



Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

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Subject: Proposed Amendment 43 to NEDE-24011-P-A-23, General Electric Standard Application for Reactor Fuel (GESTAR II) Section 3.4

The enclosed changes to Section 3.4 of GESTAR II are being proposed to make the final core loading pattern criterion more precise and reflective of processes that have evolved over the years. Some changes were editorial in nature to use terminology consistent with the Supplemental Reload Licensing Report (SRLR). The proposed revisions to Section 3.4 and a basis discussion are included in Enclosure 1.

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
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Project No. 712

Enclosures:

1. Proposed Amendment 43 to GESTAR II Section 3.4, Non-Proprietary Information – Class I (Public)

cc: J Golla, USNRC
PL Campbell, GEH/Washington
JG Head, GEH/Wilmington
JF Harrison, GEH/Wilmington
PLM Specification NEDE-24011 Revision 23.2

ENCLOSURE 1

MFN 16-084

Proposed Amendment 43 to GESTAR II Section 3.4

Non-Proprietary Information – Class I (Public)

Proposed Revision to GESTAR II Section 3.4

3.4 Final Core Loading Pattern Comparison (Reload Cores)

3.4.1 Introduction and Bases

Because the reload licensing process requires an assumption as to the condition of the core at the end of the previous cycle, the final core loading pattern may not be identical to the reference core loading pattern. To ensure that the results of the licensing analysis performed on the reference core loading pattern are applicable to the final core loading pattern, certain key parameters, which affect the licensing analysis, are examined to ensure that there is no significant adverse effect. Only when this examination has been completed and determined that the final core loading pattern satisfies the licensing basis will the core be operated.

3.4.2 Acceptable Deviations from the Reference Core Loading Pattern

The key parameters that measure the deviation between the reference core loading pattern and the final core loading pattern have been identified and are discussed in this section. The key parameters described below were determined to be important to the licensing analysis, and the allowed deviations are defined in the following sections. Section 3.4.3 must be followed if any of the following criteria is not met.

3.4.2.1 Previous End-Of-Cycle Exposure

The previous end-of-cycle (EOC) cycle exposure deviation (i.e., actual EOC cycle exposure versus assumed EOC cycle exposure) must be within the range considered in the licensing analysis.

3.4.2.2 Core Average Axial Exposure Distribution

The final core loading pattern axial exposure shape is demonstrated to be bounded by the axial exposure shapes used for the licensing analysis.

3.4.2.3 Number and Fuel Type of New Bundles

The number of new bundles for each fuel type loaded in the final core loading pattern must match the number in the reference core loading pattern.

3.4.2.4 Number and Fuel Type of Irradiated Bundles

If the number of available irradiated bundles of a given fuel type is less than specified in the reference core loading pattern, bundles of a different fuel type but of lower reactivity may be substituted.

Note that a bundle is not available for loading into the core if it is damaged or is not suitable for continued operation.

3.4.2.5 Locations of New Bundles

A new bundle of a particular fuel type must be loaded only into the location that has been designated to receive this new bundle fuel type in the reference core loading pattern.

3.4.2.6 Locations of Non-Peripheral Irradiated Bundles

Criterion 1: The locations of each individual non-peripheral irradiated bundle as designated in the reference core loading pattern is preserved, except for changes necessitated by the available inventory or necessitated by a different operating history relative to the reference core loading pattern.

Criterion 2: If a change is necessitated, an irradiated bundle may be replaced with an irradiated bundle of lower reactivity for regions of high importance. Shuffles to remedy a different operating history can result in replacing an irradiated bundle with an irradiated bundle of higher reactivity for regions of low importance (within three rows from the periphery).

Regions of high importance are defined as locations that are at least four rows in from the periphery.

3.4.2.7 Locations of Peripheral Irradiated Bundles

Bundles on the periphery may be shuffled to other locations on the periphery relative to the reference core loading pattern.

3.4.2.8 Shutdown Margin

Adequate cold shutdown margin is demonstrated for the final core loading pattern.

3.4.3 Re-Examination of Bases

If the criteria of Section 3.4.2 are not met, a re-examination of the reference core loading pattern licensing analysis is performed based on the final core loading pattern. This re-examination may consist of evaluating parameters that affect the licensing analysis or re-performing the licensing analysis for the limiting condition. The licensing analyses re-examined are:

1. Cold shutdown margin
2. Standby liquid control system shutdown margin
3. Safety Limit MCPR
4. Core-wide AOOs
5. Rod withdrawal error
6. Misloaded fuel assembly (when analyzed as an AOO)
7. Stability

The listed licensing analyses were chosen because they are reported in the cycle-specific licensing documentation (see Appendix A of country-specific supplement) and can be affected by changes between the final core loading pattern and the reference core loading pattern.

The evaluations in this section will either conclude that the current licensing documentation is adequate or that the licensing documentation needs to be updated.

