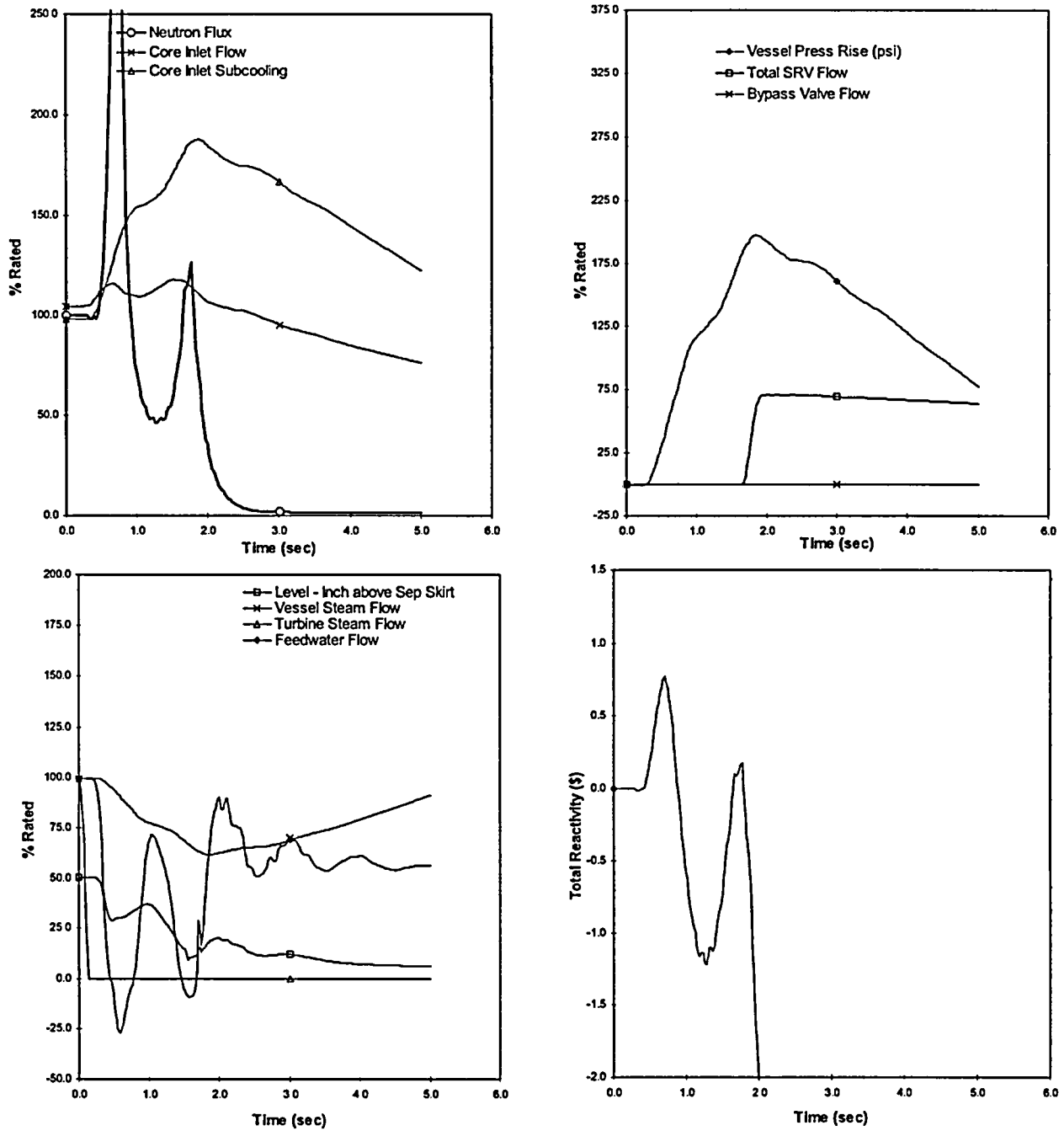
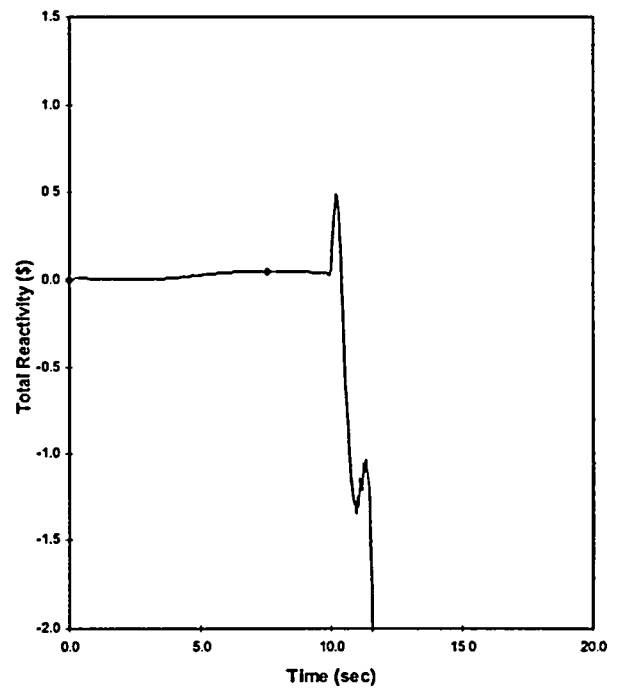
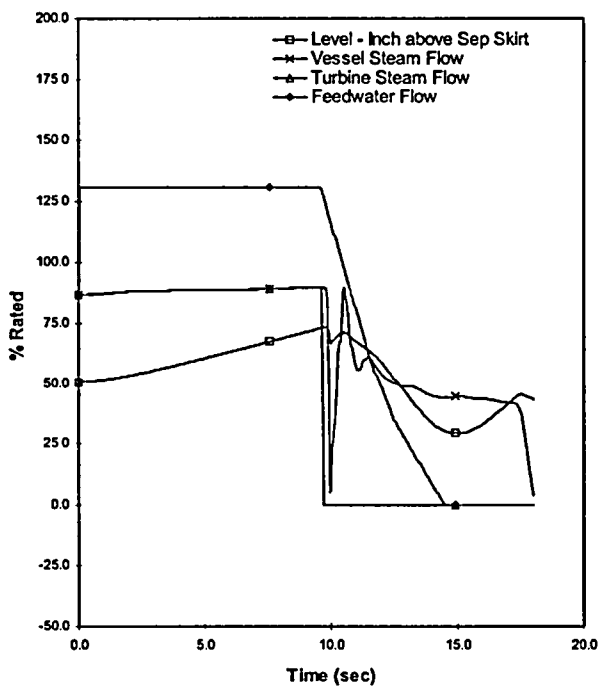
