January 5, 2018

Mr. Jerald G. Head
Senior Vice President, Regulatory Affairs
GE-Hitachi Nuclear Energy Americas, LLC
P.O. Box 780, M/C A-18
Wilmington, NC 28401-0780

SUBJECT: FINAL SAFETY EVALUATION FOR GLOBAL NUCLEAR FUEL - AMERICAS, LLC, PROPOSED AMENDMENT 44 TO NEDE-24011-P-A-24, "GENERAL ELECTRIC STANDARD APPLICATION FOR REACTOR FUEL (GESTARII) TO INCORPORATE THE PRIME TRANSIENT METHODOLOGY" (EPID NO. L-2017-TOP-0030)

Dear Mr. Head:

By letter dated February 14, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17046A039), Global Nuclear Fuel – Americas, LLC (GNF) submitted "Proposed Amendment 44 to NEDE-24011-P-A-23 [Rev. 25 as of this document date], General Electric Standard Application for Reactor Fuel (GESTARII) to Incorporate the PRIME Transient Methodology" to the U.S. Nuclear Regulatory Commission (NRC) staff for review.

By letter dated November 9, 2017, an NRC draft safety evaluation (SE) (ADAMS Accession No. ML17277A304) regarding our approval of "Proposed Amendment 44 to NEDE-24011-P-A-25, General Electric Standard Application for Reactor Fuel (GESTARII) to Incorporate the PRIME Transient Methodology" was provided for your review and comment. By letter dated November 22, 2017 (ADAMS Accession No. ML17326A667), you stated that you did not identify any proprietary information, factual errors, or clarity concerns in the draft SE.

The NRC staff has found that Proposed Amendment 44 to NEDE-24011-P-A-25 is acceptable for referencing in licensing applications for nuclear power plants to the extent specified and under the limitations delineated in the TR and in the enclosed final SE. The final SE defines the basis for our acceptance of the TR.

Our acceptance applies only to material provided in the subject TR. We do not intend to repeat our review of the acceptable material described in the TR. When the TR appears as a reference in licensing applications, our review will ensure that the material presented applies to the specific plant involved. License amendment requests that deviate from this TR will be subject to a plant-specific review in accordance with applicable review standards.

In accordance with the guidance provided on the NRC website, we request that GNF publish the approved Amendment 44 to NEDE-24011-P-A-25, within three months of receipt of this letter. The approved version shall incorporate this letter and the enclosed final SE after the title page. The approved versions shall include a "-A" (designating approved) following the TR identification symbol.

If future changes to the NRC's regulatory requirements affect the acceptability of this TR, GNF will be expected to revise the TR appropriately or justify its continued applicability for subsequent referencing. Licensees referencing this TR would be expected to justify its continued applicability or evaluate their plant using the revised TR.

Sincerely,

/RA/

Dennis C. Morey, Chief
Licensing Processes Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket No. 99902024

Enclosure:
Final SE

SUBJECT: FINAL SAFETY EVALUATION FOR GLOBAL NUCLEAR FUEL - AMERICAS, LLC, PROPOSED AMENDMENT 44 TO NEDE-24011-P-A-24, "GENERAL ELECTRIC STANDARD APPLICATION FOR REACTOR FUEL (GESTARII) TO INCORPORATE THE PRIME TRANSIENT METHODOLOGY" (EPID NO. L-2017-TOP-0030) DATED: JANUARY 5, 2018

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ADAMS Accession No.: ML17332A296; *concurrence via e-mail NRR-106

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OFFICE OF NUCLEAR REACTOR REGULATION DIVISION OF SAFETY SYSTEMS

SAFETY EVALUATION FOR AMENDMENT 44 TO GLOBAL NUCLEAR FUEL – AMERICAS

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

FOR REACTOR FUEL (GESTAR II) TO INCORPORATE THE PRIME MODEL FOR

TRANSIENT METHODOLOGY FOR FUEL ROD THERMAL-MECHANICAL PERFORMANCE

NEDC-33840P-A, Rev. 1

(EPID L-2017-TOP-0030)

1.0 INTRODUCTION AND BACKGROUND

By letter dated February 14, 2017, Global Nuclear Fuel – Americas, LLC (GNF) submitted proposed Amendment 44 to Topical Report (TR) to NEDE-24011-P-A-23, General Electric Standard Application for Reactor Fuel (GESTAR II) to Incorporate PRIME Transient Methodology," to the U. S. Nuclear Regulatory Commission (NRC) staff for review (Ref. 1).

In Amendment 44, GNF requests to incorporate the approved TR, NEDC-33840P, "The Prime Model for Transient Analysis of Fuel Rod Thermal-Mechanical Performance," in Section S.2.2.1 of the US Supplement to NEDE 24011-P-A-23. In addition, the proposed amendment requests revision of Section 4.3 of NEDO-24011 by adding a new Section 4.3.6 to include the PRIME transient methodology as applicable to fuel rod thermal mechanical performance methodology. Also, the amendment requests addition of the accepted TR (NEDC-33840P, Revision 1) as a reference in Section 4.4 and in the US Supplement Section S.6.

The draft safety evaluation (SE) for the Amendment 44 follows.

