ENCLOSURE 2

M190143

Comment Summary Table and Draft SE Markup

Non-Proprietary Information

IMPORTANT NOTICE

This is a non-proprietary version of Enclosure 1, which has the proprietary information removed. Portions of the document that have been removed are indicated by white space with an open and closed bracket as shown here [[ ]]

**Comment Summary for Draft Safety Evaluation for
Proposed Amendment 47 to NEDE-24011-P-A-27,
"General Electric Standard Application for Reactor Fuel (GESTAR II)
Supporting Implementation of TSTF-564"**

Note: Page numbers shown in this table reflect the page numbers in this enclosure.

Location	Comment
Section 1.0 Introduction and Background	Page 2: Line 17 refers to the incorrect revision of GESTAR. This change is in relation to Revision 27 of GESTAR.
Section 3.2.3 GESTAR II Section 1.2.2 Thermal Mechanical	Page 5: Lines 1 through 14 describe a change that is already found in Revision 27 of GESTAR. Recommend removal of this section of the SE. Some of the language on Lines 7 through 13 is GNF proprietary information.
Section 6.0 References	Page 8: Lines 8 and 9 for Reference 2 should be revised to Revision 27 of GESTAR published in August 2018.

OFFICE OF NUCLEAR REACTOR REGULATION

DRAFT SAFETY EVALUATION FOR

AMENDMENT 47 TO GLOBAL NUCLEAR FUEL – AMERICAS

TOPICAL REPORT NEDE-24011-P-A-26 GENERAL ELECTRIC STANDARD APPLICATION

FOR REACTOR FUEL (GESTAR II) TO SUPPORT IMPLEMENTATION OF TSTF-564

(EPID: L-2018-TOP-0038)

1.0 INTRODUCTION AND BACKGROUND

By letter dated September 12, 2018, Global Nuclear Fuel – Americas, LLC (GNF) submitted proposed Amendment 47 to Topical Report (TR) NEDE-24011-P-A-~~26~~27, "General Electric Standard Application for Reactor Fuel (GESTAR II) To Support Implementation of TSTF-564," to the U.S. Nuclear Regulatory Commission (NRC) staff for review (Ref. 1).

In Amendment 47, GNF requests to amend GESTAR II to provide the process and methodology elements to implement TSTF-564. TSTF-564 modifies the definition of the Technical Specification Safety Limit Minimum Critical Power Ratio such that it is no longer cycle-specific. The original request for TSTF-564 was subsequently modified in response to NRC requests for additional information (RAIs). These revisions are consistent with process and methodology elements that have been documented by plant license amendment requests in past years.

Traveler TSTF-564, Revision 2, proposed changes to the standard technical specifications for boiling water reactor (BWR) designs. These changes will be incorporated into future revisions of NUREG-1433 and NUREG-1434. Associated changes were also made to the technical specifications (TS) bases. The proposed changes revise the basis, calculational method, and the value of the TS safety limit (SL) 2.1.1.2, which protects against boiling transition (BT) on the fuel rods in the core. The current basis ensures that 99.9 percent of the fuel rods in the core are not susceptible to BT. The revised basis will ensure that there is a 95 percent probability at a 95 percent confidence level that no fuel rods will be susceptible to BT using an SL based on critical power ratio (CPR) data statistics. Technical Specification 5.6.3, "Core Operating Limits Report [(COLR)]," is also modified.

GNF requested that the NRC review and approve proposed Amendment 47 to GESTAR II and is applied to all BWR plants for which GNF provides reload fuel and licensing.

2.0 REGULATORY EVALUATION

The TS SL value and method of calculation for the minimum CPR (MCPR) limit, SL 2.1.1.2, is revised for BWR plants using Global Nuclear Fuel. The revised calculation method is based on CPR data statistics ensuring 95 percent probability at a 95 percent confidence level that no fuel rods will be susceptible to BT instead of the previous basis that ensures 99.9 percent of the fuel rods in the core are not susceptible to BT.

Traveler TSTF-564, Revision 2, proposed a method for determining a revised, cycle-independent MCPR SL for any BWR fuel applicable to all BWR designs. The original MCPR SL, referred to in Traveler TSTF-564, Revision 2, as the $MCPR_{99.9\%}$ SL, ensures that 99.9 percent of the fuel in the core is not susceptible to boiling transition. The revised MCPR SL, referred to in Traveler TSTF-564, Revision 2, as the $MCPR_{95/95}$ SL, ensures there is a 95 percent probability at a 95 percent confidence level that no fuel rods will be susceptible to transition boiling.

