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U. S. Nuclear Regulatory Commission
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Subject: Submittal of Biennial Report of 10 CFR 72.48 Evaluations Performed for the NUHOMS® EOS System, CoC 1042, for the Period 06/07/17 to 06/06/19, Docket 72-1042

Pursuant to the requirements of 10 CFR 72.48(d)(2), TN Americas LLC hereby submits the subject 10 CFR 72.48 summary report. Enclosure 1 provides a brief description of changes, tests, and experiments, including a summary of the 10 CFR 72.48 evaluation of each change implemented from 6/7/2017 to 6/6/2019, including indication as to whether the evaluations had associated Updated Final Safety Analysis Report (UFSAR) changes which have been or will be incorporated into the UFSAR for the CoC 1042 NUHOMS® EOS System.

Should you or your staff have any questions regarding this submittal, please contact Mr. Glenn Mathues by telephone at (410) 910-6538, or by e-mail at Glenn.Mathues@orano.group.

Sincerely,

A. Prakash

Prakash Narayanan
Chief Technical Officer

Enclosure:

Biennial Report of 10 CFR 72.48 Evaluations Performed for the NUHOMS® EOS System for the Period 06/07/17 to 06/06/19

Electronic Information Exchange (EIE) Document Components:

001 PUBLIC TN Americas Transmittal Letter E-54367 and Encl 1– 72.48 Summaries.pdf

cc: Christian J. Jacobs (NRC SFM)

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/17 to 06/06/19

Enclosure 1 - DESIGN CHANGES

LR 721042-016, Revision 1 – (incorporated into UFSAR Revision 1)

Change Description

This change involves the introduction of the flat plate support rail (FPS) option dry shielded canister (DSC) support structure to the medium sized EOS-Horizontal Storage Modules (HSMs). The flat plate support rail is considered an alternate component for the HSM support rail structure for the HSM medium for both the monolithic EOS-HSM and the segmented EOS-Horizontal Storage Module Split (HSMS) designs.

The DSC support structure is comprised of two beams connected by bracing and supported by the HSM base at the front and rear walls only. The FPS DSC support structure is comprised of two plates with no bracing in between. The plates are supported by the FPS base at each end and at two mid-span locations. The HSM-FPS base and HSMS-FPS base are modified from the HSM base to support the FPS DSC support structure in four locations along the FPS DSC support structure's span. This is accomplished with 12-inch thick concrete pedestals in the rear and two mid-span locations. The FPS DSC support structure is supported by the HSM-FPS base front wall.

This LR also addressed the effect of reduced concrete density value used in the stability calculation.

Evaluation Summary

The design function of the HSM is to provide physical protection, radiological shielding, and decay heat removal for spent fuel by a combination of radiation, conduction, and convection during dry storage of the DSC. Only the medium-sized DSC is considered for this evaluation. The HSM FPS structure provides structural support for the DSC during loading and unloading operations of the DSC into the HSM.

The evaluation assessed the FPS option on the HSM medium designs for the structural, thermal, and shielding design functions. Confinement and criticality are unaffected by this change.

The impact due to a reduction in concrete density (from 150 pcf to 140 pcf) on the EOS-HSM stability, demand capacities ratio, and connection bolt embedment was evaluated. Load combinations for the FPS option impact on the structural integrity of the DSC shell assembly were assessed. The FPS alternate front wall options do not change front wall geometry from the original design. Only rebar layout differs. A structural analysis was performed for the alternate front walls. Results from the structural analyses demonstrate that the FPS design for the DSC and HSM is structurally adequate for all the design basis loads. The FPS rail design does not impact the design function of the HSM.

The thermal performance of the HSM was evaluated for the bounding load cases for normal hot, off-normal hot, and blocked vent accident storage conditions for the FPS option for the EOS-HSM with the EOS-37PTH DSC. The bounding wind scenario for the FPS design of the EOS-HSM with the EOS-37PTH DSC was also assessed. The method of evaluation was the same

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/17 to 06/06/19

as that for the original analysis. The proposed FPS design for the HSM was determined to be thermally adequate for all design basis loads.

EOS-HSM shielding performance for the EOS-37PTH was evaluated for impact from the proposed changes to the HSM rail. The analysis concluded that the FPS design change has no impact on the results since the bulk shielding provided by the HSM is unchanged.

All eight 72.48 evaluation criteria were met.

LR 721042-017, Revision 1 – (incorporated into UFSAR Revision 1)

Change Description

This change adds an alternative rebar design for the EOS-HSM (full) front wall and EOS-HSMS (upper and lower) front walls and their associated structural analyses. This alternate rebar configuration results in ease of fabrication.

