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PRELIMINARY SAFETY EVALUATION REPORT

DOCKET NO. 72-1004
AREVA TN
CERTIFICATE OF COMPLIANCE NO. 1004
STANDARDIZED NUHOMS® SYSTEM
AMENDMENT NO. 14

SUMMARY

This safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's review and evaluation of the amendment request to amend Certificate of Compliance (CoC) No. 1004 for the Standardized NUHOMS® System submitted by AREVA TN (AREVA) by letter dated April 16, 2015 (ADAMS Accession Number ML15114A056), as supplemented on November 11, 2015 (ADAMS Accession Number ML15331A350), and March 14, 2016 (ADAMS Accession Number ML16076A231). The proposed changes include the following:

1. Improvements to the fuel qualification tables for the BWR and PWR dry shielded canisters (DSCs) to allow for the calculation of cooling times for different uranium loading (described in Chapter 13 of this document).
2. Include new heat load zoning configurations (HLZCs) for the 61BTH, 32PTH1 and 69BTH DSCs.
3. Authorize storage of up to 61 damaged BWR fuel assemblies in the 61BTH DSC.
4. Authorize storage of up to sixteen (16) failed fuel cans (FFCs) in the 32PTH1 DSC.
5. Expansion of the 37PTH criticality analysis to include poison rod assemblies (PRAs).
6. Evaluation of the horizontal storage module (HSM) model HSM-H for shielding impact of reduced density concrete and gaps during installation.
7. Clarify and revise various terms and definitions in the Technical Specifications (TSs).
8. Authorize acceptance testing for neutron absorber content to be performed by either neutron transmission or by B-10 volume density measurement.
9. Amend the Technical Specifications to remove language that requires a transfer cask (TC) containing a dry shielded canister (DSC) be returned to the spent fuel pool following a drop of over 15 inches, and instead permit the general licensee to determine the best available option for inspection of the TC/DSC by either returning it to the spent fuel pool or an alternate means.
10. Revise the minimum soluble boron concentration of 2800 ppm for Type A2 poison for Westinghouse (WE) 17x17 fuel design only.
11. Update the existing Fuel Qualification Table (FQT) for the 32PTH1 Dry Shielded Canister (DSC) with a heat load of 1.2 kW/FA.

Enclosure

12. Allow for an alternative loading configuration of 16 damaged fuel assemblies in the 32PTH1 DSC.

The revised CoC, when codified through rulemaking, will be denoted as Amendment No. 14 to CoC No. 1004.

This SER documents the review and evaluation of the proposed amendment. The staff followed the guidance of NUREG-1536, Revision 1, “Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility”; Interim Staff Guidance (ISG) -11, “Cladding Considerations for the Transportation and Storage of Spent Fuel”; ISG-21, “Use of Computational Modeling Software”; and ISG-23, “Application of ASTM Standard Practice C1671-07 when performing technical reviews of spent fuel storage and transportation packaging licensing actions.”

The staff's evaluation is based on a review of AREVA’s application and whether it meets the applicable requirements of 10 CFR Part 72 for dry storage of spent nuclear fuel. The staff’s evaluation focused only on modifications requested in the amendment as supported by the submitted revised final safety analysis report (FSAR) (see ADAMS Accession Nos. ML15114A056, ML15331A350, and ML16076A231) and did not reassess previous revisions of the FSAR nor previous amendments to the certificate of compliance.

1.0 GENERAL DESCRIPTION

The objective of this chapter is to review the changes requested to CoC No. 1004 for the Standardized NUHOMS® System to ensure that AREVA provided an adequate description of the pertinent features of the storage system and the changes requested in the application. The specific changes requested by the applicant are described and evaluated in the following sections of this SER.

1.1 Findings

F1.1 The staff concludes that the information presented in the proposed FSAR pages satisfies the requirements for the general description under 10 CFR Part 72. This finding is reached on the basis of a review that considered the regulation itself, Regulatory Guide 3.61, and accepted practices. The staff concludes that the applicant’s information is sufficiently detailed to allow NRC staff to familiarize themselves with the pertinent features of the system and the changes requested.

2.0 PRINCIPAL DESIGN CRITERIA EVALUATION

The applicant did not propose any changes that affect the staff’s principal design criteria evaluation provided in previous safety evaluations for CoC No. 1004, Amendments 1 through 11 and Amendment 13. Therefore, the staff determined that a new evaluation was not required.

3.0 STRUCTURAL EVALUATION

The applicant requested several changes related to the structural evaluation of the Standardized NUHOMS® System. The specific changes reviewed in this evaluation pertain to Item No. 6 in the summary of changes related to the analyzed concrete density of the horizontal storage modules (HSMs), Item No. 9 regarding the removal of the technical specification requirement to return a transfer cask (TC) with a loaded DSC to the spent fuel pool following a cask drop, and Item No. 12 regarding the changes to the technical specifications to allow up to 16 failed fuel cans in the 32PTH1 DSC.

The applicant requested the use of concrete with a density of 140 pounds per cubic foot (pcf) rather than concrete with an unreinforced density of 145 pcf in the HSM-H module. The applicant demonstrated that the safety factors (sliding and overturning) for tornadic, seismic, and flood-based analyses are not appreciably affected by lower concrete density. The staff reviewed the applicant's evaluation and concludes that the proposed changes to the concrete specification of the HSM-H module will not affect the ability of the cask system of meeting the requirements of 10 CFR 72.236(l).

The applicant requested to remove wording in the TSs that requires that a transfer cask containing a loaded DSC be returned to the spent fuel pool following a drop of over 15 inches. In Section 8.2.5 of the FSAR, the applicant demonstrates that there is no reasonable way for a TC/DSC drop accident to occur. In addition, the bounding FSAR safety analysis for the drop accident demonstrates the structural integrity of the DSC is met for all postulated drop scenarios. The staff reviewed the applicant's evaluation and supporting references and found that the consequences of a drop accident from a height of 80 inches (which is the limiting lifting height in the TSs) were evaluated in previous certificate approvals for the cask system, and the staff found that the structural integrity of the DSC would be maintained after this drop. Accordingly, the staff finds that the requirement of returning a transfer cask loaded with a DSC to a spent fuel pool after a drop is not necessary to confirm or verify the structural integrity of the DSC, and does not affect the ability of the cask system of meeting the requirements of 10 CFR 72.236(l).

The applicant requested authorization to store up to 4 failed fuel cans in the four corners of the innermost 4x4 cells of the DSC basket, when the remaining cells are loaded with intact or damaged fuel assemblies; or to store up to 16 failed fuel cans in a checkerboard pattern inside the 32PTH1 DSC basket, with the remaining cells either empty or loaded with dummy fuel assemblies. The staff determined that the maximum mass of the 32PTH1 DSC would not be exceeded and the center of gravity of the DSC would not be significantly altered with the addition of failed fuel cans. Accordingly, the staff finds that the structural analyses previously evaluated by staff in support of the initial approval of the 32PTH1 DSC (SER for Amendment No. 10, ADAMS Accession Number ML092290329) remain valid. The staff concludes that the revised loading configuration of the 32PTH1 DSC continues to meet the requirements of 10 CFR 72.236(l).

3.1 Findings

F3.1 Based on review of the statements and representations in the application, the staff concludes that the proposed changes to the structural design and operations for Standardized NUHOMS® System meet the requirements of 10 CFR Part 72.

4.0 THERMAL EVALUATION

The objective of the staff's review of the applicant's thermal evaluation for Amendment 14 to the Standardized NUHOMS® Storage System is to verify that the cask and fuel material temperatures will remain within the range of allowable values or criteria for normal, off-normal, and accident conditions. Specifically, the staff analyzed whether the temperatures of the fuel cladding will meet regulatory requirements throughout the storage period and will protect the cladding against degradation that could lead to gross rupture. The applicable regulatory requirements are found in 10 CFR 72.236(b), 72.236(f), 72.236(g), and 72.236(h).

The staff reviewed the information provided in the amendment request to determine whether the Standardized NUHOMS® Storage System continues to fulfill the acceptance criteria listed in Chapter 4 of NUREG-1536, Rev. 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility."

The majority of the changes requested by the applicant do not involve design changes to the major components of the Standardized NUHOMS® System and are related to the authorized contents. The changes in the application that involve thermal consideration are described below.

4.1 Standardized NUHOMS® New Heat Load Zoning Configurations

The applicant describes new heat load zoning configurations (HLZCs) for the 61BTH (HLZC#9 and HLZC#10), the 32PTH1 (HLZC#4), and the 69BTH (HLZC#7) DSCs.

4.1.1 Standardized NUHOMS® 61BTH DSC with HLZC#9

Section T.4.6.10 of the application describes the thermal evaluation of the NUHOMS® 61BTH DSC with HLZC#9 and HLZC#10, and presented in the Technical Specifications at Figures 1-25a and 1-25b, respectively. HLZC#9 has a maximum decay heat of 22.0 kW per DSC, which applies to the 61BTH Type 1 and Type 2 DSCs. HLZC#9 also has a maximum per assembly decay heat up to 0.48 kW and is in a zone configuration. The maximum decay heats for HLZC#9 equal the decay heat values for the 61BTH DSCs previously evaluated by the applicant (SER for Amendment No. 10, ADAMS Accession Number ML092290329).

The applicant's previous evaluation of DSC shell temperature, contained in Amendment No. 10, treated decay heat as a heat flux on the radial inner surface of the DSC or as a volumetric heat generation rate applied over a homogenized basket. Because of this, the proposed new heat loading zone configuration(s) will not affect the maximum temperatures of the canister inner surface and the maximum temperatures will be uniform across the surface of the DSC. The applicant described the DSC shell temperature profiles for storage conditions in Section T.4.4 of the application and for transfer operations in Section T.4.5 of the application and concluded that the profiles remain applicable for HLZC #9 and HLZC#10. The staff reviewed Section T.4.6.10 of the application and determined that the DSC shell temperature profile from Section T.4.4 and T.4.5 remains applicable for HLZC #9 and #10 of the 61BTH canister.

