

BSEP 04-0127
Enclosure

**Brunswick Steam Electric Plant, Units 1 and 2,
Calculation Number 0B21-0112, Revision 11,
10 CFR 50.46 SAFER/GESTR-LOCA ECCS Analysis Update**

NF-1703.9803

Title and Approval Cover Sheet

SYSTEM# 1005
 CALC. SUB-TYPE NUF
 PRIORITY CODE 4
 QUALITY CLASS A

NUCLEAR GENERATION GROUP

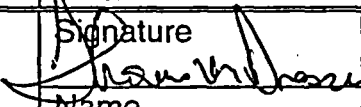
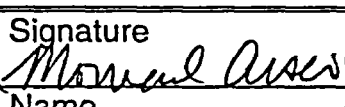
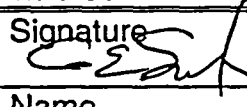
0B21-0112

10CFR50.46 SAFER/GESTR-LOCA ECCS Analysis Update
 (Title including structures, systems, components)

☒ BNP UNIT 0

☐ CR3 ☐ HNP ☐ RNP ☐ NES ☐ ALL

APPROVAL

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Owner's Review By _____ Date _____

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Revision Summary

Rev. #	Date	Revision Summary
0	1/6/98	Original documentation
1	8/31/98	Revised to include 6/30/98 annual Reporting of Changes and Errors and to create/save electronic copy of design calculation 0B21-0112
2	2/8/99	Revised to incorporate 1/27/99 GE notification WHH:99-007 of failure to include in 1996 LOCA calculation the known sensitivity to small input parameter changes (up to $\pm 50^{\circ}\text{F}$ error). This error is in addition to the 10°F BHD error already being tracked and requires 30 day 10CFR50.46 report to NRC. Revision 2 independently reviews entire 10CFR50.46 error reporting table since inception and verifies/revises table as necessary. Formats 0B21-0112 per OENP-303 Rev. 3.
3	8/12/99	Revised to incorporate 6/25/99 GE letter WHH:99-044 "10 CFR50.46 Notification Letter" (with associated letter NF-99A-0145) and 6/30/99 annual notice MFN-004-99 "Summary of Changes and Errors in ECCS Evaluation Models".
4	9/21/99	Update Revision 3 oversight: headers of section 4.1 Tables 2 and 3 to show "Change Summary Through 06/30/99"
5	8/11/00	Revised to incorporate 6/30/00 GE letter WHH:2000-044 "Summary of Changes and Errors in ECCS Evaluation Models" (with associated 6/30/00 annual notice FLN-2000-06 "Summary of Changes and Errors in ECCS Evaluation Models"). Also revised to reflect 7/31/00 telephone conference between Dresser, Kremer of PGN and Thacker, Stott of GE during which PGN was informed that GE had identified and verified four previously unreported errors in the GE13 LOCA analysis for BNP (AR 2226; see also Reference 2.4.20).
6	11/17/00	Revised to incorporate 11/7/00 GE letter WHH:2000-073 "Revised 10 CFR 50.46 Error Report for Brunswick 1&2 SAFER/GESTR Analysis" (with associated 11/7/00 10 CFR 50.46 notification letter "Brunswick 1&2 SAFER/GESTR Analysis Errors - Rev. 1"). Also revised to incorporate NEDC-31624P Supplement 3 Revision 1 (the warranty reanalysis report for the work which identified the changes made in Revision 5 to this calculation).
7	3/17/01	Revised to incorporate GE-NE-J1103781-09-02P, "Brunswick Steam Electric Plant Units 1 and 2 ECCS-LOCA Evaluation for GE14," February 2001.

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Rev. #	Date	Revision Summary
8	6/7/01	Revised to incorporate 5/24/01 GNF letter WHH:2001-010 "10 CFR 50.46 Notifications for Brunswick 1&2," received 5/28/01. Letter transmits three notices: 2001-01, 2001-02, 2001-03.
9	5/15/02	Revised to incorporate GE-NE-A22-00113-27-01, "Brunswick Nuclear Plant Unit 1 and 2 Extended Power Uprate – Task T0407: ECCS-LOCA SAFER /GESTR". This report documents the impact of EPU operation on PCT values.
10	6/23/03	Revised to incorporate seven notices: 2002-01 through 2002-05, 2003-01, and 2003-03.
11	8/12/04	Revised to incorporate one notice 2003-05 (received May 14, 2004).

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Attachments Title

0	Document Indexing Table
1	GE 10CFR50.46 Analysis Information Transmittals
2	BNP SAFER/GESTR-LOCA ECCS Analysis Change/Error Summary
3	Design Verification
4	User Production and Controlled Library Maintenance Request

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1 Purpose

1.1 Function

The function of this design calculation is to document the BNP SAFER/GESTR-LOCA ECCS Analysis Change and Error Summary based upon information received from General Electric (GE) and the status of design changes implemented for Brunswick Units 1 and 2 through August 10, 2004. The summary tables included in Attachment 2 document – in addition to PCT changes - the most recent information regarding maximum cladding oxidation, maximum hydrogen generation, coolable geometry, and long term cooling conditions. These parameters will not change appreciably unless PCT increases significantly. Each reload SRLR documents that the maximum cladding oxidation remains <1% and the maximum hydrogen generation <0.1%. This calculation is prepared in accordance with References 2.1.1 through 2.1.3 to satisfy 10CFR50.46 requirements and contains appropriate information for inclusion in the 10CFR50.46-required annual or 30-day NRC report. This calculation applies the accumulated absolute value of PCT changes to the licensing PCT to satisfy 10CFR50.46 reporting requirements, and also applies the accumulated PCT change to the Upper Bound PCT (not a 10CFR50.46 requirement) to ensure that the conditions of the SER for GE's SAFER/GESTR are maintained. This Upper Bound PCT requirement serves as reasonableness test to ensure that the Appendix K assumptions remain bounding for the LOCA.

1.2 Background

Although GE provided ECCS error notifications to PGN in 1990, 1991, 1992, and then ceased, PGN did not recognize its obligation to track and report the effect of changes or errors in LOCA methodology and application until 1996. GE provided the backlog of notices in response to PGN's request in July 1996, and the cumulative errors were evaluated by PGN to be less than 25 °F for BNP1 and 23 °F for BNP2. This evaluation was documented as a corrective action in Condition Report BNP 96-02802, initiated in September 1996. Note that the evaluation was not performed and verified as a design calculation. Annual reports from GE have been incorporated into the database since that time by Revisions 0 and 1 to this design calculation 0B21-0112. Revision 2 incorporated an error notification and also included an expanded scope to incorporate the notices which were received prior to 0B21-0112 into the design calculation. Revision 2 therefore includes References 2.4.1 through 2.4.15 in its Attachment 1. Revision 2 also includes Reference 2.3.7 as its Attachment 5. The scope of all subsequent revisions need therefore include only changes since the previous revision of 0B21-0112 and any supporting change and error report references.

