

FW Amendment No. 7 Clarification Requests

The following requests relate to information Holtec submitted on May 8, 2023 (ML23128A303) and supplemented on June 30, 2023 (ML23181A193) and August 15, 2023 (ML23227A248) in response to the staff's March 23, 2023, Request for Additional Information (ML23074A101). Holtec adequately responded to the staff's RAI with its supplemented RAI responses. However, the RAI responses introduced a change to the design criterion for the fuel baskets that requires the staff's review and approval for HI-STORM FW Amendment No. 7.

As the staff explained on the clarification call on August 3, 2023 (ML23216A217), the staff views the maximum permanent deflection design criterion as a change that Holtec proposed for Amendment No. 7 in its May 8, 2023 (ML23128A303) response to the staff's RAIs. Specifically, the proposed change is to replace the maximum total (elastic + plastic) deflection design criterion for the fuel basket with a less conservative¹ maximum permanent (plastic only) deflection design criterion. Prior to Holtec's RAI responses and supplements, the HI-STORM FW FSAR described the deflection criterion as "maximum total deflection" and stated that the definition and basis for the criterion was the reference, DS-331, which presented a technical basis for how a total deflection limit demonstrates structural integrity of the basket. Prior to Holtec's RAI responses and supplements, Holtec (1) had not previously described the permanent deflection design criterion in the FSAR (2) did not have a technical justification for a permanent deflection design criterion, and (3) the staff had not approved the permanent deflection design criterion. For these reasons, the staff views the maximum permanent deflection limit as an updated proposed change to the fuel basket design criteria in Amendment No. 7, and the staff initiated a review of the proposed change.

DS-331 Revision 0 and 1 provided the technical basis for the total deflection criterion describing how the total deflection limit resulted in stresses slightly above yield and was more conservative than ASME service level acceptance criteria for demonstrating structural integrity. After clarification discussions, Holtec provided a technical basis for a permanent deflection design criterion in DS-331 Rev. 2 and Rev. 3 demonstrating how a permanent deflection limit ensures structural integrity of the basket. These revisions to DS-331 present analyses of two basket strips deflected to the permanent deflection limit with results showing that the stresses in the two basket strips are slightly less than 90% of the true ultimate stress at temperatures up to 400 °C.

Limiting deflections is imprecise and does not directly indicate structural performance. DS-331 shows that the deflection limits demonstrate structural safety by comparing them to the stresses of ASME service limits, which do directly indicate structural performance. However, use of a deflection limit criterion gives varying stress results because of different basket geometries and does not guarantee that a basket will remain below a certain stress. This is demonstrated in DS-331, which shows that a single deflection limit produces different stress results in different baskets. This variability in stresses could lead to a situation where a basket meets the proposed deflection criterion but exceeds the stress limits that formed the basis for the deflection criterion.

The previous total deflection limit offset the variability of the deflection criterion with conservatism when compared to ASME service limits. However, the proposed permanent deflection criterion targets ASME's most severe service limit with no additional conservatism.

¹ Less conservative because neglecting elastic strain in an acceptance criterion allows more plastic strain to accumulate, thus reducing the margin to material failure.

The targeting of an ASME service limit with a minimal safety margin combined with the variability in stress results with basket geometries makes the proposed permanent deflection criterion less conservative than previously accepted design criteria for fuel baskets.

Demonstration of the structural integrity of the basket is necessary to ensure that the fuel remains in a subcritical condition. Based on its review of the permanent deflection criterion and its technical basis in Rev. 2 and Rev. 3 of DS-331, the staff concludes that the maximum permanent deflection, as presented, would not satisfy the requirements of 10 CFR 72.236(c), which requires CoC holders to design storage casks to maintain spent fuel in a subcritical condition.

Based on the review of the permanent deflection criterion and its technical basis in Rev. 2 and Rev. 3 of DS-331, the staff believes that the proposed permanent deflection design criterion reduces margin against structural failure of the fuel baskets (neutron absorbers) without adequate justification.

As a result, the staff is issuing the following requests to address these concerns.

1. Revise the structural design criteria for the fuel basket in section 2.2.8 and throughout the HI-STORM FW SAR to ASME B&PV Code service limits or to criteria that ensures comparable structural reliability and performance. To address the role of the deflection criterion in ensuring the assumed deflections in the criticality analysis are bounding, consider taking one of the following approaches:
 - a) Keep the maximum permanent deflection limit in addition to the ASME service limit and verify that both criteria are met;
 - b) Keep the deflection limit in addition to the ASME service limit but propose conditions for when the deflections would need to be verified and provide technical justification for the conditions, including a discussion on the safety function of limiting deflections for the criticality analysis; or
 - c) Provide some other justification or change to the criticality analysis that would remove the need for controlling deflections.

This information is needed to demonstrate compliance with the regulatory requirements in 10 CFR 72.236(b) and (c).

2. Ensure that the revised design criteria for the fuel baskets are met for all fuel baskets authorized for use in the HI-STORM FW system in Amendment No. 7.

This information is needed to demonstrate compliance with the regulatory requirements in 10 CFR 72.236(c).