The applicant evaluated the 61BTH DSC Type 1 loaded in the HLZC#9 and presented the results in Section T.4.5 of the application. The applicant used the DSC shell temperature profiles from the thermal evaluation for the 61BTH DSC at 22 kW to bound the thermal performance of the 61BTH DSC with HLZC#9 because the DSC Type 1 is thermally less efficient than the DSC Type 2. The maximum fuel cladding temperature for the 61BTH Type 1 DSC was reported as 741°F, which is below the allowable limit of 752°F established in ISG-11.

The applicant examined off-normal and accident conditions, and determined that under the most serious accident condition, a blocked vent condition, the fuel cladding temperature remained 200°F below the limit of 1058°F for zircaloy cladding, established in ISG-11. The applicant's earlier evaluation of the allowable stresses on the basket assembly and the top grid at a temperature of 750°F concluded that the structural evaluation remains bounded. While the average helium temperature increased by 3°F, the applicant concluded the small increase does not affect the maximum internal pressure.

The staff reviewed the applicant's analyses and concludes that the 61BTH Type 1 DSC bounds the thermal performance of HLZC#9. The staff finds the proposed configuration provides reasonable assurance that the fuel cladding and component maximum temperature will remain below the limits in ISG-11.

4.1.2 Standardized NUHOMS® 61BTH DSC with HLZC#10

Section T.4.6.10 of the application describes the thermal evaluation of the NUHOMS® 61BTH DSC with HLZC#9 and HLZC#10, and presented in the Technical Specifications at Figures 1-25a and 1-25b, respectively. The HLZC#10 has a maximum decay heat of 31.2 kW per DSC, which applies only to the 61BTH Type 2 DSC. The HLZC#10 also has a maximum per assembly decay heat up to 0.9 kW and is in a zone configuration. The maximum decay heat for HLZC#10 is equivalent to the decay heat for the 61BTH DSCs reported by the applicant in its earlier evaluation.

The applicant's previous evaluations of DSC shell temperature, contained in Amendment No. 10, treated decay heat as a heat flux on the radial inner surface of the DSC or as a volumetric heat generation rate applied over a homogenized basket. Because of this, the proposed new heat loading zone configuration(s) will not affect the maximum temperatures of the canister inner surface and the maximum temperatures will be uniform across the surface of the DSC. The DSC shell temperature profiles for storage conditions are described in Section T.4.4 of the application and the profiles for transfer operations are described in Section T.4.5 of the application. The applicant concluded the profiles remain applicable for HLZC#10. The staff reviewed Section T.4.6.10 of the application and determined that the DSC shell temperature profiles described in Sections T.4.4 and T.4.5 remain applicable for HLZC#10 of the 61BTH canister.

The applicant performed a thermal evaluation of the 61BTH DSC Type 2 with HLZC#10 and presented the results in Sections T.4.4 and T.4.5 of the application. The DSC shell temperature profiles from the thermal evaluation for the 61BTH Type 2 DSC at 31.2 kW set the boundary conditions to evaluate the thermal performance of the 61BTH Type 2 DSC with HLZC#10. The applicant calculated the maximum fuel cladding temperature for the 61BTH Type 2 DSC as equal to 711°F, which is below the allowable limit of 752°F, established in ISG-11. The applicant calculated 1°F increases in the temperature for the basket rails and top grid under normal storage conditions. The applicant calculated a 1°F increase in the temperature for the top grid and 2°F increase in the temperature for the basket rails under vertical transfer conditions. The staff reviewed the temperature values and confirmed that they will remain below allowable limits in ISG-11. For this reason, the staff finds that changes in DSC temperature profiles will not affect the thermal or structural performance of the casks.

The applicant concluded the maximum fuel cladding temperatures under normal, off-normal, and accident conditions of the 61BTH Type 2 DSC are bounding for HLZC#10. The applicant calculated the 61BTH Type 2 DSC with a maximum decay heat of 31.2 kW, has a transfer time limit of 13 hours. The transfer time limit for HLZC#7 and for all 61BTH Type 2 DSCs is also 13 hours. The staff concludes that using the same transfer time limits will ensure that the maximum temperatures for HLZC#10 during transfer are bounded by the previously established limits of the 61BTH Type 2 DSC, (SER for Amendment No. 10, ADAMS Accession Number ML092290329). Although the average helium temperature increased by 3°F, the applicant concluded the small increase does not affect the maximum internal pressure. Based on its review of this evaluation, the staff determined that the existing transfer time limit remains valid for the transfer operations of HLZC#10, and that the increase in average helium temperature will not affect the maximum internal pressure of the DSC.

4.1.3 Standardized NUHOMS® 69BTH DSC with HLZC#7

Section Y.4.6.11 of the application discusses the thermal evaluation of the Standardized NUHOMS® 69BTH DSC in the HLZC#7 and the evaluation is also referenced in the Technical Specifications at Figure 1-38. The HLZC#7 has a maximum decay heat of 35.0 kW per DSC and fuel assemblies with a decay heat of up to 0.9 kW in a zone configuration. The maximum decay heat for HLZC#7 is equal to that previously evaluated by the applicant for the 69BTH DSC in Amendment No. 13 to the Standardized NUHOMS System (ADAMS Accession Number ML14153A579).

The applicant's previous evaluations of DSC shell temperature in Amendment No. 13 treated decay heat as a heat flux on the radial inner surface of the DSC or as a volumetric heat generation rate applied over a homogenized basket. Because of this, the proposed new heat loading zone configuration(s) will not affect the maximum temperatures of the canister inner surface and the maximum temperatures will be uniform across the surface of the DSC. The applicant concluded the DSC shell temperature profiles for storage conditions, presented in Section Y.4.4.8 of the application will also be applicable to HLZC#7. The staff reviewed the conclusions in Section Y.4.6.11 of the application and determined that the applicant's conclusion that the DSC shell temperature profiles from Section Y.4.4.8 will remain applicable for HLZC#7 of the 69BTH canister.

In its thermal evaluation of the 69BTH DSC with HLZC#7, the DSC shell temperature profiles in Section Y.4.4 of the application are used as boundary conditions to evaluate the thermal performance of the 69BTH DSC with HLZC#7. The applicant calculated a maximum fuel cladding temperature for HLZC#7 during storage conditions of 730°F. For normal and off-normal short term transfer operations, the applicant calculated a maximum fuel cladding temperature for HLZC#7 of 737°F. The staff finds that these temperatures remains below the allowable limit of 752°F established in ISG-11.

The applicant's calculations indicate that the peak fuel cladding temperature of the HLZC #7 increases by 2°F to 861°F during storage and by 6°F to 924°F during transfer operations. The staff finds that this temperature remains below the peak fuel cladding temperature limit of 1058°F established in ISG-11. In the previous evaluation of the 69BTH DSC (contained in Amendment No. 13), the applicant determined the transfer time limit was 13 hours for the maximum decay heat of 35 kW. The transfer time limit is the same for HLZC#1 through HLZC#5, HLZC#7, and for all 69BTH DSCs. Accordingly, the staff concludes that using the same transfer time limits will ensure that the maximum temperatures for HLZC#7 during transfer are bounded by the previous limits of the 69BTH DSC. Because the average helium temperature remains unchanged, the staff determined that there is no effect on the maximum internal pressure of the DSC.

The staff reviewed the applicant's supporting analyses in Section Y.4.6.11 of the application and determines that the applicant's analysis of fuel cladding temperature provides reasonable assurance that the fuel temperatures will remain below the limits in ISG-11.

4.1.4 Standardized NUHOMS® 32PTH1 DSC with HLZC#4

Section U.4.9 of the application describes the thermal evaluation of the NUHOMS® 32PTH1 DSCs with HLZC#4, the evaluation is also referenced in the Technical Specifications at Figure 1-28a. The HLZC#4 has a maximum decay heat of 31.2 kW per DSC and fuel assemblies with a decay heat of up to 1.5 kW in a zone configuration. The HLZC#4 also accommodates up to 16 damaged fuel assemblies and up to four failed fuel assemblies stored in failed fuel cans. However, the remaining fuel assemblies are intact assemblies. The maximum decay heat for HLZC#4 is equal to that previously evaluated by the applicant for the 32PTH1 DSC in Amendment No. 10 (ADAMS Accession Number ML092290329). The applicant's previous evaluations of DSC shell temperature in Amendment No. 10 treated decay heat as a heat flux on the radial inner surface of the DSC or as a volumetric heat generation rate applied over a homogenized basket. Because of this, the proposed new heat loading zone configuration(s) will not affect the maximum temperatures of the canister inner surface and the maximum temperatures will be uniform across the surface of the DSC. The applicant described the DSC shell temperature profiles for storage conditions in Section U.4.4 and for transfer conditions in Section U.4.5 of the application and concluded that the profiles remain applicable for HLZC#4. The staff reviewed Section U.4.9 of the application and determined that the DSC shell temperature profiles from Section U.4.4 and U.4.5 remain applicable for HLZC#4 of the 32PTH1 canister because the proposed new heat loading configurations will not affect the temperatures and the temperatures will remain uniform.

The applicant performed a sensitivity study that concluded the placement of higher decay heat fuel assemblies in the outermost compartments would lower the peak fuel cladding temperature. Accordingly, the applicant's evaluation maximized the decay heat within the inner compartments and lowered the heat load within the outer compartments. Because there are two zones of outer compartments in HLZC#4, the applicant performed two sets of sensitivity studies where the fuel assembly decay heat in each of the two outer zones was reduced to determine the bounding configuration. The applicant determined that the bounding configuration for HLZC#4 was obtained by maximizing the per-assembly decay heat within the inner compartments in addition to Zone 6, and reducing the per-assembly decay heat within Zone 4a. The applicant reviewed the results of the previously evaluated 32PTH1 DSC Type 1 and Type 2 basket designs (from Amendment No. 10) with the maximum decay heat to determine the design load cases under normal, off-normal, and accident conditions. The applicant determined the limiting design load cases for evaluating the thermal performance were: 1) normal storage at 106°F ambient; and 2) off-normal transfer with vertical loading conditions with 140°F ambient.

