SAFETY EVALUATION REPORT
TRANSNUCLEAR, INC.
NUHOMS® HD HORIZONTAL MODULAR STORAGE
SYSTEM FOR IRRADIATED NUCLEAR FUEL
DOCKET NO. 72-1030
AMENDMENT NO. 2

SUMMARY

By letter dated September 28, 2012, (see Agencywide Documents Access and Management System (ADAMS) Accession No. ML12283A012) as supplemented on December 20, 2012, (see ADAMS Accession No. ML12356A391) and July 25, 2013, (see ADAMS Accession No. ML13210A074), Transnuclear, Inc. (TN) requested approval of an amendment, under the provisions of Title 10, *Code of Federal Regulations* (10 CFR) Part 72, Subparts K and L, to Certificate of Compliance (CoC) No. 1030 for the NUHOMS® HD Horizontal Modular Storage System for Irradiated Nuclear Fuel (NUHOMS® HD). TN requested the following changes:

- increase the soluble boron concentration to 2800 ppm for criticality safety analyses and add maximum enrichments for Combustion Engineering 14x14 fuel assemblies that were previously unauthorized for storage,
- improve clarity of certain Technical Specifications (TS), such as heat load zoning configuration, fuel qualification table, fuel class, intact fuel/damaged fuel definitions, etc.,
- allow for increased individual fuel assembly weight by 25 pounds,
- revise definition of control components,
- include blended low enriched uranium (BLEU) fuel material,
- increase shielding effectiveness of the horizontal storage module (HSM-H) by adding optional dose reduction hardware,
- update licensing basis documents based on recent experience with ongoing licensing actions involving other NUHOMS® systems, and
- re-analyzing to accommodate installation practices for a limiting gap size that was evaluated based on dose rates.

This amendment, when codified through rulemaking, will be denoted as Amendment No. 2 to the CoC.

In support of the amendment, TN submitted revised pages to the Final Safety Analysis Report (FSAR) for the NUHOMS® HD system. The revised pages also included changes that were incorporated by the applicant through the 10 CFR 72.48 change process as of December 20, 2012. The changes made pursuant to 10 CFR 72.48 changes are not part of this amendment request. Therefore, changes made under the 10 CFR 72.48 process were not evaluated by the NRC staff as part of this amendment and are not formally authorized as part of this certification action for the NUHOMS® HD system.

This safety evaluation report (SER) documents the review and evaluation of the proposed amendment. The NRC staff reviewed the amendment and supplements to the

amendment using guidance in NUREG-1536, “Standard Review Plan for Dry Cask Storage Systems,” Rev. 1, dated July 2010. Based on the statements and representations in the application, as supplemented, and the conditions specified in the CoC and TS, the staff concludes that the requested changes meet the requirements of 10 CFR Part 72.

The staff's assessment is based on whether TN meets the applicable requirements of 10 CFR Part 72 for independent storage of spent fuel and 10 CFR Part 20 for radiation protection. The staff’s assessment focused only on modifications requested in the amendment as supported by the submitted revised FSAR and did not reassess previously approved portions of the FSAR or CoCs through Amendment No. 1.

1.0 GENERAL DESCRIPTION

The objective of this chapter is to review the design changes made to the NUHOMS® HD storage system to ensure that TN provided a description that is adequate to familiarize reviewers and other interested parties with the pertinent features of the system, including the changes requested.

1.1 Drawings

The applicant submitted drawings of optional dose reduction hardware that may be installed on the vents to reduce occupational dose.

1.2 Evaluation Findings

The applicant’s drawings of the dose reduction hardware supplied in support of this amendment allows staff to conclude that the information presented in Chapter 1, “General Information” of the FSAR continues to satisfy the requirements for the general description under 10 CFR Part 72 because the drawings contain sufficient detail on dimensions, materials, and specifications to show the optional configuration. This finding is reached on the basis of a review that considered the regulation itself and accepted practices. Thus, based on the NRC staff's review of information provided for Amendment No. 2 for the NUHOMS® HD system, the staff determines the following:

F1.1 Drawings for structures, systems, and components (SSCs) important to safety are presented in the FSAR. Details of specific structures, systems, and components are evaluated in Sections 3 through 9 of this SER.