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1.3 Current Notices

The current revision of 0B21-0112 incorporates one notice received from GE since the last calculation revision to support the annual report for the NRC (Reference 2.2.1). This design calculation, 0B21-0112, is being transmitted to BNP Licensing/Regulatory Programs to support the normal annual 10 CFR 50.46 report.

2 References

2.1 Procedures

- 2.1.1 REG-NGGC-0006, "Identification of Changes to (or Errors in) LOCA Evaluation Models or Applications According to 10 CFR 50.46", Revision 2
- 2.1.2 EGR-NGGC-0003, "Design Review Requirements", Revision 9
- 2.1.3 EGR-NGGC-0017, "Preparation and Control of Design Analyses and Calculations", Revision 1
- 2.1.4 NGGS-NFP-0009, "Nuclear Fuels Management and Safety Analysis Controlled Location File Transfer", Revision 0

2.2 Regulatory

- 2.2.1 Letter from Edward T. O'Neil to U.S. Nuclear Regulatory Commission Document Control Desk, "BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2 DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62 ANNUAL REPORT OF CHANGES AND ERRORS IN EMERGENCY CORE COOLING SYSTEM EVALUATION MODELS", Serial: BSEP 03-0107, July 9, 2003.

2.3 LOCA Analysis References

- 2.3.1 NEDC-31624P, "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis (Revision 0)", September 1988.
- 2.3.2 Letter from E. G. Tourigny to L. W. Eury, "SAFER/GESTR-LOCA Analysis, Brunswick Steam Electric Plant, Units 1 and 2 (TAC Nos. 72854/72855)", June 1, 1989 (NRC-89-401). Transmitted NRC SER for NEDC-31624P, Revision 0.
- 2.3.3 NEDC-31624P, "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis (Revision 1)", February 1990. This report was not submitted to the NRC.

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- 2.3.4 NEDC-31624P, "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis (Revision 2)", July 1990.
- 2.3.5 Letter from Ngoc B. Le to L. W. Eury, "Revision of SAFER/GESTR-LOCA Analysis - Brunswick Steam Electric Plant, Units 1 and 2 (TAC Nos. 77585 and 77586)", January 10, 1991 (NRC-91-018). Transmitted NRC SER for NEDC-31624P, Revision 2.
- 2.3.6 NEDC-31624P, Supplement 3, Revision 0, "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis: Application to GE13 Fuel", January 1996. Transmitted to NRC with B2C12 COLR. NRC SER not required since this is an application of an approved methodology, not a methodology change.
- 2.3.7 GE-NE-208-05-0393 (DRF-A00-05316), "Low Pressure Core Spray Out-Of-Service for BSEP Units 1 and 2", September 1993. Not sent to the NRC, but is included as Attachment 5 to 0B21-0112 Revision 2. Contains a comparison between SAFER02 and SAFER04 results.
- 2.3.8 NEDC-31624P, Supplement 3, Revision 1, "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis: Application to GE13 Fuel", November 2000 (see calculation 0B21-0199 for Reference 2.3.8 & its Owner Review).
- 2.3.9 GE-NE-J1103781-09-02P, "Brunswick Steam Electric Plant Units 1 and 2 ECCS-LOCA Evaluation for GE14," February 2001 (see calculation 0B21-0199 for Reference 2.3.9 & its Owner Review).
- 2.3.10 GE-NE-A22-00113-27-01, "Brunswick Nuclear Plant Unit 1 and 2 Extended Power Uprate – Task Report T0407: ECCS-LOCA SAFER /GESTR", Revision 0, Class III, June 2001. The NRC SER for Tech Spec amendment 222 (transmitted May 31, 2002) indicated the NRC review & acceptance of this document.

2.4 Change and Error Report References

- 2.4.1 Letter from R. C. Mitchell to Director of Nuclear Reactor Regulation, "Reporting of Changes and Errors in ECCS Evaluation Models", June 13, 1990 (MFN 023-90).
- 2.4.2 Letter from P. W. Marriot to Office of Nuclear Reactor Regulation, "Reporting of Changes and Errors in ECCS Evaluation Models", March 12, 1991 (MFN 025-91).
- 2.4.3 Letter from S. J. Stark to Office of Nuclear Reactor Regulation, "Reporting of Changes and Errors in ECCS Evaluation Models", June 26, 1992 (MFN 058-92).
- 2.4.4 Letter from R. C. Mitchell to Office of Nuclear Reactor Regulation, "Reporting of Changes and Errors in ECCS Evaluation Models", June 30, 1993 (MFN 090-93).

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- 2.4.5 Letter from R. C. Mitchell to Office of Nuclear Reactor Regulation, "Reporting of Changes and Errors in ECCS Evaluation Models", July 1, 1994 (MFN 088-94).
- 2.4.6 Letter from J. F. Klapproth to Document Control Desk (R.C. Jones, Jr.), "Reporting of Changes and Errors in ECCS Evaluation Models", June 24, 1995 (MFN 087-95).
- 2.4.7 Letter from R. J. Reda to Document Control Desk (R.C. Jones, Jr.), "Reporting of Changes and Errors in ECCS Evaluation Models", December 15, 1995 (MFN 278-95).
- 2.4.8 Letter from R. J. Reda to Document Control Desk (R.C. Jones, Jr.), "Reporting of Changes and Errors in ECCS Evaluation Models", February 20, 1996 (MFN 020-96).
- 2.4.9 Letter from R. J. Reda to Document Control Desk (R.C. Jones, Jr.), "Reporting of Changes and Errors in ECCS Evaluation Models", June 28, 1996 (MFN 088-96).
- 2.4.10 Letter from G. R. Hull to Mike DeVoe, "Reporting of Changes and Errors in ECCS Evaluation Models", July 16, 1996. (GRH:96-088).
- 2.4.11 Letter from G. R. Hull to Mike DeVoe, "Reporting of Changes and Errors in ECCS Evaluation Models", July 22, 1997. (GRH:97-073).
- 2.4.12 Letter from R. J. Reda to Document Control Desk (J.E. Lyons), "Reporting of Changes and Errors in ECCS Evaluation Models", June 27, 1997 (MFN 029-97).
- 2.4.13 Letter from G. A. Watford to Document Control Desk (T.E. Collins), "Reporting of Changes and Errors in ECCS Evaluation Models", June 30, 1998 (MFN 032-98).
- 2.4.14 Letter from W. H. Hetzel to A. T. Kremer, "10CFR50.46 Error Notification - Brunswick Units 1 and 2", January 27, 1999 (WHH:99-007).
- 2.4.15 Letter from W. H. Hetzel to A. T. Kremer, "10CFR50.46 Error Notification - Brunswick Units 1 and 2", February 10, 1999 (WHH:99-011).
- 2.4.16 Letter from William H. Hetzel to A. T. Kremer, "10 CFR 50.46 Notification Letter", June 25, 1999 (WHH:99-044).
- 2.4.17 Letter from Ann T. Kremer to Dan Pappone, "50.46 GE Notification Letter on Licensing Basis PCTs and Applicability to Brunswick Nuclear Plant", July 26, 1999 (NF-99A-0145).
- 2.4.18 Letter from G. A. Watford to Document Control Desk (J. L. Wermiel), "Summary of Changes and Errors in ECCS Evaluation Models", June 30, 1999 (MFN-004-99) [cover letter from William H. Hetzel to A. T. Kremer, July 28, 1999 (WHH:99-053)].