2.0 REGULATORY EVALUATION

Regulatory guidance for the review of fuel system design and analysis is based on General Design Criteria (GDC)-10, GDC-27, and GDC-35 of Title 10 of the *Code of Federal Regulations,* Part 50, Appendix A. The review criteria for fuel system design and analysis methodology is provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Standard Review Plan (SRP), Section 4.2, "Fuel System Design." In accordance with SRP Section 4.2, the objectives of the fuel system safety review are to provide assurance that:

a. The fuel system is not damaged as a result of normal operation and anticipated operational occurrences (AOOs),
b. Fuel system damage is never so severe as to prevent control rod insertion when it is required,
c. The number of fuel rod failures is not underestimated for postulated accidents, and
d. Coolability is always maintained

An approved fuel rod thermal-mechanical model and application methodology is utilized to demonstrate compliance to SRP 4.2 fuel design and performance criteria. NEDC-33840P describes the technical basis, qualification, and application methodology for the PRIME transient functionality. The staff's review of this TR is to ensure that the PRIME transient functionality is capable of accurately (or conservatively) predicting the in-reactor performance of fuel rods under fast transient AOO conditions.

3.0 TECHNICAL EVALUATION

NEDC-33840P incorporates the transient functionality into the existing PRIME code to perform fully integrated best-estimate predictions of fuel rod thermal and mechanical performance in both steady state and transient operational regimes up to and beyond the currently licensed burnup limits. In NEDC-33840P, the PRIME steady state thermal solution is augmented with a transient thermal solution in which the radial temperature in the fuel and cladding are determined by a transient heat transfer analysis for simulating fast AOOs. Transient thermal results are fed in to the PRIME mechanical model to solve mechanical and material variables, including displacements, stresses, and strains.

PRIME methodology addressed the effects of fuel/cladding thermal expansion, fuel phase change, volume change, fuel irradiation swelling, densification, relocation and fission gas release, fuel-cladding axial slip, cladding creepdown, irradiation hardening and thermal annealing of irradiation hardening, pellet and cladding plasticity and creep, pellet hot pressing and plastic collapse, and development of a porous pellet rim at high exposure. In the transient PRIME model (NEDC-33840P-A) (Ref. 2), the PRIME transient functionality is applied within the approved peak pellet exposure limits of the existing PRIME code. The NRC staff's SE (Ref. 3) for this TR consists of the following sections/cases:

- Transient temperature solution with validation and qualification of PRIME transient model.
- Fuel thermal conductivity model with effects of burnup, gadolinia and additives (doped fuel pellets) included in the PRIME transient model
- Thermal, material and mechanical models and properties used in PRIME transient that are unchanged from the PRIME steady-state
- High burnup fuel models and properties used in the PRIME transient

NEDC-33840 TR PRIME transient methodology describes transient analysis to predict the fuel temperature and cladding strain response during specified fast AOOs.

In summary, GNF has implemented a transient functionality in its previously approved PRIME fuel rod thermal-mechanical model. The PRIME steady-state methodology will continue to be applied to slow transient AOOs. The NRC staff has determined that GNF's PRIME transient fuel rod thermal-mechanical performance model and application methodology are acceptable.

The NRC staff has determined that with the approval of NEDC-33840P TR, the PRIME transient functionality confirms compliance to GESTAR fuel temperature and cladding strain acceptance criteria.

4.0 LIMITATIONS

Section 5.0 of the staff's SE for NEDC-33840 TR has listed several limitations and conditions. Licensees referencing the PRIME transient fuel rod thermal-mechanical model (NEDC-33840P-A) must ensure compliance with those limitations and conditions.

5.0 CONCLUSIONS

The NRC staff has reviewed the request for Amendment 44 to GESTAR II and Section S.2.2.1 of the US Supplement to GESTAR II to implement PRIME transient methodology (Ref. 4). Also, the staff has reviewed the request for revision of Section 4.3 of NEDO-24011 by adding a new Section 4.3.6 to include the PRIME transient methodology as applicable to fuel rod thermal-mechanical performance methodology. The NRC staff has determined that the approved TR (NEDC-33840P-A) and its methodology shows compliance to GESTAR acceptance criteria for fuel temperature and cladding strain. Therefore, the requested Amendment 44 to GESTAR II is approved.

The NRC staff also approves the amendment request for addition of the accepted TR (NEDC-33840P-A, Revision 1) as a reference in GESTAR II Section 4.4 and in the US Supplement Section S.6.

6.0 REFERENCES

1. Letter, M170031from Brian R. Moore (GNF- A) to US NRC, Proposed Amendment 44 to NEDE-24011-P-A-23, General Electric Standard Application for Reactor Fuel (GESTAR II) to Incorporate PRIME Transient Methodology," Global Nuclear Fuel, February 14, 2017.

2. Letter, MI170194 from Brian R. Moore (GNF-A) to US NRC, "Approved Version of NEDC-33840P, Revision 0, "The PRIME Model for Transient Analysis of Fuel Rod Thermal-Mechanical Performance," Global Nuclear Fuel, August 18, 2017 (Enclosure 1, NEDC-33840P-A, Revision 1).

3. Letter, from Dennis C. Morey (USNRC) to Jerald G. Head (GEH), "Final Safety Evaluation for Global Nuclear Fuel - Americas, LLC NEDC-33840P, Revision 0, 'The PRIME Model for Transient Analysis of Fuel Rod Thermal – Mechanical Performance' (CAC NO. MF7687)," USNRC, July 19, 2017.

4. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel (GESTAR II)," Global Nuclear Fuel, Latest approved version.

Principal Contributor: Mathew M. Panicker,
NRR/DSS/SNPB

Date: January 5, 2018