HITACHI

GE Hitachi Nuclear Energy

Jerald G. Head
Senior Vice President
Regulatory Affairs

P.O. Box 780
3901 Castle Hayne Road
MC A10
Wilmington, NC 28402
USA

T 910 819 5692
F 910 362 5692

MFN 098-96 Sup 1

Docket No. 52-010

March 31, 2014

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Subject: **Implementation of Improved GE Steady-State Nuclear Methods**

Reference:

1. MFN 098-96, Letter from GE Nuclear Energy to U.S. Nuclear Regulatory Commission, Subject: Implementation of Improved GE Steady-State Nuclear Methods, July 2, 1996 (ML070400507)

This supplement to MFN-098-96 provides a public version of the Proprietary Attachment previously provided in Reference 1. See Enclosure 1 entitled GE Steady State Nuclear Methods Update (Public Version).

If you have any questions concerning this letter, please contact me at (910) 819-5692.

I declare under penalty of perjury that the foregoing information is true and correct to the best of my knowledge, information, and belief.

Sincerely,

Jerald Head

Jerald Head
Senior Vice President – Regulatory Affairs

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NRO

Commitments: No additional commitments are made in this response.

Enclosure:

1. GE Steady State Nuclear Methods Update (Public Version)

cc: w/enclosures
David Misenhimer, NRC

cc: w/o enclosures
J. G. Head, GEH
P. Yandow, GEH
J.F. Harrison, GEH
P.L. Campbell, GEH
L.F. Dougherty, GEH

ENCLOSURE 1

MFN 098-96 Sup 1

GE Steady State Nuclear Methods Update

Non-Proprietary Information – Class I (Public)

IMPORTANT NOTICE

This is a non-proprietary summary of the Attachment in MFN 098-96.

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This document is a non-proprietary summary of the proprietary Attachment in MFN-098-96.

GE Steady State Nuclear Methods Update (Public Version)

This document provides justification for the immediate use of GE's new steady state nuclear methods. This description includes a brief discourse of the changes to the nuclear modeling methodology, an explanation of the differences between this methodology and the previously submitted Licensing Topical Report [1], a summary of the benchmark and qualification data for the methods and a description of the impact of the new methods on transient analysis results.

Description of the Changes

The BWR Core Simulator (PANACEA) is a three-dimensional computer program representing the BWR core exclusive of the external flow loop. Provisions are made for fuel cycle and thermal limits calculations. The program is used for design and operational calculations of BWR neutron flux and power distributions and thermal performance as a function of control rod position, refueling pattern, coolant flow, reactor pressure, and other operational and design variables.

Neutronic parameters used by PANACEA are obtained from the 2-D lattice physics code (TGBLA) and parametrically fitted as a function of moderator density, exposure, control and moderator density history for a given fuel type.

The new version of the core simulator contains an improved physics model which accounts for spectral history and control blade history reactivity corrections. Control blade history local peaking effects are also considered in the new model. A pin power reconstruction model is incorporated to account for the effect of flux gradients across the nodes on the local peaking distribution.

Certain approximations in Ref. [1] used to reduce the complexity are no longer necessary with the new methods since all parameters required for the flux to power conversion have been calculated explicitly.

Qualification Summary

The core simulator code was benchmarked against a fine mesh, 3 energy group diffusion theory code from Argonne National Laboratory. This comparison technique allows not only the eigenvalue and power distribution to be validated, but also serves as qualification of the pin power reconstruction model.

A substantial improvement has been made in the radial power distribution calculation of the core simulator. Overall improvement is substantial with the mean peak to peak error dropping to virtually zero. This is also an indication that the radial power distribution calculation has been greatly improved.

This coupled set of physics models has been used to simulate over 30 cycles of actual plant data and represents a significant improvement in predictive capability over the previous versions of TGBLA and PANACEA. Specifically, the spread in critical eigenvalue predictions relative to plant data has been reduced by 40%, and cold critical predictions are more reliable. The difference between in-sequence and local cold critical predictions has also been reduced. The improved methods also represent an improvement in power distribution accuracy.

The peak RMS error between the simulation and measured TIPs has been markedly reduced. As with

the benchmark calculations, the radial power calculation is greatly improved.

Transient Analysis Impact

The effect on dynamic response has also been evaluated. Nuclear cross sections, dynamic parameters and state conditions are supplied to the transient analysis codes through the codes steady-state physics. Several plants were analyzed for several different events. Core tracking was performed on these plants for several cycles. Transient scenarios for three plants were analyzed. The initial statepoints for the transients are somewhat different owing to the improvement in exposure and relative water density tracking through the several cycles with the new methods.

In summary, the sum total effect of the new initial statepoints for the transients (exposure, void, void history and power distributions) and the change in nuclear parameters on the dynamic response is an average change below the resolution of the calculation accuracy. Hence, there is negligibly small impact of the new methods on licensing analyses.

References

1. NEDO-30130-A, "Steady State Nuclear Methods", Licensing Topical Report, May 1985.