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- 2.4.19 Letter from G. A. Watford to Document Control Desk (J. L. Wermiel), "Summary of Changes and Errors in ECCS Evaluation Models", June 30, 2000 (FLN-2000-06)
[cover letter from William H. Hetzel to A. T. Kremer, June 30, 2000 (WHH:2000-044)].
- 2.4.20 Letter from W. H. Hetzel to A. T. Kremer, "10CFR50.46 Error Report for Brunswick 1 & 2 SAFER/GESTR Analysis", August 9, 2000 (WHH:2000-053).
- 2.4.21 Letter from W. H. Hetzel to Mike Blom, "Revised 10 CFR 50.46 Error Report for Brunswick 1&2 SAFER/GESTR Analysis", November 7, 2000 (WHH:2000-073)
- 2.4.22 Letter from W. H. Hetzel to Mike Blom, "10 CFR 50.46 Notifications for Brunswick 1&2", May 24, 2001 (WHH:2001-010). Letter transmits 10 CFR 50.46 Notification Letters 2001-01, 2001-02, and 2001-03.
- 2.4.23 Email from Glenn A. Watford to Michael Blom, Subject: "10 CFR 50.46 Notification - 2002-01 - SAFER Core Spray Injection Elevation /2002-02 - SAFER Bulk Water Level Error - Brunswick", 6/13/2002 8:46 P.M.
- 2.4.24 Email from Glenn A. Watford to Michael Blom, Subject: "10 CFR 50.46 Notification - 2002-03, 2002-04, 2002-05", 8/26/2002 7:13 P.M.
- 2.4.25 Email from Margaret Harding to Michael Blom, Subject: "RE: 10 CFR 50.46 Notification - 2003-01 - Progress Energy", 5/16/2003 3:26 P.M.
- 2.4.26 Email from Margaret Harding to Michael Blom, Subject: "10 CFR 50.46 Notification - 2003-03 - Progress Energy", 5/16/2003 3:36 P.M.
- 2.4.27 Email from Michael Blom to Tom Dresser et al, Subject: "Emailing: 10CFR5046_2003_05_Progress_Energy.pdf", 5/14/2004 2:28 P.M

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3 Body of Calculation

3.1 Design Inputs

3.1.1 The cumulative PCT impact (including estimated licensing PCT) is currently not tracked by break size or phase of accident, but is considered to be cumulative to the limiting break and phase documented in the base analysis. This practice will not be changed unless separate PCT errors/changes tracking become appropriate in the future (for example, to track errors in portions of the LOCA analysis not bounding at BNP).

3.1.2 The current error notice (References 2.4.27) was received May 14, 2004. The PCT impact of this error is insignificant such that 10CFR50.46 does not require its reporting until the next scheduled annual NRC report. Error notice 2003-02 was specific to TVA plants and 2003-04 was specific to Vermont Yankee, and so the correct sequence of notices tracked for BNP is 2003-01, 2003-03, 2003-05. There have not been any notices issued to date in the 2004-xx sequence.

3.1.3 This calculation is prepared in accordance with References 2.1.1, 2.1.3 and 2.1.4, and verified in accordance with Reference 2.1.2.

3.2 Assumptions

None

3.3 Computer Codes Used

None

3.4 Computers Used

None

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3.5 Calculations

3.5.1 Records Storage

The historical information for the BNP SAFER/GESTR-LOCA ECCS Analysis Change and Error Summary is compiled as two linked tables, because the number of columns of data associated with each analysis/error notice is large. Each analysis/error notice is described in the same row in either table. This data is maintained in the NFM&SA DOS Controlled Library as:

PROGRAMS on 'NT000229'P:\site\HNP Apps\Control\data\bwr\bar\ DC 0B21-0112 Rev.10_June_2003.doc

The pertinent information from this file and supporting references were most recently reported by BNP to the Nuclear Regulatory Commission in Reference 2.2.1.

The same general format is preserved for the update of the historical summary with the current analysis. The information received from GE through Reference 2.4.27 was incorporated into the historical file and an entry was added for the specific change on the summary tables. There were no design changes to Brunswick Units 1 and 2 which had an impact on the Change and Error Summary at the time of this update (the UB PCT limit change from 1600°F to 2200°F will be associated with the licensing of MELLLA+). The revised summary including the current analysis result change (Entry No. 36) is provided in Attachment 2 and electronically stored as part of the file containing this design calculation in:

NGGSHARE on 'NT000230'N:\fuels\BNP LOCA\10CFR50.46\DC 0B21-0112 Rev.11_August 2004.doc

prior to transfer to the same controlled library. Attachment 4 illustrates the form (User Production and controlled Library Maintenance Request) to effect this transfer, which may be approved, completed and/or verified subsequent to the completion of this calculation.

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3.5.2 10CFR50.46 Notification: 2003-05

This error correction results in no (0°F) PCT increase for GE13 and GE14 at BNP.

A new heat source during the LOCA event has been postulated. This heat source involves the recombination of hydrogen and oxygen within the fuel bundle during the core heatup. The additional heat will raise the temperature of the steam heat sink in the bundle, resulting in a potential increase in the peak cladding temperature and local oxidation. This recombination is spontaneous at temperatures above approximately 900°F. The hydrogen is generated by the steam-zirconium reaction during heatup. The oxygen enters the vessel either as a dissolved gas in the ECCS water or through the break when the vessel fully depressurizes and draws the containment noncondensable gases back into the vessel. The current LOCA evaluation models do not include this new heat source.

The impact of hydrogen-oxygen recombination was incorporated by increasing the heat generated due to metal water reaction. The evaluations were performed assuming that recombination occurs within the fuel channels at the cladding surface. The additional source of oxygen from the containment will only contribute to increasing the PCT for the non-jet pump plants. This is due to the fact that the oxygen from the containment enters the vessel late in LOCA event, after the core has reflooded for jet pump plants.

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4. Conclusions

4.1 Summary of Results

Tables 1, 2 and 3 contain pertinent results from the current analysis to support a BNP 10CFR50.46 annual NRC report. The 2002 annual report included only the impact of extended power uprate, an analysis that included all outstanding changes & errors then reported, that was reviewed and accepted by the NRC (Reference 2.3.10). Therefore the accumulated absolute value of errors was reset at zero prior to Revision 10 of 0B21-0112 in 2003. Table 1 lists the error notices, tracks the estimated Licensing PCT, and accumulates the cumulative absolute value of all errors since the most recent NRC report (i.e., only notice 2003-05). Table 2 presents the most recent analyzed Licensing PCT, the most recent reported (evaluated) Licensing PCT, the current evaluated Licensing PCT and the change in PCT since the last report. Table 3 presents an Upper Bound PCT summary corresponding to Table 2.

