UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

December 19, 2019

Ms. Margaret M. Doane
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SAFETY EVALUATION FOR GLOBAL NUCLEAR FUEL – AMERICAS, LLC, LICENSING TOPICAL REPORT NEDE-33885P, REVISION 0, "GNF CRDA APPLICATION METHODOLOGY"

Dear Ms. Doane:

During the 669th meeting of the Advisory Committee on Reactor Safeguards, December 4-6, 2019, we completed our review of the staff's safety evaluation (SE) on Global Nuclear Fuel – Americas, LLC (GNF-A), licensing topical report (LTR) NEDE-33885P, Revision 0, "GNF CRDA Application Methodology." Our Thermal-Hydraulic Subcommittee also reviewed this SE on December 3, 2019. As part of our review, we met with NRC staff and representatives from GNF-A. We also had the benefit of the referenced documents.

Conclusion and Recommendation

1. The GNF-A methodology for evaluation of control rod drop accidents (CRDAs) is sound and provides additional flexibility that will accommodate licensees with different control rod operating strategies. Results from application of this methodology can be used to verify compliance with updated acceptance criteria such as those proposed in draft regulatory guide DG-1327, "Pressurized Water Reactor Control Rod Ejection and Boiling Water Reactor Control Rod Drop Accidents."

2. The SE should be published.

Background

Topical report NEDE-33885P documents the newest GNF-A methodology for evaluation of CRDA events in reload analyses. It extends the CRDA methodology by using the previously approved TRACG and PANACEA codes and the PRIME fuel thermal-mechanical code for fuel rod properties. The staff SE addresses the applicability of the CRDA LTR to boiling water reactor (BWR) product lines and fuel types for which the TRACG and PANACEA have previously been approved, and it also considers transition cores with more than one fuel type.

A typical BWR CRDA scenario for these analyses begins with the operator withdrawing control rods, but a control rod becomes decoupled from its drive and remains stuck at the full-in position. After the bank is withdrawn, the stuck rod falls at the terminal velocity and produces a high local reactivity increase in a small region of the core. The initial power burst is limited by Doppler reactivity feedback and, later, by void formation and the reactor protection system.

The historical basis for GNF-A analysis methodology for the CRDA event is the Banked Position Withdrawal Sequence (BPWS) described in NEDO-21231, "Banked Position Withdrawal Sequence," dated January 1977. The goal is to establish control rod withdrawal sequences that minimize the worth of individual rods. The new CRDA methodology is based on detailed TRACG and PANACEA calculations, and it uses acceptance criteria compatible with the new draft regulatory guide DG-1327, “Pressurized-Water Reactor Control Rod Ejection and Boiling-Water Reactor Control Drop Accidents." DG-1327 identifies two separate fuel failure mechanisms: high temperature cladding failure, which is sensitive to differential clad pressure; and pellet-clad mechanical interaction (PCMI), which is sensitive to the clad hydrogen concentration. The GNF-A CRDA methodology applies to the current Standard Review Plan acceptance criteria and can also be applied to updated criteria proposed in DG-1327.

Discussion

The staff has previously approved specific applications of the PANACEA, TRACG, and PRIME codes as part of the GESTAR II methodology. No changes were necessary to the technical models as previously reviewed and approved. The staff review focused on: validation for fast reactivity transients; application of the new acceptance criteria; and the analysis procedure to identify all configurations that need detailed evaluation.

The technical models for the PANACEA, TRACG, and PRIME codes have been previously reviewed and approved for general neutronics, transient analysis, and fuel thermal performance applications. Any limitations and conditions associated with these analysis codes remain applicable. This is expected to be controlled as part of the overall GNF-A GESTAR II fuel program methodology.

The staff reviewed the applicability of the TRACG and PANACEA models to calculate the prompt enthalpy rise that occurs in the fuel during postulated CRDA events. The staff also reviewed the GNF-A qualification of the analysis methodology against the Special Power Excursion Reactor Test (SPERT) reactivity transient tests. The staff concluded that the methodology is applicable and adequately reproduced experimental data from these tests.

The methodology provides several options to accommodate various control rod operating strategies used in different plants. It allows flexibility in defining the cycle exposures at which each CRDA analysis is to be performed. It also provides options for plant operators to specify the rod withdrawal order within a rod group. Some of these options provide additional operating flexibility at the expense of increasing the number of analysis steps required. But each step uses the same approved TRACG/PANACEA analysis method. The staff has reviewed the proposed options and concludes that all provide acceptable results. However, the staff imposed four limitations and conditions to ensure consistent implementation.

The staff reviewed changes to the GESTAR II methodology and standard technical specifications that will be necessary to allow licensees to use the proposed CRDA methodology. The changes to GESTAR II primarily consist of the addition of the proposed CRDA methodology. This provides an option for licensees to use new CRDA methodologies without seeking approval to modify their licensing basis. The staff confirmed that the changes are consistent with the intended use of the CRDA methodology. The methodology also provides for direct applicability when new codes are approved by the staff without further review.

Summary

The GNF-A methodology for CRDA evaluation is sound and provides more flexibility to accommodate licensees with different control rod operating strategies. Results from application of this methodology can be used to verify compliance with updated acceptance criteria such as those proposed in draft regulatory guide DG-1327. The SE should be published.

We are not requesting a formal response from the staff to this letter report.

Sincerely,

/RA/

Peter Riccardella
Chairman

References

1. U.S. Nuclear Regulatory Commission (NRC), “Draft Safety Evaluation for Global Nuclear Fuel – Americas, LLC (GNF) Licensing Topical Report NEDE-33885P, Revision 0, ‘GNF CRDA Application Methodology’”, November 2019 (ADAMS Accession No. ML19254E535).

2. Global Nuclear Fuel Report NEDO-33885/NEDE-33885P, Revision 0, "GNF CRDA Application Methodology," February 2018 (ADAMS Accession Nos. ML18059A878 (Non-Public)/ML18059A880 (Public)).

3. Global Nuclear Fuel Report NEDE-24011-P-A, Revision 29, "General Electric Standard Application for Reactor Fuel (GESTAR II) (Main and United States Supplement)," October 2019 (ADAMS Accession No. ML19276D426).

4. General Electric Company Report NEDO-21231, "Banked Position Withdrawal Sequence," January 1977 (ADAMS Accession No. ML090771242 (Non-Public)).

5. USNRC Draft Regulatory Guide DG-1327, "Pressurized-Water Reactor Control Rod Ejection and Boiling-Water Reactor Control Drop Accidents," released for public comment July 2019 (ADAMS Accession No. ML18302A106).

6. USNRC NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” (https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/).

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