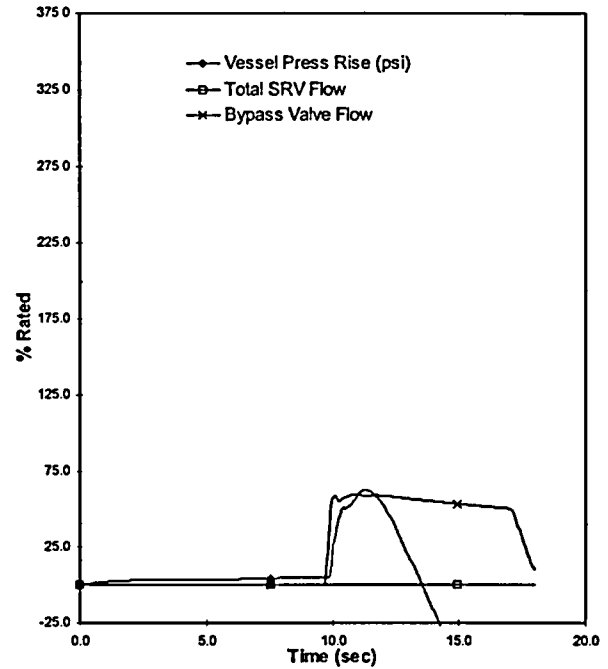
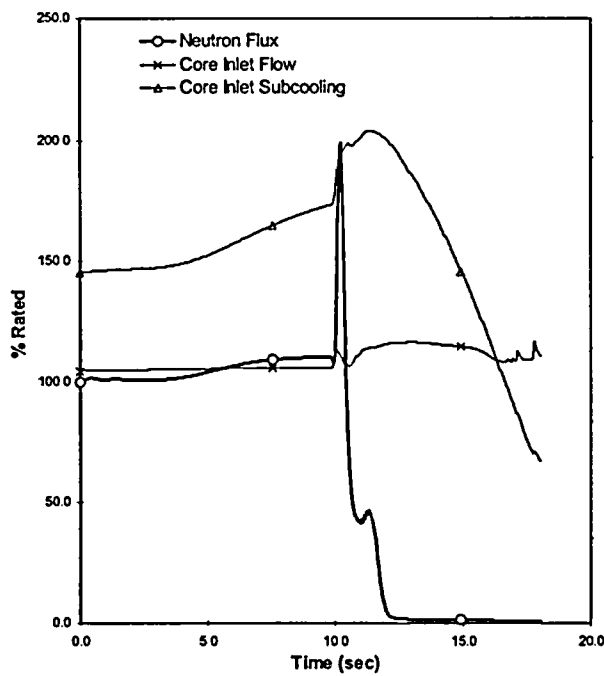


