TRANSNUCLEAR
AN AREVA COMPANY

February 10, 2006
E-23293

Mr.Joe Sebrosky
Spent Fuel Project Office, NMSS
U. S. Nuclear Regulatory Commission
11555 Rockville Pike MIS 0-6-F-18
Rockville, MD 20852

Subject: Transnuclear, Inc. (TN) Review Comments on the Preliminary Certificate of Compliance and Safety Evaluation Report for the NUHOMS® HD System (TAC No. L23738)

Reference: Preliminary Certificate of Compliance and Safety Evaluation Report for the NUHOMS® HD System (TAC No. L23738), dated February 8, 2006

Dear Mr. Sebrosky:

Enclosed herewith is a marked up copy of the reference documents which reflects TN's review comments. Please note that only those pages with comments have been included herewith.

Should you or your staff require additional information to support review of this application, please do not hesitate to contact me at 410-910-6881 or Mr. U.B. Chopra at 510-744-6053.

Sincerely,

Jayant Bondre, PhD
Director of Engineering and Licensing

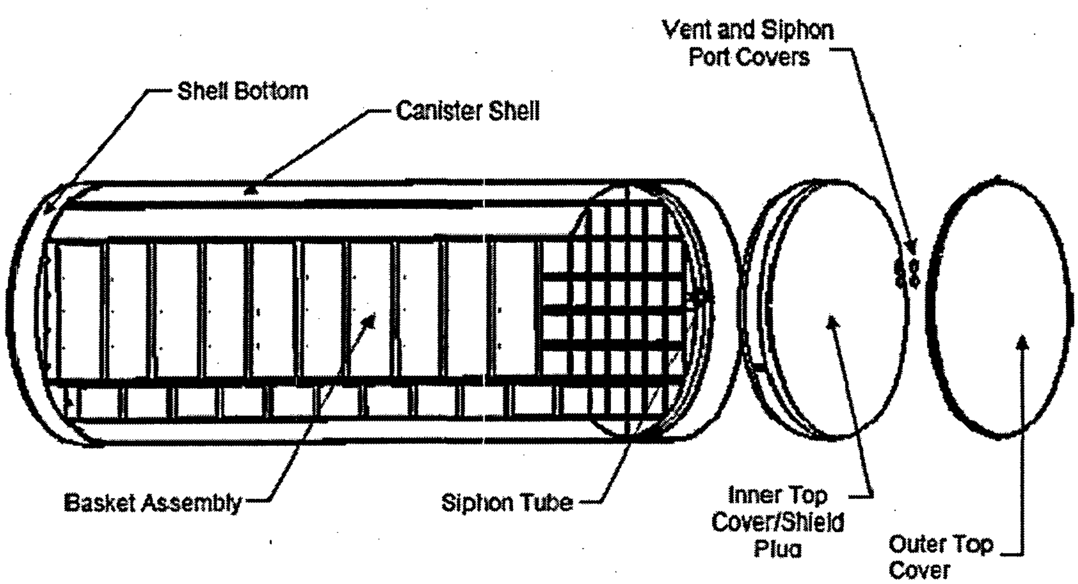
Docket 72-1030

Enclosures: As stated

1.1.1 Dry Shielded Canister (32PTH DSC)

The 32PTH DSC is designed to store up to 32 intact pressurized water reactor (PWR) Westinghouse 15x15 (WE 15x15 and WES 15x15), Westinghouse 17x17 (WE 17x17, WEV 17x17 and WEO 17x17), Framatome ANP Advanced MK BW 17x17 (MK BW 17x17) and/or Combustion Engineering 14x14 (CE14x14) fuel assemblies. Non-Fuel Assembly Hardware (NFAHs) like Vibration Suppressor Inserts (VSI), Burnable Poison Rod Assemblies (BPRAs), or Thimble Plug Assemblies (TPAs) are allowed for these fuel assemblies except for CE 14x14 fuel assemblies. The 32PTH DSC is also designed for storage of up to 16 damaged fuel assemblies, and remaining intact assemblies, utilizing top and bottom end caps. The maximum heat load per 32PTH DSC, including any integral insert components, is 34.8 kW for WE 15x15, WES 15x15, WE 17x17, WEV 17x17, WEO 17x17, and MK BW 17x17 assemblies and 33.8 kW for CE 14x14 assemblies. inner

The 32PTH DSC consists of a stainless steel cylindrical shell with welded inner top cover/shield plug and bottom cover plate which form the confinement boundary. Shield plugs are installed inside of the confinement boundary, at the top and bottom, to provide radiological shielding. Inside of the 32PTH DSC is a basket assembly that consists of stainless steel square tubes and support strips for structural support, and geometry control; and aluminum/borated aluminum for heat transfer and criticality control. The 32PTH DSC is very similar to the 24PTH DSC.



