Enclosure 3 to E-45191

Revised Responses to RAI 3-2 and RAI 4-1

(Public Version)

Chapter 3 – Structural Evaluation

2. Clarify the design criteria for the trunnion weld.

Section 3.9.5.4.1 states that the trunnions are designed in accordance with the allowable stress defined by ANSI N14.6 for a non-redundant lifting device. Section 4.2.1.1 of ANSI N14.6-1993 states that the acceptance criteria shall apply to the load-bearing members of the special lifting device. ANSI N14.6 further defines load-bearing members as any part in the load path of the special lifting device in which the induced stress is directly affected by the weight of the container connected to it. Based on this definition and the description in the SAR, the trunnion welds should be evaluated against the same design criteria as the trunnions.

This information is needed to demonstrate compliance with 10 CFR 72.236(l).

RESPONSE TO RAI 3-2

The evaluation of the trunnion welds in Section 3.9.5.4 of the SAR was revised in Revision 5 to consider the ANSI N14.6 design criteria for the critical 1g (plus dynamic load factor) lift load case. The trunnion weld size was increased (revised Sheet 5 of Drawing EOS01-2001-SAR and revised Sheet 5 of Drawing EOS01-2011-SAR) in Revision 5 of the SAR to accommodate the greater design factors required by ANSI N14.6. The associated methodology, criteria, analysis, results, and tables (Tables 3.9.5-4 and 3.9.5-5) in Section 3.9.5 (3.9.5.1, 3.9.5.4.1, 3.9.5.4.2, and 3.9.5.4.4) of the SAR were updated accordingly in Revision 5 of the SAR. In addition, SAR Section 8.2.1.2 was revised in Revision 5 to clarify that the upper lifting trunnions and the trunnion welds are designed in accordance with the ANSI N14.6 stress allowables for a non-redundant lifting device. Furthermore, for clarification, the evaluation for the 3g test load case, which represented the trunnion test load case, has been removed from Sections 3.9.5.4.1 and 3.9.5.4.2 and Table 3.9.5-4 since it did not provide a safety basis.

In addition, based on a followup discussion during a meeting held via telephone with NRC staff on May 5, 2016, additional clarification has been added to the description of the structural adequacy of the PWR and BWR fuel assembly cladding for the accident drop load. Reference has been added to SAR Sections 3.9.6.3, 3.9.6.4, 3.9.6.5 and 3.9.6.7 to describe other AREVA TN analyses that have been previously reviewed and approved by the NRC in other licensing actions for 10 CFR Part 72.

Application Impact:

SAR Sections 3.9.5.1, 3.9.5.4.1, 3.9.5.4.2, 3.9.5.4.4, and 8.2.1.2 were previously revised in Revision 5 of the SAR. Additional changes have been made to SAR Sections 3.9.5.4.1, 3.9.5.4.2 and 3.9.5.4.4 as described in the response. SAR Sections 3.9.6.3, 3.9.6.4, 3.9.6.5, and 3.9.6.7 have been revised as described in the response.

SAR Tables 3.9.5-4 and 3.9.5-5 were previously revised in Revision 5. In addition, SAR Table 3.9.5-4 has been further revised as described in the response.

Drawings EOS01-2001-SAR and EOS01-2011-SAR in Section 1.3.4 of the SAR were previously revised in Revision 5 as described in the response.

Chapter 4 – Thermal Evaluation

1. Demonstrate that the developed thermal model adequately captures the wind impact on the thermal performance of the EOS-HSM storage system.

The applicant analyzed the wind impact on the cooling of the NUHOMS-EOS with wind speeds of [ ] mph and predicted a peak cladding temperature of 735°F at a side wind speed of [ ]. The applicant proposed the TS 5.5 for requirements of installing the wind deflectors: "If the heat load is less than 50 kW, the user can decide to install wind deflector or the need for wind deflectors can be determined by an evaluation using the methodology documented in the SAR."

The staff reviewed the 1st-round RAI response and the analysis described in SAR Appendix 4.9.4 Wind Impact on the Thermal Performance of the EOS-HSM and examined Figure 4.9.4-2(c) for side wind exterior boundary conditions. The wind effect analyses presented by the applicant does not appear to be adequate to predict the peak cladding temperature (PCT).

The applicant used [ ] at the canister wall to perform the analysis and an [ ] to predict the PCT. The values they used [ ], were obtained for different configurations and different ambient conditions and therefore, they may not be directly applicable to the peak cladding temperature calculation when wind effect is considered. This [ ] method is inconsistent and may introduce additional unknown errors. The errors need to be known and bounded as the predicted peak cladding temperature margin is very small.

To avoid additional uncertainties in the analysis, the applicant needs to include the canister internals in the thermal model (including the fuel region).

Due to the small margin and uncertainty of the calculations, the staff requests that the applicant applies an appropriate reduction factor for additional safety margin for requirements of installing the EOS-HSM wind deflectors. A reduction factor to the design basis heat load (e.g., 20%) could be adequate to have acceptable margin.

The applicant needs to provide all thermal analysis files used to perform the wind calculations for review.

