Holtec Response to Request for Additional Information Docket No. 72-1032 Holtec International HI-STORM 100 Flood/Wind Multipurpose Canister Storage System Certificate of Compliance No. 1032 Amendment No. 3

Chapter 6

6-1 *Update the SAR with descriptions, reasons and the associated criticality analysis for the Technical Specification, and FSAR changed pages, for the change from 1500 to 1600 ppm boron concentration for undamaged 14x14 and 16x16 assemblies with maximum initial enrichment of 5.0% U-235.*

In a prior amendment, a description and analysis for increasing boron concentration for only intact 16x16A assemblies within DFCs with maximum initial enrichment of 5.0% U-235 was provided. Descriptions and reasons for increases to the minimum boron concentration for all 16x16 and 14x14 assemblies need to be provided in this amendment in addition to the analysis for 14x14 and 16x16B and 16x16C assemblies.

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

Holtec Response:

The additional option for loading of intact fuel assembly class 16x16A in DFCs in all 37 locations of the MPC-37 basket was added in the application for HI-STORM FW Amendment 2 (1032-2), in support of the HI-STORM UMAX Amendment 2 application (1040-2). This option is discussed in Subsection 6.3.1 and the results are presented in Table 6.1.1. These updated FSAR pages were previously submitted to the staff with the submittal of HI-STORM FW Amendment 2 (Holtec Letter 5018034). Due to the presence of the DFCs in all basket walls the reactivity was increased in comparison with the reference model with the 16x16A array/class. Thus, to maintain a consistent substantial safety margin, the soluble boron concentration has been increased from 1500 to 1600 ppm. For simplicity, this bounding concentration of 1600 ppm is provided in the technical specification for all 14x14 and 16x16 fuel assemblies. This is conservative and increases the safety margin for all those fuel classes, since based on the calculations presented in Table 6.1.1 a lower boron concentration is sufficient to maintain the reactivity below the regulatory requirement. The application for HI-STORM FW Amendment 2 did not properly include the update to CoC Appendix A to match the FSAR table, and so it was included in this amendment for completeness.

6-2 *Justify the use of the 15x15H, 15x15B, 16x16A as representative assemblies for the burnup credit analyses.*

In Section 6.I.B.1.1 of the SAR, the applicant states that they use the 15x15H fresh fuel assembly and 15x15B spent fuel assembly to represent all 15x15 and 17x17 fuel assembly classes, and the 16x16A fresh and spent fuel assemblies to represent all

16x16 fuel assembly classes when performing burnup credit evaluations. The staff did not find a justification for using these assemblies as representative. The applicant needs to revise the SAR to include this justification.

a) *Section 6.I.B.4.1 of the SAR states the bounding axial profiles were determined for four sets of assemblies. The applicant needs to revise this section of the SAR to clarify how it uses these groupings to determine that the axial profile for the representative assembly is bounding for all assemblies it is representing.*

b) *Similar to part a) of this RAI, the staff does not understand how the applicant uses the assembly groupings in Table 6.I.B.2 to determine the depletion parameters for the limiting assemblies are bounding for all assemblies it is representing. The staff requests that the applicant discuss how this was done.*

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

Holtec Response:

As discussed in Subsection 6.I.B.1.1, the 15x15H and 15x15B fuel assembly classes have been selected as the representative fuel assemblies, since they were expected to be the most reactive fresh and spent PWR fuel design, respectively. All studies and evaluations to determine the design basis condition were therefore performed using these representative assemblies. For the same reason, the 16x16A fuel assembly class has been selected as the representative fuel for the set of all 16x16 assemblies (establishment of loading curves). These selections are based on the study calculations documented in Appendix C, Table 6.0.1 of the supporting document HI-2156424 "Criticality Evaluation of HI-STAR 190" [6.I.3.3] that was submitted with the HI-STAR 190 license application. The design basis calculations have been performed and documented in Appendix C of [6.I.3.3] for all PWR assembly classes (see Tables 6.B.23(c), 6.B.23(d) and 6.1.1) to validate the loading curves and to show compliance with the regulatory requirements. However, only the most reactive PWR results for the representative 15x15B and 16x16A assembly classes are presented in Tables 6.I.1.1 and 6.I.B.23 of Supplement 6.I.

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b) [

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6-3 Discuss how assemblies that have been located under a control rod bank that was permitted to be inserted more than 8 inches from the top of the active length during full power operation are excluded from crediting burnup.

Section 6.I.B.2.2.2 of the SAR states: "Any assemblies that have been located under a control rod bank that was permitted to be inserted more than 8 inches from the top of the active length during full power operation are permitted for storage in the Configuration 2 of MPC-37, specifically in the basket cells intended for the fresh fuel assemblies." The staff did not find any restrictions of this nature in the proposed language for revising Appendix B to the Certificate of Compliance. The applicant needs to discuss if this was an oversight or how this restriction is implemented. Alternatively the applicant should justify that this condition does not need to be included.

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

<u>Holtec Response:</u>

The Appendix B to the Certificate of Compliance is revised as attached to these responses and appropriate restriction is included.