The transfer trailer is not important to safety because the NUHOMS® HD System Technical Specifications (TS) limit the lifting height of the 32PTH DSC to eighty inches which is within the design basis drop for the DSC. Therefore, the transfer trailer was not evaluated in this SER.

1.2 Drawings

Section 1 of the SAR contains the non-proprietary drawings for the NUHOMS® HD System, including drawings of the structures, systems, and components (SSC) important to safety. The staff determined that the drawings contain sufficient detail on dimensions, materials, and specifications to allow for a thorough evaluation of the NUHOMS® HD System. Specific SSC are evaluated in Sections 3 through 12 of this SER.

1.3 32PTH DSC Contents

The 32PTH DSC is designed to store up to 32 intact CE 14x14, WE 15xl5, WE 17x17, and/or FA 17x17 assemblies. Non-Fuel Assembly Hardware like VSIs, BPRAs, or TPAs are allowed for these fuel assemblies except for CE 14x14 fuel assemblies. The 32PTH DSC is also designed for storage of up to 16 damaged fuel assemblies, and remaining intact assemblies. Additional fuel characteristics are discussed in Sections 2 and 6 of the SAR.

1.4 Technical Qualifications of Applicant

Section 1.3 of the SAR contains identification of agents and contractors. The prime contractor for design and procurement of the NUHOMS® HD System components is TN. TN will subcontract the fabrication, testing, on-site construction, and QA services as necessary to qualified firms on a project specific basis in accordance with the TN QA program requirements. The TN QA program is evaluated in Section 13 of this SER.

1.5 Evaluation Findings

F1.1 A general description of the NUHOMS® HD System is presented in Section 1 of the SAR with special attention to design and operating characteristics, unusual or novel design features and principal safety considerations.

F1.2 Drawings for SSC important to safety are presented in Section 1 of the SAR. Specific SSC are evaluated in Sections 3 through 12 of this SER.

F1.3 Specifications for the spent fuel to be stored in the NUHOMS® HD System are stated in SAR Sections 1, 2, and 6.

F1.4 The technical qualifications of the applicant to engage in the proposed activities are identified in Section 1.3 of the SAR.

F1.5 The quality assurance program, and implementing procedures are described in Section 13 of the SAR.

3.0 STRUCTURAL EVALUATION

This section presents the results of the review for the structural evaluation of the NUHOMS® HD System. The NUHOMS® HD System consists of the 32PTH DSC basket and shell assemblies, the HSM-H horizontal storage module, and the OS187H Transfer Cask. The 32PTH DSC is a new dual purpose canister designed to accommodate up to 32 intact PWR fuel assemblies (or up to 16 damaged assemblies, with the remaining intact) and a total heat load of up to 34.8 kW. The HSM-H is an enhanced version of the NUHOMS® Standardized HSM (CoC 1004) to enable storage of the higher heat load 32PTH DSC. The OS187H is a modified version of the OS197 Transfer Cask with a redesigned shielding panel to improve thermal performance, a shortened cavity length, and increased inside diameter to accommodate the 32PTH DSC.

The 32PTH DSC is a cylindrical stainless steel canister backfilled with helium to provide dry storage of the spent fuel assemblies in an inert atmosphere; the HSM-H is a reinforced concrete horizontal storage module that houses and provides environmental protection and shielding to the 32PTH DSC; the OS187H transfer cask is a stainless steel cask with lead shielding that handles and protects the 32PTH DSC during transfer to and from the HSM-H.

A complete structural evaluation of the 32PTH DSC shell assembly and basket components, the HSM-H, and the OS187H transfer cask has been performed. The structural evaluation shows that the NUHOMS® HD system design is compatible with the requirements of 10 CFR 72.236 (Reference 1) for maintaining the spent fuel in a subcritical condition, providing adequate radiation shielding and confinement, having adequate heat removal capability, providing a redundant sealing of the confinement system, and providing wet or dry transfer capability. The structural review was conducted against the appropriate regulations as described in 10 CFR 72.11, 10 CFR 72.122, 10 CFR 72.146, and 10 CFR 72.236.

