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LTR-NRC-10-63

September 28, 2010

Subject: Westinghouse Comments to NRC on DSS-ISG-2010-01, "Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools", Docket ID NRC-2010-0289.

Enclosed is a copy of Westinghouse Electric Company's comments on the draft Interim Staff Guidance (ISG) on criticality safety analysis for spent fuel pools.

Very truly yours,

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Enclosure

9/01/2010
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# Westinghouse Comments to NRC on DRAFT Interim Staff Guidance DSS-ISG-2010-01

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Westinghouse has eagerly been awaiting the issuance of Interim Staff Guidance (ISG) DSS-ISG-2010-01, in the hopes that a clear and consistent guidance is provided for performing spent fuel criticality analysis. Currently, licensees and vendors performing spent fuel pool criticality analysis have had to rely on judging the most recent NRC requirements by reviewing RAIs on analyses currently under NRC review and attempting the discern current NRC expectations based on NRC staff comments during public meetings. While we are encouraged with the issuance of the draft guidance, and believe it provides a focal point to further discussions on the appropriate methodology for spent fuel pool criticality analyses, the draft ISG, as currently written, does not provide the clear and concise guidance that was expected. Specifically, the concerns with the draft ISG can be summarized in the following points:

- New issues are identified in the draft ISG that have not been previously discussed as areas of NRC staff concern in either public meetings or RAIs for plant specific license amendment requests regarding spent fuel criticality analyses. These new issues promote an ongoing uncertainty as to the scope of issues that must be addressed in a spent fuel pool criticality analysis.

- In several cases the recommended resolution of the on-going technical uncertainties in spent fuel criticality analyses are either impossible or prohibitively conservative. The most extreme example of this is the requirement to include a validation of fission products. Given that there are limited critical experiments with fission product isotopes available for inclusion in a validation this is a requirement that is not possible to be met.

- The wording in the draft guidance is sufficiently vague or misleading as to preclude the level of guidance that was expected. The wording leads to more confusion and uncertainty versus providing necessary guidance as to the proper way to address the technical details in spent fuel criticality analyses that the NRC staff would find acceptable.

Additionally, comments on specific sections of the draft guidance are provided below:

General Comment: Please clarify how this ISG will be applied to license amendment requests currently under NRC review that were submitted prior to issuance of the draft ISG or ultimately the final ISG. It is recommended that those applications submitted prior to the issuance of the final ISG not be subjected to the new issues identified in the draft or final ISG.

Section 1a: Clarify what is meant by "other parameters" when assessing the limiting fuel assembly.

Section 2.a.i: Application of the depletion uncertainty to the isotopic number density is not technically defensible. There is no technical data to defend the appropriateness of this value for isotopic number densities. The 5% depletion uncertainty has traditionally been applied to cover the uncertainty in the depletion computer code and the lack of critical experiments with fission products. There is no indication in the public literature that this is still not the case. In fact, in the May 1st, 2009 NRC meeting the industry provided technical information as to why the 5% depletion uncertainty was sufficient to cover these issues. Additionally, the NRC has reviewed and approved recent applications with the 5% depletion uncertainty used as intended in the Kopp memo. It is respectfully requested that this statement be removed and the 5% depletion uncertainty be identified as sufficient.

Section 2.a.ii: Remove the requirement "with or without residual neutron absorber". This recommendation would require an inconsistent application of conservatisms in two cases.

Issue 1: The first inconsistency impacts the application of the depletion uncertainty at low burnups with burnable neutron absorbers (IFBA, Gd, Erbia, WABA, BPRA, Pyrex, etc). As shown on the left side in Figure 1, the difference in reactivity between an assembly that contains burnable absorbers versus an assembly that does not contain burnable absorbers is significant at low burnups. Applying 5% of the reactivity difference between the fresh assembly and the assembly with burnable absorbers would suggest that a significant conservative uncertainty be applied even in the case where the residual neutron absorber is not credited in the low burnup assembly. This would also create a large discontinuity in the maximum $k_{eff}$ (which includes all biases and uncertainties) between the fresh fuel assembly where integral absorber is not credited in the spent fuel pool and the slightly burned fuel assembly, where the large "depletion uncertainty" would be applied according to the prescription in the draft ISG. Neglecting the residual burnable absorber is a much more significant conservatism than applying the 5% depletion uncertainty and therefore it is not necessary to apply both of these conservatisms.

