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

April 27, 2010

Mr. R.W. Borchardt
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: LICENSING TOPICAL REPORT, NEDC-33173P, SUPPLEMENT 3, "APPLICABILITY OF GE METHODS TO EXPANDED OPERATING DOMAINS - SUPPLEMENT FOR GNF2 FUEL"

Dear Mr. Borchardt:

During the 571st meeting of the Advisory Committee on Reactor Safeguards, April 8-10, 2010, we reviewed the Staff's evaluation of GE-Hitachi Nuclear Energy (GEH) Licensing Topical Report, NEDC-33173P, Supplement 3, "Applicability of GE Methods to Expanded Operating Domains - Supplement for GNF2 Fuel." Our Power Uprate Subcommittee also reviewed this matter during a meeting on March 3, 2010. During these meetings, we had the benefit of discussions with representatives of the NRC staff, GEH, and Global Nuclear Fuel – Americas (GNF-A). We also had the benefit of the documents referenced.

RECOMMENDATIONS

1. GE-Hitachi Licensing Topical Report, NEDC-33173P, Supplement 3, "Applicability of GE Methods to Expanded Operating Domains - Supplement for GNF2 Fuel," should be approved.

2. Review of advanced computational tools for nuclear core analysis should be given high priority to expedite the introduction of updated methods into the regulatory process.

BACKGROUND

In a letter report dated June 22, 2007, we concurred with the staff's conclusion that application of the methods documented in GEH Licensing Topical Report NEDC-33173P to extended power uprate (EPU) and the maximum extended load limit line analysis plus (MELLLA+) operating domain, with the limitations imposed by the staff, was acceptable. In addition, we also concurred with the staff's conclusion that the process (documented in the GEH Licensing Topical Report NEDC-33006P, Revision 2) for analysis of operation in the MELLLA+ expanded domain, with the limitations imposed by the staff, including the modifications made by the staff during our discussions, was acceptable.

MELLLA+ expands the "operating domain" in a BWR power-flow map to 120 percent of the originally licensed thermal power for core flow as low as 80 percent of the rated value. For core flows less than 80 percent, the upper boundary of the expanded domain is approximately defined by a power-flow line that extends from 120 percent power at 80 percent flow, down to

less than the originally licensed power at 55 percent of the rated flow. The MELLLA+ expanded operating domain increases operating flexibility, particularly at EPU conditions, by allowing control of reactivity at maximum power by changing flow rather than rod insertion and withdrawal.

One of the limitations placed on acceptance of these GEH methods was that if new fuel designs were proposed for operation at EPU and MELLLA+ conditions, their acceptability should be reevaluated. GEH Licensing Topical Report NEDC-33173P, Supplement 3 addresses this limitation for the new GNF2 fuel design. In comparison to GE14 fuel, for which the GEH methods were found to be acceptable, GNF2 fuel incorporates several design features which improve performance but increase heterogeneity and complexity.

DISCUSSION

In qualifying the methods for GNF2 fuel in Supplement 3 to NEDC-33173P, GEH used an approach similar to that used for qualification of GE14 fuel. The staff reviewed the applicability of the methodology to GNF2 by comparison to their prior review of GE14 fuel. The content of Supplement 3 is consistent with the GEH licensing approach presented in Amendment 22 to GESTAR II, which establishes a set of fuel licensing acceptance criteria for new fuel designs.

The same penalties and limitations on the application of the methods in NEDC-33173P to GE14 are imposed on the GNF2 fuel designs operating in the MELLLA+ expanded domain. These include a 0.02 added margin, commonly called an “adder,” to the safety limit minimum critical power ratio (SLMCPR). The adder compensates for increased uncertainties in calculations of pin and bundle powers. GEH calculations benchmarked against MCNP simulations indicate that these uncertainties are of similar magnitude for GNF2 and GE14 fuel. Therefore, retaining the same SLMCPR adder is justified.

A further 0.01 adder was imposed on the operating limit minimum critical power ratio (OLMCPR) to account for uncertainties in void fraction predictions, including their impact on void reactivity coefficients during anticipated operational occurrences. The OLMCPR adder necessary to account for the uncertainty in void fraction prediction increases with the difference between the predicted void fraction and its upper bound. The uncertainty in the void fraction prediction is expected to be similar for GE14 and GNF2 fuel, because the homogeneous equilibrium model provides an upper bound to the void fraction for both fuel designs. Since the 0.01 OLMCPR adder was found to be adequate in previous analyses of GE14 fuel, we concur with the staff in maintaining the same adder for GNF2 fuel.

As fuel assembly designs have evolved, heterogeneity in bundle geometry, composition, and complexity have increased. These give rise to three-dimensional effects that may not be adequately captured by present models and methods. Vendors are aware of these issues, and they are making efforts to update codes to adopt state-of-the-art modeling techniques and methods. The lattice physics code LANCER has been submitted for staff review, and the three-dimensional simulator code AETNA will be submitted in the near future. Review of such computer codes that modernize nuclear core analyses should be given high priority. Use of these new analytical tools need to be expeditiously incorporated into future regulatory reviews of more complex fuel designs and core loading patterns.

