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a joint venture of
Constellation Energy
eDF

CALVERT CLIFFS
NUCLEAR POWER PLANT

December 8, 2011

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Independent Spent Fuel Storage Installation; Docket No. 72-8
License Amendment Request: High Burnup NUHOMS®-32PHB Dry Shielded Canister and Horizontal Storage Modules

Pursuant to 10 CFR 72.56, the Calvert Cliffs Nuclear Power Plant, LLC hereby requests an amendment to Materials License No. SNM-2505 by incorporating the changes described below into the Technical Specifications for the Calvert Cliffs Independent Spent Fuel Storage Installation (ISFSI).

Calvert Cliffs is in the process of optimizing its dry spent fuel storage capacity by upgrading portions of its ISFSI to allow use of modular high burnup horizontal storage modules for future expansion. In addition, to accommodate recent Westinghouse and AREVA Combustion Engineering (CE) 14x14 fuel designs, higher fuel enrichments and discharge burnups, and shorter cooling times, approval for a new Nutech Horizontal Modular Storage (NUHOMS®)-32PHB canister design is being requested. Finally, Calvert Cliffs requests approval to increase the number of horizontal storage modules allowed to be installed within the existing ISFSI site from 120 to 132 to create sufficient dry storage capacity for continued power plant operation through their current 60-year operating license period.

The environmental assessment and technical basis for this proposed change are provided in Attachment (1). Marked-up Technical Specification pages are provided in Attachment (2). Enclosures 1 through 8 contain calculations provided to support the technical basis described in Attachment (1).

Enclosures 1 and 6 are Transnuclear, Inc. calculations that contain information that is proprietary to Transnuclear, Inc. Therefore, they are accompanied by an affidavit [Attachment (3)] signed by Transnuclear, Inc., the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission, and addresses, with specificity, the considerations listed in 10 CFR 2.390(b)(4). Accordingly, it is requested that the information proprietary to Transnuclear, Inc. be withheld from public disclosure. Non-proprietary versions of these two calculations are provided in Enclosures 9 and 10 for public disclosure.

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The proposed amendment to the Calvert Cliffs ISFSI License has been reviewed by our Plant Operations Review Committee. They concluded that implementing this license amendment will not result in an undue risk to the health and safety of the public.

All of the current Calvert Cliffs ISFSI horizontal storage modules are planned to be loaded by 2012. Future transfers will require approval of this proposed amendment. In order to maintain appropriate space in the Unit's spent fuel pools, we must resume loading fuel in the ISFSI in 2014. Therefore, we request approval of this change by March 1, 2013.

Should you have questions regarding this matter, please contact Mr. Douglas E. Lauver at (410) 495-5219.

Very truly yours,

STATE OF MARYLAND :
: TO WIT:
COUNTY OF CALVERT :

I, George H. Gellrich, being duly sworn, state that I am Vice President - Calvert Cliffs Nuclear Power Plant, LLC (CCNPP), and that I am duly authorized to execute and file this License Amendment Request on behalf of CCNPP. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other CCNPP employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 8 day of December, 2011.

WITNESS my Hand and Notarial Seal:

Notary Public

My Commission Expires:

1/9/2014
Date

GHG/PSF/bjd

Wendy L. Hunter
NOTARY PUBLIC
Calvert County, Maryland
My Commission Expires 1/9/2014

Attachments: (1) Evaluation of the Proposed Change

Enclosures:

1. Proprietary TN Calculation NUH32PHB-0503, HSM-HB Shielding Analysis for NUHOMS 32PHB System
2. TN Calculation NUH32PHB-0600, Criticality Evaluation for NUHOMS 32PHB System
3. TN Calculation NUH32PHB-0603, USL Evaluation for NUHOMS 32PHB System
4. TN Calculation NUH32PHB-0408, Thermal Analysis of NUHOMS 32PHB DSC for Vacuum Drying Operations
5. TN Calculation NUH32PHB-0406, Thermal Evaluation of NUHOMS 32PHB Transfer Cask for Normal, Off Normal, and Accident Conditions (Heat Loads <29.6kW)
6. Proprietary TN Calculation NUH32PHB-0401, Thermal Evaluation of NUHOMS 32PHB Transfer Cask for Normal, Off Normal, and Accident Conditions with Forced Cooling (Steady State)
7. TN Calculation NUH32PHB-0402, Thermal Evaluation of NUHOMS 32PHB Transfer Cask for Normal, Off-Normal, and Accident Conditions
8. TN Calculation NUH32PHB-0212, CCNPP-FC Transfer Cask Structural Evaluation – Accident Conditions, 75G Side Drop and 75G Top End Drop Cases
9. Non-Proprietary TN Calculation NUH32PHB-0503, HSM-HB Shielding Analysis for NUHOMS 32PHB System
10. Non-Proprietary TN Calculation NUH32PHB-0401, Thermal Evaluation of NUHOMS 32PHB Transfer Cask for Normal, Off Normal, and Accident Conditions with Forced Cooling (Steady State)

(2) Marked Up Technical Specification Pages
(3) Transnuclear, Inc. Proprietary Affidavit

cc: **(Without Enclosures)**

D. V. Pickett, NRC	S. Gray, DNR
W. M. Dean, NRC	C. Haney, NMSS
Resident Inspector, NRC	V. L. Ordaz, NMSS

ATTACHMENT (1)

EVALUATION OF THE PROPOSED CHANGE

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1.0 SUMMARY DESCRIPTION

Calvert Cliffs Nuclear Power Plant (Calvert Cliffs) is in the process of optimizing its dry spent fuel storage capacity by upgrading portions of its Independent Spent Fuel Storage Installation (ISFSI).

