AREVA

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U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Subject: Submittal of Biennial Report of 10 CFR 72.48 Evaluations Performed for the Standardized NUHOMS® System, CoC 1004, for the Period 07/24/14 to 07/25/16, Docket 72-1004

Pursuant to the requirements of 10 CFR 72.48(d)(2), AREVA Inc. 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 7/24/2014 to 7/25/2016, including indication as to whether the evaluations had associated Updated Final Safety Analysis Report (UFSAR) changes that will be incorporated into the UFSAR for the CoC 1004 Standardized NUHOMS® System.

Should you or your staff have any questions regarding this submittal, please contact Mr. Dennis Williford by telephone at (704) 805-2223, or by e-mail at Dennis.Williford@areva.com.

Sincerely,

P. Shih

Peter Shih
Senior Manager, Design and Licensing

cc: Christian J. Jacobs (NRC SFM), provided in a separate mailing

Enclosure:

1. Biennial Report of 10 CFR 72.48 Evaluations Performed for the Standardized NUHOMS® System For the Period 07/24/14 to 07/25/16

NMSS26

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE STANDARDIZED NUHOMS® SYSTEM FOR THE PERIOD 07/24/14 to 07/25/16

Licensing Review (LR) 721004-1067, Rev. 1 – (will be incorporated into next UFSAR revision)

Change Description

A summary of Revision 0 of this LR was provided in the previous biennial summary report (E-39211 dated July 23, 2014, ML14210A013). Revision 0 was written against CoC 1004 Amendment 13 ongoing provisions prior to Amendment 13 becoming effective. The purpose for Revision 1 is to reconcile the Revision 0 conclusions with the final Amendment 13 provisions.

Evaluation Summary

The evaluation summary and conclusions in Revision 0 of this LR remain unchanged and applicable to Revision 1.

Licensing Review (LR) 721004-1079, Rev. 1 – (will be incorporated into next UFSAR revision)

Change Description

A summary of Revision 0 of this LR was provided in the previous biennial summary report (E-39211 dated July 23, 2014, ML14210A013). The only changes in Revision 1 are minor editorial corrections to the Updated Final Safety Analysis Report (UFSAR) for purposes of clarification.

Evaluation Summary

The evaluation summary and conclusions in Revision 0 of this LR remain unchanged and applicable to Revision 1. Revision 1 of this LR was revised to include UFSAR changes that were contingent upon approval and incorporation of UFSAR changes associated with Amendment 13.

LR 721004-1112 Rev. 1 – (will be incorporated into next UFSAR revision)

Change Description

A summary of Revision 0 of this LR was provided in the previous biennial summary report (E-39211 dated July 23, 2014, ML14210A013). The revision to this LR was created to make the design modifications to the welds as "OPTIONAL WELDS" in lieu of changing the base design. This alternate weld design option has also required a revision to Figure R.3-14 from Appendix R of the UFSAR.

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Evaluation Summary

The evaluation summary and conclusions in Revision 0 of this LR remain unchanged and applicable to Revision 1.

LR 721004-1117 Rev. 1 – (no associated UFSAR change)

Change Description

This change involves some technical and editorial corrections to structural calculations for the HSM-H and HSM-HS based on a corrective action report. The only correction that impacts the licensing design basis in the UFSAR is a change in the ductility ratio of the concrete shield door of the horizontal storage module (HSM). The maximum ductility ratio of the front door for the 12-inch steel pipe missile was changed from being "less than 2 inches" to "less than 5 inches." This UFSAR change was included in Revision 14 of the UFSAR.

Evaluation Summary

The NUHOMS® HSM-H and HSM-HS protect the dry shielded canister (DSC) from the potentially adverse effects of natural phenomena hazards, such as earthquake, tornado, tornado missiles, flood and extreme ambient conditions. The relevant accident conditions are extreme wind and tornado missiles, and blockage of air inlet and outlet openings. The change in the ductility ratio of the HSM shield door has no impact on the structural integrity of the HSM-H and HSM-HS for normal and off-normal conditions. For accident conditions, the change in the ductility ratio is a conservative change that still demonstrates an ample margin to the required limit against failure (the ductility ratio shall not exceed 20) due to the 12-inch pipe tornado missile accident event. The thermal and shielding design functions of the HSM-H and HSM-HS modules are not impacted by this change.

