ENCLOSURE 2

MFN 10-211

Draft SE Markup

Non-Proprietary Information

DRAFT SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

AMENDMENT 31 TO TOPICAL REPORT NEDE-24011-P-A/NEDO-24011-A

"GENERAL ELECTRIC STANDARD APPLICATION FOR REACTOR FUEL (GESTAR II)"

GLOBAL NUCLEAR FUEL – AMERICAS, LLC

PROJECT NO. 712

1.0 INTRODUCTION

By letter dated December 7, 2007, Global Nuclear Fuel – Americas, LLC (GNF) submitted Amendment 31 to topical report (TR) NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel (GESTAR II)" to the U.S. Nuclear Regulatory Commission (NRC) staff for review and approval (Reference 1). GESTAR II provides a fuel design and core reload process used extensively by licensees with GNF or GE Hitachi Nuclear Energy Americas, LLC (GEH) fuel designs. This amendment proposes to make changes to GESTAR II and its U.S. Supplement to incorporate updates to the Stability Analysis sections and the Supplemental Reload Licensing Report (SRLR) template, as well as several administrative changes.

The NRC staff's safety evaluation (SE) was based on review of the GESTAR II Amendment 31 submittal, GNF's responses (References 2, 3, and 4) to the NRC staff's Request for Additional Information (RAI, Reference 5), and several conference calls for the clarification of the draft RAI responses.

2.0 REGULATORY EVALUATION

The NRC staff will ensure that approved methodologies are used to establish setpoints and demonstrate the adequacy of the protection systems **(See Comment 1)** to prevent violation of the critical power ratio (CPR) safety limits in compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, General Design Criteria (GDC) for Nuclear Power Plants, GDC-10 "Reactor Design" and GDC-12, "Suppression of Reactor Power Oscillations."

Criterion 10 - Reactor design. 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 (AOOs).

Criterion 12 - Suppression of reactor power oscillations. The reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.

To assure compliance with GDC 10 and 12, the NRC staff confirms that the thermal and hydraulic design of the core and the reactor coolant system (RCS): has been accomplished using acceptable analytical methods; provides acceptable safety margins from conditions that could lead to fuel damage during normal reactor operation and AOOs; and is not susceptible to thermal-hydraulic instability. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP), Section 4.4, "Thermal and Hydraulic Design," describes the normal review of thermal and hydraulic design and requires that additional independent audit analyses be performed for new CPR correlations. SRP Section 15.9, "BWR Core Stability," describes the possibility of thermal-hydraulic instability in boiling water reactors (BWRs), analytical methods and codes to predict the stability characteristics of BWRs, and long-term stability solutions.

3.0 TECHNICAL EVALUATION

The NRC staff's technical review of GESTAR II Amendment 31 included review of the proposed changes and updates to the following sections of GESTAR II in accordance with the provisions in Chapter 15.0 of NUREG-0800.

3.1 Sections 3.1.2, 3.2.2, and Table 3.1 - Modified "Maximum Linear Heat Generation Rate (MLHGR)" to "LHGR Operating Limit" for consistency with terminology used in Section 2.

The MLHGR is one of the important technical specification (TS) limits used to determine that the fuel will not exceed required licensing limits during AOOs or accidents. It is cited in Section 3.1.2 - "Overpower Bases," Section 3.2.2 - "Power Distribution," and Table 3.1 - "Definition of Fuel Design Limits." The linear heat generation rate (LHGR) operating limit is established to ensure that the steady-state LHGR value experienced by any fuel rod at any axial location will not violate the fuel thermal-hydraulic licensing acceptance criteria should an AOO occur. The steady-state operating limit on LHGR can be identified either as the "MLHGR" or as the "LHGR operating limit." The change from "MLHGR" to "LHGR operating limit" in these sections is strictly a nomenclature clarification. Therefore, the proposed change is acceptable.

3.2 Section 3.4.2.10 - Added a new criteria section for the stability analysis.

This new Section 3.4.2.10, "Stability" states that the stability analysis for the reference core is applicable to the actual core if the core loading remains within the allowable criteria of GESTAR II Section 4.2, "Description of Thermal-Hydraulic Design of the Reactor Core" and the exposure remains within the specified window. The NRC staff reviewed this added section for stability analysis and found it acceptable because the reference core will use the same inputs applied to actual core specified in GESTAR II Section 4.2.

3.3 Section 4.3.1.2.8 - Modified the text used in AOO transient power/flow conditions to use the End-Of-Rated (EOR) terminology instead of End-Of-Cycle (EOC) to be more consistent with current terminology.