More, detailed, data are needed to qualify and assess the accuracy and predictive capability of the analytical methods in use and under development. Such data, some of which is already

being obtained, should include measurements of pin and bundle powers based on gamma scans and direct measurements of the void fraction in representative fuel bundle geometries. We anticipate reviewing developments in these areas when we consider the staff's evaluation of Supplements 1 and 2 to NEDC-33173P.

GEH has taken a systematic approach in providing topical reports containing generic safety analyses, which can be reviewed comprehensively in advance of application to specific plants. This approach is preferred to plant-specific applications which may contain *ad hoc* developments of methodology for analyses of safety-significant issues.

Sincerely,

/RA/

Said Abdel-Khalik
Chairman

References:

1. NEDC-33173P Supplement 3, "Applicability of GE Methods to Expanded Operating Domains – Supplement for GNF2 Fuel," GE Hitachi Nuclear Energy, 07/31/2009 (ML092151090) (proprietary)

2. Letter to Luis A. Reyes, General Electric (GE) Licensing Topical Reports on Maximum Extended Load Limit Line Analysis Plus (MELLLA+) and Applicability of GE methods to Expanded Operating Domains, 06/22/2007 (ML071760346) (proprietary)

3. Memorandum to Edwin Hackett, GE-Hitachi Nuclear Energy Americas (GEH) Licensing Topical Report (LTR) NEDC-33173P, Supplement 3, "Applicability of GE Methods to Expanded Operating Domains-Supplement for GNF2 Fuel," 02/04/2010 (ML100330482) (proprietary)

4. Licensing Topical Report, "Applicability of GE Methods to Expanded Operating Domains," 02/28/2006 (ML060450690) (proprietary)

5. Letter to Jerald G. Head, GE Hitachi Nuclear Energy Americas LLC, Final Safety Evaluation for GE Hitachi Nuclear Energy Americas, LLC Licensing Topical Report NEDC-33173P, "Applicability of GE Methods to Expanded Operating Domains," 07/21/2009 (ML092020255)

6. Licensing Topical Report, "General Electric Boiling Water Reactor Maximum Extended Load Line Limit Analysis Plus," 01/2002 (ML020330031) (proprietary)

7. Letter to Mr. Robert Brown, GE-Hitachi Nuclear Energy Americas LLC, Correction of Final Safety Evaluation for General Electric (GE)-Hitachi Nuclear Energy Americas, LLC (GEH) Licensing Topical Report (LTR) NEDC-330006P, "Maximum Extended Load Line Limit Analysis Plus," 10/15/2008 (ML082830769)

8. Enclosure 7 MFN-10-045 GNF-2 Advantage Generic compliance with NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel II (GESTAR II)," NEDC-33270P, Revision 3, 03/05/2010 (ML100700462) (proprietary)

9. Letter to U.S. Nuclear Regulatory Commission, "LANCR02 Lattice Physics Model Description Licensing Topical Report, NEDC-33376P, Revision 1, June 2009, and LANCR02 Lattice Physics Model Qualification Licensing Topical Report, NEDC-33377P, Revision 1, June 2009," MFN 09-440, Global Nuclear Fuel, 06/30/2009 (ML091820493)

10. Enclosure 1 MFN-09-647, Supplement 1, Response to NRC RAI 8 - NEDC-33173P Supplement 3, GEH Proprietary Information, 11/30/2009 (ML093360136) (proprietary)

11. Enclosure 1 MFN-09-647, Response to NRC RAIs - NEDC 33173P, Supplement 3, GEH Proprietary Information, 10/20/2009 (ML092990415) (proprietary)

12. Enclosure 7 MFN 10-045, GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II), NEDC-33270P, Revision 3, 3/5/2010 (ML100700462) (proprietary)

13. Audit Report for Global Nuclear Fuel (GNF) GNF2 Advanced Fuel Assembly Design GESTAR II Compliance Audit, 01/31/2008 (ML081630625)

14. Letter to U.S. Nuclear Regulatory Commission, Amendment 32 to NEDE-24011-P, General Electric Standard Applications for Reactor Fuel (GESTAR II), 10/15/08 (ML082910505)

15. Memorandum to Stacey Rosenberg, U.S. Nuclear Regulatory Commission, Safety Evaluation for NEDE-24011-P-A (GESTAR II) Limiting Peak Pellet Burnup to 45 GWD/MTU for Application to GNF Fuel Design, 09/16/2008 (ML082600707) (proprietary)

16. Memorandum to Antonio F. Dias, U.S. Nuclear Regulatory Commission, Written Responses to Comments and Questions Raised by the Power Uprates Subcommittee During the March 3, 2010, Meeting Regarding Supplement 3 to NEDC-33173P, "Applicability of GE Methods to Expanded Operating Domains - Supplement for GNF2 Fuel," 03/29/2010 (ML100880104) (proprietary)

17. Memorandum to Stacey Rosenberg, U.S. Nuclear Regulatory Commission, Audit Results Summary Report for an Audit Related to Supplement 3 to NEDC-33173 "Applicability of GE Methods to Expanded Operating Domains – Supplement for GNF2 Fuel," (TAC No. ME1815), 10/06/2009 (ML092740158) (proprietary)

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