The estimated Upper Bound PCT is being tracked by PGN not directly in support of 10CFR50.46, but to ensure the SAFER/GESTR-LOCA SER conditions are being met. Unless specific direction to the contrary is provided by GE, the tracking is conservatively performed in exactly the same manner as the licensing basis PCT is tracked. The absolute value of Appendix K DBA Δ PCT is cumulatively summed for Upper Bound PCT as well as Licensing Basis PCT impact assessment. The SAFER/GESTR SER limit remains 1600°F until the MELLLA+ license amendment is approved, at which time it will become 2200°F.

The UFSAR was updated per LDCR 02FSAR-031 (EPU Changes) to reflect reference updates. The table in UFSAR 6.3.3.5.3 should be updated if the evaluated Licensing PCT approaches a significant difference (50°F) from the temperatures reported in the UFSAR (currently 1710°F for GE13, 1580°F for GE14).

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Table 1										
BNP SAFER/GESTR-LOCA ECCS Analysis Change/Error Summary										
Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	GE BWR Estimated Licensing PCT Impact	Estimated BNP Licensing PCT Impact and Estimated PCT		Cumulative BNP Licensing PCT Change		Is BNP Licensing PCT Change Greater than 50°F?	
					GE13	GE14	GE13	GE14	Incremental	Cumulative
10CFR 50.46 Notice 2003-05	May, 2004	through 8/10/04	Additional heat source from Oxygen and Hydrogen recombination	generically not reported	0°F U1 < U2 <1732°F	0°F U1 < U2 <1567°F	15°F	20°F	No	No

Table 2			
BNP Licensing PCT Change Summary Through 8/10/04*			
Fuel Type (most recent LOCA analysis Licensing PCT)	Most Recent Licensing PCT Reported in a LOCA Document Submitted to the NRC (Analysis or Notice)	Current Estimated Licensing PCT	Change from reported Licensing PCT
GE13 (Ref. 2.3.8: 1710°F)	<1717°F (Ref. 2.3.10)	<1732°F	15°F
GE14 (Ref. 2.3.9: 1580°F)	<1557°F (Ref. 2.3.10)	<1567°F	10°F

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Table 3 BNP Upper Bound PCT Change Summary Through 8/10/04*			
Fuel Type (most recent LOCA analysis Upper Bound PCT)	Upper Bound PCT Corresponding to Table 2 Most Recent Submitted to the NRC	Current Estimated Upper Bound PCT	Change from Previous Upper Bound PCT
GE13 (Ref. 2.3.8: 1560°F)	<1567°F (Ref. 2.3.10)	<1582°F	15°F
GE14 (Ref. 2.3.9: 1490°F)	<1487°F (Ref. 2.3.10)	<1497°F	10°F

*BNP LOCA Results presented for Unit 2, which bounds Unit 1

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4.2 Precautions/Limitations

- 4.2.1 The results provided in this design calculation apply to the period ending August 8, 2004.
- 4.2.2 Once accumulated change/error exceeds 50°F, each new error or change in the SAFER/GESTR-LOCA model will continue to require a 30-day NRC notification under 10CFR50.46 while the accumulated absolute value of reported errors remains above 50°F (that is, until results are reported from a new calculation performed with an acceptable evaluation model). The accumulated error can be re-baselined to zero once the new calculation has been submitted to the NRC.
- 4.2.3 The UFSAR should be updated when its value differs by a "significant" amount (50°F) from the evaluated licensing basis PCT. Once the UFSAR is updated to remove references to the PCT of fuel types no longer in use at BNP, tracking of those fuel types in this calculation should be discontinued (although their history will remain in the Attachment 2 tables).
- 4.2.4 The Upper Bound PCT must be monitored against its acceptance criterion of 1600°F to ensure that the conditions of the SAFER/GESTR-LOCA SER are satisfied. Remaining margin to this criterion is much less than that to the 10CFR50.46 Licensing Basis PCT, however the NRC has approved and BNP will implement with MELLLA+ a new criterion of 2200°F.

Preparer: Tom Dresser	CALCULATION SHEET	Calculation No. 0B21-0112
Verifier: Mourad Aissa		Revision 11
Supervisor: George E. Smith		Page 18 of 18
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5 Scope of Verification

The following is a suggested minimum verification scope for this calculation:

- 5.1 Verify the accuracy of any hand calculations used to incorporate errors from the current reporting period into the historical summary.
- 5.2 Perform a Design Verification Review of this calculation in accordance with Reference 2.1.2. Document all findings and resolutions on the EGR-NGGC-0003 Record of Lead Review form (current form included in Attachment 3).

Preparer: Tom Dresser	CALCULATION SHEET	Calculation No. 0B21-0112
Verifier: Mourad Aissa		Revision 11
Supervisor: George E. Smith		Page 0-1 of 0-2
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Attachment 0

Document Indexing Table

DOCUMENT INDEXING TABLE

CALCULATION NO. 0B21-0112

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REVISION 11

Document Type (i.e. Calc, Dwg, Tag, Procedure, Software).	ID Number (e.g., Calc. No., Dwg. No., Equip. Tag No., Procedure No., Software Name & Version)	Function (i.e., IN for Design Inputs or References, OUT for affected Documents)	Relationship to Calc. (e.g., Design Input, Assumption Basis, Reference, Document Affected by Result)
Federal Regulation	10CFR50.46	IN- "Acceptance Criteria For Emergency Core Cooling Systems For Light-Water Nuclear Power Reactors"	Controlling Regulation
FSAR	UFSAR 6.3.3.5.3	OUT- "Confirmation of Emergency Core Cooling Systems with 10CFR50.46"/ "Liquid Line Breaks"	Documents License Basis PCT Results
Design Document	NEDC-31624P, Revision 2	IN- "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis (Revision 2)"	Input
Design Document	NEDC-31624P, Supplement 3, Revision 1	IN- "Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis: Application to GE13 Fuel"	Input
Design Document	GE-NE-208-05-0393 (DRF-A00-05316)	IN- "Low Pressure Core Spray Out-Of-Service for BSEP Units 1 and 2"	Input
Calculation	0B21-0112 (previous revisions)	IN- "10CFR50.46 SAFER/GESTR-LOCA ECCS Analysis Update"	Input
Calculation	0B21-0199 (subsequent to Revision 0)	IN- "ECCS Analysis Results" (Revision 1 consolidates the design basis documentation which provides input to this calculation. It contains NEDC-31624P, Supplement 3, Revision 1 and the associated Owner's Review).	Input
Design Document	GE-NE-J1103781-09-02P, Revision 0	IN- "Brunswick Steam Electric Plant Units 1 and 2 ECCS-LOCA Evaluation for GE14," February 2001"	Input
Design Document	GE-NE-A22-00113-27-01, Revision 0	IN- "Brunswick Nuclear Plant Unit 1 and 2 Extended Power Uprate – Task Report T0407: ECCS-LOCA SAFER /GESTR"	Input