All eight 72.48 evaluation criteria were met.

LR 721004-1198 Rev. 1 – (no associated UFSAR change)

Change Description

A summary of Revision 0 of this LR was provided in the previous biennial summary report (E-39211 dated July 23, 2014, ML14210A013). The revision to this LR was created to reconcile the latest licensing references, including UFSAR Revision 14. The UFSAR changes associated with Revision 0 of this LR were incorporated into UFSAR Revision 14.

Evaluation Summary

The evaluation and conclusions in Revision 0 of this LR remain unchanged and applicable to Revision 1.

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LR 721004-1242 Rev. 0 – (will be incorporated into next UFSAR revision)

Change Description

This change was initiated to allow the density of concrete for the HSM-H loaded with a 37PTH DSC to be as low as 142 pcf, which is lower than the concrete density of the 145 pcf that was specified in the UFSAR.

Evaluation Summary

The effect of the reduced concrete density is a small increase in the maximum dose rate for three UFSAR analyzed cases. The HSM-H roof bird screen, end shield wall surface, and HSM door exterior surface at 1 meter exhibit a higher maximum dose rate than the values published in UFSAR Table Z.5-1. However, there is no impact on the site boundary doses. With respect to the impact of the lower density concrete on postulated accidents, the dose rates calculated for the HSM-H using the lower density concrete continue to be below the Technical Specification (TS) limits listed in TS 5.4.2. In addition, the doses received by an individual located 100 meters away from the independent spent fuel storage installation (ISFSI) and by an offsite individual located 500 meters away from the ISFSI for an assumed duration of 8 hours are below the values reported in the UFSAR for the extreme wind and tornado missiles accident cases. For the blocked vent accident, there are no offsite dose consequences, but there are doses to site workers associated with the recovery operation. However, the average dose rate on the HSM front or roof continues to be bounded by the current SAR value of 15.5 mrem/hr.

The change does not alter the concrete compressive strength or the design of the steel reinforcing bars. The change in the material density of concrete will not affect the structural integrity of the HSM-H.

The thermal design functions are not impacted since the thermal performance of the HSM-H with the 37PTH DSC is bounded by the evaluations presented for the 32PTH1 DSC in UFSAR Appendix U.

All eight 72.48 evaluation criteria were met.

LR 721004-1299 Rev. 0 – (no associated UFSAR change)

Change Description

This design change involves a new, taller cask spacer to be utilized in the OS200 Onsite Transfer Cask (TC) loaded with a 37PTH-S DSC. Drawing NUH-08-8005-SAR, presented in Section U.1.5 of the UFSAR, provides a cask spacer design to accept the varying length of DSCs, including the 37PTH DSC. The spacer within the TC is used to maintain the DSC geometry and to limit its axial movement so that the loading operation can be performed. The new cask spacer has minor configuration differences and a heavier weight (1.62 kips) as compared to the cask spacer shown in the current SAR drawing and described in Table Z.3.2-1 of the UFSAR (1.3 kips).

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Evaluation Summary

The total dry dead weight of the OS200 with this new spacer is equal to 109.72 kips, which is less than the 110 kips credited in the structural analysis for normal and accident conditions. The dead weight load, thermal loads and handling loads are not impacted by the use of this new taller cask spacer. The design change does not adversely affect the structural integrity or the thermal performance of the TC. The TC and cask spacer remain in compliance with the allowable criteria identified in the NUHOMS® UFSAR for the normal, off-normal, and accident conditions, and there are no changes to loading/unloading/handling operations.

All eight 72.48 evaluation criteria were met.

LR 721004-1401 Rev. 0 – (will be incorporated into next UFSAR revision)

Change Description

This activity involves a determination of the time limit for completion of transfer operations once the air circulation is interrupted for the 32PTH1, 37PTH and 69BTH DSCs. It also verifies that the time limits determined are in compliance with the time limits noted in Technical Specification 3.1.3 without any adverse effects on design functions. If the air circulation is activated as a recovery operation during transfer operations, the air circulation needs to be interrupted by turning off the blowers before transferring the DSC into the storage module. In addition, since the time limits determined to complete the transfer operations once the air circulation is interrupted begins with the system under steady-state conditions, a minimum time required to operate the blowers to achieve this steady-state condition is also determined.