Evaluation Summary

The design functions of the HSM are to provide physical protection, radiological shielding, and decay heat removal for spent fuel by a combination of radiation, conduction, and convection during dry storage of the DSC. The alternative rebar design changes to the HSM do not impact the ability of the HSM structures to resist an accident such as a seismic event or a tornado.

The structural performance of the EOS-HSM and EOS-HSMS front wall capacities for each portion of the wall for the proposed modifications was evaluated and compared to the results of the design demand loads. The evaluations of the alternative rebar layout versus the original rebar layout concluded that the structural integrity of the HSM designs is maintained and that the bounding values remain valid. The demand/capacity ratios continue to meet Code acceptable limits.

All eight 72.48 evaluation criteria were met.

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/17 to 06/06/19

LR 721042-020 Revision 0 – (will be incorporated into next UFSAR revision)

Change Description

This change incorporates a number of improvements to UFSAR drawings and design for the EOS-TC125/TC135 transfer cask (TC). These changes improve fabricability, dimensional control and incorporate editorial corrections. The changes identified as requiring evaluation modify the configuration (positions, quantity, and thicknesses) of the rails along the inside surface of the TC (more rails, around the entire circumference, and reduced thickness).

Evaluation Summary

The TC is designed to provide shielding and protection from potential hazards during dry shielded canister (DSC) loading and closure operations and subsequent transfer to the HSM. The primary function of the TC is to provide onsite transfer of loaded DSCs between the plant spent fuel pool and the plant onsite independent spent fuel storage installation. The NUHOMS® EOS-37PTH DSC and EOS-89BTH DSC each consist of a cylindrical shell assembly and a basket assembly. For this change, the relevant accident is a 65-inch side drop of a loaded TC. The TC canister rails support the DSC and the configuration of the TC rails most directly affects stresses/strains in the fuel basket assembly of the DSC for high inertial loads due to the postulated side drop of the TC.

The additional rails enhance the protection for the inside surface of the inner shell of the TC when the empty DSC is inserted or removed from the TC. The modified rail configuration has no significant effect on the structural function of the TC since analyses do not credit the rails for strength.

The evaluation of the interference between the DSC and the TC determined that the radial gap between the DSC shell and the TC inner cavity due to thermal expansion/contraction was sufficient to allow transfer of the DSC to and from the TC.

Structural analyses for side and end drop loads for the EOS-37PTH DSC and EOS-89BTH DSC basket configurations were revised to assess the impact of the additional TC rails as well as the modified rail configuration. For both the EOS-37PTH DSC and EOS-89BTH DSC using the modified TC125/TC135 rail configuration, the analyses demonstrated that, for the side drop of the basket assembly, all the revised strain and stress values remain below the allowable strains and stresses. Therefore, the proposed change does not affect the structural design function of either the EOS-37PTH DSC or the EOS-89BTH DSC. The structural, shielding, thermal, and criticality design functions of the DSC basket are maintained.

All eight 72.48 evaluation criteria were met.

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/17 to 06/06/19

LR 721042-026 Revision 1 – (will be incorporated into next UFSAR revision)

Change Description

This change impacts the EOS-TC, models EOS-TC108, EOS-TC125, and EOS-TC135, and the use of the appropriate temperature when determining material properties used in the top ring-to-trunnion weld calculation. Room temperature material properties were used in the original calculation; however, the weld zone is subject to load at 225 °F.

Evaluation Summary

The weld between the trunnion and the top ring is affected since ultimate tensile strength (UTS) decreases as temperature increases. Revision of the analysis conservatively used a UTS at 250 °F, which is 68.6 ksi. The result was a reduction of weld metal allowable stress from 7.5 ksi to 6.86 ksi and a reduction in margin of safety from 0.12 to 0.03 for the critical lift case. The calculation conclusions and bounding values remain valid. The analysis demonstrates that the calculated stress-to-allowable ratios continue to meet Code acceptable limits. Despite the decrease in margin, the structural integrity of the TC is maintained since the margin of safety remains positive and is therefore consistent with Section 3.5.5 of the Safety Evaluation Report for Certificate of Compliance No. 1042, Amendment 0, dated May 3, 2017, which states that the structural strength of the trunnions is adequate to provide reasonable assurance that the TC will not be dropped due to trunnion failure under normal and off-normal lifting conditions.

The revision to the material properties used in the top ring-to-trunnion weld calculation results in no physical change to the TC and no impact on the ability of the TC to resist an accident (such as a seismic event or a tornado). No changes to the shielding or thermal functions of the TC were made.