The applicant evaluated the 32PTH1 DSC with HLZC#4 for these bounding heat load and limiting design load cases. The applicant specifically evaluated 32 intact fuel assemblies, and 16 damaged fuel assemblies stored in the inner compartments (zones 1, 2, and 5a, as shown in Figure 1-28a of the Technical Specifications) with the remaining 16 intact. The applicant showed that the maximum fuel cladding and basket assembly components temperatures for HLZC#4 remained bounded by the HLZC#2 previously evaluated in Amendment No. 10. The applicant concluded that the temperature of the 32PTH1 DSC components remain within their limits, and bounded by the transfer time limits of HLZC#2. The applicant also concluded that the average helium temperature and internal canister pressure remains bounded by HLZC#2.

The NRC staff reviewed the applicant's evaluation of the 32PTH1F DSC with both the HLZC#4 that includes up to four failed fuel cans (FFCs) and the HLZC#3 that includes up to 16 FFCs. The staff's evaluation and corresponding conclusions for HLZC#4 that includes up to four failed fuel cans (FFCs) is described in Section 4.3 and 4.6 of this SER, and the staff's evaluation and corresponding conclusions for HLZC#3, which includes up to 16 FFCs, are described in Section 4.3.1 of this SER. The evaluation includes an alternative loading configuration of 16 damaged fuel assemblies stored in the outer most locations which are identified as zones 4a and 6 shown in Figure 1-28a of the Technical Specifications.

4.2 Storage of up to 61 Damaged BWR Fuel Assemblies in Standardized NUHOMS® 61BTH DSC

Section T.4.6.11 of the application described allowance for up to 61 damaged BWR fuel assemblies to be stored in the 61BTH DSC. In addition, based on Table 1-1t of the Technical Specifications, there could be anywhere from 1 to 60 intact fuel assemblies with up to 61 damaged fuel assemblies (such that the total of intact and damaged fuel assemblies adds up to 61). The applicant stated that the damaged fuel assemblies maintain an overall physical configuration similar to those of intact fuel assemblies during normal and off-normal conditions. The applicant also concluded that due to the maintained physical configuration and structural integrity, the effective thermal properties and the thermal evaluations in Sections T.4.6.6 and T.4.6.7 remain valid for normal and off-normal conditions. The applicant stated that during a hypothetical drop accident, high-burnup damaged fuel assemblies could experience further damage potentially turning into rubble. The applicant performed a sensitivity study to determine the maximum basket temperatures with 61 damaged fuel assemblies as rubble during the bounding transfer accident conditions. Because the fuel temperature limits in ISG-11 are not applicable to fuel that has turned into rubble, the staff concludes that there are no fuel thermal limits applicable to the fuel or to any of the basket components associated with this scenario. Additionally, there are no components, such as seals, whose performance is directly impacted by the potential shift in the fuel.

The applicant performed a sensitivity study of five combinations of damaged / intact fuel to determine the effect of the damaged fuel assemblies turning into rubble on the surrounding intact fuel assemblies and basket components during the bounding transfer accident conditions. The results of these sensitivity studies showed that the maximum calculated intact fuel cladding temperature was 955°F for one centrally located intact fuel assembly surrounded by 60 damaged fuel assemblies considered as rubble. Also, according to Technical Specification Figure 1-25, Note 1, four of the damaged fuel assemblies may be failed fuel assemblies. This scenario was analyzed by the applicant in Section T.4.6.9 of the Standardized NUHOMS Updated Final Safety Analysis Report (UFSAR). The staff has reviewed the applicant's analyses and determined that the calculated temperature is well below the allowable peak fuel cladding temperature limit of 1058°F established in ISG-11.

4.3 Storage of Four Failed Fuel Cans in Standardized NUHOMS® 32PTH1F DSC

Sections U.3.6.4, U.4.9, and U.4.9.2 of the application describes the thermal analysis for the storage of up to four failed fuel cans (FFCs) in the 32PTH1F DSC, as part of HLZC#4. The applicant evaluated the 32PTH1F DSC with HLZC#4 with: 1) up to four FFCs in Zone 5a, as shown in Figure 1-28a of the Technical Specifications, up to 12 damaged fuel assemblies in the inner most locations zones 1 and 2 shown in Figure 1-28a of the technical specifications, and the remaining fuel assemblies intact; and 2) up to four FFCs in Zone 5a, as shown in Figure 1-28a of the Technical Specifications, with the remaining fuel assemblies intact.

As discussed in Section 4.1.4 of the SER, the applicant stated that the bounding configuration for HLZC#4 was obtained by maximizing the per-assembly decay heat within the inner compartments, in addition to Zone 6, and by reducing the per-assembly decay heat within Zone 4a. The applicant also modified the heat generation rate equation based on the FFC maximum decay heat load, active fuel length and peaking factor. The applicant also stated the two limiting design load cases (described in Section 4.1.4 of the SER for normal storage and off-normal transfer conditions) also apply to the 32PTH1F DSC with HLZC#4 with up to four FFCs. The applicant showed that the maximum fuel cladding and basket assembly components temperatures for HLZC#4 remained bounded by the HLZC#2 previously evaluated in Amendment No. 10 (ADAMS Accession Number ML092290329), except for the basket rails. Although the maximum basket rail temperature increases by up to 8°F, the applicant concluded this temperature increase would not affect the structural performance, because it was evaluated at a bounding temperature of 350°F The applicant concluded that the temperature of the 32PTH1F DSC components remain within their limits, and bounded by the transfer time limits of HLZC#2.

The applicant also analyzed normal, off-normal, and off-normal transfer conditions and calculated the maximum FFC wall temperature for the 32PHT1F DSC with HLZC#4. The analyses showed the FFC wall temperature was within the temperature limits. The applicant found the average helium temperature of the 32PHT1F DSC with HLZC#4 remains bounded by 32PTH1 DSC with HLZC#2, except for the off-normal transfer condition. Although the bounding average helium temperature for the 32PHT1F DSC with HLZC#4 increased by 2°F, the applicant concluded that will not increase internal pressure in the DSC. This is because the four failed fuel assemblies will not have any internal pressure, thus they will negate the pressure effects of the small increase in temperature.

The applicant chose to conservatively evaluate the storage of four FFCs in the 32PTH1F DSC. The applicant examined the HLZC#4 during accident conditions and assumed all four failed fuel assemblies have been reduced to rubble. The applicant compared this configuration to the configuration described in the NUHOMS® HD UFSAR, Revision No. 5 (Docket No. 72-1030). The NUHOMS® HD USFAR describes temperature changes in the DSC during accident conditions. Table 4-27 of the UFSAR indicates that, the temperature of intact fuel assemblies and DSC components decreases when 16 damaged fuel assemblies are transformed into rubble during an accident. The applicant concluded the 32PHT1F DSC with HLZC#4 would be similar to the NUHOMS® HD 32PTH DSC, since the same locations are chosen for the failed fuel assemblies. The staff reviewed the applicant’s analyses in Sections U.3.6.4, U.4.9, and U.4.9.2 of the application and finds that the applicant conservatively analyzed the proposed storage configuration of four FFCs in the 32PTH1F DSC because it assumed all four fuel assemblies are reduced to rubble. The staff finds that, under the analyzed accident conditions, the proposed configuration of FFCs will not increase the cladding temperature of surrounding intact fuel assemblies beyond the limits in ISG-11.

4.3.1 Storage of 16 Failed Fuel Cans in Standardized NUHOMS® 32PTH1F DSC

Sections U.4.6, and U.4.10 of the application evaluates the storage of up to 16 failed fuel cans (FFCs) in the 32PTH1F DSC as part of HLZC#3. The applicant evaluated the 32PTH1F DSC with HLZC#3 with up to 16 FFCs, with the remaining cells empty or loaded with dummy assemblies. Figure 1-28 of the Technical Specifications specifies that if an FFC is stored any of the designated locations, intact or damaged fuel assemblies cannot be loaded. The applicant determined the maximum heat load for 16 failed fuel assemblies was 12.8kW, which is significantly lower than the maximum heat load of 24kW for HLZC#3. The applicant determined that the limiting design load case for evaluating the thermal performance was transfer loading conditions with 140°F ambient temperature.

The applicant evaluated the 32PTH1F DSC with HLZC#3 at the maximum allowable 24kW heat load and this limiting design load case. The applicant specifically evaluated a scenario where 16 failed fuel assemblies would be reduced to rubble. The applicant showed that the maximum basket assembly components temperatures for HLZC#3 with 16 failed fuel assemblies remain bounded by the HLZC#3 with intact fuel under normal and off-normal conditions. After evaluating accident conditions, the applicant concluded that a 32PTH1F DSC with 16 failed fuel assemblies in the HLZC#3 will remain bounded by the maximum temperatures found in Tables U.4-24 through U.4-26 of the UFSAR. The applicant also concluded the average helium temperatures for normal/off-normal and accident conditions are much lower than those for

HLZC#3 with intact fuel, due to the lower decay heat of the failed fuel assemblies. The staff reviewed the applicant's analyses in Sections U.4.6 and U.4.10 of the application and finds that the applicant conservatively analyzed the proposed storage configuration of sixteen FFCs in the 32PTH1F DSC because it assumed 16 failed fuel assemblies would be reduced to rubble. The staff finds that, under the analyzed accident conditions, the proposed configuration of FFCs will not increase the cladding temperature of surrounding intact fuel assemblies beyond the limits in ISG-11, and that the proposed storage configuration for sixteen FFCs is bounded by the HLZC#3 analyses previously evaluated in Amendment No. 10 (ADAMS Accession Number ML092290329).

4.4 Storage of Poison Rod Assemblies (PRAs) in Standardized NUHOMS® 37PTH DSC

Section Z.6 of the application states the PRAs are inserted into the guide tubes within the WE 17x17 class fuel assemblies. Section Z.4.9 of the Updated Final Safety Analysis Report (UFSAR) for the Standardized NUHOMS System shows that the effective thermal properties for the fuel assemblies in the 37PTH are based on the thermal evaluations for the 24PTH DSC (see Section P.4.8.1 of the UFSAR) and the 32PT DSC (see Section M.4.8.1 of the UFSAR). The USFAR indicates that solid PRAs are modeled as helium to determine the effective thermal conductivity in the transverse direction. The USFAR describes the cladding conductivity weighted by its fractional area, which is in accordance with the guidance in NUREG-1536. The staff reviewed the applicant's analyses and finds the storage of PRAs in the 37PTH will not alter bounding thermal conductivities and will not increase the maximum fuel cladding or DSC component temperatures.