Evaluation Summary

After air circulation is interrupted, the maximum temperatures for the basket assembly components, DSC shell and TC components increase. In addition, the internal pressure of the DSC under normal operating condition increases from 8.48 psig to 9.0 psig. The effects of these temperature and pressure changes on the design functions described in the UFSAR for the 32PTH1 DSC and OS200FC TC were evaluated. Since the maximum temperatures determined 15.75 hours after the air circulation is interrupted within the 32PTH1 DSC and OS200FC TC remain below the allowable limits considered in the thermal evaluation, and also remain below the temperatures considered for the structural evaluation, there is no effect on the structural or thermal design function of the DSC or the TC. In addition, the maximum internal pressure of the 32PTH1 DSC maintains a significant margin to the design pressure. Therefore, there is a negligible effect on the design functions of the 32PTH1 DSC.

If the TC is in a horizontal orientation on the transfer skid, and the required time limit for completion of DSC transfer specified in TS 3.1.3 is not met, air circulation is initiated in the TC/DSC annulus by starting one of the blowers on the transfer skid and continuing blower operation for a minimum duration of 36 hours.

All eight 72.48 evaluation criteria were met.

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LR 721004-1419 Rev. 2 – (no associated UFSAR change)

Change Description

This activity is to assess an overload condition in which a 125 kips ram force was applied to the grapple ring of 37PTH-DSC #1 and HSM-H #1 during insertion operations. This exceeds the design basis load of 110 kips evaluated for the 37PTH-DSC in the UFSAR (Table Z.2-15).

Evaluation Summary

The effect of applying a force of 125 kips to the outer bottom cover plate (OBCP) via the grapple ring, 14 percent higher than the design basis ram push load, was evaluated for its impact on the structural protection of the DSC and its contents. The OBCP does not form part of the confinement boundary. The 110 kips ram push load is an off-normal load condition. The controlling load combination consists of the 100 kip ram push load plus deadweight, combined with and without internal pressure and transfer thermal cases. Analysis demonstrates that the stresses in the DSC bottom end components are within the ASME Service Level B limits and can accommodate a maximum load of up to 140 kips. The OBCP remains in compliance with the allowable stress criteria identified in the UFSAR for Level B stress limit. In addition, the shielding design functions remain unaffected.

All eight 72.48 evaluation criteria were met.

LR 721004-1432 Rev. 0 – (will be incorporated into next UFSAR revision)

Change Description

This change involves the introduction of a variant to the 32PTH1 Type 2 basket, designated as Type 2-W. The proposed new design option consists of a reduction in poison plate thickness and reduction in the thickness of the center section basket plates, with the intent to accommodate the fabrication of a larger fuel compartment size with a corresponding larger fuel gauge size. A revision is also being made to the requirements for the MMC poison material.

The Technical Specifications and UFSAR allow for loading of B&W 15x15 fuel assemblies into the NUHOMS® 32PTH1 DSC. The B&W 15x15 assembly envelops a square of 8.536 inches prior to irradiation. After irradiation, the fuel assembly may bow and grow, making it likely that the irradiated fuel assembly may not fit into the designed fuel compartment. This new basket design option accommodates a larger fuel compartment size. Many of the changes did not require a 72.48 evaluation; the changes described below were evaluated:

1. The fuel compartment size was increased from 8.65 inches to 8.76 inches.
2. Change in the combined thickness of the paired aluminum and poison plates from 0.495 inch to 0.365 inch.