3.1 Structural Design of the NUHOMS® HD System

3.1.1 Dry Shielded Canister 32PTH DSC

For the purpose of the structural analysis, the 32PTH DSC is divided into the 32PTH DSC shell assembly and the internal basket assembly. The canister shell assembly and details are shown on drawings 10494-72-1 through 10494-72-7 in Chapter 1, Section 1.5. The shell assembly provides confinement of radioactive materials, encapsulates the fuel in an inert atmosphere (i.e., the canister is backfilled with helium before being sealed by welds), and the top shield plug and the shell bottom provide biological shielding during fuel loading operations and dry storage. The 32PTH DSC shell assembly is designed, fabricated, examined and tested in accordance with the requirements of Section III, Division 1, Subsection NB of the ASME Code (Reference 2). The 32PTH DSC top closure is composed of an outer top cover plate and an inner top cover/shield plug. The outer top cover plate and inner top cover/shield plug are sealed by separate welds. The inner top cover/shield plug is welded to the 32PTH DSC shell to form the inner pressure boundary. The outer top cover plate is welded to the shell to provide a redundant confinement boundary as required by 10 CFR 72.236(e). The inner top cover/shield plug, the siphon/vent block, and the siphon/vent port cover plate are designed, fabricated and inspected in accordance with the ASME Code Subsections NB to the maximum practical extent. Alternatives to the ASME code are discussed in Section 3.10 of the SAR and are listed in TS 4.4.4, "Alternatives to Codes and Standards."

During fabrication, leak tests of the welds in the 32PTH DSC shell and bottom are performed in accordance with ANSI N14.5-1997 to demonstrate that the canister shell assembly is leaktight to $1x10^{-7}$ ref· cm^3/sec. Post-fabrication and after the fuel loading, the top closure welds (including the shell-to-inner top cover plate/shield plug weld, the vent and siphon cover plate welds, and the shell-to-top cover plate weld), are leak tested to demonstrate leaktightness. This leaktight testing is also discussed in Section 9.1.2 of this SER.

The details of the 32PTH DSC basket are shown in drawings 10494-72-8 through 10494-72-12 in Chapter 1, Section 1.5. The basket is an assembly of stainless steel fuel tubes that is designed to accommodate 32 PWR fuel assemblies. The tubes are intermittently fusion welded to Type 304 stainless steel support plates. Neutron poison plates, either a boron-aluminum alloy or a boron carbide aluminum metal matrix composite, are sandwiched between the walls of the fuel tubes and the 304 stainless steel support plates. The neutron poison plates provide criticality control and a heat conduction path from the fuel assemblies to the canister shell. Stainless steel rails are oriented parallel to the axis of the canister and attached to the periphery of the basket to support the basket and maintain its orientation. The basket structure is open at each end and the fuel tubes are nominally 8.70 inches x 8.70 inches in cross section to provide clearances around the fuel assemblies. The overall length of the basket is 162.00 inches which is less than the canister cavity length of 164.50 inches to allow thermal expansions. The basket structure must provide sufficient rigidity to meet heat transfer, nuclear criticality, and structural requirements. The basket design is based on the allowable stresses of Section III, Subsection NG of the ASME Code. Stress limits for Level A through D service conditions are summarized in Table 3-3 of the SAR.

3.1.2 HSM-H Reinforced Concrete Structure

The HSM-H concrete and steel components are designed to the requirements of ACI 349 and the AISC Manual of Steel Construction, respectively. The loads and load combinations are in accordance with those specified in ANSI 57.9. The details of the HSM-H module are shown in drawings 10494-72-100 through 10494-72-109 in Chapter 1, Section 1.5. The HSM-H consists of two separate units: a base storage unit, where the 32PTH DSC is stored, and a top shield block that provides environmental protection and radiation shielding. The top shield block is attached to the base unit by vertical reinforcing bars. Three-foot thick shield walls are installed behind each HSM-H (single row array) and at the ends of each row to provide additional shielding.