4.5 Decrease in HSM-H Concrete Density to 140 Pounds per Cubic Foot (pcf)

Section U.4.4.8.1 of the application describes the evaluation of the thermal effects of a reduction in the density concrete from 145 pcf to 140 pcf on the horizontal storage module (HSM) model HSM-H. The applicant reported that a change in the density of the HSM-H concrete only affects the thermal mass of the storage system. The applicant evaluated an HSM-H loaded with the 32PTH1 DSC, which has the maximum decay heat of 40.8 kW. The applicant determined that the 40-hour blocked-vent accident condition results in the highest component temperatures. The applicant showed that the fuel cladding and maximum component temperatures will remain below allowable limits.

The staff reviewed the applicant's analyses in Section U.4.4.8.1 of the application and finds that the fuel cladding and maximum component temperatures remain below the allowable limits in ISG-11, as a result of the reduction in HSM concrete density.

4.6 Alternative Loading Configuration of 16 Damaged Fuel Assemblies in the 32PTH1 DSC

Section U.4.9.3 of the application evaluates the storage of up to 16 damaged fuel assemblies stored in the outer most locations of the 32PTH1 DSC basket loaded in HLZC#4. Figure 1-28a of the Technical Specifications shows Zones 4a and 6, where the damaged assemblies may be stored when the remaining fuel compartments contain only intact fuel. Figure 1-28a of the Technical Specifications prohibits the loading of failed fuel assemblies when a damaged fuel assembly is stored in an outer most location. The applicant determined the maximum heat load based on the evaluations in Section U.4.9.1.1 of the application. The applicant determined the limiting design load cases for evaluating the thermal performance were: 1) normal storage at 106°F ambient, and; 2) transfer accident conditions with 117°F ambient.

The applicant evaluated 16 intact and 16 damaged fuel assemblies loaded in Zones 4a and 6 of a 32PTH1 DSC with HLZC#4 to determine the bounding heat load and limiting design load. The results of the evaluation showed the maximum fuel cladding and basket assembly components temperatures for HLZC#4 remain bounded by the HLZC#2 previously approved in Amendment No. 10 for normal/off-normal conditions. In accident conditions, the fuel cladding temperature of the intact fuel also remains bounded by the HLZC#2 previously approved in Amendment No. 10. The applicant concluded that the 32PTH1 DSC components remain within temperature limits and the transfer time limits associated with HLZC#2 remain bounding. Although increases in temperature of the fuel compartment and basket rails may occur during accident conditions, the staff determined that these increases are not sufficiently large to exceed the design limits of the DSC. The applicant also showed the average helium temperatures for normal and accident conditions remain bounded by previous evaluations in Amendment No. 10.

The staff reviewed the applicant's analyses and concludes that the analyses for HLZC#2 previously approved in Amendment No. 10 (ADAMS Accession Number ML092290329) bound this configuration and that the storage of 16 damaged fuel assemblies in the 32PTH1 canister will not result in an increase in the temperature of the surrounding intact fuel assemblies.

4.7 Changes in Technical Specifications

The staff reviewed the proposed changes to the Technical Specifications for the Standardized NUHOMS® system to implement the requested changes in fuel types and fuel load configurations requested in the amendment application. The staff's evaluation of these proposed changes to the Technical Specifications is found in Chapter 13 of this SER.

4.8 Evaluation Findings

F4.1 The staff has reasonable assurance that the structures, systems, and components (SSCs) important to safety are described in sufficient detail in Appendices T, U, Y, and Z of the SAR to enable an evaluation of their thermal effectiveness. Cask SSCs important to safety remain within their operating temperature ranges.

F4.2 The staff has reasonable assurance that the Standardized NUHOMS® 32PTH1, 37PTH, 61BTH, and 69BTH DSCs within the HSM or HSM-H systems are designed with a heat-removal capability having verifiability and reliability consistent with its importance to safety. The casks are designed to provide adequate heat removal capacity without active cooling systems.

F4.3 The staff has reasonable assurance that the spent fuel cladding is protected against degradation which could lead to gross ruptures. The cladding temperature will be maintained below maximum allowable limits in a helium gas environment in the cask cavity under normal, off-normal, and accident storage conditions. In addition, protecting the cladding against degradation is expected to allow ready retrieval of spent fuel for processing or disposal at a later time.

F4.4 The staff concludes that the thermal design of the Standardized NUHOMS® 32PTH1, 37PTH, 61BTH, and 69BTH DSCs within the HSM or HSM-H systems complies with 10 CFR Part 72, and furthermore, that the applicable design and acceptance criteria are satisfied. The staff finds the thermal design provides reasonable assurance that the Standardized NUHOMS® 32PTH1, 37PTH, 61BTH, and 69BTH DSCs within the HSM or HSM-H systems will allow safe storage of spent fuel for a licensed life of 20 years. The staff reaches this finding after a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

5.0 CONFINEMENT EVALUATION

There were no changes requested in the amendment application requiring an evaluation of the confinement criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

6.0 SHIELDING EVALUATION

The staff's objective in reviewing the applicant's shielding evaluation for Amendment 14 to the Standardized NUHOMS® Storage System is to verify the proposed changes to the cask systems structures, systems, and components of the Standardized NUHOMS® Cask System meet the requirements of 10 CFR 72.104, and 72.106 during normal, off-normal, and design-basis accident (DBA) conditions.

The staff reviewed the information provided in the amendment request to determine whether the proposed changes to the Standardized NUHOMS® Storage System are consistent with the acceptance criteria listed in Chapter 6 of NUREG-1536, Rev. 1,"Standard Review Plan for Dry Cask Storage Systems at a General License Facility."

The proposed changes to the cask system's design affecting the shielding evaluation are:

- Update to the existing Fuel Qualification Table (FQT) for the 32PTH1 Dry Shielded Canister (DSC) with a heat load of 1.2 kW/FA.
- Reduction of the concrete density to a minimum of 140 pounds per cubic foot (pcf) in the HSM-H MCNP model.
- Increase of the gap between adjacent HSM-H modules and shield walls of up to 1.5 inches.

The applicant requested to change Table 1-5e of the Technical Specifications, "*PWR Fuel Qualification Table for Zone 5 or Zone 5a with Damaged or Failed Fuel with 1.2 kW and 490* *kgU per FA, for the NUHOMS®-32PTH1 DSC*" which specifies the minimum cooling times for PWR fuel to be stored in the 32PTH1 DSC. The applicant stated that the revised cooling time values for this table have been recalculated using the same methodology used for Tables 1-5a though 1-5d of the TSs. Prior to this revision, the applicant used a linear interpolation method to estimate the values for Table 1-5e. The staff reviewed the proposed changes to Table 1-5e and finds that the methodology used for estimating the cooling times is consistent with the method used for Tables 1-5a through 1-5d, which was previously approved by the staff in Amendment No. 10 (ADAMS Accession Number ML092290329).

The applicant performed a bounding analysis based on a minimum concrete density of 140 pounds per cubic foot (pcf) in the HSM-H MCNP model combined with a maximum gap of 1.5 inches between adjacent HSM-H modules and shield walls. The results of these analyzes are documented in Appendix U.5, Section 5.4.10 of the FSAR.

The analyses performed by the applicant were based on a 2x1 side-by-side array of HSM-Hs containing 32PTH1 DSCs. The results show that the lower density concrete and 1.5-inch gaps increase the maximum dose rates on the HSM roof by approximately 40%, and increase the maximum dose rate at the HSM-H front bird screen by 10%, and increase the maximum dose rate at the HSM-H door centerline by 14%.

The Technical Specifications, Section 5.4.2 provide the dose rate limits for the Standardized HSM and HSM-H at the following locations:

1. HSM front bird screen for the 32PTH1 DSC Model - 525 mrem/hr;
2. Outside HSM door for the 32PTH1 DSC Model - 2 mrem/hr;
3. End Shield Wall Exterior 32PTH1 DSC Model - 20 mrem/hr.

The applicant calculated gamma dose rates at the same locations for the lower density concrete and 1.5-inch gaps as follows:

1. HSM front bird screen for the 32PTH1 DCS Model - 518 mrem/hr;
2. Outside HSM door for the 32PTH1 DCS Model - 0.68 mrem/hr;
3. End Shield Wall Exterior 32PTH1 DCS Model - 7.14 mrem/hr.

Although the applicant states that dose rates may be further reduced with the installation of dose reduction hardware, the staff found the regulatory requirements are fully met without the reduction hardware. The applicant describes the optional dose reduction hardware in FSAR Section U.5.

The staff analyzed selected dose rates using the MAVRIC sequence of the SCALE 6.1 code system with the Monaco three-dimensional Monte Carlo shielding analysis code. The staff's confirmatory analyses used the lower concrete density of 140 pcf and 1.5 inches gap between HSM modules. The dose rates calculated by the staff were consistent with the values provided in the applicant's FSAR. The staff finds that the applicant's analyses include additional conservative assumptions. For example, additional support for the applicant's position that the expected dose rates will be lower than those calculated in the FSAR is found because the use of high-density rebar in the HSM-H module was not specially credited.

6.1 Findings

F6.1 Based on its review of the application, the staff finds that the proposed changes to the cask system's shielding design do not affect the ability of the Standardized NUHOMS® System to meet the dose limits in 10 CFR 72.104 and 72.106.

7.0 CRITICALITY EVALUATION

The staff's objective in reviewing the applicant's criticality evaluation for Amendment 14 to the Standardized NUHOMS® spent fuel storage system design is to verify that the spent fuel contents remain subcritical under the normal, off normal, and accident conditions of loading, unloading, transfer, and storage. The applicable regulatory requirements are those in 10 CFR 72.24(c)(3), 72.24(d), 72.124, 72.236(c), and 72.236(g).