3. Change to allow a maximum number of 3 Type 1100 aluminum shims with a maximum combined thickness of 0.24 inch. The shims are installed between the rail and the basket.
4. Revise the fuel compartment dimension from 8.70 inches to 8.85 inches.
5. Revise slot spacing for selected basket plates from 9.58 inches to 9.60 inches.
6. Reduced thickness for selected basket plates from 0.5 inch to 0.375 inch.
7. Reduce the length of the R90 Transition Rail for the 32PTH1 Type 2-W basket from 37.11 inches to 36.57 inches.
8. Increase in the centerline dimension for the R90 Transition Rail from 28.79 inches to 28.99 inches (as a result of reducing the R90 Transition Rail length).
9. Revise dimension for the Rail Face for the 32PTH1 Type 2-W basket from 9.14 inches to 9.1625 inches.
10. Add dimensions to the centerline of the DSC from the corner of the R45 Transition Rail. Horizontal and vertical dimensions from the corner to the centerline of the DSC are both 19.45 inches. The increase in the centerline dimension is the result of reducing the R45 transition rail size to accommodate the 32PTH1 Type 2-W basket design.

Evaluation Summary

A sensitivity study was performed for the criticality design function to compare the new configuration of 32PTH1 Type 2 – W to the design and licensing basis configuration, the NUHOMS® 32PTH1 Type 2 DSC. The licensing approach for the criticality evaluation is to determine the NUHOMS® 32PTH1 Type 2 – W DSC most reactive configuration (MRC), and then to compare it to the NUHOMS® 32PTH1 DSC MRC. It is concluded that the NUHOMS® 32PTH1 MRC bounds the NUHOMS® 32PTH1 Type 2 – W MRC with a margin of about 4σ. Regarding criticality control, the analysis indicates that the most limiting k_{eff} for the 32PTH1 Type 2 – W is 0.9309, which is bounded by the most limiting k_{eff} of 0.9336 for the 32PTH1 Type 1 as currently reported in the UFSAR, and satisfies the established Upper Subcritical Limit (USL) of 0.95 considering all applicable biases and uncertainties, such that the 32PTH1 Type 2 - W system is maintained in a safe sub-critical condition.

The structural analyses for the 32PTH1 Type 2 – W demonstrate that the 32PTH1 Type 2 – W DSC is bounded by the normal, off-normal, and accident limits, as described in the UFSAR. The stress analysis results demonstrate that all ASME code criteria are satisfied, and the buckling evaluation demonstrates that the basket remains stable for side drop accident events, such that the proposed design changes have no adverse effect on the stress and buckling analyses of the basket and shell for the credited structural design functions.

Regarding thermal performance, the analyses demonstrate that the maximum fuel temperatures for the system are maintained within the established limits of 752 °F for the normal conditions of storage and the normal and off-normal conditions of transfer, and 1058 °F for the off-normal and accident conditions of storage and the accident conditions of transfer. The most limiting load cases for normal and off normal conditions of storage were reanalyzed with the revised parameters for the 32PTH1 Type 2-W. The design basis maximum temperatures and the maximum DSC internal pressures for the 32PTH1 Type 2

DSC, reported in Appendix U.4 of the UFSAR for the normal, off-normal, and accident storage conditions, remain bounding for the 32PTH1 Type 2 - W DSC.

Assessment of the shielding function concluded that there are no adverse effects on dose rates.

The results of the supporting analyses for the design change activities indicate that the 32PTH1 Type 2-W continues to satisfy the same design requirements as the original design for 32PTH1 Types 1 and 2, in such a way that the criticality safety, thermal performance, and structural integrity of the basket assembly are maintained.

All eight 72.48 evaluation criteria were met.

LR 721004-1470 Rev. 0 – (will be incorporated into next UFSAR revision)

Change Description

This activity involves determining the time limit for completion of transfer operations once the air circulation is interrupted for the 24PTH DSC. It also verifies that the time limits determined are in compliance with the time limits noted in TS 3.1.3 without any adverse effects on design functions. If the air circulation is activated as a recovery operation during transfer operations, the air circulation needs to be interrupted by turning off the blowers before transferring the DSC into the storage module.

Evaluation Summary

After air circulation is interrupted, the maximum temperatures for the basket assembly components, DSC shell and TC components increase. The effects of these changes in temperature on the design functions described in the UFSAR for the 24PTH DSC were evaluated. There is no impact on the DSC internal pressure since the average helium temperature remains below the temperature used in the design basis calculation to determine the maximum internal pressure.