Applicable General Design Criterion 10, "Reactor design," of Title 10 of the *Code of Federal Regulations* Part 50 Appendix A, "General Design Criteria of Nuclear Power Plants," states:

> *The reactor core and associated coolant control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.*

The limit placed on the MCPR acts as a specified acceptable fuel design limit to prevent BT, which has the potential to result in fuel rod cladding failure.

An applicable guidance Section 4.4, "Thermal and Hydraulic Design," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP) provides acceptance criteria for establishing fuel design limits such as:

A. For departure from nucleate boiling [(DNB)] ratio (DNBR), CHFR [critical heat flux ratio] or CPR correlations, there should be a 95-percent probability at the 95-percent confidence level that the hot rod in the core does not experience a DNB or boiling transition condition during normal operation or AOOs [anticipated operational occurrences].

B. The limiting (minimum) value of DNBR, CHFR, or CPR correlations is to be established such that at least 99.9 percent of the fuel rods in the core will not experience a DNB or boiling transition during normal operation or AOOs.

3.0 TECHNICAL EVALUATION

3.1 Introduction

In Amendment 47, GNF requests to amend GESTAR II to provide the process and methodology elements to implement TSTF-564. TSTF-564 modifies the definition of the TS MCPR such that it is no longer cycle-specific. The NRC staff approved the TSTF-564, Revision 2, in Reference 1. Traveler TSTF-564, Revision 2, is applicable to BWR nuclear power plants. The proposed change revises Revision 4 of the STS, Volumes 1 and 2 of NUREG-1433, "Standard Technical Specifications, General Electric Plants BWR/4," and NUREG-1434, "Standard

Technical Specifications, General Electric Plants BWR/6." Volume 1 of these NUREGs can be accessed in the Agencywide Documents Access and Management System (ADAMS) under Accession Nos. ML12104A192 and ML12104A195, respectively. Volume 2 of these NUREGs can be accessed in ADAMS under Accession Nos. ML12104A193 and ML12104A196, respectively. In accordance with the staff's approval of TSTF-564, GNF submitted an application (Ref. 1) in which GNF lists changes to GESTAR Sections 1 and 4 (Ref. 2) that provide the process and methodology elements to implement TSTF-564. This SE lists the changes to GESTAR II per the approval of TSTF-564.

3.2 GESTAR II Revisions for Amendment 47

3.2.1 GESTAR II Section 1.1.5 Safety Limit Minimum Critical Power Ratio

For plants that have adopted TSTF-564, the TS Safety Limit MCPR is cycle independent as described in Reference 4 as approved by the staff. TSTF-564 uses the term $SLMCPR_{95/95}$ to define the cycle independent SL that will be applied in TS 2.1.1.2. The cycle-specific SLMCPR is termed $MCPR_{99\%}$ and shall be included in the cycle-specific COLR. The methodology for calculating the cycle-specific SLMCPR is included in Sections 1.2.5 and 4.3.1.1 of Reference 2. The proposed cycle-independent TS safety limit ($MCPR_{95/95}$) values for fuel product lines GE14, GNF2, and GNF3 are included in Table 1 of TSTF-564.

Table 1 Proposed $MCPR_{95/95}$ Values by Vendor and Fuel Bundle Type.

Vendor	Fuel Type	Proposed $MCPR_{95/95}$
Global Nuclear Fuel	GE14	1.06
Global Nuclear Fuel	GNF2	1.07
Global Nuclear Fuel	GNF3	1.07
Westinghouse	Optima2	1.06

The methodology for developing $SLMCPR_{95/95}$ is described in Section 3.1 of TSTF-564.

For plants that have NOT adopted TSTF-564, the TS SLMCPR shall be a cycle-specific SLMCPR, as described in GESTAR Sections 1.2.5 and 4.3.1.1.

3.2.2 GESTAR Section 1.1.7 Critical Power Correlation

The addition to this section of GESTAR II is regarding the double-hump (DH) power shape that may exist in cycle core designs. The critical power (CP) correlations (CPCs) developed using the process in Section 1.1.7 have been shown to be non-conservative, and therefore, specific analyses are used to estimate a bounding effect on the basis and uncertainty.