3.1.3 OS187H On-Site Transfer Cask

The NUHOMS® -OS187H on-site transfer cask consists of a stainless structural shell, gamma shielding material (cast chemical lead), and solid (Resin) and liquid (water) neutron shields. The top cover is bolted to the top flange by 24 -1.5 in. diameter high strength bolts and sealed with an O-ring. A cover plate is provided to seal the bottom hydraulic ram access penetration of the cask (by 12-1/2 in. high strength bolts with O-ring) during fuel loading and transferring the DSC to the ISFSI. Detailed design drawings for the OS187H Transfer Cask are provided in drawings 10494-72-15 through 10494-72-21 in Chapter 1, Section 1.5. Sets of upper and lower trunnions, welded to the structural shell of the transfer cask, provide support, lifting, and rotation capabilities for transfer cask operations. The top trunnions are constructed from SA-182 Type FXM-19 and the bottom trunnions are constructed from SA-182 Type 304. The top trunnions are designed, fabricated, and tested in accordance with ANSI N14.6 as critical lifting devices. Consequently they are designed with a factor of safety of six against the material yield strength and a factor of safety of ten against the material ultimate strength. The OS187H TC is designed to meet the criteria of ASME Code Subsection NC for Class 2 Components. Service Level A allowable stress limits are used for all normal and off-normal loadings. Service Level D allowable stress limits are used for load combinations that include postulated accident condition loadings.

3.2 Materials

The applicant provided a general description of the materials of construction in SAR Sections 1.1,1.2, and 3.1.1.1. Additional information regarding the materials, fabrication details and testing programs can be found in SAR Section 9.1. The staff reviewed the information contained in these Sections; Section 3.10, ASME Code Exceptions (Alternatives) and the information presented in the license drawings, to determine whether the NUHOMS HD system meets the requirements of 10 CFR 72.24(c)(3) and (4), 72.122(a), (b), (h) and (l), and 72.236(g) and (h). In particular, the following aspects were reviewed: materials selection; brittle fracture; applicable codes and standards; weld design and specifications; chemical and galvanic corrosion, and cladding integrity.

3.2.1 Structural Materials

Most of the structural components of the 32PTH-DSC (e.g., shell, bottom plate, and top cover plate) are fabricated from austenitic stainless steel (i.e., SA, Type 304 or A Type 304). The fuel compartment boxes in the 32PTH-DSC basket are also fabricated from austenitic stainless steel. The sections of the stainless steel fuel compartments are fusion welded to Type 304 stainless steel structural plates. This type of steel was selected because of its high strength, ductility, resistance to corrosion and metallurgical stability. Because there is no ductile-to-brittle transition temperature in the range of temperatures expected to be encountered for this steel, its susceptibility to brittle fracture is negligible. The staff concludes that the selection of 304 stainless steel is acceptable for use in the DSC.

The HSM-H is a free standing reinforced concrete structure designed to provide environmental protection and radiological shielding for the 32PTH DSC. The design of the HSM-H for 32PTH DSC is the same as the HSM-H for Amendment 8 to CoC 1004 for 24PTH DSC that has been approved by staff. The main structural components of the HSM-H are fabricated with reinforced concrete and carbon steel. The HSM-H components are fabricated from American Society for Testing and Materials (ASTM) A 36 steel, a commonly used steel for structural applications, ASTM A 615 reinforcing steel, and ASTM A-992 steel. The minimum specified concrete compressive strength and density is 5000 psi and 145 lb/ft^3, respectively. The staff concludes that the concrete materials meet the requirements of ACI 349, and, the materials comprising the HSM-H are suitable for structural support, shielding, and protection of the 32PTH-DSC from environmental conditions.

Transfer cask structural components (including the inner and outer shells, trunnions, top and bottom covers, etc.) are primarily fabricated from ASME SA 240, chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels and for general applications. This type of steel is a common structural material. The staff concludes that this steel is suitable for use in the transfer cask.

3.2.2 Nonstructural Material

Criticality control in the PWR DSC basket is achieved by including neutron absorbers (also called poisons). The neutron absorber plates provide criticality control and a heat conduction path from the fuel assemblies to the canister shell. The DSC basket is a welded assembly of stainless steel fuel compartment boxes, and designed to accommodate PWR fuel assemblies. The sections of the stainless steel fuel compartments are fusion welded to Type 304 stainless steel structural plates, sandwiched between the box sections. Neutron poison plates are composed of 1) a borated aluminum alloy, 2) a boron carbide aluminum metal matrix composite, or 3) Boral. The absorbers are sandwiched between the sections of the stainless steel walls of the adjacent box and the adjacent stainless steel plates. In accordance with Section 9.1 of the SAR and TS 4.3.1, appropriate acceptance testing will be used to ensure that the neutron absorbers have the minimum specified ^{10}B loading (content) and perform their function. Section 9.1.3 of this SER discusses the neutron absorber testing in greater detail.