Figure 3 - Plant Response to FW Controller Failure
BOC17 to EOFPC17-3145 MWd/MT (2853 MWd/ST)
ICF-HBB



**Figure 4 - Plant Response to Load Reject w/o Bypass
 EOFPC17-3145 MWd/MT (2853 MWd/ST) to EEOC17
 ICF-HBB**



**Figure 5 - Plant Response to FW Controller Failure
 EOFPC17-3145 MWd/MT (2853 MWd/ST) to EEOC17
 ICF-HBB**

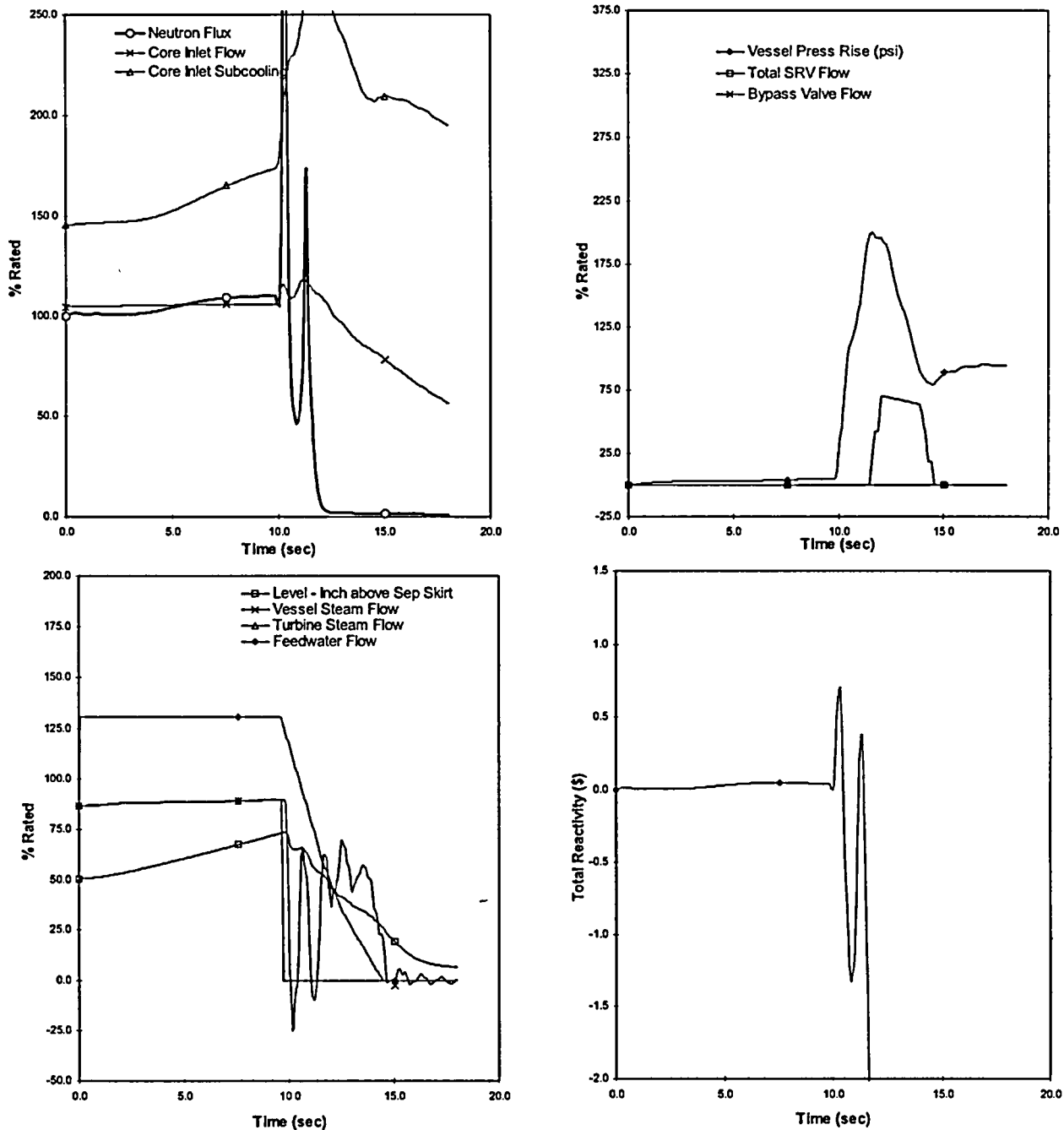


Figure 6 - Plant Response to FW Controller Failure
BOC17 to EEOC17
ICF-FWTR-TBVOOS-UB