The staff reviewed the information provided in the amendment request to determine whether the Standardized NUHOMS® system continues to fulfill the acceptance criteria listed in Chapter 7 of NUREG-1536, Rev. 1, "Standard Review Plan for Dry Cask Storage Systems at a General License Facility."

7.1 Criticality Design Criteria and Features

The applicant provided a summary of the proposed changes to the Standardized NUHOMS® spent fuel storage system in Enclosure 11 to AREVA's letter dated November 11, 2015 (AREVA Document E-42938, "Application for Amendment 14 to Standardized NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 1, Response to First Request for Additional Information"). This section of the safety evaluation report describes the proposed changes and their potential effects on the criticality safety design features of the storage system. These proposed changes are as follows:

- Revision to UFSAR Appendix M for the 32PT DSC and Technical Specifications Table 1-1g1, to add enrichment limits corresponding to a 2800 parts per million (ppm) soluble boron loading for the WE 17x17 fuel assembly class in the Type A2 basket with 24 poison plates and zero poison rod assemblies (PRAs), with and without control components.

- Revision to UFSAR Appendix T for the 61BTH DSC and Technical Specifications Table 1-1x, to allow for storage of up to 61 damaged fuel assemblies in a Type 2 DSC that contain D, E, or F ^{10}B areal density neutron absorber plates.

- Revision to UFSAR Appendix U for the 32PTH1 DSC; and Technical Specifications Table 1-1aa, Figure 1-28a, and Figure 1-28,to allow:

    - Storage of up to four failed fuel canisters (FFCs) in the corners of the 16 innermost fuel cells within the DSC

    - Storage of up to 16 damaged fuel assemblies in peripheral locations of the DSC

  - o Storage of up to 16 FFCs in specified locations, with the remaining 16 locations empty.

- Revision to UFSAR Appendix Z for the 37PTH DSC and Technical Specifications Table 1-1pp to permit additional loading configurations for WE 17x17 class fuel assemblies with 5 or 9 PRAs. These fuel assemblies must have borated water in the casks during loading. The minimum concentrations of soluble boron required are dependent on the type of fuel that is loaded into cask. These requirements apply for assemblies with and without control components.

7.2 Fuel Specification

The changes requested in the amendment application do not involve a change in the fuel types allowed for storage. The changes add initial enrichment/soluble boron/neutron absorber ^{10}B loading combinations for existing fuel types. The amendment also seeks to change the number and configuration of damaged or failed fuel assemblies allowed for specific DSCs. The applicant requests changes to the criticality control components for DSCs previously approved by the NRC. The definitions of intact, damaged, and failed fuel are unchanged. The full fuel specifications for the 32PT, 61BTH, 32PTH1, and 37PTH DSCs are presented in the Technical Specification at Tables 1-1e, 1-1t, 1-1aa, and 1-1ll, respectively.

The applicant proposed adding an initial enrichment/soluble boron/neutron absorber ^{10}B loading combination for the 32PT DSC. The request seeks permission to load WE 17x17 class fuel in a Type A2 DSC with zero PRAs and the 24 poison plate configuration. This type of fuel assembly class was previously approved for storage in this configuration with a 2500 ppm soluble boron concentration during loading and unloading (in Amendment No. 10, ADAMS Accession Number ML092290329). The applicant proposed to add language in Table 1-1g1 of the Technical Specifications that would require a 2800 ppm soluble boron concentration be used during loading and unloading of higher initial enrichment fuel. This new requirement would apply in situations with and without control components.

The applicant also requested adding a storage configuration for the 61BTH that contains up to 61 damaged fuel assemblies. The NRC previously approved configurations of the 61BTH DSC 1) for up to 16 damaged fuel assemblies with all additional assemblies being intact, or 2) for up to 4 failed fuel assemblies and up to 12 damaged fuel assemblies, and the remaining assemblies intact. These configurations, also approved in Amendment No. 10, are illustrated in Figure 1-25 of the Technical Specifications. The storage of 61 damaged fuel assemblies in the 61BTH Type 2 DSC must be in combination with poison identifications of D, E, or F, as shown in Table 1-1x of the Technical Specifications. The first 57 damaged fuel assemblies are limited to 3.3 weight-percent ^{235}U, while the remaining 4 corner fuel assemblies may either be intact at 5.0 weight-percent ^{235}U, or damaged at 4.2 weight-percent ^{235}U.

The applicant requested several changes to the Technical Specifications applicable to the 32 PTH1 DSC. The applicant seeks NRC's approval of the storage of failed fuel in the 32PTH1 DSC in a new configuration. Specifically, the application requests permission to store up to four failed fuel canisters in the corners of the 16 inner fuel locations identified in Figure 1-28a of the

Technical Specifications. All other DSCs in the Standardized NUHOMS® system have received NRC approval for the storage of failed fuel. The applicant proposed to limit the mass of 100 failed fuel rods to no more than 2.5 kg initial uranium per rod. This mass is significantly less than the mass of a typical intact or damaged PWR fuel assembly. The initial enrichment and soluble boron requirements for this proposed configuration are the same as the configuration shown in Table 1-1dd of the Technical Specifications, which allows 16 damaged fuel assemblies to be stored in the interior fuel locations.

The current Technical Specifications at Figures 1-28 and 1-28a provide the general licensee an option to store up to 16 damaged fuel assemblies in the 16 interior locations of the 32PTH1 DSC. The applicant proposed to add an option to store 16 damaged fuel assemblies in peripheral locations, but requiring the remaining assemblies to be intact, as shown in Figure 1-28a of the Technical Specifications. The initial enrichment and soluble boron requirements for this proposed configuration are the same as the configuration shown in Table 1-1dd of the Technical Specifications for up to 16 damaged fuel assemblies in the interior fuel locations.

The applicant also requested to add a 32PTH1 configuration for up to 16 failed fuel assemblies in FFCs, with the remaining locations empty. The 16 FFCs must be loaded in the pattern described by Figure 1-28. Initial enrichment and soluble boron requirements for all basket types and fuel assembly classes are provided in Table 1-1dd1 of the Technical Specifications.

For the 37PTH DSC, the applicant requested to add storage configurations that rely on PRAs for criticality control, for the WE 17x17 fuel assembly class. These configurations include either five or nine PRAs, and require a lower soluble boron loading than for configurations without PRAs. Initial enrichment and soluble boron requirements for five or nine PRAs are given in Table 1-1pp of the Technical Specifications. The minimum linear ^{10}B content, from Table 1-1ss of the Technical Specifications, is 0.088 grams per centimeter. The required fuel assembly locations for five or nine PRAs are given in Figures 1-41 and 1-42 of the Technical Specifications, respectively, and the arrangement and dimensions of the PRAs are given in Figure Z.1-1 of the UFSAR. The locations of the PRA rods within the WE 17x17 fuel assembly are shown in Figure Z.6-16 of the UFSAR.

7.3 Model Specification

7.3.1 Configuration

The applicant modeled the Standardized NUHOMS® system with the 32PT, 61BTH, 32PTH1, and 37PTH DSCs using the most reactive configuration of the DSC basket and fuel assemblies determined from previous analyses. For the basket geometry, the configuration consisted of the most reactive combination of basket guide tube wall and neutron absorber plate thicknesses, and eccentric positioning of fuel assemblies. For the fuel assemblies, the configuration consisted of the most reactive combination of tolerances for the pellet diameter, outer clad diameter, and clad thickness, as well as the maximum active fuel length (or infinite length, in cases where this was modeled). The applicant continued to model the fuel material as UO_2 at a stack density of 97.5% theoretical density, without allowance for dishing or chamfer, which increases the fuel material in the assembly. Additionally, the applicant conservatively assumes that the gap is filled with full density water.

To calculate the optimum moderated condition for damaged fuel assemblies, the applicant assumes a variable fuel rod pitch and the absence of fuel rods. To identify the most reactive configuration for failed fuel canisters, the applicant varies the pitch of a 10x10 array of 100 fuel rods. The applicant modeled failed rods without cladding to increase the conservatism of the analysis. Additionally, a sensitivity study evaluated fuel material that could accumulate in the bottom of a failed fuel rod storage box or FFC.

The staff finds that the modeling assumptions proposed by the applicant for the fuel and DSC configurations are sufficiently conservative and consistent with NRC guidance provided in NUREG-1536.

7.3.2 Material Properties

The 32PT, 61BTH, 32PTH1, and 37PTH DSC basket materials have not changed from the design previously approved in Amendment No. 5 (ML040150842), No. 10 (ML092290329), and No. 13 (ML14153A579) to the Standardized NUHOMS System, and these materials are described in the appendix for each DSC. These descriptions include the composition of the major components of each DSC, including UO_2 fuel, steel and aluminum structural components, and neutron absorber panels and poison rod assemblies. In accordance with NRC guidance in NUREG-1536, the criticality analyses and modeling performed by the applicant make conservative assumptions about the DSC components that limit reactivity. Specifically, the applicant's criticality calculations may use only 75% of the manufacturer's recommended minimums for the neutron absorber ^{10}B content for Boral® panels and B_4C poison rod assemblies. Because of these more robust material verification requirements, the applicant's criticality analyses assume no more than 90% of the minimum specified ^{10}B content, for borated aluminum and aluminum/B_4C metal matrix composite neutron absorbers.

The staff finds that the modeling assumptions proposed by the applicant for the materials properties of the fuel and DSC are sufficiently conservative and consistent with NRC guidance provided in NUREG-1536.

7.4 Criticality Analysis

The applicant performed a criticality analysis of the requested new configurations using the criticality model and material properties described in Section 7.2 of the SER. The calculated maximum initial enrichments, minimum required concentration of soluble boron for loading and unloading, and the associated k_{eff} values for the 32PT, 61BTH, 32PTH1, and 37PTH DSCs are reported in the UFSAR at Appendixes M, T, U, and Z, respectively.