2.0 PRINCIPAL DESIGN CRITERIA EVALUATION

There were no requested changes requiring evaluating 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. The fuel specification changes requiring evaluation are documented in other sections to this SER.

3.0 STRUCTURAL EVALUATION

The objectives of the structural review were to assess the safety analysis of the structural design features, the structural design criteria, and the structural analysis methodology used to evaluate the expected structural performance capabilities under normal operations, off-normal operations, accident conditions, and natural phenomena events for those SSCs important to safety included in this application.

3.1 Control Components

The staff's review of NUHOMS® HD storage system Amendment No. 2 noted that the applicant proposes to add unirradiated, non-fuel hardware designated as control components as authorized contents. Examples include instrument tube tie rods (ITTRs), guide tube anchors (GTA), guide inserts, and burnable poison rod assembly (BPRA) spacer plates. The addition of control components such as these is subject to an evaluation pursuant to 10 CFR 72.48 to determine whether the conditions of the original CoC are maintained. Note that the individual fuel assembly weight (including control components) increased from 1585 pounds to 1610 pounds). The maximum weight previously evaluated in the structural evaluation exceeded the nominal weight by over 38 pounds, which is greater than 1610 pounds. Since this change was performed under 10 CFR 72.48 change authority and the resulting weights of the modified fuel assemblies were bounded by a previously approved maximum assembly weight, no further review was required.

The applicant also made minor changes to loading inputs for various analyses including end drops and side drops for canisters, baskets, and transfer casks. None of the modified inputs resulted in significant changes in the stress levels for any of the components analyzed; therefore, the previous safety basis remains unchanged.

3.2 Evaluation Findings

Based on the information provided in the SAR, by reference, and by supporting documentation, the staff finds that the application meets the acceptance criteria specified in NUREG-1536, Rev. 1, with the requested changes. The SAR adequately describes all SSCs that are important to safety, providing drawings and text in sufficient detail to allow evaluation of their structural effectiveness.

F3.1 The SAR adequately describes all SSCs that are important to safety, providing drawings and text in sufficient detail to allow evaluation of their structural effectiveness.

F3.2 The applicant has met the requirements of 10 CFR Part 72.236(b). The SSCs important to safety are designed to accommodate the combined loads of normal or off-normal operating conditions and accidents or natural phenomena events with an adequate margin of safety. Stresses at various locations of the cask for various design loads are determined by analysis. Total stresses for the combined loads of normal, off-normal, accident, and natural phenomena events are acceptable and are found to be within limits of applicable codes, standards, and specifications.

F3.3 The applicant has met the requirements of 10 CFR 72.236 with regard to inclusion of the following provisions in the structural design:

- Structural Designs that are Compatible with Retrievability of SNF.

The staff concludes that the structural properties of the structures, systems, and components of the NUHOMS® HD storage system are in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied. The evaluation of the structural properties provides reasonable assurance that the TN NUHOMS® HD will allow safe storage of spent fuel. This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

4.0 THERMAL EVALUATION

The thermal review of the NUHOMS® HD Amendment No. 2 includes evaluating the thermal effects of changes to the TSs, increasing the fuel assembly weight by 25 pounds, and heat transfer for BLEU fuel material.

4.1 Technical Specifications (TS) and FSAR Changes

This amendment includes editorial changes that, according to the applicant, improve the clarity of certain TS requirements, such as heat load zoning configuration, fuel qualification table, fuel class, and intact fuel/damaged fuel definition, without changing the heat load limit, zoning, or distribution. The staff found that the changes, mentioned above in the SAR and TS, have no impact on thermal design and evaluations of the NUHOMS® HD storage system.

4.2 Increased Fuel Assembly Weight

The applicant stated in the SAR that the fuel assembly includes both spent fuel rods and control components. The 25-lb weight increase per fuel assembly is in the control components (not in the spent fuel rods) and thus does not increase the heat load of the fuel assembly. Based on the heat load limit, zoning, or distribution described in the SAR, the staff concludes that the thermal heat load and design features are not changed, and accepts that increased control component weight has no significant thermal effect on the NUHOMS® HD system.