All eight 72.48 evaluation criteria were met.

LR 721042-030 Revision 0 – (will be incorporated into next UFSAR revision)

Change Description

This change impacts the EOS-TC, models EOS-TC125 and EOS-TC135. This change revises the class of bolting material for the TC top cover closure bolts described in the UFSAR from SA 540 Grade B23 CLASS 1 to CLASS 3. This change decreases the mechanical properties of the material but allows the fabricator to more easily obtain material that will pass the required Charpy test.

Evaluation Summary

The EOS-TC is designed to provide shielding and protection from potential hazards during DSC loading and closure operations and subsequent transfer to the EOS-HSM. The design function of the top cover closure bolt is to ensure that the top cover plate remains secure to the top ring of the TC during transfer operations for normal and accident loading conditions.

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/17 to 06/06/19

The change to SA 540 Grade 23 Class 3 fasteners was evaluated for the TC top cover closure bolts and for their impact on the structural integrity of the TC. The analysis demonstrated that the stress ratio remains well below the design basis limit for accident loads resulting from postulated accidents as a result of the change to SA 540 Grade B23 Class 3 top cover closure bolts as described in EOS UFSAR Section 12.3. The change in the material class of the TC top cover closure bolts is structural in nature and does not adversely affect any thermal, shielding, confinement, or criticality evaluations. The original design objective of the top cover closure bolts is maintained and unchanged as a result of this activity.

All eight 72.48 evaluation criteria were met.

LR 721042-031 Revision 0 – (will be incorporated into next UFSAR revision)

Change Description

This change evaluates the qualification of the HSM with the FPS configuration with a DSC medium length of 176.0 inches to 199.5 inches. The original analysis was performed for a maximum DSC length of 199.5 inches. However, the short DSC length of 176.0 inches does not rest on the rearmost pedestal of the EOS-HSM-FPS or EOS-HSMS-FPS and constitutes a new controlling load configuration for the DSC design.

Evaluation Summary

The design function of the DSC is to provide structural support, thermal and radiological shielding, criticality control, and confinement safety functions for spent fuel assemblies. The DSC provides gamma shielding at its ends by the use of shielded end plugs. Structural support for the fuel assemblies is provided by basket plates that form the fuel compartments.

The design function of the HSM is to provide physical protection, radiological shielding, and decay heat removal for spent fuel by a combination of radiation, conduction, and convection during dry storage of the DSC. The EOS-HSM design allows for various DSC lengths. The EOS-HSM-FPS rail structure provides structural support for the DSC during loading and unloading operations of the DSC into the EOS-HSM. When a DSC is loaded into the HSM, the DSC sits on the support rails, which are inside the HSM. In the evaluations for a minimum DSC length of 176.0 inches, the rear pedestal does not provide direct support to the DSC through the DSC support rail since all the DSCs have a minimum requirement of 6 inches of the overhang at the front of the HSM and this constitutes a new controlling load configuration for the DSC design.

An analysis was performed for the DSC length of 176.0 inches for load combinations affected by the DSC support rail. Due to the reduced number of pedestal supports for the 176.0-inch DSC configuration, the 176.0-inch DSC stress results are controlling for the DSC design and replace results documented in the UFSAR. Results from the analysis demonstrate that the stress ratio remains below 1.0 and the DSC ranging between 176 and 199.5 inches is acceptable for all load combinations provided in Chapter 3 of the UFSAR. Therefore, the DSC is structurally adequate for all storage and transfer conditions.

Structural analyses of the EOS-HSM-FPS and EOS-HSMS-FPS with the 176.0-inch length DSC were performed since the shorter DSC will not rest directly on the rear pedestal; the flexibility of the DSC supporting rails affects the loads at the FPS pedestals. Results from the analyses demonstrate that the EOS-HSM-FPS demand-to-capacity ratios remain below 1.0 and are acceptable for all load combinations provided in Chapter 3 of the UFSAR. Therefore, the EOS-HSM-FPS and EOS-HSMS-FPS are structurally adequate for all storage and transfer conditions.

The analysis performed for the EOS-DSC and EOS-HSM used the same method of evaluation as described in the UFSAR. The evaluation of the EOS-DSC and the EOS-HSM-FPS for the bounding DSC length does not affect the design functions of the DSC or HSM. There will be no increase in radiological dose.

All eight 72.48 evaluation criteria were met.