Neutron absorbers and gamma shields (ASTM B29) will be fabricated from materials that can perform well under all conditions of service during the license period. The lead and steel shells of the transfer cask provide shielding between the DSC and the exterior surface of the package for the attenuation of gamma radiation. Axial neutron shielding is primarily provided by a borated polyester resin compound. The resin compound is cast into stainless steel cavities on the outside surface of the top closure and bottom assembly. The *Vyal B* resin material is an unsaturated polyester cross-linked with styrene, with about 50% weight mineral and fiberglass reinforcement. The components are polyester resin, styrene monomer, alpha methyl styrene, aluminum oxide, zinc borate, and chopped fiberglass.

The transfer cask lid and port cover o-rings may be fluorocarbon, silicone, EPDM, or other material with a service temperature range from -15 °F to 300 °F.

The staff concludes that the neutron absorbers, shielding materials, and o-rings will be adequately durable during the service life of the cask. As stated above, the acceptance and qualification for the neutron absorbers are discussed in Section 9.1.3 of this SER.

3.2.3 Welds

The 32PTH DSC shell assembly is designed, fabricated, examined and tested in accordance with the requirements of Subsection NB of the ASME Code. The circumferential and longitudinal shell plate weld seams are multi-layer full penetration butt welds. The butt weld joints are fully radiographed and inspected according to the requirements of NB-5000 of the ASME Boiler and Pressure Vessel Code. The full penetration inner bottom cover plate to shell weld is inspected to the same Code standards.

The DSC materials of construction (e.g., stainless steel) are readily weldable using common available welding techniques. The use of an experienced fabricator will ensure that the process chosen for fabrication will yield a durable canister. The DSC welds were well-characterized on the license drawings, and standard welding symbols and notations in accordance with American

The maximum calculated pressure for off-normal conditions corresponds to 9.2 psig (11.0 psig with BPRAs), which is below the DSC off-normal condition design pressure of 20 psig. The average (bulk) temperature in the liquid neutron shield annulus (water region) is 265 °F (129 °C). This corresponds to a pressure of 23.8 psig. This pressure is less than the set point of the pressure relief valves (40 psig).

4.7 Evaluation of Cask Performance for Accident Conditions

The maximum fuel cladding temperature for the fire accident during the transfer case is 1036 °F (557.8 °C), which is below the maximum limit of 1058 °F (570 °C). The maximum calculated fuel cladding temperature for the blocked vent event after 34 hours is 823 °F (439.4 °C), which is below the maximum limit of 1058 °F (570 °C). The maximum concrete temperature reported during the blocked vent event was above the limit specified by the applicant. TS 5.5 requires that the concrete used to fabricate the HSM-H module will be tested at an elevated temperature to demonstrate that the concrete will perform satisfactorily.

The maximum calculated pressure without BPRAs for the accident conditions corresponds to 74.8 psig, which is less than the DSC design pressure limit of 120 psig. The maximum calculated pressure with BPRAs for the accident conditions corresponds to 91.0 psig, which is less than the DSC design pressure limit of 120 psig. The calculated maximum fire transient DSC surface temperature is 790 °F (421 °C). Therefore, the NUHOMS® HD DSC temperatures and pressure calculations for the accident conditions are below the maximum allowable limits.

4.8 Evaluation of Cask Performance for Loading/Unloading Conditions

The maximum cladding temperature reached after 12 hours of completion of vacuum drying when applying Procedure B (as described in the SAR) is 751 °F (399.5 °C). Therefore, backfilling of the transfer cask must start immediately after completion of the vacuum drying if Procedure B is chosen to assure that the maximum cladding temperature remains well below the maximum limit of 752 °F (400 °C) per ISG-11. The NUHOMS® HD DSC only undergoes a one time temperature drop during the backfilling of the DSC with helium gas. Because this is a one time event, the DSC does not undergo any thermal cycling. The maximum fuel cladding temperature during cask reflooding operations will be significantly less than the vacuum drying condition because of the presence of water and/or steam in the DSC cavity.

4.9 Analysis of the HSM Module

The applicant's HSM module analysis model is described in Sections 4.3.1.2, 4.11, 4.12, and 4.13 of the SAR. The analysis utilizes the ANSYS finite element code with several stack effect calculations to characterize aspects of the flow through the module (see SAR Section 4.13). The staff expressed some concerns about the accuracy of this model and of similar calculations in previous applications (Reference 7). In previous applications (Reference 7), the applicant responded by conducting a confirmatory analysis using a different modeling approach (a robust computational fluid dynamics (CFD) program (FLUENT)) to predict the DSC surface and module temperatures, and the module flow patterns. The CFD results (SAR Table P.4-40 of Reference 7) were similar to the ANSYS results for the DSC shell and module base concrete temperatures. However, the CFD results for the roof concrete and top and side heat shields were higher than the ANSYS results (the side heat shield temperature prediction was 44°F higher). The applicant qualification

qualification

5.2.2 Source Specification

assembly average

for each fuel assembly.