~~3.2.3 GESTAR II Section 1.2.2 Thermal Mechanical~~

~~This section describes the criteria for fuel design evaluations. GNF has modified this section with the following:~~

~~Item vi of this section describes how to evaluate the loss of fuel rod mechanical integrity that will not occur due to excessive cladding pressure loading.~~ [[

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3.2.4 GESTAR II Section 1.2.5 Safety Limit Minimum Critical Power Ratio

Section 1.2.5 of GESTAR II (Ref. 2) provides information on cycle-specific SLMCPR calculations. Amendment 47 adds item number viii to this section regarding analyses that are performed at maximum extended load line analysis (MELLLA) and maximum extended load line analysis plus (MELLLA+) core power low consistent with the licensed domain boundary.

1. Non-MELLLA+ Plants with Minimum Core Flow ≥99%: Rated Core Power / Rated Core Flow
2. Non-MELLLA+ Plants with Minimum Core Flow <99%: Rated Core Power / Rated Core Flow, and Rated Core Power / Minimum Core Flow
3. MELLLA+ Plants: Rated Core Power / Rated Core Flow, Rated Core Power / Increased Core Flow, Rated Core Power / Minimum Core Flow, and Off-Rated Core Power at Minimum Core Flow on MELLLA+ boundary

Also, this section is amended to include bias and uncertainty when a DH power shape is identified during the determination of cycle-specific SLMCPR.

3.2.5 GESTAR II Section 1.2.7 Critical Power Correlation

Section 1.2.7 of GESTAR II (Ref. 2) establishes criteria for currently approved CPCs and for any new correlation that must be established if significant new data exists for any new fuel designs. An additional subsection (D) is added to this GESTAR II Section 1.2.7 to describe a methodology if a DH axial shape exists. Because there is insufficient data for DH shape, an improved statistical approach similar to the one in Section 1.1.7 of GESTAR II is developed and the documentation is provided in subsection D of Section 1.2.7 of GESTAR II.

3.2.6 GESTAR II Section 4.3.1 Critical Power

Section 4 of GESTAR II (Ref. 2) describes various thermal-hydraulic design aspects of the reactor core and the reactor coolant system based upon the objective of no fuel damage during AOOs or during normal operation. Section 4.3.1 of GESTAR II provides information on the fuel cladding integrity SL statistical model; the MCPR operating limit calculational procedure for AOO pressurization events, AOO slow events, rod withdrawal error calculation; MCPR uncertainty considerations; low flow and low power effects on MCPR; and end-of-cycle coastdown considerations.

GNF has modified the introduction to Section 4.3.1 by adding the same text as in Section 1.1.5 of GESTAR II (See Section 3.2.1 of this SE).

3.2.7 GESTAR II Sections 4.3.1.1.2, 4.3.1.1.3, and 4.3.1.1.4 Boiling Water Reactor Statistical Analysis

Section 4.3.1.1.2 is modified to include a statement that uncertainties in MCPR are confirmed during the cycle specific analysis process by the plants. The plants may elect to use larger uncertainties during this process.

Section 4.3.1.1.2 modification also includes a directive for plants licensed for operation in the MELLLA+ extended operating domain (Ref. 5), that the required core power and core flow state points and associated uncertainties are defined in Reference 5. Additional margin for such plants with MELLLA+ operation may also be required per the SE for Reference 6.

A new subsection 4.3.1.1.3 has been introduced in GESTAR II as “Methodology Restrictions.” This section reiterates four restrictions that were listed in the SE for TRs, NEDC-32601-P, NEDC-32694P, and Amendment 25 to GESTAR II. These four restrictions were addressed for GE14 in FLN-2001-1016, for GNF2 in section 3.6 of its GESTAR II compliance report and for GNF3 in Section 3.6 of its GESTAR II compliance report. The four restrictions from NEDC-32601P TR SE are listed below:

1. The TGBLA fuel rod power calculational uncertainty should be verified when applied to fuel designs not included in the benchmark comparisons of Table 3.1 of NEDC-32601-P, since changes in fuel design can have a significant effect on calculation accuracy.
2. The effect of the correlation of rod power calculation uncertainties should be reevaluated to insure the accuracy of R-Factor uncertainty when the methodology is applied to a new fuel lattice.
3. In view of the importance of MIP criterion and its potential sensitivity to changes in fuel bundle designs, core loading, and operating strategies, the MIP criterion should be reviewed periodically as part of the procedural review process to ensure that the specific value recommended in NEDC-32601-P is applicable to future designs and operating strategies.
4. The 3D-MONICORE bundle power calculational uncertainty should be verified when applied to fuel and core designs not included in the benchmark comparisons in Tables 3.1 and 3.2 of NEDC-32694P.