LR 721042-045 Revision 0 – (will be incorporated into next UFSAR revision)

Change Description

The proposed activity involves the structural qualification of the heat shields for the NUHOMS® EOS System horizontal storage module flat plate support rail (EOS-HSM-FPS) option.

Evaluation Summary

The design function of the HSM is to provide physical protection, radiological shielding and decay heat removal for spent fuel by a combination of radiation, conduction, and convection during dry storage of the DSC. Ambient air enters the HSM through ventilation inlet openings located on both sides of the lower front wall of the HSM and circulates around the DSC and the heat shields. For thermal protection of the HSM concrete, thin stainless steel heat shields are installed inside the HSM. The interior surface of the upper part of the side wall is protected with side heat shields (SHS), and the underside of the roof unit is protected with roof heat shields (RHS).

The RHS design is the same for the EOS-HSM and EOS-HSM-FPS. Therefore, the modal and 1g static analysis results for the EOS-HSM roof heat shields were used for the EOS-HSM-FPS. Structural evaluation of the RHS was performed using the same method of evaluation as discussed in the EOS UFSAR. The resulting RHS seismic loads were calculated for X, Y and Z directions. The required strengths were reanalyzed based on the updated g-loads to determine the demand-to-capacity ratios of the RHS. Based on the evaluation, the demand-to-capacity ratios still remain below the limit of 1.0. Therefore, the RHS design is adequate to perform its intended functions.

The dimensions and associated stud locations for the SHS panel are changed due to the EOS-HSM-FPS design configuration. Structural evaluation of the SHS was performed using the same method of evaluation as discussed in the EOS UFSAR. The resulting SHS seismic loads were calculated for X, Y and Z directions. The required strengths were recalculated based on the updated SHS seismic loads to determine the demand-to-capacity ratios of the SHS. Based on the evaluation, the demand-to-capacity ratios still remain below the limit of 1.0. Therefore, the SHS design is adequate to perform its intended functions.

The longitudinal seismic acceleration loads for the axial retainer (DSC at 3% damping) increased for the EOS-HSM-FPS design spectral accelerations as provided in the EOS UFSAR. The required strength was recalculated based on the updated g-loads to determine the

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/17 to 06/06/19

demand-to-capacity ratios of the axial retainer restraint. The results show that the impact on flexure and shear demand-to-capacity ratios slightly decreased from 0.82 and 0.72 in the original analysis to 0.78 and 0.69, respectively, and still remain below the design basis limit of 1.0. Therefore, the axial retainer design is adequate to perform its intended function.

Thermal temperature distributions or heat load limits, shielding and confinement functions are unaffected due to the changes to the heat shields.

All eight 72.48 evaluation criteria were met.

LR 721042-057 Revision 0 – (will be incorporated into next UFSAR revision)

Change Description

The proposed activity involves evaluating the effect of o-rings in the drain port quick connect fitting and the effect of losing two lubricated o-rings from a drain tube connection tool into the confinement boundary inside the cavity of either the EOS-37PTH or EOS-89BTH DSCs and their effect on the cavity gas purity.

Evaluation Summary

Helium provides an inert gas cover within the DSC for protection against corrosion of the fuel, the fuel cladding, and the low alloy steel materials comprising the basket. It provides thermal conductivity to remove heat from the fuel to the basket and then to the outer shell of the DSC. The thermal deterioration of organic materials within the confinement boundary can introduce impurities into the helium gas, thus creating the possibility of reduced thermal conductivity and reduced corrosion protection for the fuel, fuel cladding, and the basket's low alloy steel.

As shown by analysis, the outgassing products may include low-molecular-weight species of antioxidants and UV stabilizers, unreacted polymer residues and degradation products, low-molecular-weight plasticizers, water vapor, and carbon dioxide. These products are not corrosive, considering that o-rings and o-ring lubricants are intended for use in contact with metals. Outgassing from o-rings lost into the DSC cavity would have no effect on the hydrogen sensor used during welding of the inner cover. Welding takes place either before the DSC is drained, or very shortly after it is drained, so that thermally-driven outgassing will either not occur or the gaseous products will be swept out with the inert gas purge during welding. After welding and draining, the quantity of outgassing that could occur is negligible compared to residual water vapor, and thus insufficient to affect the pressure gauge or helium mass spectrometer used to confirm the conditions of the technical specification. The impurities contributed by o-ring outgassing are insufficient to cause either temperature-related or corrosive damage to the fuel or DSC internals. Thus, the effect on long term corrosion of the DSC or the fuel cladding, and thermal conductivity of the backfill helium is negligible.

All eight 72.48 evaluation criteria were met.