Preparer: Tom Dresser	CALCULATION SHEET	Calculation No. 0B21-0112
Verifier: Mourad Aissa		Revision 11
Supervisor: George E. Smith		Page 2-1 of 2-18
Calculation Title: 10CFR50.46 SAFER/GESTR-LOCA ECCS Analysis Update		

Attachment 2

BNP SAFER/GESTR-LOCA ECCS Analysis Change/Error Summary

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change in Model?	Error in Model?	Change in Application?	Error in Application?	Other? (See Note 4)
1	Base LOCA Analysis NEDC 31624P Rev 0	(9/88)	N/A	Change to SAFER/GESTR-LOCA Methodology (NEDE 23785, SAFER02) Calculated results: <div> <div>Unit 1</div> <div>Unit 2</div> <div>Licensing Basis PCT 1533 °F (GE7) 1537 °F (GE7)</div> <div>Peak Local Oxidation 0.299% (GE7) 0.306% (GE7)</div> <div>Metal-Water Reaction 0.046% (GE7) 0.036% (GE7)</div> </div> <div>Upper Bound PCT 1353°F (GE7) 1390 °F (GE7)</div>	Yes	No ¹	Yes	No	N/A
2	NEDC 31624P Rev 1	(2/90)	N/A	This revision was to correct documentation errors (the reported value of an input parameter) found in Revision 0. However, Revision 1 contained publication errors and was never distributed for use. NO CALCULATIONS WERE MADE.	No	No	No	No	N/A
3	MFN 023-90	6/13/90	10/17/88 - 6/13/90	Coding errors in SAFER - energy balance in unheated bottom node, modeling of steam quenching by the LPCI system, calculation of the bypass void profile.	No	Yes	No	No	N/A
4	NEDC 31624P Rev 2	(7/90)	N/A	Corrected publication errors in Revision 0. NO CALCULATIONS WERE MADE.	No	No	No	No	N/A
5	MFN 025-91	3/12/91	6/13/90-3/12/91	No errors or changes. GE notified NRC that they are in the process of adapting SAFER/GESTR methodology to accommodate GE11.	No	No	No	No	N/A
6	MFN 058-92	6/26/92	3/12/91-6/26/92	Considered N/A prior to Revision 2 of 0B21-0112, currently considered change in application. See Note 5.	No	No	Yes	No	Yes

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change in Model?	Error in Model?	Change in Application?	Error in Application?	Other? (See Note 4)
7	MFN 090-93	6/30/93	6/26/92-6/30/93	<p>Two minor coding errors; improper upper plenum flow initialization and sign error in a pressure drop calculation for the top of the hot channel.</p> <p>Noted that model sensitivity to small input parameter changes could be greater than that originally reported in NFM 058-92. Variation could be greater than +/- 50 °F for some BWR/4 plants with LPCI injection into the lower plenum (total variation of less than 85 °F for most cases but with one case showing a range of 102 °F).</p> <p>Also noted that the identified sensitivity is related to the explicit numerical treatment in SAFER combined with rapid and simultaneous variations of multiple parameters. Sensitivity will be limited through better control of time steps in the computations.</p> <p>PGN 10CFR50.46 evaluations prior to OB21-0112 Rev. 2 concluded that "The second and third paragraphs above do not apply to BNP because BNP analyses have not been rerun." It is currently recognized that this notice is stating that better computational controls were implemented to maintain the sensitivity described in notice MFN 058-92 to +/- 50 °F.</p> <p>(see note 5)</p>	No	Yes	Yes	No	Yes

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change in Model?	Error in Model?	Change in Application?	Error in Application?	Other? (See Note 4)
8	LPCS-OOS Report	Sept. 1993	N/A	<p>GE Document GE-NE-208-05-0393, DRP-AOO-05316, "Low Pressure Core Spray Out-of-Service for BSEP Units 1 and 2.</p> <p>Section 3.2 establishes a baseline between the current version of SAFER (SAFER04) and the original BSEP licensing basis version of SAFER (SAFER02). SAFER04 includes several modeling improvements relative to SAFER02.</p> <p>This baseline comparison also includes several ECCS parameter relaxations relative to the licensing basis (L3=LL1 changed from 519.5 to 517 and L1=LL3 changed from 369.5 to 358.0). These water level setpoint changes impact the PCT by only approximately 1 °F and therefore this baseline calculation gives a very good indication of the effect of modeling changes and errors on the licensing basis PCTs.</p> <p>The results indicate that, with the updated version of SAFER, the licensing basis PCT for BNP2 GE7 fuel increases from 1537 °F to 1550 °F. (Approximately 1 °F of this increase is due to the reduced water level setpoints assumed.)</p> <p>The results indicate that, with the updated version of SAFER, the upper bound PCT for BNP2 GE7 fuel increases from 1390 °F to 1440 °F. (Approximately 1 °F of this increase is due to the reduced water level setpoints assumed.)</p>	Yes	No	Yes, Water Level	No	N/A
9	MFN 088-94	7/1/94	6/30/93-7/1/94	No changes or errors.	No	No	No	No	N/A
10	MFN 087-95	6/24/95	7/1/94-6/24/95	No changes or errors.	No	No	No	No	N/A
11	MFN 278-95	12/15/95	7/1/94-12/15/95	Revises NFM 087-95. Pointed out that in March of 1995 a domestic utility asked about the impact of the RPV bottom head drain (BHD) on LOCA evaluations. GE stated that the BHD impact is believed to be less than 10 °F.	No	No	Yes	No	N/A