4.3 BLEU Fuel Material

The application states that BLEU fuel material is identical to UO_2 fuel material except for the presence of higher cobalt impurity. The qualification of fuel assemblies containing BLEU fuel pellets requires an additional cooling time of 2.5 years to ensure that the source terms calculated with UO_2 materials are bounding.

Table 4.16.2-6 (BLEU fuel with initial enrichment equal to or greater than 1.5 weight-percent ^{235}U) and Table 4.16.2-7 (BLEU fuel with initial enrichment less than 1.5 weight-percent ^{235}U) in the application provide the results of decay heat calculation using the applicable range of initial enrichment, burnup, and cooling time of the BLEU fuel. The staff reviewed these calculations and found that the calculated fuel assembly thermal power bounds the actual assembly thermal power for the BLEU fuel for all cases. Therefore, the staff finds that the decay heat limits are met when storing the BLEU fuel material in the NUHOMS® HD storage system.

4.4 Evaluation Findings

F4.1 Editorial changes in the thermal sections of the SAR and TS have no impact on thermal design and evaluations of the NUHOMS® HD system.

F4.2 An increased fuel assembly weight by 25 pounds (with unchanged heat load limit and an unchanged heat load zoning/distribution) has no significant effect on the NUHOMS® HD thermal system.

F4.3 The actual decay heat limit from the BLEU fuel meets the applicable heat load zone limit when storing the BLEU fuel material in the NUHOMS® HD-32PTH dry shielded canister (DSC) storage system.

The staff concludes that the thermal evaluation of the structures, systems, and components of the NUHOMS® HD storage system are in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied. The thermal evaluation provides reasonable assurance that the TN NUHOMS® HD will allow safe storage of spent fuel. This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

5.0 CONFINEMENT EVALUATION

The confinement review of the NUHOMS® HD Amendment No. 2 ensures that radiological releases to the environment will be within the limits established by the regulations and that the spent fuel cladding and fuel assemblies will be sufficiently protected during storage against degradation that might otherwise lead to gross ruptures. The confinement scope of this amendment to the NUHOMS® HD storage system is to review changes to the TS and changes described in Chapter 9 of the application.

5.1 Changes in Technical Specifications and SAR

Figure 7-1 of the FSAR was revised to show the confinement boundary and redundant sealing of the NUHOMS® HD-32PTH DSC closure.

According to the application, the DSC confinement boundary is helium leak tested to meet the leaktight criteria, 1×10^{-7} ref-cm^3/s, as defined in ANSI N14.5-1997, "Radioactive Materials - Leakage Tests on Packages for Shipment." The DSC shell, inner bottom cover plate and associated welds are leak tested to meet the leaktight criteria during fabrication. The inner top cover plate, vent and siphon port cover plates, and associated welds are also helium leak tested to meet the leaktight criteria after loading the DSC. According to the applicant, this ensures that an inert atmosphere is maintained inside the DSC throughout the duration of storage. In doing so, the staff concludes that this prevents oxidation of the fuel and ensures radiological consequences will be negligible.

5.2 Evaluation Findings

F5.1 The confinement system is leaktight for normal conditions and anticipated occurrences, thus the confinement system will reasonably maintain confinement of radioactive material. Chapter 11, "Radiation Protection Evaluation" of the SER for the initial issuance of the certificate of compliance (see ADAMS Accession No. ML070160089), shows that the direct dose from the NUHOMS® HD-32PTH

DSC satisfies the regulatory requirements of 10 CFR 72.104(a) and 10 CFR 72.106(b).

F5.2 The confinement system has been evaluated by analysis. Based on successful completion of specified leakage tests and examination procedures, the staff concludes that the confinement system will reasonably maintain confinement of radioactive material under normal, off-normal, and credible accident conditions.

The staff concludes that the design of the confinement system of the NUHOMS® HD-32PTH DSC is in compliance with 10 CFR Part 72 and that the applicable design and acceptance criteria have been satisfied. The evaluation of the confinement system design provides reasonable assurance that the NUHOMS® HD-32PTH will allow safe storage of spent fuel. This finding considered the regulation itself, the appropriate regulatory guides, applicable codes and standards, the applicant's analyses, the staff's confirmatory analysis, and acceptable engineering practices.