A new subsection 4.3.1.1.4 is added to GESTAR II for deviations from NEDC-32601P (Ref. 7) for the following items:

1. R-Factor

The GEXL R-Factor uncertainty was increased from 1.6 percent to 2.0 percent to account for an increase in channel bow due to the phenomenon called control blade shadow corrosion induced channel bow.

2. Core Flow Rate and Random Effective TIP Reading

Per Section 1.1.5 of GESTAR II, analyses are performed at core power/flow points consistent with the domain boundary and Section 1.2.5 presents general guidance for the core power and flow state points to be analyzed. At each state point, the analysis is performed using an approved SLMCPR methodology. For the Two Loop Operation calculations performed at less than 99 percent core flow, the approved uncertainty values for the core flow rate (2.5%) and the random effective Traversing In-Core Probe reading (1.2%) are conservatively adjusted by dividing them by the percent core flow/100. For example:

Core Flow Rate Uncertainty at 90% Core Flow = 100%*2.5%/90% = 2.78%

For Single Loop Operation (SLO), the minimum core flow SLMCPR analysis remains the same as in the rated flow SLO SLMCPR analysis since these uncertainties already account for the effects of operating at reduced core flow.

3. Flow Area Uncertainty

Flow area uncertainty calculations for GE14, GNF2, and GNF3 are performed using the process described in Section 2.7 of Reference 7. This recalculation determined that the flow area uncertainty for GE14, GNF2, and GNF3 is larger than the Reference 7 value of 2.0 percent. If the flow area uncertainty using methodology of Reference 7 is greater than 2 percent, then it shall be documented in the GESTAR II Compliance Report for that product and used in the cycle specific SLMCPR calculations.

3.2.8 Summary

In summary, Amendment 47 that supports the implementation of TSTF-564 has been reviewed by the NRC staff which determined that the changes to GESTAR II are in accordance with the approved TSTF-564.

4.0 LIMITATION AND CONDITION

Amendment 47 to GESTAR II shall be applied to all BWR plants for which GNF provides reload fuel and licensing.

5.0 CONCLUSION

The staff reviewed the documents related to the proposed GESTAR II Amendment 47 which describes implementation of TSTF-564 which modifies the definition of TS SLMCPR. TSTF-564 revises the TS SL value and method of calculation for the MCPR limit, TS 2.1.1.2 for BWR plants. The staff has reviewed the documents pertaining to TSTF-564 and its implementation in Amendment 47 to GESTAR II. The staff determined that Amendment 47 to GESTAR II has complied with the approved TSTF-564 and therefore is acceptable for adoption by licensees subject to the condition specified in Section 4.1.

6.0 REFERENCES

1. Letter, M180100 from Brian Moore (GNF- A) to US NRC, Proposed Amendment 47 to NEDE-24011-P-A-27, General Electric Standard Application for Reactor Fuel (GESTAR II) Supporting Implementation of TSTF-564," September 12, 2018, ADAMS Accession No. ML18256A012

2. NEDE-24011-P-A-~~26~~27, General Electric Standard Application for Reactor Fuel (GESTAR II), Global Nuclear Fuel, ~~January~~ August 2018.

3. Technical Specification Task Force (TSTF) TSTF-18-12, Attachment 1 "TSTF Comments on TSTF-564 Draft Safety Evaluation," Attachment 2, "TSTF Markup Safety Evaluations," Enclosure "TSTF-564 Revision 2," Boiling Water Reactor Owners Group, October 24, 2018.

4. USNRC Letter to Technical Specifications Task Force, "Final Safety Evaluations of Technical Specifications Task Force Traveler TSTF-564, Revision 2," 'Safety Limit MCPR, Using the Consolidated Line Item Improvement Process,'" USNRC, November 16, 2018, ADAMS Package Accession No. ML18299A048.

5. NEDC-32006P-A, Revision 3 "General electric Boiling Water Reactor, Maximum Extended Load Line Limit Analysis Plus," General Electric, June 2003.

6. NEDC-33173P-A Revision 4, "Licensing Topical Report Applicability of GE Methods to Expanding Operating Domains," General Electric, June 2009.

7. NEDC-32601P-A, Methodology and Uncertainties for Safety Limit MCPR Evaluations," General Electric, August 1999.

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Date: July 25, 2019