The source specification is presented in Section 5.2 of the SAR. The gamma and neutron source terms were calculated with the SAS2H (ORIGEN-S) module with the 44-group ENDF/B-V cross section set in the SCALE 4.4 computer code. The applicant's source term was generated for a burnup of 60,000 MWD/MTU, a minimum enrichment of 4.0 weight percent ^{235}U and a minimum cooling time of 7 years. This combination of burnup, enrichment and cooling time provides up to 1500 watts of decay heat per assembly and the storage cask can only store up to eight fuel assemblies with this decay heat and radiological characteristics. In the shielding evaluation, the applicant assumed that the all 32 fuel assemblies have this combination of burnup, enrichment and cooling time. If reconstituted fuel assemblies with stainless steel replacement rods undergo further irradiation cycles, their gamma source term will need to be bounded by the total design basis gamma source term documented in Table 5-10 of the SAR. Typically the source term from reconstituted fuel assemblies that receive further irradiation should be compared on a energy group basis instead of a total source term basis. Considering that the applicant has already presented a bounding source term given both the current design basis source term and the allowable source term from the fuel quantification tables (Table 4 of the TS), the staff is accepting the applicant's proposal for comparison of source terms for reconstituted fuel assemblies. If either the design basis source term is reduced or the fuel quantification tables in the TSs are revised, the staff should reconsider the method used by the applicant to evaluate cobalt source term in reconstituted fuel assemblies. Additionally, the fuel quantification tables specify the maximum enrichment ~~instead of minimum enrichment, which would be~~ consistent with ISG-5. ~~Because decay heat limits the proposed contents, instead of the source term used in the shielding evaluation, and the fact that the neutron dose is generally low compared to the gamma dose adjacent to each HSM-H, the staff accepted the maximum enrichment limits in the fuel quantification tables.~~

qualification

Following the individual gamma and neutron source term determinations, the source terms were utilized in the shielding models to calculate dose rates around the HSM-M and transfer cask.

5.2.2.1 Gamma Source

SAR Tables 5-10, 5-11 and 5-12 provide the SAS2H calculated gamma source terms for the active fuel region, TPAs and BPRAs, respectively. The hardware activation analysis considered the cobalt impurities in the assembly hardware. The amounts of impurities considered in the analysis are presented in SAR Table 5-8 and 5-9. Although cobalt impurities can vary, the applicant's assumed values are reasonable and acceptable. To correct for changes in the neutron flux outside the fuel zone during irradiation, the masses of the materials in the bottom end fitting, plenum, and top end fitting, were multiplied by scaling factors of 0.2, 0.2, and 0.1, respectively. These are the scaling factors recommended in ORNL/TM-11018, "Standard- and Extended-Burnup PWR and BWR Reactor Models for the ORIGEN2 Computer Code," and are considered to provide appropriate values. Based on these results, the MTU loading of FR 17x17 fuel assembly together with the BPRAs and hardware from the WE17x17, provide the design bases gamma source term.

They also specify the minimum assembly average enrichment for loading fuel assemblies in each of the decay heat zones,

7.0 CONFINEMENT EVALUATION

The staff reviewed the NUHOMS® HD 32PTH-DSC System confinement features and capabilities to ensure a) that any radiological releases to the environment will be within the limits established in 10 CFR Part 72 (Reference 1), and b) that the spent fuel cladding will be protected against degradation that might lead to gross ruptures during storage, as required in 10 CFR 72.122(h)(1). This application was also reviewed to determine whether the NUHOMS® HD 32PTH DSC System fulfills the acceptance criteria listed in Section 7 of NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems," (Reference 2) and applicable Interim Staff Guidance documents (ISGs) (Reference 3). The staff's conclusions are based on information provided in the NUHOMS® HD 32PTH DSC System Safety Analysis Report (SAR).

7.1 Confinement Design Characteristics

The confinement boundary of the NUHOMS® HD 32PTH-DSC is described as follows: the cylindrical shell, the top shield plug/inner cover,[1] the vent and siphon plates, the shell bottom, and the associated welds. An outer top cover plate, which rests atop the top shield plug/inner cover and is welded to the cylindrical shell, provides a redundant confinement boundary as required by 10 CFR 72.236(e). The outer top cover plate weld to the DSC shell is a structural weld. All penetrations in the DSC confinement boundary are welded shut.