6.0 SHIELDING EVALUATION

6.1 Summary

TN requested changes to the TS attached to CoC No. 1030, with supporting revisions to the NUHOMS® HD FSAR, in order to reflect the addition of BLEU fuel, to update the documents that form the certification basis due to recent experience with ongoing certification actions involving other NUHOMS® systems, the addition of optional dose reduction hardware, and re-analysis for enhanced installation of certain system components.

6.1.1 Objective

The objective of this review is to verify that the shielding features limit the dose to members of the public so that the dose remains within regulatory requirements during normal operating, off-normal, and design-basis accident conditions. The review seeks to ensure that the shielding design is sufficient and reasonably capable of meeting the operational dose requirements of 10 CFR 72.104 and 72.106 in accordance with 10 CFR 72.236(d).

6.2 Description

6.2.1 Shielding Design Criteria

TS dose rate evaluation in the application includes maximum dose rate limits as calculated for a content of design basis fuel as well as procedures to determine whether the dose rate at the prescribed locations exceeds the maximum dose rate limit.

6.2.2 Shielding Design Features

According to the application, the NUHOMS® HD-32PTH DSC is placed within a HSM-H. The OS-187H transfer cask (TC) provides shielding and protection during loading, closure and transfer operations. The concrete walls and roof of the HSM-H provide the bulk of the shielding in storage conditions. During loading and transfer operations, the steel end-plugs of the -32PTH DSC and steel/lead/neutron shield material of the OS-187H provide shielding for personnel.

6.3 Source Specification

6.3.1 Gamma Source

BLEU fuel is similar to UO_2 pellets except for the presence of higher quantities of certain impurities. These impurities result in additional gamma emission only. The applicant has postulated that an additional 2.5 years of cooling time will reduce gamma radiation to the levels of the previously analyzed source term. Prior gamma source terms are presented in Table 5-10 of the application; however the change to the gamma source is not explicitly presented for BLEU fuel.

6.3.2 Neutron Source

According to the applicant, the addition of BLEU fuel as authorized contents does not result in any change to the design basis neutron source term previously analyzed.

6.4 Shielding Model

The staff has determined that the changes to the shielding model are described in sufficient detail to conduct a review of the package shield design.

6.4.1 Configuration of Shielding and Source

According to the application, the configuration of the source material within the -32PTH DSC is identical to that in the prior analysis.

One of the proposed changes in the application results in additional gap width between side and rear walls of adjacent HSM-H modules. The presence of vents results in a larger dose rate increase in side wall gaps than rear wall gaps. The gap widths modeled in the application range from 0.5 to 1.25 inches.

Additional hardware is modeled by the applicant in this analysis of the HSM-H. The new model features the DSC support rails which provide some shielding to the front vents. The new model also takes credit for the sloped concrete above the bottom vents that was ignored in the original model. A reflective boundary condition on one side of the HSM-H model accounts for dose contribution from an adjacent module.

The rear-wall dose gap dose rates are multiplied by 2 to account for array configuration, according to the application.

6.4.2 Material Properties

According to the applicant, the shielding material compositions used in the analysis are the same as in the prior analysis.

6.5 Shielding Analyses

6.5.1 Computer Codes

The applicant used the MCNP computer code with minor changes to the geometry input from the prior review.

6.5.2 Flux-to-Dose-Rate Conversion

The flux distribution calculated by MCNP is converted to dose rates in the application using the flux-to-dose rate conversion factors from ANSI/ANS-6.1.1-1977, "Neutron and Gamma-Ray Flux-to-Dose Conversion Factors."

6.5.3 Dose Rates

The maximum and average dose rates are presented in Table 5-21 in the application. Dose rates due to side-to-side gaps are presented in Table 5-26 in the application. The expected dose rates resulting from the loading of BLEU fuel with an additional 2.5 year cooling time is presented in Table 5-27, in the application.