For the 32PT DSC, the applicant calculated the maximum system k_{eff} for WE 17x17 class fuel assemblies in a Type A2 basket with no PRAs and the 24 poison plate configuration, with a 2800 ppm minimum required soluble boron loading in the water. The applicant varied the internal moderator density to find the optimum to produce the highest k_{eff}, for fuel assemblies with and without control components. The k_{eff} results for this analysis are reported in Table M.6-57 of the UFSAR.

For the 61BTH DSC, the applicant calculated the maximum system k_{eff} for the most reactive BWR fuel assembly class, for the configuration with up to 61 damaged fuel assemblies. The enrichment for 57 damaged fuel assemblies was constant at 3.3 weight-percent ^{235}U, while the remaining 4 corner fuel assemblies were modeled as either intact at 5.0 weight-percent ^{235}U, or as additional damaged fuel assemblies at 4.2 weight-percent ^{235}U. The applicant varied the internal moderator density to find the optimum to produce the highest k_{eff}. The k_{eff} results for this analysis are reported in Tables T.6-22 and T.6-23 of the UFSAR.

For the 32PTH1 DSC, the applicant calculated the maximum system k_{eff} for damaged and failed fuel configurations with the WE 17x17, WE 14x14, CE 14x14, BW 15x15, and CE 15x15 fuel assembly classes. The applicant calculated the maximum k_{eff} for the DSC with four FFCs replacing damaged fuel assemblies in the four corners of the internal 16 fuel locations, with the remaining 12 internal locations containing damaged fuel assemblies, and the 16 peripheral locations containing intact fuel assemblies. The applicant also calculated the maximum k_{eff} for the DSC with 16 damaged fuel assemblies of all PWR fuel assembly classes in the peripheral locations, and 16 intact fuel assemblies in the interior locations. In both cases, the maximum calculated k_{eff} was bounded by the maximum calculated for the configuration with 16 damaged fuel assemblies in the interior locations and 16 intact fuel assemblies in the peripheral locations, previously approved by NRC staff in Amendment No. 10 (ML092290329). Therefore, the staff finds that the initial enrichment and soluble boron requirement combinations of Table 1-1dd of the Technical Specifications are applicable for these additional configurations.

The applicant performed an additional analysis assuming that failed fuel material could collect at the bottom of the stainless steel tubes of a rod storage box, which necessarily have a larger diameter than the fuel rods themselves. Based on the results of this analysis, given in Table U.6-33a of the UFSAR, the staff finds that this configuration is bounded by lower diameter intact fuel rod material.

For the 32PTH1 DSC with up to 16 FFCs, the applicant calculated the maximum system k_{eff} with all fuel assembly classes loaded according to the requirements in Figure 1-28 of the Technical Specifications. The applicant assumed the maximum PWR fuel assembly enrichment of 5.0 weight-percent ^{235}U, with a minimum soluble boron concentration of 2400 ppm. The Type 1C and 2C basket neutron absorber plate ^{10}B areal densities were evaluated, but higher areal densities in Type 1D, 2D, 1E, or 2E baskets are also allowed, as are higher soluble boron loadings. The k_{eff} results for this analysis are reported in Table U.6-33b of the UFSAR.

For the 37PTH DSC with WE 17x17 class fuel assemblies with either 5 or 9 PRAs, the applicant evaluated the system with 9 PRAs and soluble boron concentrations of 2000, 2300, 2400, 2500, and 2600 ppm. The applicant evaluated an additional configuration with 5 PRAs and a soluble boron concentration of 2600 ppm. For each initial enrichment and soluble boron concentration combination, the applicant varied the internal moderator density to determine the most reactive value. The resulting k_{eff} values, for the WE 17x17 fuel assembly class, with and without control components, for intact and damaged fuel configurations, are reported in Tables Z.6-46 through Z.6-53 of the UFSAR.

The staff has reviewed the calculated keff values reported by the applicant for the new fuel configurations to be used in the 32PT, 61BTH, 32PTH1, and 37PTH DSCs and determined that all of the proposed configurations will remain below the Upper Safety Limits calculated for each DSC. Further discussion of these results is provided in Section 7.4.2 of this SER. Accordingly, the staff finds that the new proposed configurations for these DSCs will meet the criticality safety requirements of 10 CFR 72.124.

7.4.1 Computer Programs

The applicant used the CSAS5 sequence of the SCALE 6.0 code system with the KENO V.a three-dimensional Monte Carlo neutron transport program and the 44-group ENDF/B-V cross section library for all k_{eff} calculations for this amendment. The SCALE code system is a standard in the nuclear industry for performing Monte Carlo criticality safety and radiation shielding calculations.

The staff performed confirmatory calculations using the CSAS5 sequence of the SCALE 6.1 code system, with the KENO V.a three-dimensional Monte Carlo neutron transport program and the continuous-energy ENDF/B-VII cross section library. The staff's calculations are discussed in section 7.4.2 below.

7.4.2 Multiplication Factor

The applicant demonstrated that k_{eff} values for the additional storage configurations for the 32PT, 61BTH, 32PTH1, and 37PTH DSCs are all below the Upper Safety Limits (USL) calculated for each DSC in the benchmarking analysis for the SCALE 6.0 code and 44-group ENDF/B-V cross section library used in the criticality analysis.

The staff performed confirmatory criticality evaluations of the Standardized NUHOMS® system with additional fuel configurations in the 32PT, 61BTH, 32PTH1, and 37PTH DSCs. Using assumptions derived from the applicant's analyses, the staff calculated k_{eff} values for select configurations which were within the margin of error of those calculated by the applicant. Therefore, the staff finds the Standardized NUHOMS® system with the 32PT, 61BTH, 32PTH1, and 37PTH DSCs will remain subcritical under normal, off-normal, and accident conditions, and will meet the criticality safety requirements of 10 CFR 72.124.

7.4.3 Benchmark Comparisons

The applicant provided a benchmarking analysis for the SCALE 6.0 code and 44-group ENDF/B-V cross section library used for the additional 32PT, 61BTH, and 32PTH1 configurations in the Standardized NUHOMS® storage system, since this code differs from what was used in the original analysis. The details of this analysis are provided in Sections M.6.5.3, T.6.5.3, and U.6.5.3 of the UFSAR.

The benchmarking analysis for the 32PT and 32PTH1 DSCs used 92 fresh uranium oxide experiments, chosen to have characteristics similar to various DSCs within the Standardized NUHOMS® storage system. The experiment parameters evaluated for range of applicability and trends included:

- ^{235}U enrichment,

- Fuel rod pitch,
- Moderator/fuel volume ratio,
- Assembly separation,
- Average energy group causing fission (AEG), and
- Soluble boron concentration

The applicant evaluated each critical experiment using the same code, cross section library, computer platform, and modeling techniques as was used for the criticality evaluation.

The applicant determined the USL for the Standardized NUHOMS® storage system using recommendations from NUREG/CR-7109, “An Approach for Validating Actinide and Fission Product Burnup Credit Criticality Safety Analyses—Criticality (k_{eff}) Predictions,” and NUREG/CR-6698, “Guide for Validation of Nuclear Criticality Safety Calculational Methodology.” Since the k_{eff} values from the benchmarking analysis were normally distributed, the applicant determined a single-sided lower tolerance limit USL computed according to the recommendations in NUREG/CR-6698. The applicant also determined that there is no significant correlation of the k_{eff} results to the independent trending parameters listed above. The resulting USL for PWR fuel in the 32PT and 32PTH1 DSCs is 0.9404.

The applicant performed a similar benchmarking analysis for the 61BTH DSC in the Standardized NUHOMS® storage system, using a subset of 51 unborated experiments from the set identified in the 32PT and 32PTH1 benchmarking analysis. The experiment parameters evaluated for range of applicability and trends included:

- ^{235}U enrichment,
- Fuel rod pitch,
- Water/fuel volume ratio,
- Assembly separation, and
- Average energy group causing fission (AEG).

Similar to the 32PT and 32PTH1 benchmarking analysis, the k_{eff} values from the benchmarking analysis were normally distributed, and the applicant determined a single-sided lower tolerance limit USL computed according to the recommendations in NUREG/CR-6698. The applicant also determined that there is no significant correlation of the k_{eff} results to the independent trending parameters listed above. The resulting USL for BWR fuel in the 61BTH DSC is 0.9418.

For the 37PTH DSC, the applicant previously used the SCALE 6.0 code and 44-group ENDF/B-V cross section library. Therefore, the benchmarking analysis for this code and cross section library, previously approved in Amendment No. 13 (ML14153A579), is applicable to the criticality analysis to support the additional fuel configurations requested for this DSC.

The staff reviewed the benchmarking analysis performed by the applicant, and determined that the USL was determined in accordance with relevant NRC guidance in NUREG/CR-6361. The staff also determined that the critical experiments chosen are appropriate for the system being evaluated, and the resulting USLs are bounding and acceptable.

7.5 Evaluation Findings

F7.1 Structures, systems, and components important to criticality safety are described in sufficient detail in Chapters M.2, M.6, T.2, T.6, U.2, U.6, Z.2, and Z.6 of the UFSAR to enable the staff to conduct an evaluation of their effectiveness.

F7.2 The cask and its spent fuel transfer systems are designed to be subcritical under all credible conditions.

F7.3 The criticality design is based on favorable geometry, fixed neutron poisons, and soluble poisons of the spent fuel pool. An appraisal of the fixed neutron poisons has shown that they will remain effective for the term requested in the CoC application and there is no credible way for the fixed neutron poisons to significantly degrade during the requested term in the CoC application. Therefore, there is no need to provide a positive means to verify their continued efficacy as required by 10 CFR 72.124(b).

F7.4 The analysis and evaluation of the criticality design and performance have demonstrated that the cask will enable the storage of spent fuel for the term requested in the CoC application.

The staff concludes that the criticality design features for the Standardized NUHOMS® spent fuel storage system design comply with 10 CFR Part 72. The staff also finds that the applicable design and acceptance criteria have been satisfied. The evaluation of the criticality design provides reasonable assurance that the Standardized NUHOMS® spent fuel storage system design will allow safe storage of spent fuel. These findings are reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

8.0 MATERIALS EVALUATION

The applicant requested several changes requiring a materials evaluation for the Standardized NUHOMS® System. The specific changes reviewed in this evaluation pertain to changes in the amounts and the condition of fuel assemblies authorized for storage, changes in the acceptance testing methods used for neutron absorber materials, and the changes to the analyzed concrete density of the horizontal storage modules.