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change in Model?	Error in Model?	Change in Application?	Error in Application?	Other? (See Note 4)																				
12	NEDC 31624P Supplement 3 Rev. 0	(1/96)	N/A	<p>BNP GE13 LOCA analysis (NEDC-23785, SAFER04).</p> <p>Relative to the base analysis, this analysis was done with a revised version of the SAFER model.</p> <p>Calculated results:</p> <table><tr><td></td><td>GE13</td></tr><tr><td>Licensing Basis PCT</td><td>1535 °F</td></tr><tr><td>Peak Local Oxidation</td><td>0.27% 0.27%</td></tr><tr><td>Metal-Water Reaction</td><td>0.036% 0.036% (GE7)</td></tr></table> <p>Upper Bound PCT 1448 °F</p> <p><u>Summary of BNP ECCS Results as of B1C11 and B2C12</u></p> <table><tr><td></td><td>Unit 1</td><td>Unit 2</td></tr><tr><td>Licensing Basis PCT</td><td>1535°F GE13</td><td>1537°F GE7</td></tr><tr><td>Peak Local Oxidation</td><td>0.299% GE7</td><td>0.306% GE7</td></tr><tr><td>Metal-Water Reaction</td><td>0.046% GE7</td><td>0.036% GE7</td></tr></table> <p>Upper Bound PCT 1353°F (GE7) 1390 °F (GE7)</p> <p>Upper Bound PCT 1448 °F GE13 1448 °F GE13</p> <p>Note that this analysis did not attempt to model BHD effects. Therefore, the PCT impact described in NFM 278-95 applies to the GE 13 analysis. Also the 50°F uncertainty described in MFN 058-92 applies to all fuel.</p>		GE13	Licensing Basis PCT	1535 °F	Peak Local Oxidation	0.27% 0.27%	Metal-Water Reaction	0.036% 0.036% (GE7)		Unit 1	Unit 2	Licensing Basis PCT	1535°F GE13	1537°F GE7	Peak Local Oxidation	0.299% GE7	0.306% GE7	Metal-Water Reaction	0.046% GE7	0.036% GE7	Yes	No	Yes	No Yes, for GE 13 BHD	No
	GE13																												
Licensing Basis PCT	1535 °F																												
Peak Local Oxidation	0.27% 0.27%																												
Metal-Water Reaction	0.036% 0.036% (GE7)																												
	Unit 1	Unit 2																											
Licensing Basis PCT	1535°F GE13	1537°F GE7																											
Peak Local Oxidation	0.299% GE7	0.306% GE7																											
Metal-Water Reaction	0.046% GE7	0.036% GE7																											
13	MFN 020-96	2/20/96	12/15/95-2/20/96	Revises NFM 278-95. Just adds a drawing to more clearly describe the BHD concern. No change in estimated PCT impact.	N/A	N/A	N/A	N/A	N/A																				
14	MFN 088-96	6/28/96	2/2/96-6/28/96	<p>No changes or errors but some applications used the wrong number of fuel rods for GE9/10/11/12/13 (designs containing large water rods).</p> <p>It has been confirmed that this notice does not apply to BNP LOCA evaluations (see GRH 96-088).</p>	No	No	No	Yes	N/A																				
15	MFN 029-97	6/27/97	6/28/96-6/27/97	No changes or errors.	No	No	No	No	N/A																				
16	MFN 032-98	6/30/98	6/28/97-6/30/98	No changes or errors.	No	No	No	No	N/A																				

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change In Model?	Error In Model?	Change In Application?	Error In Application?	Other? (See Note 4)
17	WHH:99-007 (supplemented by WHH:99-011, dated 2/10/99)	1/27/99	7/1/98-1/27/99	Notification that $\pm 50^{\circ}\text{F}$ for sensitivity to small input parameter changes for BWR/4 plants with LPCI injection into the lower plenum (see MFN-090-93) as well as 10°F BHD error (see MFN-020-96) not included in NEDC 31624P Supplement 3 Rev. 0 analysis. (see notes 1, 5)	No	No	No	Yes	No
18	WHH:99-044 (supplemented by NF-99A-0145, dated 07/26/99)	6/25/99	1/27/99-6/25/99	CCFL error: for jet pump plants including GE10 fuel, SAFER counter core flow limiting coefficients not matched to flow area (upper tie plate area used but top spacer is flow limited). Impact is $+5^{\circ}\text{F}$ to $+25^{\circ}\text{F}$ for affected plants. Both letter and attached table identify Brunswick Units 1 & 2 as not affected. Supplemental letter clarifies basis for NA determination.	No	No	No	Yes	No
19	MFN-004-99	6/30/99	7/1/98-6/30/99	For non-jet pump plants, water rod diameter not transferred between software routines. For jet pump plants including GE10 fuel, notice for CCFL error described above. Impact is $+5^{\circ}\text{F}$ to $+25^{\circ}\text{F}$ for affected plants.	No	No	No	Yes	No
20	WHH:2000-044	6/30/00	7/1/99-6/30/00	NA for BNP. Error in vessel heat slab model heat transfer areas for BWR/6 design only.	No	Yes	No	No	No
21	WHH:2000-053	8/9/00	7/1/00 – 8/08/00	$+5^{\circ}\text{F}$ for Heat Conduction Time Step Size	No	No	Yes	Yes	No
				$+1^{\circ}\text{F}$ for GESTR Fuel File Interpolation	No	Yes	No	No	No
				$+90^{\circ}\text{F}$ for LPCI Condensation	No	Yes	No	No	No
				$+2^{\circ}\text{F}$ for Low Water Level Setpoint	No	No	No	Yes	No
22	WHH: 000-073	11/7/00	8/9/00 – 11/7/00	Same deltas as prior notice WHH:2000-053 (revised new estimates for UB PCT and LB PCT)	No	Yes	Yes	Yes	No
23	NEDC-31624P, Supplement 3, Rev. 1	November, 2000	through 11/7/00	New LOCA calculation for GE13 fuel PCT baseline	No	Yes	Yes	Yes	No

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change in Model?	Error in Model?	Change in Application?	Error in Application?	Other? (See Note 4)
24	GE-NE-J1103781-09-02P	February, 2001	through 2/28/00	Original BNP LOCA calculation for GE14 fuel	Yes	No	Yes	No	No
25	10CFR50.46 Notification Letter 2001-01	May, 2001	through 5/24/01	LPCI Condensation Error as noticed in WHH:2000-053 and WHH:2000-073	No	Yes	No	No	No
26	10CFR50.46 Notification Letter 2001-02	May, 2001	through 5/24/01	Impact of SAFER Pressure Rate Inconsistency Error on	No	Yes	No	No	No
27	10CFR50.46 Notification Letter 2001-03	May, 2001	through 5/24/01	BNP GE14 Analysis Dryout Time and Initial Pressure Errors	No	No	No	Yes	No
28	GE-NE-A22-00113-27-01	June 2001	Through 5/15/02	ECCS-LOCA analysis to evaluate EPU (2923 MWt) impact on PCT	No	No	Yes	No	No
29	10CFR50.46 Notification Letter 2002-01	June, 2002	Through 6/01/02	SAFER Core Spray Injection Elevation Error	No	No	No	Yes	No
30	10CFR50.46 Notification Letter 2002-02	June, 2002	Through 6/01/02	SAFER Bulk Water Level Error Impact on PCT	No	No	No	Yes	No
31	10CFR50.46 Notification Letter 2002-03	August, 2002	Through 8/26/02	GESTR Input File Interpolation Error Impact on PCT	No	Yes	No	No	No
32	10CFR50.46 Notification Letter 2002-04	August, 2002	Through 8/26/02	SAFER04 Computer Platform Change Impact on PCT	Yes	No	Yes	No	No
33	10CFR50.46 Notification Letter 2002-05	August, 2002	Through 8/26/02	WEVOL S1 Volume Error Impact on PCT	No	No	No	Yes	No

Entry No.	Change or Error Notice	Notice or Document Date	Period Covered	Change or Error Description	Change In Model?	Error In Model?	Change In Application?	Error In Application?	Other? (See Note 4)
34	10CFR50.46 Notification Letter 2003-01	May, 2003	Through 5/06/03	SAFER Level/Volume Table Error Impact on PCT	No	No	No	Yes	No
35	10CFR50.46 Notification Letter 2003-03	May, 2003	Through 5/06/03	SAFER Initial Separator Pressure Drop Error Impact on PCT	No	No	No	Yes	No
36	10CFR50.46 Notification Letter 2003-05	May, 2004	Through 8/10/04	New Hydrogen-Oxygen Recombination Heat Source	No	Yes	No	Yes	No