6.5.4 Confirmatory Analysis

The staff performed a depletion calculation with the TRITON/NEWT modules within the SCALE 6.1 package to verify the source term difference between BLEU fuel and the existing analyzed fuel composition. Staff verified that an additional 2.5 years of cooling time brings the dose rate using the ANSI/ANS-6.1.1-1977 response function within close agreement to the fuel designs that were previously approved. Staff analyzed several burnup values of both BLEU and standard UO_2 fuel, including the bounding scenarios postulated by the applicant. Burnup was analyzed with both a single pin calculation and an infinite array of Westinghouse 17x17 class of assemblies.

The staff also evaluated the effect of gap size on dose rates. The staff homogenized the source region and used the gamma spectrum of the bounding Framatome ANP Advanced MK BW 17x17 assemblies cooled to 7 years. The staff's model ignored the additional HSM-H concrete and the support rails included in the applicant's model used for this amendment request. The magnitude of the dose rate from the staff's initial calculation was significantly different, although the relative changes between 0.5 inch and 1.25 inch gaps was in acceptable agreement. Using one of the applicant's calculated points for reference, the source strength was scaled. In follow-up calculations, the staff's results were close enough to verify the applicant's predicted dose rates.

The optional dose reduction hardware was not evaluated.

6.6 Evaluation Findings

F6.1 Sections 1, 2, and 5 of the SAR describe shielding structures, systems, and components important to safety in sufficient detail to allow evaluation of their effectiveness.

F6.2 Section 5 of the SAR provides reasonable assurance that the radiation shielding features are sufficient to meet the radiation protection requirements of 10 CFR 72.104 and 10 CFR 72.106.

F6.3 Operational restrictions to meet dose and 10 CFR Part 20 requirements to keep doses as low as reasonably achievable, 10 CFR 72.104, and 10 CFR 72.106 are the responsibility of the general licensee. The NUHOMS® HD shielding features are designed to assist in meeting these requirements.

The staff concludes that the design of the shielding system of the NUHOMS® HD-32PTH DSC is in compliance with 10 CFR Part 72 and that the applicable design and acceptance criteria have been satisfied. The evaluation of the shielding design provides reasonable assurance that the NUHOMS® HD-32PTH will allow safe storage of spent fuel. This finding considered the regulation itself, the appropriate regulatory guides, applicable codes and standards, the applicant's analyses, the staff's confirmatory analysis, and acceptable engineering practices.

7.0 Criticality Evaluation

The criticality review and evaluation ensures that spent fuel to be placed into the NUHOMS® HD storage system remains subcritical under normal, off-normal, and accident conditions involving handling, packaging, transfer, and storage. The scope of the review is confined to the applicant's request to increase the soluble boron concentration up to a maximum of 2800 ppm.

The applicant used the calculations performed for the NUHOMS® -32PTH1 DSC (ref. Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, NUH-003, Rev. 12) as a bounding model for the NUHOMS® HD, which, according to the applicant, is conservative, since the DSC transition rails have been modeled more conservatively in both the intact and damaged configurations. All of the analyses at 2800 ppm of soluble boron also use solid aluminum basket transition rails, which the applicant contends is also conservative, since the aluminum enhances the scatter of neutrons to adjacent casks.

In response to an acceptance review request for supplemental information, the applicant clarified how the calculations for the NUHOMS® -32PTH1 at 2800 ppm of soluble boron bound the current system, and subsequently revised their application to provide a detailed justification in Section 6.4.2 of the application. With the addition of this enhanced justification for utilizing the bounding analysis, staff finds this analysis adequate to ensure the safety of the NUHOMS® HD system, and that the maximum planar average initial enrichment for intact and damaged fuel loading for the various assembly classes and basket types cited in Table 6-1 of the application and Table 7 of the TSs are appropriate for a minimum soluble boron concentration of 2800 ppm. This staff conclusion is based upon the fact that in all instances the calculated maximum k_{eff} of the most reactive configuration of each fuel type is below the upper subcritical limit.

The other changes requested by the applicant as part of this amendment do not directly impact the criticality safety of the NUHOMS® HD system. The addition of BLEU fuel is equivalent to standard UO_2 fuel, except for the presence of a higher quantity of cobalt impurity.