This information is needed to demonstrate compliance with 10 CFR 72.236(f).

RESPONSE TO RAI 4-1

To address the staff's concerns with regard to the thermal evaluation for the impact of wind on the EOS-HSM, the following changes have been made to the application:

1.a Technical Specifications:

Proposed Technical Specification (TS) 5.5 was modified in Revision 5 of the SAR to eliminate user calculations with regard to the requirements for installing the wind deflectors. The modified language also includes a reduction factor for the requirements of installing the wind deflectors as requested in the RAI question. The following replaces the existing language in the revised proposed TS 5.5:

> If the heat load of an EOS-37PTH DSC during STORAGE OPERATIONS is greater than 41.8 kW, wind deflectors shall be installed on the EOS-HSM.
>
> If the heat load of an EOS-89BTH DSC during STORAGE OPERATIONS is greater than 41.6 kW, wind deflectors shall be installed on the EOS-HSM.

The maximum fuel cladding temperature is 688 °F based on the evaluation presented in Section 4.9.4.7 of the application for the EOS-HSM with the EOS-37PTH DSC at a heat load of 41.8 kW and without the wind deflectors. This provides assurance that at heat loads less than or equal to 41.8 kW, there is significant margin to the maximum fuel cladding temperature limit of 752 °F even under the worst case wind conditions without the installation of the wind deflectors.

For heat loads greater than 41.8 kW and up to 50 kW, the above requirement of installing the EOS-HSM wind deflectors provides an additional safety margin since the bounding thermal evaluations are based on a heat load of 50 kW. It also eliminates ambiguity and provides clear instructions to the users on the requirements for installing the wind deflectors.

[

] the ambient temperature specification has been revised in the list of site-specific parameters in TS 4.5.3 (Item 3) depending on the heat load of the DSC. For DSCs with a heat load greater than 41.8 kW, the maximum yearly average temperature is 70 °F for normal storage conditions. These same limitations apply for the EOS-89BTH for heat loads greater than 41.6 kW

1.b Safety Analysis Report:

Sections 4.9.4.1, 4.9.4.2, 4.9.4.7, and Tables 4.9.4-1 and 4.9.4-2 were previously revised in Revision 5 of the SAR to delete heat load zone configuration (HLZC) #3. Load Case #2, described in Table 4.9.4-1, was redefined in SAR Revision 5 to evaluate the maximum heat load at which the wind deflectors are not needed.

Tables 2-9 and 4.9.4-2, and Sections 4.2, 4.3, and 4.9.4.6.1 have been revised due to the change in the ambient temperature specification as discussed above (Part 1a).

2. Thermal Model:

   a) Canister Internals:

[

] This evaluation is presented in new Section 4.9.4.6.1 of the application. [

] This confirms that the original evaluation is conservative.

In addition, to support the changes to TS 5.5 (as discussed in Item 1a), an additional evaluation has been performed for the EOS-HSM with the EOS-37PTH DSC based on HLZC # 2 (41.8 kW) in Section 4.9.4.7. [

] However, the heat generation rates for this evaluation are adjusted based on HLZC # 2 with a maximum heat load of 41.8 kW and the wind deflectors eliminated. The maximum fuel cladding temperature determined from this evaluation is 688 °F. Therefore, for heat loads less than or equal to 41.8 kW for the EOS-37PTH, wind deflectors are not needed.

b) Evaluation of GCI:

[ ]

As a part of this new added section, Figure 4.9.4-7 was replaced and Figures 4.9.4-8 and 4.9.4-9 were added in Revision 5 of the SAR. The added sections also caused a renumbering of the corresponding reference section in Appendix 4.9.4 of SAR Revision 5. In Revision 6, Figures 4.9.4-8 and 4.9.4-9 have been revised and Table 4.9.4-3 has been added.

All computer files associated with the above discussion are submitted for NRC staff review as part of this RAI response in Enclosure 10. Enclosure 9 contains a listing and a description of the thermal files provided in Enclosure 10.

Application Impact:

Technical Specification 5.5 was previously revised in Revision 5 of the proposed TS. Technical Specification 4.5.3 has been revised as described in the response.

SAR Sections 4.2, 4.3 and Appendix 4.9.4 have been revised as described in the response. Section 4.9.3.3, Table 4.9.3-3, and Figure 4.9.3-3, which were previously added in Revision 5 of the SAR, have been deleted. Sections 4.9.4.6.1 and 4.9.4.7 were previously revised in Revision 5 of the SAR and have been revised again as described in the response. Section 4.9.4.8 was added revised in Revision 5 of the SAR and has been revised as described in the response. SAR Section 4.9.4.9 has been revised as described in the response.

Table 2-9 has been revised as described in the response. Table 4.9.4-1 was previously revised in Revision 5 of the SAR. Table 4.9.4-2 was previously revised in Revision 5 and has been revised again as described in the response. Table 4.9.4-3 has been added as described in the response. Figure 4.9.4-7 was previously revised in Revision 5 of the SAR. Figures 4.9.4-8 and 4.9.4-9 were previously added in Revision 5 of the SAR and have been revised as described in the response.