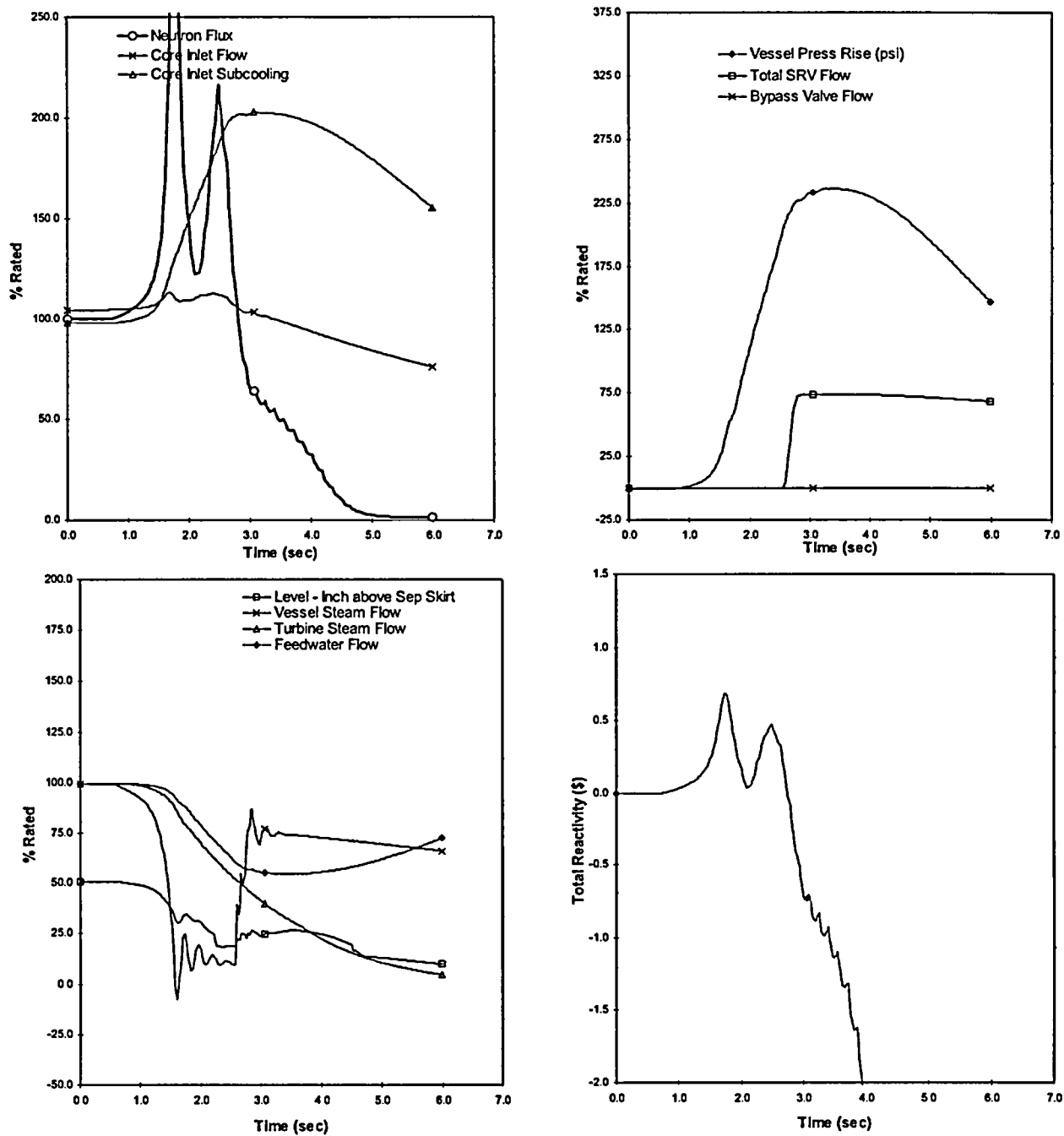


Figure 7 - Plant Response to MSIV Closure
 Flux Scram

Appendix A Analysis Conditions

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

Table A-1

| Parameter | Analysis Value | |
|---|-----------------------|-----------------------|
| | NFWT | RFWT |
| Thermal power, MWt | 2923.0 | 2923.0 |
| Core flow, Mlb/hr | 80.5 | 80.5 |
| Reactor pressure, psia | 1057.8 | 1035.8 |
| Inlet enthalpy, BTU/lb | 528.7 | 512.5 |
| Non-fuel power fraction ¹⁸ | - | - |
| Steam flow, Mlb/hr | 12.73 | 11.06 |
| Dome pressure, psig | 1029.3 | 1008.6 |
| Turbine pressure, psig | 963.5 | 958.2 |
| No. of Safety/Relief Valves | 10 | 10 |
| Relief mode lowest setpoint, psig | 1163.9 | 1163.9 |
| Recirculation pump power source | on-site ¹⁹ | on-site ¹⁹ |
| Turbine control valve mode of operation | Partial arc | Partial arc |

¹⁸ Not available in the TRACG output files.

¹⁹ Bounds operation with off-site power source for reload licensing events for Cycle 17.

Appendix B

Decrease in Core Coolant Temperature Events

The Loss of Feedwater Heating (LFWH) event was analyzed for Brunswick Steam Electric Plant Unit 2 Cycle 17 at 100% rated Extended Power Uprate (EPU) 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 Steam Electric Plant Unit 2 Cycle 17 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-3 and C-6. Due to a safety limit change for Brunswick Unit 2 Cycle 17 from the reference safety limits used in References C-6, C-3 and C-5, there will be a required adjustment to the MCPR(p) below P-bypass limits, a required adjustment to the MCPR(f) limits, and a validation of the required minimum GE14 OLMCPR for the recirculation pump seizure event. Further, the implementation of TRACG (Reference C-7) requires an adjustment to the K(P) above P-bypass.

MCPR(p) below P-bypass is increased for a Safety Limit of 1.11 by the ratio of $\left(\frac{1.11}{1.09}\right)$.

The limit figures are as follows for all fuel types in the core:

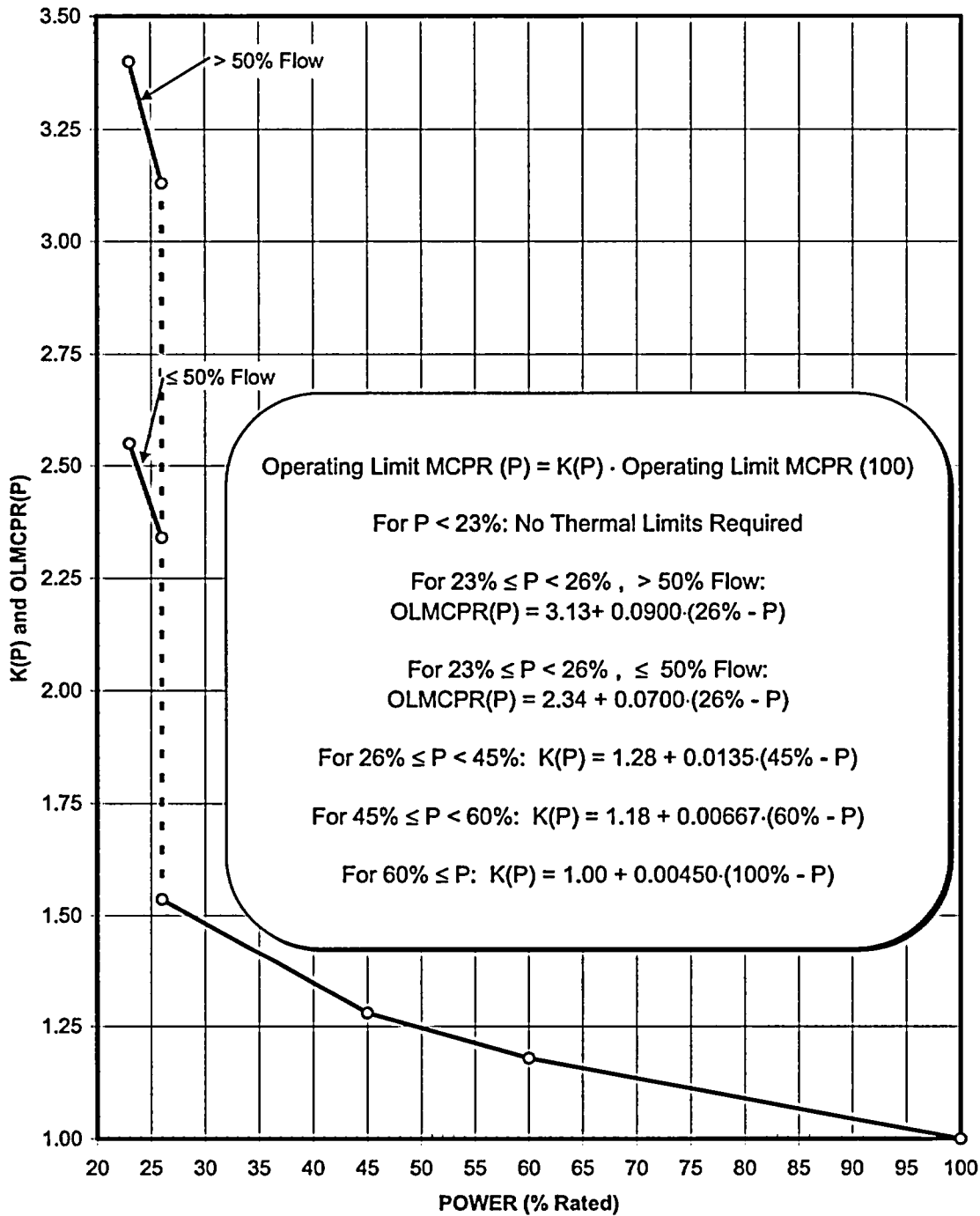


Figure C-1 - Power Dependent MCPR for Brunswick Unit 2 Cycle 17

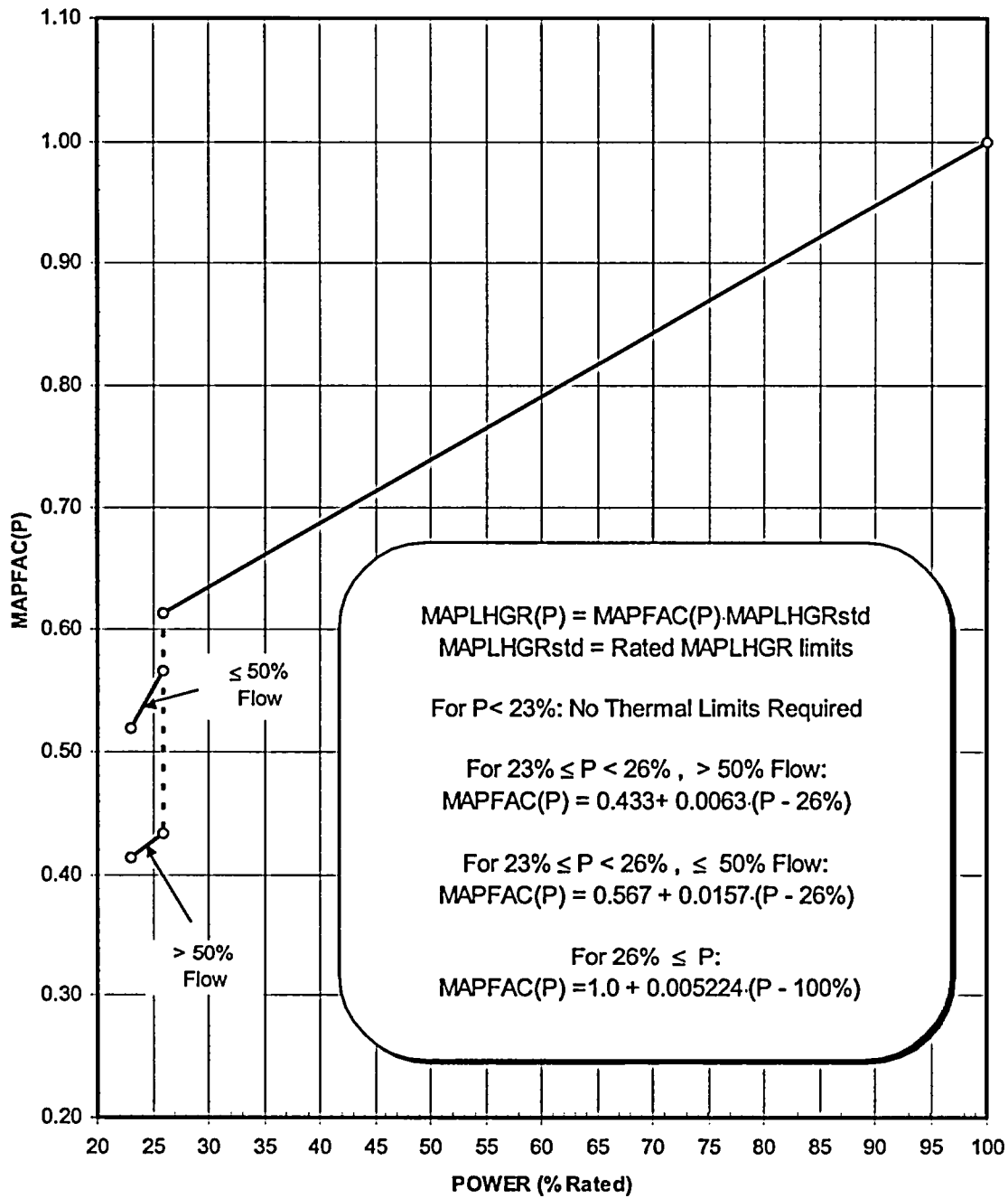


Figure C-2 - Power Dependent MAPLHGR Factor for Brunswick Unit 2 Cycle 17

The Reference C-3 MCPR(f) limits are increased for a Safety Limit of 1.11 by the ratio of $\left(\frac{1.11}{1.07}\right)$. 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 2 Cycle 17.

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 MWt, 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 MWt is unchanged, but represents about 73.3% of licensed thermal power, resulting in a K(P) of about 1.12 (See Figure C-1). Since the SLO SLMCPR is 1.13 for Unit 2 Cycle 17, the SLO OLMCPR must be greater than or equal to $1.40 \times (1.13/1.12) = 1.41$ for the pump seizure event. Therefore, the minimum GE14 OLMCPR of 1.33 (See Section 11) is conservative for the SLO pump seizure event ($1.33 \times K(73.3) = 1.33 \times 1.12 = 1.49 > 1.41$).

