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Subject: Proposed Amendment 46 to NEDE-24011-P-A-26, General Electric Standard Application for Reactor Fuel (GESTAR II) to Provide Clarity and Formality to the Standby Liquid Control System (SLCS) Shutdown Margin Analysis

The enclosed changes to Section 3.2.4.3 of GESTAR II and Appendix A of the US Supplement to GESTAR II are proposed to provide clarity and formality to the SLCS shutdown margin analysis. Note that the methodology for the SLCS shutdown margin calculation is not being changed in any way. Appendix A (Supplemental Reload Licensing Report template) Section 5 is being revised to use a variable designation for the plant specific analysis temperatures instead of specific values. Only sections with changes are enclosed.

If you have any questions about the information provided here, please contact me at (910) 819-6684 or Jim Harrison at (910) 620-1826.

Sincerely,

Brian R. Moore, Ph.D
General Manager, Core & Fuel Engineering
Global Nuclear Fuel – Americas, LLC

Project No. 712
Docket No. 99901376

Enclosures:

1. Proposed Amendment 46 to GESTAR II Main Section 3.2.4.3 and US Supplement Appendix A – Non-Proprietary Information – Class I (Public)

cc: J Golla, USNRC
PL Campbell, GEH/Washington
JG Head, GEH/Wilmington
JF Harrison, GEH/Wilmington
PLM Specification 004N6942 R0

ENCLOSURE 1

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Proposed Amendment 46 to GESTAR II Main Section 3.2.4.3 and US Supplement Appendix A

Non-Proprietary Information – Class I (Public)

3.2.4.3 Standby Liquid Control System

The Standby Liquid Control System (SLCS) provides an alternate means of reactor shutdown by injecting soluble boron into the reactor core moderator. ~~The Standby Liquid Control System (~~SLCS~~)~~ is designed to provide the capability of bringing the reactor, at any time in a cycle, to a subcritical condition with the reactor in the most reactive xenon–free state with all of the control rods in the full–out condition. The requirements of this system are dependent primarily on the reactor power level and on the reactivity effects of voids and temperature between full–power and cold, xenon–free condition.

The SLCS shutdown margin is defined as the difference between the cold critical eigenvalue and the eigenvalue predicted for the borated conditions as determined using the BWR simulator code (see Section 3.3). The SLCS shutdown margin is calculated based on the limiting reactivity carryover from the expected previous cycle shutdown.

The SLCS analysis is performed using borated fuel libraries at a temperature representative of the most reactive condition for the plant and cycle specific fuel types to provide an accurate calculation of the effectiveness of SLCS. The most reactive condition occurs when the shutdown cooling mode of the Residual Heat Removal (RHR) system is initiated, which results in a substantial dilution of the boron concentration due to the inclusion of the RHR system volume. Because of the positive moderator temperature coefficient of borated water, the point of RHR startup is the point of minimum SLCS shutdown margin. The evaluated boron concentration is the plant's Technical Specification boron concentration requirement adjusted for changes in water density between its reference temperature and the analysis temperature.

The minimum SLCS shutdown margin requirement represents the biases and uncertainties associated with the calculation of the cold, borated core, which include:

- **Bias and uncertainty associated with the calculation of a cold, un-borated core as determined from benchmarks of the BWR simulator code against cold critical plant startup data.**
- **Bias and uncertainty associated with the calculation of the worth of boron as determined from benchmarks of the lattice physics code (see Section 3.3) against a higher-order computational method (e.g., Monte Carlo), which in turn is benchmarked against critical experiments.**

An additional temperature reactivity bias is included when the SLCS shutdown margin evaluation is performed for an analysis temperature that is less than the most reactive condition (i.e., the point of RHR startup) to account for the temperature reactivity effect. The uncertainties are one-sided 95/95 tolerance level multipliers combined with the biases to establish the minimum SLCS shutdown margin requirement needed to assure subcriticality. The SLCS shutdown margin requirement is dependent on the fuel design type, and the most conservative requirement (largest shutdown margin) is applied when a core is comprised of multiple fuel design types.

The shutdown capability of the SLCS is given in the FSAR or the supplemental reload licensing report.

Appendix A

Standard Supplemental Reload Licensing Report

And

Fuel Bundle Information Report

5. Standby Liquid Control System Shutdown Capability

Boron (ppm) (at [nn]~~20~~°C)	Shutdown Margin (Δk) (at [nnn]~~160~~°C, Xenon Free)	
	Analytical Requirement	Achieved
[nnn]	≥ [n.nnn]	[n.nnn]