Figure 7-1 of the SAR depicts the confinement boundaries and welds, and describes the non-destructive examination requirements for the confinement boundary welds. SAR Chapters 8 and 9 also discuss the confinement boundary welds and the leak testing performed to verify their integrity. Additionally, the administrative controls in the TSs address leak-testing requirements.

confinement boundary

The fabrication welds of the DSC that are part of the confinement boundary include the multiple-layer weld applied to the shell bottom and the full-penetration welds applied to the cylindrical shell. These welds are inspected via radiographic or ultrasonic means, in accordance with Subsection NB of the ASME Code. The remaining welds are applied using a multi-layer technique during DSC closure operations in accordance with NRC staff guidance and ASME Code. All welds are leak tested to show that the leakage rate is less than or equal to 1×10^{-7} ref·cm^3/s, which meets the leaktight criteria in ANSI N14.5-1997.

7.2 Confinement Monitoring Capability

Periodic surveillance of the storage module for blockage of inlet and outlet vents, as well as the licensee's use of radiation monitors are adequate to ensure the continued effectiveness of the confinement boundary. Because the DSC is welded shut, the staff finds that the periodic surveillance adequately enables the licensee to detect any closure degradation and to take appropriate corrective actions to maintain safe storage conditions.

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[1]The three configurations, including option 2 and option 3 designs, of the top shield plug/inner cover are shown in detail in SAR drawing 10494-72-4, sheet 1 of 2, revision 1. The option 2 design of the top shield plug/inner cover consists of a siphon/vent block, an alignment pin block, a top casing plate, a lifting post, and a side casing plate; all of which are part of the confinement boundary, except for the side casing plate. The option 3 design of the top shield plug/inner cover consists of top shield plug inner and outer plates, of which only the top shield plug outer plate is part of the confinement boundary.

7.3 Nuclides with Potential Release

The DSC is fully welded, and the welds are leak tested, in accordance with ANSI N14.5-1997, to demonstrate that the DSC is leaktight to 1×10^{-7} ref·cm³/sec. Additionally, a dry, inert atmosphere (helium) is maintained inside the DSC throughout the duration of storage to prevent oxidation of the fuel. The analyses presented in SAR Chapters 3 and 7 demonstrate that the confinement boundary is not compromised during normal, off-normal, and accident conditions. Hence, there is no contribution to the radiological consequences due to a potential release of canister contents.

7.4 Confinement Analysis

TN has demonstrated that the welds and applicable non-destructive examinations meet the applicable requirements demonstrating DSC integrity as set forth in ISG-5 and ISG-15, as follows:

1. The DSC is fabricated with austenitic stainless steel;

2. The DSC closure welds meet the requirements of ISG-15, Section X.5.2.3 "Weld Design and Specifications," or an approved alternative;

3. The DSC maintains its integrity during normal operating conditions, anticipated off-normal conditions, and credible accidents and natural phenomena, as required by 10 CFR Part 72;

4. Records documenting the fabrication and closure welding of DSCs meet the requirements of 10 CFR 72.174, "Quality Assurance Records," ANSI N45.2.9, "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants;" and,

5. Activities related to inspection, documentation, and welding of DSCs are performed in accordance with an NRC-approved quality assurance program as required in 10 CFR Part 72, Subpart G, "Quality Assurance."

Additionally, ~~both the fabrication and the field~~ all confinement boundary welds are leak tested to demonstrate that the confinement boundary is leaktight, as defined by ANSI N14.5-1997, to 1×10^{-7} ref·cm³/sec.

The confinement boundary is shown to maintain confinement during all normal, off-normal, and accident (including natural phenomena) conditions. Also, the temperature and pressure of the canister are within design-basis limits. Therefore, no discernable leakage is credible.

7.5 Supportive Information

Supportive information or documentation includes drawings of the NUHOMS® HD 32PTH-DSC System confinement boundary and applicable pages from referenced documents.

7.6 Evaluation Findings

F7.1 Sections 1, 2, and 7 of the SAR describe confinement structures, systems, and components (SSCs) important to safety in sufficient detail to permit evaluation of their effectiveness.

F7.2 The design of the DSC adequately protects the spent fuel cladding against degradation that might otherwise lead to gross ruptures. Chapter 4 of the safety evaluation report (SER) discusses the relevant temperature considerations.