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of Impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
1	N/A	Yes	Approx. -660 °F Switch to Best Estimate LOCA Method.	Yes	Approx. 660 °F Switch to Best Estimate LOCA Method.	Yes	No	Yes, BNP	03/29/89 NRC SER issued 06/01/89.
2	N/A	No	N/A U1 1533 °F GE7 U2 1537 °F GE7	No	N/A Reset by 06/01/89 SER	No	No	No, not required.	N/A
3	+20 °F to -100 °F	Yes	Unknown, assume +100 °F for error accumulation and +20 °F for evaluation of PCT impact U1 1633 °F GE7 U2 1637 °F GE7	Yes	100 °F	Yes	No	Yes, GE	06/13/90
4	N/A	No	No U1 1633 °F GE7 U2 1637 °F GE7	No	100 °F	Yes	No	Yes, BNP	09/06/90 NRC SER issued 01/10/91.
5	N/A	No	No U1 1633 °F GE7 U2 1637 °F GE7	No	100 °F	Yes	No	Yes, GE	03/12/91
6	less than +/- 50 °F	Yes	N/A U1 1683 °F GE7 U2 1687 °F GE7	No	150 °F	Yes	No	Yes, GE	06/26/92

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3).	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
7	+/- 5 °F	Yes	Unknown, assume +5 °F (see note 5) U1 1688 °F GE7 U2 1692 °F GE7	No	155 °F	Yes	No	Yes, GE	06/30/93
8	N/A	Yes	Licensing PCT increase of 13 °F relative to base analysis for impact of errors noted in MFN 023-90 (Entry 3) and MFN 090-93 (Entry 7). Corresponding Upper Bound PCT increase of 50 °F for Entries 3 and 7. 50 °F from MFN 058-92 (Entry 6) remains. U1 1596 °F GE7 U2 1600 °F GE7	No	63 °F Cumulative change reduced from 155 °F to 63 °F based on revised estimate of prior effects obtained from the LPCS-OOS Report. Corresponding Upper Bound PCT cumulative change reduced from 155 °F to 100 °F based on revised estimate of prior effects obtained from the LPCS-OOS Report.	Yes	No	No	N/A
9	N/A	No	N/A U1 1596 °F GE7 U2 1600 °F GE7	No	63 °F 100 °F Upper Bound PCT	Yes	No	Yes, GE	07/01/94
10	N/A	No	N/A U1 1596 °F GE7 U2 1600 °F GE7	No	63 °F 100 °F Upper Bound PCT	Yes	No	Yes, GE	06/24/95

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
11	10 °F	Yes	Unknown, assume 10 °F U1 1606 °F GE7 U2 1610 °F GE7	No	73 °F 110 °F Upper Bound PCT	Yes	No	Yes, GE 1	12/15/95
12	N/A	Yes	Unit 1 licensing basis PCT increased by 2 °F relative to original GE7 calculations but no increase relative to the current estimated GE 7 PCT. GE13 Upper Bound PCT increases 58 °F to 1448 °F relative to original GE7 UB. 10 °F increase for GE13 due to the BHD issue. 50 °F increase for GE13 due to the Entry 6 (MFN 058-92) issue. U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	No	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	Yes	No	No	N/A Errors have not been reported but the GE13 Supplement to the base LOCA report was provided to the NRC with the B2C12 COLR, SRLR, and cycle specific LOCA report.

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
13	N/A	N/A	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	N/A	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	Yes	No	Yes, GE	02/20/96
14	less than 30 °F	No	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	N/A	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	No	No	Yes, GE	06/28/95
15	N/A	No	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	N/A	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	No	No	Yes, GE	06/27/97
16	N/A	No	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	N/A	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	No	No	Yes, GE	06/30/98

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
17	less than 60°F (10°F for BHD already included by PGN)	Yes	This notice results in additional 50°F accumulated PCT. Table tracks this 50°F starting in Entry 6. See Note 5 U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	Yes See Note 5	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	Yes	No	To be reported by 02/26/99 by PGN	To be reported by 02/26/99 by PGN
18	+5°F to +25°F	No	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	No	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	Yes	No	To be reported by PGN in annual notice	To be reported by PGN in annual notice
19	+5°F to +25°F	No	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	No	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	Yes	No	Yes, GE. To be reported by PGN in annual notice	06/30/99 To be reported by PGN in annual notice
20	0°F to -45°F	No	N/A U1 1606 °F GE7 U2 1610 °F GE7 U1 1595 °F GE13 U2 1595 °F GE13	No	73 °F GE7 60 °F GE13 Upper Bound PCT: 110 °F GE7 60 °F GE13	Yes	No	Yes, GE. To be reported by PGN in annual/30 day notice	06/30/99 To be reported by PGN in annual/30 day notice

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
21	+5°F for Heat Conduction Time Step Size +1°F for GESTR Fuel File Interpolation +90°F for LPCI Condensation +2°F for Low Water Level Setpoint	Yes Yes Yes Yes	+98°F total U1 1704°F GE7 U2 1708°F GE7 U1 1693°F GE13 U2 1693°F GE13	Yes	171°F GE7 158°F GE13 Upper Bound PCT: 208°F GE7 158°F GE13	Yes	No	Yes, GE. Reported by PGN in annual notice	06/30/00 08/29/00
22	Same changes & delta-PCTs as entry 21 (revised new estimates for UB PCT and LB PCT)	No (included by entry 21)	NA U1 1704°F GE7* U2 1708°F GE7* U1 1693°F GE13 U2 1693°F GE13	No	+171°F GE7* +158°F GE13	Yes	No	Reported by PGN in 30 day notice	12/7/00 via BSEP 00-0165

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
23	New LOCA calculation for GE13 fuel PCT baseline	Yes	New GE13 PCT calculation to zero accumulated error U1 1704°F GE7* U2 1708°F GE7* GE13: U1 < U2 <1710°F	No	+171°F GE7* 175°F GE13 [§]	Yes	No	Reported by PGN in LOCA calculation update notice	12/7/00 via BSEP 00-0165
24	New LOCA calculation for GE14 fuel	Yes	GE13: U1 < U2 <1710°F GE14: U1 < U2 <1580°F	No	0°F for both GE13 and GE14 (no earlier fuel designs remain in use)	No	No	Reported by PGN via typical reload licensing update notice	3/16/01 per BSEP 01-0029
25	Generically 0 to +220°F for LPCI Condensation (Unchanged for BNP from entry 21)	No (included by entry 21)	GE13: U1 < U2 <1710°F GE14: U1 < U2 <1580°F	No	0°F for both GE13 and GE14 (no earlier fuel designs remain in use)	No	No	Yes, GE. Reported by PGN in LOCA calculation update notice	06/30/00 7/11/01 via BSEP 01-0083
26	Generically ±10°F for LPCI injection through jet pumps	Yes	GE13: +10°F U1 < U2 <1720°F GE14: NA U1 < U2 <1580°F	No	10°F for GE13 0°F for GE14	No	No	Reported by PGN in LOCA calculation update notice	7/11/01 via BSEP 01-0083