7.1 Evaluation Findings

F7.1 Structures, systems, and components important to criticality safety are described in sufficient detail in Chapters of the FSAR to enable 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 NUHOMS® HD are in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied. The evaluation of the criticality design provides reasonable assurance that the NUHOMS® HD will allow safe storage of spent fuel. This finding is 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 minor revisions to the materials of the NUHOMS® HD storage system. Requested changes include inclusion of some control components, revised definition of damaged fuel, an exemption to the American Society for Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, the addition of BLEU fuel, changes to welding metal, and concrete testing. The remaining materials used in the fabrication of the NUHOMS® HD storage system are unchanged.

8.1 Control Components

The applicant requested the inclusion of non-fuel hardware that is positioned within the fuel assembly after the fuel assembly is discharged from the reactor. Cladding material for the non-fuel hardware includes zirconium alloys, nickel alloys and stainless steel. The internal components of non-fuel hardware include non-fuel materials such as boron carbide, aluminum oxide, Inconel, etc. These materials of construction are not affected by storage in spent fuel pools, dry casks or dry cask loading or unloading conditions. Therefore, the staff finds the inclusion of these components acceptable.

8.2 Damaged Fuel

The applicant requested that the definition of damaged fuel in Table 2-1 of the TSs be expanded to include fuel assemblies with missing or partial fuel rods and clarified the language stating that the extent of cladding damage shall be limited such that the fuel assembly can be handled by normal means. The applicant also clarified that damaged assemblies may should contain top and bottom end fittings, nozzles or tie plates, depending on the fuel type. The staff has determined that including fuel assemblies with missing or partial rods along with the normal fuel assembly end fittings (top and bottom end fittings or nozzles or tie plates), as appropriate for the fuel type, as requested by the applicant, does not impact the handling or properties of the spent fuel; therefore the staff finds inclusion of these fuel assemblies acceptable.

8.3 Neutron Absorber Tests

The application contains three distinct changes to the description and acceptance criteria of the absorber materials. In Section 9.1.7.2 of the SAR, the applicant requested the use of molten metal infiltration as a fabrication method to produce metal matrix composites (MMCs). There are two distinct types of molten metal infiltration relevant for the application: 1) Molten metal (aluminum) is mixed with a secondary reinforcing phase (boron carbide particles) and is cast into a mold. The metal cools and solidifies creating a composite material. 2) The secondary reinforcing phase (boron carbide particles) are placed into a mold and molten metal (aluminum) infiltrates the pore space between the secondary phase and solidifies. In this latter technique, pressure is usually used to ensure the molten metal infiltrates the pore space between the secondary phase. The staff finds this change acceptable, because molten metal infiltration is a commonly used technique to produce metal matrix composites in industry and qualifying and acceptance tests in the technical specifications will verify the molten metal infiltration process produces neutron absorbers with the required critical characteristics, which the staff finds acceptable.

In Section 9.1.7.4, the applicant clarifies that neutron absorbing materials which do not meet the visual acceptance criteria will be reworked, repaired or scrapped. The staff finds this change acceptable, as there is no safety significance to bringing a defective component into compliance with the required specifications or scrapping a defective component.

Section 9.5.3.4 specifies clad MMCs shall be subjected to a thermal damage test following a pressurized water immersion test. The test conditions approximate conditions in a spent fuel canister during drying. The test criteria are similar to what has been previously approved in Section 8.1.7.8.3.1 for the Model No. TN-LC transportation package (ADAMS Accession Number: ML12340A312 and Docket No. 71-9358). Therefore the staff finds the test adequate for ensuring MMCs with aluminum cladding will not delaminate or blister during drying. Other changes to the qualification and acceptance testing of the neutron absorbers are also consistent with the approval for the Model No. TN-LC package, therefore the staff finds them acceptable.