F7.3 The design of the DSC provides redundant sealing of the confinement system closure joints using multiple welds: the inner welds, consisting of the weld joining inner top cover/shield plug (including option 2 or option 3) to the DSC shell along with the vent and siphon port covers and welds; and the outer, structural weld joining the top cover plate to the DSC shell.

F7.4 The DSC has no bolted closures or mechanical seals. The confinement boundary contains no external penetrations for pressure monitoring or overpressure protection. No instrumentation is required to remain operational under accident conditions. Because the DSC uses an entirely welded, redundant closure system, no direct monitoring of the closure is required.

F7.5 The TSs ~~(section 12)~~ and sections 7, 8, 9 of the SAR describe the leakage tests performed to verify that the confinement boundary is leaktight, as defined by ANSI N14.5-1997.

F7.6 The confinement system will reasonably maintain confinement of radioactive material. Chapter 10 of the SER shows that the direct dose from the DSC satisfies the regulatory requirements of 10 CFR 72.104(a) and 10 CFR 72.106(b).

F7.7 The staff concludes that the design of the confinement system of the DSC is in compliance with the requirements in 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 DSC 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, the applicant's analysis and the staff's confirmatory analysis, and accepted engineering practices.

7.7 References

1. American National Standards Institute, Institute for Nuclear Materials Management, "American National Standard for Radioactive Materials - Leakage Tests on Packages for Shipment," ANSI N14.5, 1997.

2. U.S. Code of Federal Regulations, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, Title 10, Part 72.

3. U.S. Nuclear Regulatory Commission, Standard Review Plan for Dry Cask Storage Systems, NUREG-1536, January 1997.

4. U.S. Nuclear Regulatory Commission, Spent Fuel Project Office, Interim Staff Guidance-5, Revision 1, "Confinement Evaluation."

5. U.S. Nuclear Regulatory Commission, Spent Fuel Project Office, Interim Staff Guidance-15, "Materials Evaluation."

ensuring the presence of the ^{10}B content specified for fabrication of the borated aluminum and the boron carbide metal matrix composite plates. The important portions of the neutron absorber tests are captured in TSs. Specifically, TS 4.3.1, "Neutron Absorber Tests," incorporates by reference into the TSs SAR sections 9.1.7.1, 9.1.7.2, 9.1.7.3, 9.5.2, 9.5.3.5, and 9.5.4.3. Therefore, prior NRC approval is required before any changes can be made to these sections of the SAR. The staff finds the acceptance tests for the neutron absorber material acceptable for this application. In addition, the staff finds the TS for ^{10}B areal contained in Table 6 of the TSs and the neutron absorber material acceptance tests contained in TS 4.3.1 to be acceptable for this application.

Qualification Tests

Qualification tests are used to demonstrate suitability and durability for a specific application. The applicant presented specifications that will be used to qualify a new borated material or changes to an existing borated material. The staff reviewed the design requirements, tests for durability (e.g., corrosion and thermal damage), and testing to demonstrate the ^{10}B uniformity. Important portions of these qualification tests are captured in TS 4.3.1, "Neutron Absorber Tests," mentioned above. The staff finds the qualification tests for the neutron absorber material acceptable for this application. In addition, the staff finds the qualification tests contained in TS 4.3.1 to be acceptable.

9.2 Evaluation Findings

F9.1 Sections 9.1.7 of the SAR describes the applicants proposed program for pre-operational testing and initial operations of the neutron absorber in the DSC.

F9.2 SSCs important to safety will be designed, fabricated, erected, tested, and maintained to quality standards commensurate with the importance to safety of the function they are intended to perform. Section 2, Tables 2-5 of the SAR identify the safety importance of SSCs and Section 3 of the SAR presents the applicable standards for their design, fabrication, and testing.

F9.3 The applicant will examine and/or test the DSC to ensure that it does not exhibit any defects that could significantly reduce its confinement effectiveness. Sections 9.1.2 and 9.1.3 of the SAR describes this inspection and testing.

F9.4 The 32PTH DSC will be marked with a data plate indicating its model number, unique identification number, and empty weight. Drawing 10494-72-7 in SAR section 1.2.2 illustrates and describes this data plate.

F9.5 The staff concludes that the acceptance tests and maintenance program for the NUHOMS HD DSC are in compliance with 10 CFR Part 72 and that the applicable acceptance criteria have been satisfied. The evaluation of the acceptance tests and maintenance program provides reasonable assurance that the cask will allow safe storage of spent fuel throughout its licensed or certified term. This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted practices.