The maximum fuel cladding temperatures after the loss of air circulation are 725 °F at 11.5 hours for the 24PTH DSC with Type 1 Basket and 720 °F at 27 hours for 24PTH DSC with Type 2 Basket. Considering a two hour reaction time, as noted in Section 3.1.3 of the TS, the time limit to complete the transfer after interrupting the air circulation would be 9.5 hours for the 24PTH DSC with Type 1 Basket and 25 hours for a 24PTH DSC with Type 2 Basket. These time limits are identical to the time limits specified in LCO 3.1.3 of the Technical Specification for the 24PTH DSC. Using the time limits in TS 3.1.3 after the blowers are turned off will not have an adverse effect on thermal design function of the 24PTH DSCs.

Further, the maximum fuel cladding temperatures determined after the loss of air circulation are below the maximum fuel cladding temperature of 734 °F determined for steady-state transfer operations of 24PTH DSC, Basket Type 1 with a maximum heat load of 31.2 kW. Because the maximum fuel cladding temperature remains below the previously evaluated temperature, and also below the regulatory limit for normal conditions, there is no effect on the fuel cladding. There is also no impact on the structural evaluation of the basket. Although the maximum DSC shell temperature increases for both the 24PTH1 DSC Type 1 and 2 baskets, the increased temperature on the DSC shell will not affect the structural design functions.

All eight 72.48 evaluation criteria were met.

LR 721004-1471 Rev. 0 – (will be incorporated into next UFSAR revision)

Change Description

This activity involves determining the time limit for completion of transfer operations once the air circulation is interrupted for the 61BTH DSC. It also verifies that the time limits determined are in compliance with the time limits noted in TS 3.1.3 without any adverse effects on design functions. If the air circulation is activated as a recovery operation during transfer operations, the air circulation needs to be interrupted by turning off the blowers before transferring the DSC into the storage module.

Evaluation Summary

After air circulation is interrupted, the maximum temperatures for the basket assembly components, DSC shell, and fuel cladding increase. The effects of these changes in temperature on the design functions described in the UFSAR for the 61BTH DSC were evaluated. There is no impact on the DSC internal pressure due to the loss of air circulation since the average helium temperature in the DSC is lower than the bounding average helium temperature used in the internal pressure calculation for the 61BTH Type 2 DSC.

The maximum fuel cladding temperatures after the loss of air circulation are 732 °F at 28 hours for the 61BTH Type 2 DSC with HLZC #4 and 722 °F at 15 hours for the 61BTH Type 2 DSC with HLZC #21. Considering a two-hour reaction time as noted in Section 3.1.3 of the TS, the time limit to complete the transfer after interrupting the air circulation would be 26 hours for the 61BTH Type 2 DSC with HLZC #4, and 13 hours for the 61BTH Type 2 DSC with HLZC #21. These time limits are identical to the time limits specified in LCO 3.1.3 of the TS for the 61BTH DSC. Using the time limits in TS 3.1.3 after the blowers are turned off will not have an adverse effect on the thermal design function of the 61BTH DSCs.

The increase in temperature is within the design limits of the structural or thermal design functions and is found to be acceptable. There is no impact on the structural or thermal design functions of the 61BTH Type 2 DSC.

All eight 72.48 evaluation criteria were met.

LR 721004-1512 Rev. 0 – (no associated UFSAR change)

Change Description

A customer has identified certain Babcock and Wilcox (B&W) Mark B 15x15 fuel assemblies (FAs) at their nuclear station that have slipped and/or damaged grids. This activity is to (a) evaluate the structural adequacy of these B&W 15x15 FAs with slipped and/or damaged spacer grids for storage in the 32PTH1 Type 2-W dry shielded canister (DSC) and, (b) provide recommendations for augmenting the structural capacity of these FAs with anti-fretting clips if the spacer grid damage or slippage exceeds certain limits.

These FAs with slipped and/or damaged spacer grids are considered to be in a "damaged" configuration. Accordingly, consistent with the requirements of TS Table 1-1aa, these affected FAs are to be stored in the 32PTH1 Type 2-W DSC basket cells provided with end caps in the center 16 locations earmarked for damaged FAs. Damaged FAs loaded in the NUHOMS® 32PTH1 System are evaluated for normal/off-normal handling loads in UFSAR Section U.3.6.3. For accident conditions, damaged FAs are assumed to become rubble, and are, therefore, not qualified for accident events.