6-4 *Revise Appendix 6.I.B.2.2 of the SAR to demonstrate that the potential effects of integral burnable absorbers are bounded by the assumed irradiation conditions of the PWR fuel for the burnup credit analysis.*

Section 6.I.B.2.2 contains a discussion of integral burnable absorbers, and summarizes NUREG/CR-6760, "Study of the Effect of Integral Burnable Absorbers for PWR Burnup Credit." This study shows a positive effect of integral burnable absorbers that do not cover the ends of the fuel rods in a PWR fuel assembly. Section 6.I.B.2.2 of the SAR does not address integral burnable absorbers further. NUREG/CR-6760 recommends that PWR burnup credit analyses include either: 1) a small reactivity bias to bound the effect of integral burnable absorber, or 2) demonstration that the effects of integral burnable absorbers are bounded by the effects of other modeling assumptions (e.g., BPR exposure).

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

<u>Holtec Response:</u>

The discussion of the integral burnable absorbers in Subsection 6.I.B.2.2 is revised as attached to these responses, and as shown below:

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TABLE 6.I.B.10(a)

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6.I.C.5 Integral Fuel Burnable Absorber Layouts

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6-5 *Provide information on how burnup credit assemblies are restricted to those bounded by the operating parameters in Table 6.I.B.2 of the SAR.*

Section 6.I.B.2.1 states: "Only fuel assemblies bounded by the parameters in Table 6.I.B.2 are allowable for loading." The staff did not find any restrictions on core operating parameters within the draft Certificate of Compliance Appendix B. The applicant should discuss if this was an oversight or in what other way burnup credit assemblies are restricted to those bounded by these operating parameters in Table 6.I.B.2. Alternatively the applicant should discuss how the burnup credit assemblies do not need limits for these operating parameters.

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

<u>Holtec Response</u>:

The appropriate restriction is included into the Certificate of Compliance Appendix B, as shown in the revised version attached to these responses.

6-6 *Revise the isotopic bias determination in Section 6.I.B.3.1.3 to correct the least squares fit and to evaluate trends in the bias as a function of burnup.*

This section of the SAR states that the least squares fit of calculated versus measured reactivity differences in Figures 6.I.B.1 and 6.I.B.2 was calculated to intercept 0 delta-k at 0 burnup. This may not be appropriate, as the bias will be non-linear as it nears zero burnup (i.e., will potentially jump significantly from zero burnup to a burnup value that requires isotopic depletion calculations). Additionally, Section 6.I.B.3.1.3 states that the slope of the fit can be shown to be statistically insignificant, but no such demonstration is provided. The bias appears to vary as much as 0.01 over the burnup range from 10 to 60 GWd/MTU, which is significant from a criticality safety perspective.

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

<u>Holtec Response:</u>

Following the guidance in ISG-8 Revision 3, the direct difference method was applied to validate the depletion code. The differences in reactivity between two sets of the calculations with the measured and calculated isotopic composition were determined, and the mean value with the uncertainty as well as the least squares fit is calculated. The results presented in Table 6.I.B.12 showed that the average difference (bias) is positive and sufficiently large, while the least squares fit presented in Figures 6.I.B.1 and 6.I.B.2 visually showed a small correlation with the burnup. Because of small slope and large positive bias, which is conservatively truncated (see Table 6.I.B.14), no explicit statistical analysis is performed to calculate correlation coefficient and/or the bias as a function of the burnup. In other words, no attempt was made to derive the isotopic bias for the design basis calculations using the least squares fit and latter were shown for information purpose only. Instead, a conservatively truncated zero bias and the bias uncertainty determined per ISG-8 Revision 3 have been used in the design basis calculations.

6-7 *Revise Section 6.I.B.5.1 to justify and clarify the use of a combined loading curve for* *cooling times greater than 3 years to be used with 16x16 fuel assemblies in the regionalized loading configuration.*

This section of the SAR states that the 3 and 7 year cooling time loading curves for 16x16A class fuel assemblies are combined into a single loading curve for a regionalized basket loading applicable for fuel cooled 3 years or more. The applicant needs to provide further details on how the 3 and 7 year cooling time curves were combined and justify that it was done in a conservative way. The applicant needs to update Table 6.I.1.1 with the results of k-eff evaluations to demonstrate that fuel loaded with this curve also meets the criticality safety requirements. The applicant needs to update Figure 6.I.B.8 to show the third loading curve.

The staff needs this information to determine that the applicant has met the criticality safety regulations in 10 CFR 72.236(c).

<u>Holtec Response:</u>

As discussed in Subsection 6.I.B.5.1, despite the regionalized loading curves for the set of 16x16 assemblies at 3 and 7 years cooling times appear unusual, they are correct and validated by the confirmation calculations presented in Table 6.I.B.23. Both loading curves remain applicable and may be used as appropriate. However, since those curves are closely adjacent and to simplify their common use (and avoid any confusion), they are combined in a single loading curve for regionalized basket loading that is applicable for 16x16 fuel assemblies with above 3 years cooling time. This combined loading curve was established using the same methodology as for other loading curves (see Section 6.I.B.5). [

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