8.4 Exception to ASME B&PV Code

The 32PTH DSC canister system is constructed in accordance with ASME B&PVC, Section II, 1998, through 2000 addenda, with Code exceptions listed in 4.4.4, “Alternatives to Codes and Standards of the Technical Specifications.” Section III, Division I, Subsection NB, Article 5520 of the ASME B&PV Code requires personnel conducting non-destructive evaluations be qualified to a specific edition of SNT-TC-1A, the “American Society for Nondestructive Testing, Personnel Qualification and

Certification in Nondestructive Testing." The applicant requested an exception from the specific versions SNT-TC-1A so that personnel may be qualified to more recent editions of SNT-TC-1A. The guidance in NUREG-1536 Revision 1 states, "Inspection personnel should be qualified, in accordance with the current revision of the American Society for Nondestructive Testing's (SNT) 'Personnel Qualification and Certification in Nondestructive Testing" (SNT-TC-1A),' as specified by the ASME B&PV Code." Following the guidance NUREG-1536 the staff finds using more recent versions of SNT-TC-1A, up to the 2011 edition, acceptable.

8.5 Instrument Tube Tie Rods

The applicant requested the storage of Westinghouse 15x15 and 17x17 class fuel assemblies fitted with ITTRs. Since this change was performed under the 10 CFR 72.48 change authority and the structural review indicated that the weights of the modified fuel assemblies were bounded by a previously approved maximum assembly weight, no further review was required.

8.6 BLEU Fuel

The applicant requested the storage of fuel assemblies loaded with BLEU fuel. Fuel pellets containing BLEU fuel are essentially the same as standard low-enriched uranium oxide fuel, except for higher cobalt impurity content. These similarities are documented in the "Additional Use of Blended Low Enriched Uranium (BLEU) in Reactors at TVA's Browns Ferry and Sequoyah Nuclear Plants," May 2011 (http://www.tva.gov/environment/reports/heu/ea.pdf). The higher cobalt content, verified in the "Interagency Agreement DE-SA09-01 SR18976/TVA No. P-01 N8A-249655-001 Between the Department of Energy (DOE) and the Tennessee Valley Authority (TVA) for the Off-Specification Fuel Project" (ADAMS Accession No. ML13099A253) will result in an increased gamma source term from fuel assemblies containing BLEU fuel. The increased gamma source term will be orders of magnitude lower than what is required to adversely affect the materials used to construct the NUHOMS® HD storage system or contents and the staff finds the applicant's analysis bounds any safety considerations regarding the storage of BLEU fuel in comparison to conventional uranium oxide fuel.

8.7 Weld Metal for HSM-H Structures

In Section 4.6.3 of the TSs, the applicant requested approval of weld metal with 1% or more nickel as an acceptable alternative to weld metal with 0.20% copper content. Both copper and nickel improve the corrosion resistance of steel but higher copper content can result in weld cracking. Atmospheric testing has shown steels with 1% nickel and low (≤ 0.02%) copper content have superior corrosion resistance to steels with ≥ 0.20% copper and no appreciable nickel. This corrosion trend was observed for steels with a variety of additional alloy elements. This determination is based on results cited in Larrabee, C. P. and Coburn, S. K. (1962), "The Atmospheric Corrosion of Steels as Influenced by Changes in Chemical Composition," Proceedings of First International Congress on Metallic Corrosion, Butterworths, London, pages 276-285. The staff finds the replacement of copper 0.20% copper with 1% nickel in the weld metals acceptable.

8.8 Concrete Testing

The applicant added parameters in TS 5.5 to require temperature testing of the concrete whenever the supplier of the cement, the source of the aggregate and the water-cement is changed or when the water-cement ratio changes by more than 0.04. The staff finds these additional parameters clarify previously unmentioned changes to the concrete fabrication which should require elevated temperature testing, and are therefore acceptable.

9.0 OPERATING PROCEDURES EVALUATION

Operating procedures changes requiring evaluation are documented in previous sections of this SER.

10.0 ACCEPTANCE TESTS AND MAINTANANCE PROGRAM EVALUATION

There were no requested acceptance tests or maintenance program changes requiring evaluation.

11.0 RADIATION PROTECTION EVALUATION

Radiation protection changes are evaluated and documented in previous sections of this SER.

12.0 ACCIDENT ANALYSIS EVALUATION

There were no requested accident analysis procedures changes requiring evaluation. Other accidents are bounded by previous analyses. Structures, systems, and components of the NUHOMS® HD storage system are adequate to prevent accidents, and to mitigate the consequences of accidents and natural phenomenon events that do occur.

13.0 TECHNICAL SPECIFICATIONS

TS changes are documented and evaluated in previous sections of this SER.