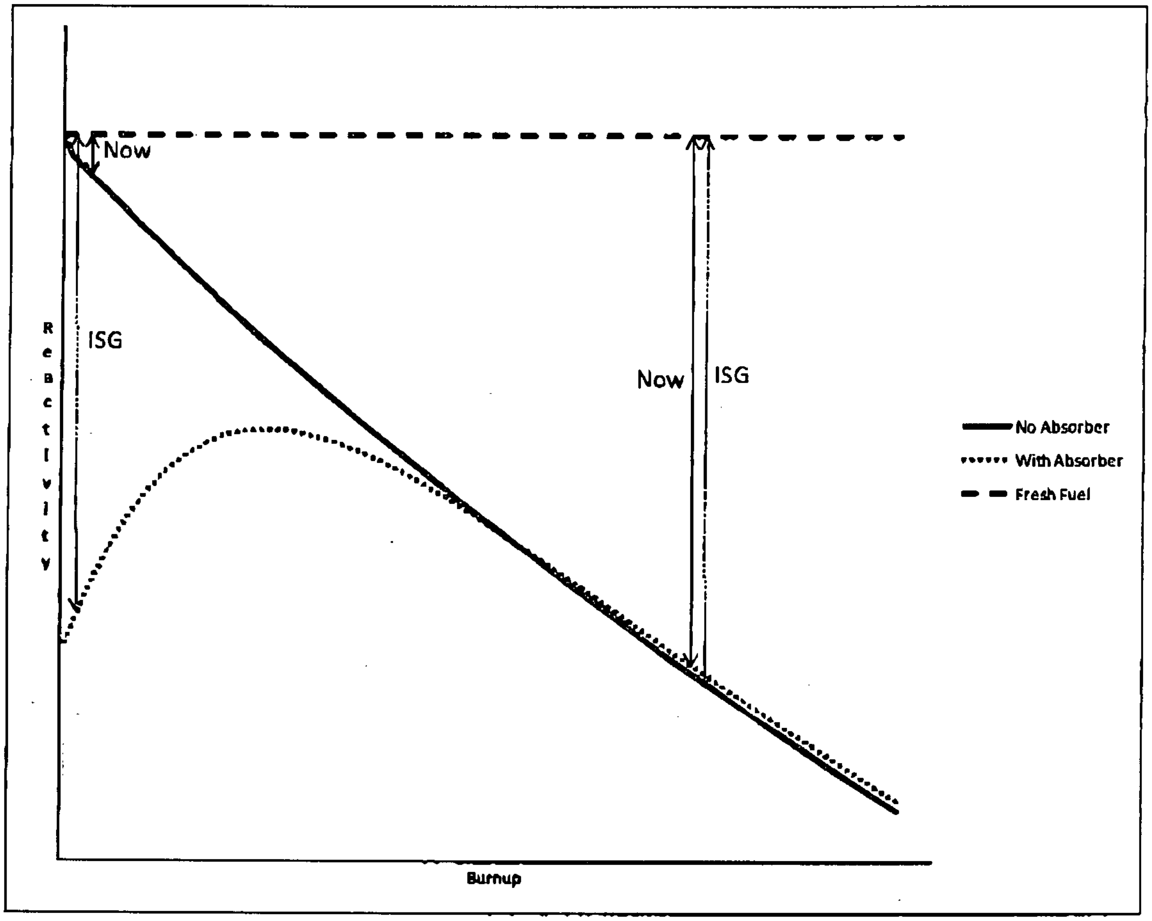


Figure 1: Representative Reactivity Effect of Burnable Absorbers

Issue 2: The guidance as written would recommend a double application of conservatisms from two separate configurations. To illustrate this point, Figure 1 shows the reactivity of two fuel assemblies in a representative spent fuel storage rack as a function of burnup. The first assembly (dotted line) includes burnable absorbers, while the second assembly (solid line) is identical to the first, only without the burnable absorber. The reactivity of the fresh fuel assembly is also shown as the horizontal (dashed) line. If the draft guidance were followed verbatim, the depletion uncertainty would have to be calculated based on the difference in reactivity of the fresh fuel assembly and the assembly that contained no neutron absorber, because it has the lower reactivity at higher burnups as shown in the left of Figure 1. However, as required by Section 2.c, burnable absorbers must be considered in their effect of hardening the spectrum and providing a more reactive fuel assembly at the same burnup and enrichment. The NRC has specified in the draft ISG the application of conservatisms from two different configurations; the depletion uncertainty from the assembly with no burnable absorbers and the burnable absorber bias from the assembly that does contain burnable absorbers. Table 1 below shows a representation of the burnable absorber bias and depletion uncertainty for assemblies with and without burnable absorbers. Recent analyses have been approved by the NRC with the depletion uncertainty and burnable absorber bias applied from the assembly with integral absorbers. This statement in the ISG essentially requires that the difference in reactivity between a fuel assembly with and without burnable absorbers to be applied as both a bias *and* an uncertainty as shown in Table 1.

Table 1: Reactivity Effect of Integral Burnable Absorbers

| | Depletion Uncertainty | Burnable Absorber Bias |
|---|---|---|
| With Integral Absorbers | 0.0250 | 0.0100 |
| No Integral Absorbers | 0.0260 | 0.0000 |

Section 2.b.ii: Please clarify what is meant by the "hot channel fuel assembly"? Is this meant to be the hot channel temperature of the bounding fuel assembly? It is not credible for any fuel assembly to operate at the hot channel temperature for the entire life of the fuel assembly in the core.