AOO analyses are performed at the rated core power, rated core flow, all-rods-out conditions, referred to as EOR. In other words, the term EOR refers to the cycle exposure at which the reactor has reached end-of-full-power reactivity at rated conditions (i.e., rated power, flow, pressure, and feedwater temperature) with all control rods fully withdrawn. This EOR point is sometimes referred to as end of reactivity. The EOR point determines the highest exposure at which full power operation can be maintained. The term EOC refers to the cycle exposure at which the reactor ceases operation for that cycle. The EOC condition can occur before, at, or after EOR, although it most often occurs after EOR. The change reflects a consistency with the current terminology used in AOO transient analyses, and therefore, is acceptable.

3.4 Section S.4 - Modified the text to reflect that the stability analysis methods are now performed or confirmed on a cycle-specific basis.

CPR response calculations are performed to demonstrate the safety limit minimum CPR (SLMCPR) protection against a thermal-hydraulic instability event using the detect and suppress methodology. The proposed change to the plant- and cycle-specific core-wide mode DIVOM (Delta CPR over Initial MCPR Versus Oscillation Magnitude) data for Option I-D plant stability analysis and the plant- and cycle-specific regional mode DIVOM data for Option II and Option III plant stability analyses is acceptable because it reflects a plant application of the BWROG position on plant- and cycle-specific core-wide mode and the regional mode DIVOM procedure guideline.

3.5 Section S.4.1.1 though S.4.1.4 - Clarified that Enhanced Option I-A, Option II, Option I-D, and Option III were reviewed and approved by the NRC staff for operation up to the Maximum Extended Load Line Limit Analysis (MELLLA) domain.

BWROG Long-Term Stability Solutions described in Sections S.4.1.1 - “Enhanced Option I-A,” S.4.1.2 - “Option II,” S.4.1.3 - “Option I-D,” and S.4.1.4 - “Option III” were reviewed and approved by the NRC staff for operation up to and including the MELLLA domain. Therefore, the proposed clarification is acceptable.

3.6 Section S.4.1.5 - Added a new section to include the reviewed and approved Detect and Suppress Solution - Confirmation Density (DSS-CD) stability method.

The proposed new section, which includes the GEH DSS-CD stability solution and a reference to the results of the SLMCPR protection calculation in the SRLR, is acceptable because the DSS-CD was reviewed and approved by the NRC staff for operation up to and including the MELLLA Plus (MELLLA+) domain.

3.7 Section S.4.2.2 and S.4.2.3 - Added two new sections on backup stability protection (BSP) for Option III and DSS-CD.

These two BSP methodologies (i.e., S.4.2.2 BSP for Option III, and S.4.2.3 BSP for DSS-CD) are very similar. However, two differences exist:

(1) The ODYSY core decay ratio (DR) acceptance criterion used for the Controlled Entry Region boundary intercept along the High Flow Control Line (HFCL) is different for the two solutions. The Option III BSP uses a DR acceptance criterion of 0.8, while the DSS-CD BSP uses a DR acceptance criterion of 0.6. For Option III BSP, the HFCL is defined as the MELLLA boundary. For DSS-CD BSP, the ~~HFLC~~ **HFCL** is defined as the MELLLA+ boundary.

(2) The other difference is the imposition of the BSP boundary on the DSS-CD solution while in the manual mode. While such a boundary does not exist in the BSP for Option III, the Option III solution limits the upper boundary to the MELLLA boundary. The Base BSP regions for Option III are defined in a GE letter to the BWR Owners' Group (BWROG), "BSP for Inoperable Option III Solution," dated July 17, 2002 (Reference 6), which provides the requirement to meet at least one of five stability controls if there is deliberate entry into the BSP Controlled Entry Region. Only the automated BSP option is approved for use as an extended backup solution to DSS-CD.

The NRC staff will require a detailed analysis for an Option III plant-specific application to confirm that BSP for inoperable Option III meets at least one of the five stability controls specified in Reference 6. **(See Comment 3)**

The BSP is required for an alternative interim prevention solution in case the Option III or DSS-CD solution is not operational. Therefore, the proposed change to add two new sections on BSP for Option III and DSS-CD with illustrations of the power/flow maps in Figure S-7 and Figure S-8, respectively, is acceptable.

3.8 Section S.5.1.3 - Clarified that the Average Power Range Monitor (APRM) Simulated Thermal Power Trip is standard equipment in some BWR/4s, and all BWR/5s and /6s.

The proposed change to add "in some BWR/4 plants and all BWR/5 and BWR/6 plants" provides a clarification that the APRM Simulated Thermal Power Trip is standard equipment in some specific BWR plants. Therefore, it is acceptable.

3.9 Section S.5.1.4 - Modified the text used in AOO transient power/flow conditions to use the EOR terminology instead of EOC to be consistent with current terminology.

The proposed change from EOC to EOR is acceptable since it is consistent with current terminology as described in Section 3.3 of this SE.

3.10 Section S.6 - Added four new references.

- S-101 GE-NE-0000-0031-6498-RO, Plant-Specific Core-wide Mode DIVOM Procedure Guideline, June 2, 2005.