GESTAR II Section 3.4 Final Loading Pattern Comparison Bases Document

The following is a section by section description of the basis for the change for each section revised in Section 3.4. Overall, the primary purpose of the revision is to refresh Section 3.4 to make the criterion for each key parameter more precise and up to date with the latest processes. Some changes were editorial in nature to use terminology consistent with the Supplemental Reload Licensing Report (SRLR).

Section 3.4.1 Introduction and Bases

Changes to this section are only editorial. For example, the word analysis is used instead of calculations.

Section 3.4.2 Acceptable Deviation from Reference Core Design

Clarified that this section is about the loading pattern, which is more specific than the broader term of core design. Other changes are primarily editorial.

Section 3.4.2.1 Core Average EOC Exposure

The section title was modified to clarify that the criteria applies to the prior cycle of operation. The criterion words are now more definitive. Instead of “significant deviation” from the assumed value, the criterion is that the EOC exposure must be within the range considered in the licensing analysis. Deviations from the previous cycle EOC exposure can occur when the previous cycle has an early shutdown or the plant did not operate to the capacity factor that had been assumed. This can result in a lower EOC exposure for the previous cycle and more reactivity carried over to the next cycle. This is accounted for in the licensing analysis by analyzing a range of previous EOC exposures to ensure that key licensing criteria such as shutdown margin are met. The range also accounts for positive deviations in case a plant operates at a higher capacity factor or extends their coastdown.

If the previous EOC exposure is not within the range considered, then specific analyses are required as indicated in Section 3.4.3.

Section 3.4.2.2 Core Average EOC Axial Exposure Distribution

The section title was modified to clarify that the criteria applies to the upcoming cycle and not just at the EOC. The words are now more definitive for the criterion in that the axial exposure shape is bounded by the axial exposure shapes used for the licensing analysis.

Section 3.4.2.3 Number of Reload Bundles

This criterion was always about the number of new bundles. The section title was modified to clarify that the criterion is for the type as well as the number of new bundles. The criterion is now more definitive and tighter in that the revised criterion requires that the number of new bundles for each fuel type loaded must match the reference core loading pattern. The revision removes the flexibility to reduce the number of new bundles without further evaluation. If the utility decides to reduce the number of new bundles to reduce reactivity, specific analyses are required as indicated in Section 3.4.3.

3.4.2.4 Type and Number of Exposed Bundles

The change in this section is primarily editorial, including the section title. The criterion is basically unchanged. If the number of irradiated bundles of a given fuel type is less than specified, bundles of a lower reactivity may be substituted. This situation may arise due to operations in the previous cycle that may have encountered a fuel leaker. If this leaker is determined to be a bundle planned for use in the following cycle, it would be discharged and unavailable. To meet the criterion, the bundle would need to be replaced with a lower reactivity bundle. The replacement with a lower reactivity bundle would result in a core that contains lower reactivity compared to the licensed core loading.

3.4.2.5 Locations of Reload Bundles

The section title was changed to use consistent terminology. The previous wording allowed for a reduction in the number of new bundles, and the new criterion is more restrictive. If the utility decides to reduce the number of new bundles to reduce reactivity, specific analyses are required as indicated in Section 3.4.3.

3.4.2.6 Locations of Exposed Bundles

This section was re-focused on the non-peripheral bundles because Section 3.4.2.7 focuses on the peripheral bundles. The section title was changed accordingly. Two criteria were defined: the first describes the reasons allowed for not preserving the reference core loading pattern, and the second describes the rules for making changes to the core loading pattern.

The first criterion was revised to be more restrictive. The previous wording was vague (“...preferentially be loaded designated...”). The updated criteria precisely states that the locations in the reference core loading pattern are preserved except as noted. Added to the exceptions is the possibility of a different operating history relative to the reference core loading pattern. An example would be bundles that are controlled for very long periods due to leaker suppression.

The second criterion clarifies what can occur in two different core regions: region of low importance (defined as three rows within the periphery) and region of high importance (everywhere else). In order to allow swapping of bundles resulting from overly controlled bundles due to power suppression, the matching bundle exposures and burn history criteria were removed for regions of low importance. For regions of high importance, the criterion (match of bundle exposures and burn history) was replaced with a bundle of lower reactivity criterion.

3.4.2.7 Shuffling of Edge Bundles

The section title was changed to more broadly encapsulate the locations of the peripheral irradiated bundles. The criteria of concentrating bundles that saw duty in the core periphery has been changed to only allow bundles on the periphery to be shuffled to other locations on the periphery. The bundles on the periphery have ample margin and the small added uncertainty due to reflector effects is not significant.

3.4.2.8 Symmetry

This section was removed because it did not impose any criteria on the core loading and it was simply informational.

3.4.2.9 Shutdown Margin

The change in this section is primarily editorial. The words are now more definitive for the criterion in that it states that adequate shutdown margin must be demonstrated.

3.4.2.10 Stability

This section was removed because it did not impose any specific criteria on the core loading.

3.4.3 Re-Examination of Bases

Changes to this section are primarily editorial. The key licensing analyses are well established and are listed in this section as items to re-examine. These evaluations are performed for situations when any of the criteria in Section 3.4.2 are not met.