Power Load Unbalance (PLU) Impact on ARTS Power Dependent Limits

A recent 10 CFR Part 21 Communication regarding ARTS off-rated power dependent limits is documented in Reference C-8. This communication concluded:

1. GENE has confirmed that the ARTS off-rated K(P) limits are not affected as long as
 - TCV fast closure and direct scram are initiated for load rejection events with no turbine bypass for reactor power above P-bypass, or
 - The load rejection event occurs at up to ~40% of rated thermal power with normal off-rated feedwater temperature and with credit for greater than or equal to 20.5% rated steam flow capability.
2. If a plant's turbine bypass capacity exceeds the power level where the PLU device will not generate a TCV fast closure, then the turbine bypass will effectively mitigate the load rejection event and the ARTS off-rated K(P) limits are not affected.

If the above conditions cannot be satisfied, the below P-bypass limits (at the P-bypass power level) may be applied between the range of P-bypass and the power level where the PLU device will not generate a TCV fast closure. Application of below P-bypass limits bounds FWTR operation provided the limits are applied at the core power level corresponding to the power level where the PLU will generate a TCV fast closure under FWTR conditions.

Note, since the PLU is based on pressure that is proportional to turbine power, operation with FWTR and the associated reduced steam flow rate may reduce the turbine power compared to the core power. This can result in a higher core power to achieve the turbine power where the PLU device will generate a fast closure signal. At this higher core power, the K(P) value is lower, and the generic off-rated limits may no longer provide the required protection with FWTR. The best method to determine the relationship of the PLU turbine power is from plant measurement or turbine heat balance data at normal and reduced feedwater temperature conditions.

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.

Appendix D

Implementation of TRACG AOO Methodology

Reference D-1 provides the results of the analyses and evaluations supporting the implementation 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 Reference D-2.

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.

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 2 Cycle 17. 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 2 Cycle 17. The reload checklist as outlined in Reference E-2 is used to confirm that the DSS-CD is applicable to Brunswick Unit 2 Cycle 17 EPU/MELLLA+ operation.

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 2 Cycle 17 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 2 Cycle 17*, GENE-0000-0034-1491-R0, January 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 List of Acronyms

| Acronym | Description |
|---------|---|
| ΔCPR | Delta Critical Power Ratio |
| Δk | Delta k-effective |
| %NBR | Percent Nuclear Boiler Rated |
| 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 |
| 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 |
| ECCS | Emergency Core Cooling System |
| EEOC | Extended End of Cycle |
| ELLA | Extended Load Line Limit Analysis |
| EOC | End of Cycle |
| EOR | End of Rated (All Rods Out 100%Power / 100%Flow / NFWT) |
| ER | Exclusion Region |
| FFWTR | Final Feedwater Temperature Reduction |
| FMCP | 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 |
| HTSP | High Trip Setpoint |

| Acronym | Description |
|---------|--|
| ICA | Interim Corrective Action |
| ICF | Increased Core Flow |
| IMCPR | Initial MCPR |
| IVM | Initial Validation Matrix |
| 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 |
| 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 |
| RFWT | Reduced Feedwater Temperature |
| RPS | Reactor Protection System |

| Acronym | Description |
|---------|---|
| RPT | Recirculation Pump Trip |
| RPTOOS | Recirculation Pump Trip Out of Service |
| 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 |
| SRV | Safety/Relief Valve |
| SRVOOS | Safety/Relief Valve(s) Out of Service |
| SS | Steady State |
| STU | Short Tons (or Standard Tons) of Uranium |
| TBPOOS | Turbine Bypass Out of Service |
| 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 |
| TTHBP | Turbine Trip with Half Bypass |
| TTNBP | Turbine Trip without Bypass |
| UB | Under Burn |

BSEP 05-0024
Enclosure 4

Global Nuclear Fuels Affidavit Regarding Withholding
NEDC-31624P, Supplement 2, Revision 9,
From Public Disclosure

Affidavit

I, Margaret E. Harding, 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 2, Revision 9, Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 2 Reload 16 Cycle 17”, January 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, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 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.

Affidavit

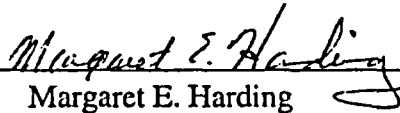
The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

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 18th day of January, 2005.



Margaret E. Harding

Global Nuclear Fuel – Americas, LLC