Evaluation Summary

The fuel assemblies with slipped and/or damaged grids have no adverse effect on the design, form, or fit of any component of the 32PTH1 Type 2-W DSC shell and basket assemblies. The structural integrity evaluation of "damaged" FAs with slipped and/or damaged grids is, therefore, focused only on the ability to retrieve these FAs under normal/off-normal conditions.

Consistent with UFSAR Appendix U.3, a new analysis has been completed that applies a 2g transverse loading (1g transverse loading and dead weight) along the entire fuel rod. For intact fuel (non-leakers), the maximum calculated bending stress, plus stress due to rod internal pressure, is compared with the yield strength of zircaloy and M5 fuel cladding material. Additional analyses are performed for situations where (a) single spacer grid is removed, and (b) multiple pairs of non-adjacent grids are removed.

For damaged fuel (leakers), the maximum calculated bending stress is used to calculate the fracture toughness stress intensity factors based on the method shown in UFSAR Section U.3.6.3.2. The evaluation of damaged fuel rods (i.e., leakers) conservatively uses the bounding fracture toughness allowable stress intensity factor (K_{IC}) of Zircaloy-4 cladding for consideration of both the M5 cladding and zircaloy cladding.

Intact Fuel Rods (Non Leakers) Stress Results

The limiting bending stress for the worst-case removed spacer grid is 11.12 ksi. The pressure stress is determined to be 21.28 ksi. Therefore, the combined (pressure + bending stress) = 21.28 + 11.12 = 32.40 ksi. The allowable yield stress for M5 and zircaloy cladding material is 52.72 ksi and 86.0 ksi, respectively. Hence, the maximum combined pressure and bending stress of the fuel rod with M5 cladding or zircaloy cladding is acceptable. Therefore, slippage of a single spacer grid or multiple non-adjacent spacer grids is acceptable "as-is". However, if multiple adjacent spacer grids have slipped, repositioning of the slipped grids is required. Also, if multiple adjacent spacer grids are damaged, "repair" of the damaged grids with installation of anti-fretting clips is required.

Damaged Fuel Rods (Leakers) Stress Results

For damaged fuel rods (leakers), the fuel rod bending stress is used to calculate the fracture toughness stress intensity factors (K_I) using the same method as in UFSAR Section

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U.3.6.3.2. Based on the new analysis, the maximum allowed slippage is 12 inches in the downward direction, with a K_I/K_{IC} ratio of 0.119, which is less than the limit of 0.12 used in UFSAR Section 3.6.3. If a spacer grid slippage is more than 12 inches, repositioning of the slipped grids is required. At single or multiple damaged spacer grid locations where the fuel rod support is no longer provided or is weakened by local damage, "repair" with installation of anti-fretting clips is required.

Combined 1g Axial Loading and Deadweight Loading

As determined in the new analysis, for each fuel rod, the maximum combined axial compressive stress + deadweight stress + hoop stress = 293 psi + 5,559 psi + 21,276 psi = 27,130 psi. This calculated maximum stress in the fuel rods is significantly less than the irradiated yield stress of the cladding material of 52,720 psi (for M5 material). Therefore, the fuel rods will maintain their structural integrity when subjected to deadweight plus a 1g longitudinal load during retrieval. Note also that the calculated total stress for axial loading is less than the transverse loading and therefore is not limiting.

Requirement for Anti-Fretting Clips

Anti-fretting clips (which are approximately of the same thickness and are fabricated from material of similar strength as the spacer grids) will provide the necessary bearing surface to replace the bearing support provided by the damaged spacer grid. Depending on the extent of slippage and/or damage to the FA spacer grids, the "as-is" condition or a "repaired" configuration consisting of either (a) repositioning the spacer grids, or (b) required installation of anti-fretting clips is acceptable.

The slipped/damaged fuel assembly grids addressed by this evaluation do not have an adverse impact on the structural, thermal, shielding, or criticality function of the 32PTH1 Type 2-W basket. The 32PTH1 Type 2-W DSC basket remains in compliance the allowable criteria (stress/strain and criticality) identified in the UFSAR for normal, off-normal and accident conditions, and there are no changes to the loading/unloading/handling operations.

All eight 72.48 evaluation criteria were met.