Section 2.c.iii: The statement "modeling burnable absorbers as full length when they are actually part length may lead to non-conservative conclusions about their effect on SFP reactivity," is an incorrect statement unless the residual burnable absorber is credited at the low burnup ends of the active fuel length. Is it the intent of the NRC to allow credit for the residual burnable absorber?

Section 3.a.i: Please remove the requirement to provide a site-specific justification for use of the axial burnup profiles from NUREG/CR-6801. This statement is inconsistent with the previous statement in this section that, "Use of the limiting axial burnup distribution from NUREG/CR-6801 are acceptable for existing PWRs..."

Section 3.a.ii: Please provide an example of an acceptable licensee control. Without such guidance each applicant could propose a different licensee control, which will cause considerable discrepancies and non-consistencies within the industry.

Section 3.a.iii: Please remove the statement "Applications that use uniform axial burnup profiles should clearly demonstrate where that [cross-over point] occurs." Identification of the cross-over point between where a uniform versus axially distributed profile is conservative is not necessary to be identified if analyses are performed with both a uniform and distributed profile modeled. This statement as written could be construed as a requirement for approval with no technical basis for this information to be provided.

Section 3.b.ii: Please clarify what is meant with regard to "efficiency of the neutron absorber". Neutron absorbers such as Boral and Metamic have been manufactured with sufficiently homogeneity that self-shielding and streaming does not occur in the environment of the spent fuel pool, where there is a continuous neutron spectrum (primarily at thermal energies) and neutrons are travelling in all directions.

Section 3.c.i: This statement should be removed. The use of the maximum biases and uncertainties from either of the individual storage configurations would make it impossible to analytically qualify the interfaces between either distinct rack designs within a pool or to qualify different storage patterns within a rack module. Table 2 shows an example of the application of this requirement to an interface between a rack module with flux traps intended for fresh fuel and a high-density rack module without flux-traps intended for spent fuel, that were both qualified to the same maximum $k_{eff}$.

Table 2 : Reactivity Effect of Interfaces per ISG-DSS-2001-01

| | Fresh Fuel Racks | Spent Fuel Racks | Interface Analysis |
|---|---|---|---|
| Calculated $k_{eff}$ | 0.980 | 0.965 | 0.980 |
| Biases + Uncertainties | 0.015 | 0.030 | 0.030 |
| Maximum $k_{eff}$ | 0.995 | 0.995 | 1.100 |

In reality the reactivity of the spent fuel pool with different storage configurations will be dominated by the most reactive configuration within the spent fuel pool, and the biases and uncertainties from that configuration would be the most applicable to be applied. The application of the maximum biases and uncertainties from any other configuration is not a technically valid application of the biases and uncertainties.

Section 4: This section seems to primarily focus on the use of the statistical treatment from NUREG/CR-6698 and the inclusion of the HTC Critical Experiment data. However, no mention is made of appropriate selection of $UO_2$ critical experiments, either from the OECD manual or other sources.

Section 4.a.1: The statement "The reviewer should verify that any validation that [is] used for SNF appropriately considers actinides and fission products." should be modified. This statement does not provide clear guidance on what the NRC finds acceptable for validation of fission products. Given that there are currently no publicly available critical experiments that include all fission products, this requirement may be impossible to meet as written. Please revise to specify a requirement that is possible to be met.

Section 4.c: The statistical treatment in NUREG-6698 includes two elements of the statistical treatment that are not appropriate. The first element from NUREG/CR-6698 is the recommendation to statistically combine the experimental measurement uncertainty with the calculational uncertainty to determine the total uncertainty. Statistically combining the uncertainties would result in a double counting of the experimental uncertainty that is already accounted for in the statistical determination of the bias and uncertainty. Second, the "experimental uncertainty" identified in the OECD manual and other sources of critical experiments is not a measurement uncertainty in the traditional sense (i.e., uncertainty in the measurement of the neutron multiplication factor, electronic equipment, experimental setup, etc.) Rather, the "experimental uncertainty" identified in the descriptions of the critical experiments is a calculation of the reactivity effect associated with the various tolerances or uncertainties in the experiment (fuel rod diameter, fuel density, temperature of the moderator boron content, water level, etc.). Therefore, the "experimental uncertainty" identified in the sources of critical experiments is an overly conservative estimation of the experimental uncertainty based on certain parameters important to the reactivity of the system and not an experimental uncertainty as indentified in NUREG/CR-6698. Therefore it is not appropriate to apply this pseudo "experimental uncertainty" described in the critical experiment benchmark sources as an experimental uncertainty.

Section 4.e: This section describes the level of detail an applicant must provide to allow for code-to-code validation of the criticality code. Previously, the NRC has made it clear that code-to-code validations are not accepted; i.e., computer codes must be validated against data, not other codes. By allowing a code-to-code validation the NRC is setting a precedent for the allowance of code-to-code validations.