- S-102 GE-NE-0000-0028-9714-R1, Plant-Specific Regional Mode DIVOM Procedure Guideline, June 2, 2005.
- S-103 General Electric Boiling Water Reactor Detect and Suppress Solution - Confirmation Density, NEDC-33075P-A, Rev. 6, January 2008.
- S-104 ODYSY Application for Stability Licensing Calculations Including Option I-D and II Long Term Solutions, NEDE-33213P-A, April 2009.

The NRC staff reviewed the proposed addition of four new references and found them acceptable. S-101 and S-102 are the BWROG positions that deal with plant-specific guidelines for core-wide and regional mode DIVOM calculations. S-103 and S-104 are approved methodologies used for DSS-CD and for Option I-D and II, respectively. **S-104 also includes approved elements common to other stability solutions. (See Comment 4)**

The NRC staff will require that future reload applications of the approved methodologies be in compliance with NRC Generic Letter 88-16 (Reference 7) guidance, which addresses the appropriate modifications to the Administrative Controls section of a facility's TS that are necessary to implement and use a Core Operating Limits Report (COLR). In particular, (1) identification of the individual specifications that address the core operating limits may be included, if desired, in the Reporting Requirements of the plant TS; (2) the supporting TRs by number and title shall be provided in the Reporting Requirements of the plant TS; and (3) specification of the TRs by number, title, revision level, and date of the approved TR shall be provided in the COLR. **(See Comment 5)**

3.11 U.S. Supp. - App. A - Replaced SRLR template with current revision.

The NRC staff participated in several phone calls with GNF to clarify the need for plant-specific numbers or specific events as examples to add to the SRLR template, which consists of sixteen sections. Subsequently, GNF addressed the issue in its RAI 8 response (References 3, 4, and 5) by providing a tabulation of typical examples for each of the various types of plant/cycle applicable descriptions as a part of the Template Symbol Keys in the beginning of Appendix A, "Standard Supplemental Reload Licensing Report." The NRC staff found the proposed addition to the SRLR template is acceptable because each applicable section of the SRLR template has a footnote indicating the appropriate information from GESTAR II or providing a specific explanation.

The NRC staff recommends that more specific information for the safety limiting values and fuel loading pattern should be added in future amendments as examples to make them more comprehensive and understandable for the users.

4.0 CONCLUSION

In its review, the NRC staff found that the proposed changes submitted in GESTAR II Amendment 31 are administrative in nature for terminology, or incorporate updates for currently approved BWR stability methodologies and a simplified SRLR template. Based on this review, the NRC staff concludes that the proposed changes to GESTAR II and its U.S. Supplement to incorporate updates to the stability analysis section, the SRLR template update, and several administrative changes in GESTAR II Amendment 31 are acceptable.

5.0 REFERENCES

1. Letter from GNF to USNRC, FLN-2007-036, "Proposed GESTAR II Amendment 31, Stability Analysis and SRLR Template Update," dated December 7, 2007. (ADAMS Package Accession Number ML073470832)

2. Letter from GNF to USNRC, MFN 09-512, "Response to Request for Additional Information Relating to Amendment 31 to NEDE-24011P-A, 'General Electric Standard Application for Reload Fuel (GESTAR II),' (TAC Number MD8425)," dated August 5, 2009. (ADAMS Package Accession Number ML092220262)

3. Letter from GNF to USNRC, MFN 09-512, Supplement 1, "Supplementary Response to Request for Additional Information Relating to Amendment 31 to NEDE-24011P-A, 'General Electric Standard Application for Reload Fuel (GESTAR II),' (TAC Number MD8425)," dated October 1, 2009. (ADAMS Package Accession Number ML092780409)

4. Letter from GNF to USNRC, MFN 09-512, Supplement 2, "Supplementary Response to Request for Additional Information Relating to Amendment 31 to NEDE-24011P-A, 'General Electric Standard Application for Reload Fuel (GESTAR II),' (TAC Number MD8425)," dated March 12, 2010. (ADAMS Package Accession Number ML101100588)

5. Letter from USNRC to GNF, "Request for Additional Information Re: Amendment 31, 'Stability Analysis and SRLR Template Update,' to the Topical Report (TR) NEDE-24011P-A, 'General Electric Standard Application for Reload Fuel (GESTAR II),' (TAC Number MD8425)," dated August 5, 2008. (ADAMS Accession Number ML082060097)

6. Letter from GE to BWR Owners' Group Detect and Suppress II Committee, OG 02-0119-260, "Backup Stability Protection (BSP) for Inoperable Option III Solution," dated July 17, 2002.

7. NRC Generic Letter 88-16, "Removal of Cycle-Specific Parameter Limits from Technical Specifications," dated October 4, 1988. (ADAMS Legacy Accession Number 8810050058)

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