8.1 New Description of Fuel Types Authorized for Storage

The staff reviewed the amendment application, the SERs for previous amendments to the Standardized NUHOMS® System, the applicable codes and standards, as well as the relevant technical literature. Based on its review of these materials, the staff determined the applicant sufficiently described and provided technical support for the storage of new and modified fuel types, as well as the use of additional hardware in the Standardized NUHOMS® System. For the reasons described in Sections 4 (thermal evaluation), 6 (shielding evaluation), 7 (criticality safety evaluation), and 8 (materials evaluation) of this SER, the staff finds that the proposed changes to the fuel types requested by the applicant do not decrease the ability of the cask system to meet the containment, shielding, and criticality safety requirements of 10 CFR Part 72.

8.2 Uniformity of Boron Carbide Neutron Absorber

The applicant proposed to add the option of using a volumetric density testing method for verifying the amount and density of Boron-10 (B-10) in neutron absorber materials (*borated aluminum alloy metal matrix composite* (MMC) or Boral®), in addition to the currently authorized neutron attenuation method. The applicant stated that the proposed alternative will support the basis of 95% probability, 95% confidence level or better in the areal density (i.e., uniformity) of B-10 neutron absorber for acceptance testing.

The applicant provided details on the sampling process and methodology to be used for the volumetric testing method. The applicant specified that the sample size extracted from volume density measurement (30-100 mg) will be significantly smaller than the mass of plate examined by neutron transmission. This sample size makes volume density measurement more sensitive to a localized loss of B_4C uniformity in production material. The applicant also proposed to benchmark the B-10 volume density method against a neutron attenuation method. Benchmarking this method consists of confirming the B-10 content, via volume density measurement, in two samples extracted from a product or qualification lot coupon. The coupon from which these two samples are extracted must have been tested using the same maximum acceptable neutron beam size.

The staff finds that the applicant's proposed sampling method for verifying the alternative B-10 volume density measurement, in conjunction with the additional benchmarking via neutron beam attenuation, is consistent with the guidance for applying ASTM Standard Practice, C1671-07, referenced in ISG-23, and therefore is acceptable.

8.3 Increased Number of Damaged Fuel Assemblies

The application seeks to increase the number of damaged fuel assemblies allowed for storage in the 61BTH DSC by up to 61 assemblies. The staff determined that the increase in the amount of damaged fuel assemblies authorized for dry cask storage may have an effect on the effectiveness of vacuum drying operations, depending on the extent and nature of the damage in the fuel. For these reasons, the staff requested that the applicant provide details on the extent and nature of fuel damage and vacuum drying operations.

The proposed Technical Specifications define damaged boiling water reactor (BWR) fuel assemblies as containing fuel rods with known or suspected cladding defects that are greater than hairline cracks or pinhole leaks. The current Technical Specifications also limit the extent of fuel damage in the fuel assembly to ensure that the fuel assembly can be handled by normal means and that retrievability is achievable following normal and off-normal conditions. Missing fuel rods are allowed. The definition is unchanged from the definition of fuel damage in previous amendments to CoC No. 1004 for the Standardized NUHOMS® System. The staff considers this definition to correspond to "undamaged fuel" discussed in ISG-1, Rev. 2, because the fuel-specific requirements can be met without canning the damaged fuel assembly.

The vacuum drying process includes evacuating the DSC cavity using the vacuum drying system, pumping down to each different level and waiting for the cavity pressure to stabilize before the vacuum drying process continues. The vacuum drying process is complete when the pressure stabilizes for a minimum of 30 minutes at 3 mm Hg absolute or less. This test is specified in TS 3.1.1.

The vacuum drying process described in UFSAR Section T.8.1.3 is based on ASTM C1553-08, which is a consensus guide on methods of drying spent nuclear fuel and confirmation of adequate dryness. The method in ASTM C1553-08 is consistent with PNL-6365 (Knoll, R. W., et al., “Evaluation of Cover Gas Impurities and Their Effects on the Dry Storage of LWR Spent Fuel,” PNL-6365, DE88003983, PNNL, November 1987) and the guidance in NUREG-1536, Rev. 1. ASTM C1553-08 states that maintaining a 3 mm Hg pressure for 30 minutes results in adequate drying (expected less than one mole of residual water inside the cask), which is expected to preclude gross damage to fuel cladding during dry storage. The staff confirmed that the proposed drying procedures are in accordance with ASTM C1553-08 and consistent with the guidance in NUREG-1536, Rev. 1. The staff finds that the proposed increase in the amount of damaged fuel (“undamaged” per ISG-1, Rev. 2) to be stored in the 61BTH DSC does not affect the ability of the cask system to meet the regulatory requirements in 10 CFR 72.236(a).

8.4 Clarifications of the Use of Low Concrete Density

The applicant proposes to change the concrete density of the HSM-H to a minimum of 140 pound per cubic foot (pcf). The staff finds that the proposed change to the proposed concrete density specification conforms with ACI 349-13 and, therefore, does not reduce the ability of the cask system to meet the requirements of 10 CFR Part 72.

8.5 Findings

F8.1 The staff concludes that the proposed changes to the materials used in the Standardized NUHOMS® System design are in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied. The staff finds the properties of DSC materials provide reasonable assurance that the Standardized NUHOMS® System will allow safe storage of spent fuel. These findings are r based on a review that considered the regulation itself, appropriate regulatory guides, applicable Codes and Standards, and accepted engineering practices.

9.0 OPERATING PROCEDURES EVALUATION

The applicant revised the operating procedures for the storage of additional damaged fuel assemblies, the storage of additional failed fuel assemblies, and implementing poison rod assembly contained in Sections T.8, U.8 and Z.8 of the FSAR for the Standardized NUHOMS® System‘s 61BTH, 32PTH1, and 37PTH DSCs, respectively.

The staff has reviewed the revised procedures and finds that the proposed revisions adequately account for the new and revised fuel types authorized for storage and that these changes will not affect the cask system’s ability to meet the regulatory requirements of 10 CFR Part 72.

10.0 ACCEPTANCE TESTS AND MAINTANANCE PROGRAM EVALUATION

The applicant's proposed changes to the acceptance tests and maintenance program for the Standardized NUHOMS® System have been discussed and evaluated in Section 8.2 of this SER.

11.0 RADIATION PROTECTION EVALUATION

There were no requested changes requiring a radiation protection evaluation for the principal design criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

12.0 ACCIDENT ANALYSIS EVALUATION

The applicant did not request changes to the principal design criteria related to the SSCs important to safety. For this reason, the staff finds the applicant complied with the relevant general criteria established in 10 CFR Part 72, and does not require an accident analysis evaluation of the principal design criteria.

13.0 TECHNICAL SPECIFICATIONS

The staff reviewed the proposed amendment to determine that applicable changes made to the conditions in the certificate of compliance, and to the TSs for CoC No. 1004, Amendment 14 would be in accordance with the requirements of 10 CFR Part 72. The staff reviewed the proposed changes to the TSs to confirm the changes were properly evaluated and supported in the applicant's revised safety analysis report. The applicant's proposed changes to the Technical Specifications are as follows:

Table 13-1 - Conforming Changes to the Technical Specifications

Cover page	Amendment number changed to 14
Table of Contents, List of Tables, and List of Figures	Updated.
LCO 3.1.3 Table (Page 3-7)	61BTH, 32PTH1, and 69BTH DSC heat load zoning configurations are added to this LCO for the time limit for completion of DSC transfer.
LCO 3.1.3 ACTION A.1 (Page 3-8)	The action to "remove the TC top cover plate" is deleted.
LCO 3.2.1 (Page 3-11)	Table 1-1pp is added to the 37PTH row of the table for minimum boron concentration.
TS 4.1 (Page 4-2)	Editorial changes are made. Table 1-1x is added to the 61BTH row.
TS 5.1, 5.3.2 (Page 5-1, 5-12)	The language requiring a return to a spent fuel pool following a cask drop has been revised to permit the general licensee to determine the best available option for inspection of the

	TC/DSC by either returning it to the spent fuel pool or an alternate means.
TS 5.2.4(e) (Page 5-8)	The configuration requirements are revised to indicate that if the required dose rates can be met without employing temporary shielding above the inner top cover plate, the temporary shielding is not required.
TS 5.4.1 (Page 5-13)	For clarity and consistency, the description and order of items 1), 2), and 3) are revised to match their corresponding column descriptions in Table 5.4.2 of the TSs.
TS 5.4.2 (Page 5-13)	The HSM-H dose rate limits for the 24PTH, 61BTH, 32PTH1, 69BTH, and 37PTH DSCs are revised.
Table 1-1c (Page T-3)	Physical Parameters for Fuel Design have been revised for clarification and consistency of Reload Fuel.
Table 1-1e (Page T-5, T-6)	The thermal and radiological parameters area of the table is revised to reflect the references to changed fuel qualification tables. The text associated with Reconstituted Fuel Assemblies has been changed from *"stainless steel rods*" to "*irradiated stainless steel rods."* Physical Parameters for Fuel Assembly Class have been revised for clarification and consistency of Reload Fuel.
Table 1-1g (Page T-8)	Table is clarified by indicating enrichment items that were previously shown with no entries.
Table 1-1g1 (Page T-9)	Revised to increase the Soluble Boron Loading Type A2 poison for WE 17x17 design only.
Table 1-1i (Page T-11)	The text associated with Fuel Class has been changed from *"stainless steel rods*" to "*irradiated stainless steel rods."* Physical Parameters for Fuel Class have been revised to change the limit of irradiated stainless steel rods in Reconstituted Assemblies from four assemblies per DSC to 40 rods per DSC.
Table 1-1j (Page T-13)	Physical Parameters for Fuel Design have been revised for clarification and consistency of Reload Fuel.
Table 1-1l (Page T-16, T-17, T-18, T-19)	The text associated with Reconstituted Fuel Assemblies has been changed from *"stainless steel rods*" to "*irradiated stainless steel rods."* Physical Parameters for Fuel Class has been revised for clarification and consistency of Reload Fuel and to change the limit of irradiated stainless steel rods in Reconstituted Assemblies from four assemblies per DSC to 40 rods per DSC. The thermal and radiological parameters area of the table is revised to reflect the references to changed fuel qualification tables.
Table 1-1m (Page T-20)	Values for maximum MTU/assembly are increased to 0.492. The row for maximum number of guide/instrument tubes is deleted for clarity and due to redundancy.
Table 1-1p (Page T-23, T-24)	For clarity, enrichment items previously indicated as NR (not required) are given values.