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
27	-20°F for Initial Pressure error, 0°F for Dryout Time error	Yes	GE13: NA U1 < U2 <1720°F GE14: -20°F U1 < U2 <1560°F	No	10°F for GE13 20°F for GE14	No	No	Reported by PGN in LOCA calculation update notice	7/11/01 via BSEP 01-0083
28	Evaluation of 2923 MWt EPU impact	Yes	GE13: -3°F U1 < U2 <1717°F GE14: -3°F U1 < U2 <1557°F	No	3°F for GE13 3°F for GE14	No	No	Reported by PGN in annual notice	7/10/02 via BSEP 02-0123
29	SAFER Core Spray Injection Elevation Error for JP plants generically -95°F to +60°F for LBLOCA, up to +30°F for SBLOCA.	Yes	GE13: +5°F U1 < U2 <1722°F GE14: +5°F U1 < U2 <1562°F	No	5°F for GE13 5°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
30	SAFER Bulk Water Level Error for BWR2-6 generically -5°F to +20°F	Yes	GE13: +10°F U1 < U2 <1732°F GE14: +10°F U1 < U2 <1572°F	No	15°F for GE13 15°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003
31	GESTR Input File Interpolation Error for BWR2-6 generically negligible	No	GE13: U1 < U2 <1732°F GE14: U1 < U2 <1572°F	No	15°F for GE13 15°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003
32	SAFER04 Computer Platform Change Impact for BWR2-6 generically negligible	Yes (GE13) No (GE14)	GE13: 0°F U1 < U2 <1732°F GE14: U1 < U2 <1572°F	No	15°F for GE13 15°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003
33	WEVOLS1 Volume Error for BWR2-6 generically negligible	Yes	GE13: 0°F U1 < U2 <1732°F GE14: 0°F U1 < U2 <1572°F	No	15°F for GE13 15°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003

Entry No.	GE BWR Estimated PCT Impact	Is there a BNP Impact ?	Estimated BNP Licensing PCT Impact (See note 3) & Estimated Licensing PCT	Is limiting BNP Licensing PCT impacted by more than +/- 50 °F? (See Note 1)	Cumulative BNP Licensing PCT change. (See note 3)	Is cumulative BNP Licensing PCT change greater than 50°F? (See Note 1)	Is ECCS performance impacted? (See Note 2 for definition of impacted.)	Reported to NRC? By GE, BNP, or Both	Date Reported
34	SAFER Level/ Volume Table Error for BWR2-6 generically not reported	Yes	GE13: 0°F U1 < U2 <1732°F GE14: -5°F U1 < U2 <1567°F	No	15°F for GE13 20°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003
35	SAFER Initial Separator Pressure Drop Error for BWR2-6 generically not reported	Yes (GE13) No (GE14)	GE13: 0°F U1 < U2 <1732°F GE14: U1 < U2 <1567°F	No	15°F for GE13 20°F for GE14	No	No	To be reported by PGN in annual notice	Projected July 2003
36	New Hydrogen-Oxygen Recombination Heat Source	No (GE13) No (GE14)	GE13: 0°F U1 < U2 <1732°F GE14: 0°F: U1 < U2 <1567°F	No	15°F for GE13 20°F for GE14	No	No	To be reported by PGN in annual notice	Projected August 2004
* GE7 bounds GE8, GE9 and GE10. PCT for fuel types prior to GE13 no longer being reported to NRC, as noticed by BSEP 01-0029 on 3/16/01.									

Notes:

- 1 - Report to NRC within 30 days
- 2 - Immediate Reportability. ECCS performance is not impacted if PCT<2200 °F, oxidation <17%, hydrogen < 1%, coolable geometry maintained, and long term cooling is available. (SAFER/GESTR results must remain below 1600 °F)
- 3 - Report to NRC annually if less than 50 °F
- 4 - Numerical convergence, change in computing platform, etc.
- 5 - No changes or errors were included prior to Revision 2 of OB21-0112 for sensitivity to changes in computer operating system or small changes in input parameters (jet pump loss coefficients). This was considered not to apply to Base LOCA Analysis NEDC 31624P Rev. 2 because BNP analyses had not been run on a new computing system. As further information became known in MFN 090-93 and WHH:99-007, this notice is recognized as a change in application where greater uncertainty is applied to compensate for the previously-unrecognized sensitivity to small input parameter changes. PGN had recognized ± 50°F for sensitivity effect but believed to be N/A for Base LOCA Analysis NEDC 31624P Rev. 2, and to be corrected in LPCS OOS GE-NE-208-05-0393 and NEDC 31624P Supplement 3 Rev. 0.

Preparer: Tom Dresser	CALCULATION SHEET	Calculation No. 0B21-0112
Verifier: Mourad Aissa		Revision 11
Supervisor: George E. Smith		Page 3-1 of 3-2
Calculation Title: 10CFR50.46 SAFER/GESTR-LOCA ECCS Analysis Update		

Attachment 3

Design Verification

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Design 0B21-0112, 10CFR50.59 SAFER/GESTR Update

Revision 11

The signature below of the Lead Reviewer records that:

- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☒ Design Verification Review ☐ Engineering Review ☐ Owner's Review
☐ Design Review
☐ Alternate Calculation
☐ Qualification Testing

☐ Special Engineering Review

☐ YES ☒ N/A Other Records are attached.

Mourad Aissa/ Mourad Aissa NE 8/11/04
Lead Reviewer (print/sign) Discipline Date

Item No.	Deficiency	Resolution
	No deficiencies identified	

FORM EGR-NGGC-0003-2-5

This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

Preparer: Tom Dresser	CALCULATION SHEET	Calculation No. 0B21-0112
Verifier: Mourad Aissa		Revision 11
Supervisor: George E. Smith		Page 4-1 of 4-2
Calculation Title: 10CFR50.46 SAFER/GESTR-LOCA ECCS Analysis Update		

Attachment 4

User Production and Controlled Library Maintenance

ATTACHMENT 1
Sheet 1 of 1
CONTROLLED LIBRARY MAINTENANCE REQUEST

FILE: ☒ NF-1100.01 ☐ _____

FORM NGGS-NFP-0009-1-0

Originator: Tom Dresser Date 8/12/04

1. File Name: DC 0B21-0112 Rev. 11 August 2004.doc Action: Copy

From: N:\Fuels\BNP LOCA\10CFR50.46

To: P:\Site\HNP Apps\Control\Data\BWR\BARF\

2. File Name: _____ Action _____

From: _____

To: _____

3. File Name: _____ Action _____

From: _____

To: _____

4. File Name: _____ Action _____

From: _____

To: _____

5. File Name: _____ Action _____

From: _____

To: _____

Reason for Action: Update for 2003-2004 10CFR50.46 notices, archive for future updates

Approved by _____ Date: _____
Software Owner or Unit Manager

Performed by _____ Date: _____
Librarian or System Administrator

Reviewed by _____ Date: _____
Reviewer