Table 1-1q (Page T-25)	For clarity, certain enrichment items previously indicated as NR (not required) are given values. Others are changed to NE (not evaluated).
Table 1-1q1 (Page T-26, T-27)	For clarity, enrichment items previously indicated as NR (not required) are given values.
Table 1-1t (Page T-30, T-31, T-32)	The text associated with Reconstituted Fuel Assemblies has been changed from *"stainless steel rods*" to "*irradiated stainless steel rods."* Physical Parameters for Fuel Class has been revised for clarification and consistency of Reload Fuel Vendors and to change the limit of irradiated stainless steel rods in Reconstituted Assemblies from four assemblies per DSC to 40 rods per DSC. The table is changed to allow storage of up to 61 damaged BWR fuel assemblies in the 61BTH DSC. The thermal and radiological parameters area of the table is revised to reflect new heat load zoning configurations and the references to changed fuel qualification tables.
Table 1-1x (Page T-37)	The new table is added to allow up to 61 damaged BWR fuel assemblies in the 61BTH DSC.
Table 1-1aa (Page T-40, T-41)	The table is revised to allow storage of failed fuel in the 32PTH1 DSC. Editorial changes to the definitions are made. The control components definition is expanded. The thermal and radiological parameters area of the table is revised to reflect new heat load zoning configurations and the references to changed fuel qualification tables. The text associated with Reconstituted Fuel Assemblies has been changed from *"stainless steel rods*" to "*irradiated stainless steel rods."* Physical Parameters for Fuel Class has been revised for clarification and consistency of Reload Fuel Vendors and to change the limit of irradiated stainless steel rods in Reconstituted Assemblies from four assemblies per DSC to 40 rods per DSC.
Table 1-1bb (Page T-42)	Values for maximum MTU/assembly are increased to 0.492. The row for maximum number of guide/instrument tubes is deleted to avoid redundancy.
Table 1-1dd (Page T-45, T-46, T-47)	The table is changed to allow storage of failed fuel in the 32PTH1 DSC.
Table 1-1dd1 (Page T-48)	The table is added to specify the fuel parameters for the storage of failed fuel in the 32PTH1 DSC.
Table 1-1ee (Page T-48)	The terms "/sec/Assembly" and "Watts/Assembly" are changed to "/sec/DSC" and "Watts/DSC", respectively, for clarity and to be consistent with the UFSAR. The values are updated as well.
Table 1-1gg (Page T-51)	The thermal and radiological parameters area of the table is revised to reflect new heat load zoning configurations and the references to changed fuel qualification tables. The text associated with Reconstituted Fuel Assemblies has been changed from *"stainless steel rods*" to "*irradiated stainless steel rods."* Physical Parameters for Fuel Class have been revised

	for clarification and consistency of Reload Batches from Fuel Vendors and to change the limit of irradiated stainless steel rods in Reconstituted Assemblies from four assemblies per DSC to 40 rods per DSC.
Table 1-1ll (Page T-56, T-57)	The control components definition is revised. Editorial changes are made. Changes are made due to referencing Burnup, Enrichment, and Minimum Cooling Time tables. Changes are made due to referencing new maximum planar average initial fuel enrichment tables. The text associated with Reconstituted Fuel Assemblies has been changed from *"stainless steel rods"* to "*irradiated stainless steel rods."* Physical Parameters for Fuel Class have been revised for clarification and consistency of Reload Batches from Fuel Vendors and to change the limit of irradiated stainless steel rods in Reconstituted Assemblies from four assemblies per DSC to 40 rods per DSC.
Table 1-1nn (Page T-59)	The row for maximum number of guide/instrument tubes is deleted for clarity and to avoid redundancy.
Table 1-1pp (Page T-61)	A new table is added to allow PRAs in the 37PTH DSC.
Table 1-1qq (Page T-62)	The terms "/sec/Assembly" and "Watts/Assembly" are changed to "/sec/DSC" and "Watts/DSC", respectively, for clarity and to be consistent with the UFSAR. The values are updated as well.
Table 1-1rr (Page T-63)	The table is revised to allow PRAs in the 37PTH DSC.
Table 1-1ss (Page T-64)	The new table is added to specify the minimum B-10 content for PRAs stored in the 37PTH DSC.
Table 1-2d to 1-2h (Page T-67 to T-78)	The fuel qualification tables are revised to include fuel assemblies with 400 kg U per assembly, and make editorial corrections to Note 5.
Table 1-3a to 1-3k (Page T-83 to T-103)	The fuel qualification tables are revised to include fuel assemblies with 400 kg U per assembly, and make editorial corrections to Note 5. The fuel qualification tables are revised to include burnup and enrichment combinations not previously allowed. New Table 1-3k is added for qualification of 492 kg U fuel.
Table 1-4a to 1-4h (Page T-104 to T-120)	The fuel qualification tables are revised to include fuel assemblies with 170 kg U per assembly, and make editorial corrections to Note 5. New Table 1-4g is added to account for low enrichment, low burnup fuel.
Table 1-5a to 1-5g (Page T-121 to T-128)	The fuel qualification tables are revised to allow storage of failed fuel and to include burnup and enrichment combinations not previously allowed. New Table 1-5g is added for qualification of 492 kg U fuel.
Table 1-6a (Page T-129)	Editorial change for consistency.
Table 1-7a, Tables 1-7a1, Tables 1-7b to 1-7m (Page T-134 to T-162)	New Table 1-7a is added to allow storage of low enrichment, low burnup fuel. The fuel qualification tables are revised to include fuel assemblies with 170 kg U per assembly, and make editorial corrections to Note 6.

Table 1-8a, Tables 1-8c to 1-8f (Page T-163 to T-175)	The fuel qualification tables are revised to include fuel assemblies with 400 kg U per assembly, and make editorial corrections to Note 6. New Table 1-8f is added to allow storage of low enrichment, low burnup fuel.
Figure 1-25 (Page F-26)	Changes made to allow storage of both damaged and failed fuel in all 61BTH DSC fuel compartments, per the figure requirements.
Figure 1-25a, Figure 1-25b (Page F-27, F-28)	Added new figures for the 61BTH DSC Heat Load Zoning Configurations No. 9 and 10.
Figure 1-28, (Page F-31)	The table has been revised to allow up to 16 failed fuel cans. The notes for this table have been revised.
Figure 1-28a (Page F-32)	Added new figure for the 32PTH1 DSC Heat Load Zoning Configuration No. 4 to allow alternative loading configurations for up to 16 failed fuel canisters.
Figure 1-34 (Page F-38)	Note 1 is revised to clarify that the center fuel compartment (Zone 1) remains empty in this configuration.
Figure 1-38 (Page F-42)	Added new figure for the 69BTH DSC Heat Load Zoning Configuration No. 7.
Figure 1-41, Figure 1-42 (Page F-45, F-46)	Added new figures for the 37PTH DSC PRA locations with five PRAs or nine PRAs.

The staff finds that the proposed changes to the Technical Specifications for the Standardized NUHOMS® System conform to the changes requested in the amendment application and do not affect the ability of the cask system to meet the requirements of 10 CFR Part 72. The proposed changes provide reasonable assurance that the Standardized NUHOMS® System will continue to allow safe storage of spent nuclear fuel.

14.0 QUALITY ASSURANCE EVALUATION

There were no changes to AREVA's quality assurance program requested in the amendment application.

15.0 CONCLUSIONS

The staff has performed a comprehensive review of the amendment application, during which the following requested changes to the Standardized NUHOMS® System were considered:

1. Improvements to the fuel qualification tables for the BWR and PWR dry shielded canisters (DSCs) to allow for the calculation of cooling times for different uranium loading (described in Chapter 13 of this document).
2. Include new heat load zoning configurations (HLZCs) for the 61BTH, 32PTH1 and 69BTH DSCs.
3. Authorize storage of up to 61 damaged BWR fuel assemblies in the 61BTH DSC.
4. Authorize storage of up to sixteen (16) failed fuel cans (FFCs) in the 32PTH1 DSC.
5. Expansion of the 37PTH criticality analysis to include poison rod assemblies (PRAs).

6. Evaluation of the horizontal storage module (HSM) model HSM-H for shielding impact of reduced density concrete and gaps during installation.
7. Clarify and revise various terms and definitions in the Technical Specifications (TSs).
8. Authorize acceptance testing for neutron absorber content to be performed by either neutron transmission or by B-10 volume density measurement.
9. Amend the Technical Specifications to remove language that requires a transfer cask (TC) containing a dry shielded canister (DSC) be returned to the spent fuel pool following a drop of over 15 inches, and instead permit the general licensee to determine the best available option for inspection of the TC/DSC by either returning it to the spent fuel pool or an alternate means.
10. Revise the minimum soluble boron concentration of 2800 ppm for Type A2 poison for Westinghouse (WE) 17x17 fuel design only.
11. Update the existing Fuel Qualification Table (FQT) for the 32PTH1 Dry Shielded Canister (DSC) with a heat load of 1.2 kW/FA.
12. Allow for an alternative loading configuration of 16 damaged fuel assemblies in the 32PTH1 DSC.

Based on the statements and representations provided by the applicant in its amendment application, as supplemented, the staff concludes that the changes described above to the Standardized NUHOMS® System do not affect the ability of the cask system to meet the requirements of 10 CFR Part 72. Amendment No. 14 for the Standardized NUHOMS® System should be approved.

Issued with Certificate of Compliance No. 1004, Amendment 14
on ________________________ .