The existing 72 horizontal storage modules (HSMs) are planned to be filled by the end of 2012. Therefore, it is necessary to construct additional HSMs to allow loadings to continue beyond that time and ensure that full core offload capability is maintained in the Calvert Cliffs spent fuel pool. Expansion of the ISFSI total capacity from 120 HSMs to 132 HSMs (and increase in the licensed amount of uranium which can be stored there) is being undertaken to ensure sufficient storage capacity between the spent fuel pool and ISFSI to allow for 60 years of operation for both Calvert Cliffs Units.

In addition, a number of changes in the Combustion Engineering (CE) 14x14 fuel design used at Calvert Cliffs have occurred since the ISFSI was originally licensed, which must be accounted for in the design of the ISFSI. These include introduction of Westinghouse Value Added Pellets (VAP) in 2000, Zirlo cladding in 2002, peak pin enrichments above the current 4.5% limit for ISFSI, 6 inches top and bottom low enriched (2.6%) axial blankets, and zirconium diboride (ZrB_2) burnable absorber in 2005, and most recently the change to AREVA fuel with M5 cladding, gadolinia (Gd_2O_3) burnable absorber, and high thermal performance grids in 2011. In addition, 24-month cycle operation and high Calvert Cliffs capacity factors for more than the past decade have resulted in a continuing trend towards higher fuel assembly discharge burnups which need to be considered in the ISFSI design.

Finally, the time required for a discharged fuel assembly to cool to the current ISFSI Technical Specification 3.1.1(5) decay heat limit of 660 watts is 10 to 16 years. Due to the recent issues at the Fukushima Daiichi plant in Japan, there is a focus toward decreasing the number of fuel assemblies stored in spent fuel pools. To shorten the time required for cooling to the allowed heat load, and thus expand the population of fuel assemblies eligible to be loaded into the ISFSI, an increase in the fuel assembly decay heat limits and maximum canister heat load is required.

2.0 DETAILED DESCRIPTION

The Calvert Cliffs ISFSI is a Nutech Horizontal Modular Storage (NUHOMS®) dry storage system designed by Transnuclear, Inc. Calvert Cliffs has a site-specific materials license for the ISFSI. The storage system uses a reinforced concrete HSM to store fuel that is sealed in a stainless steel dry shielded canister (DSC). Each DSC holds 24 or 32 spent fuel assemblies depending on its design. The HSM provides radiological shielding and physical protection for the DSC and has internal air flow passages to provide natural circulation cooling for decay heat removal. The Calvert Cliffs ISFSI is currently licensed for 120 HSMs. Seventy-two HSMs have been built. Forty-eight HSMs were loaded with NUHOMS®-24P DSCs, the rest are being loaded with NUHOMS®-32P DSCs.

The spent fuel assemblies are first discharged into the spent fuel pool, where they are allowed to decay and cool. The assemblies are then transferred to and stored within the DSC which is loaded inside the transfer cask. The interior of the DSC is then vacuum dried, filled with the inert gas medium (helium), and sealed by welding. The DSC and transfer cask are then transported to the HSM.

The DSC is aligned with the storage location in an HSM and pushed in by a ram mechanism. The spent fuel assembly decay heat is removed from the HSM by natural air circulation. The storage of the fuel assemblies is a completely passive system.

New HSM Design

Future phases of HSMs to be built at the Calvert Cliffs ISFSI will utilize the prefabricated high burnup horizontal storage module (HSM-HB) module design. The HSM-HB (Figure 1) is similar to the horizontal storage module HSM-H with flat stainless steel heat shields described in the Updated Final Safety Analysis Report for the standardized NUHOMS® System, Appendix P and the for NUHOMS®HD System. The HSM-HB is a free standing reinforced concrete structure designed to provide protection and radiological shielding for the 32PHB DSC. Each HSM-HB provides a self contained modular structure for the storage of the DSC with spent fuel assemblies. A single HSM-HB is capable of storing a 32PHB DSC containing 32 pressurized water reactor fuel assemblies. The HSM-HB permits heat rejection by natural convection in order to maintain acceptable temperatures. The HSM-HB is capable of storing both the 32PHB and 32P DSCs, however the former is bounding.

The HSM-HBs will be prefabricated and assembled at the Calvert Cliffs ISFSI site. Each HSM-HB is placed in contact with an adjacent HSM-HB to form an array. Figure 1 provides a sketch of a representative array of HSM-HB modules. The air inlet vents extend through the front on both sides of the front wall. The air outlet vents are provided in the roof unit. Similar to the current poured in place HSMs, flat stainless steel panels are used as heat shields on the interior walls of the HSH-HB. The heat shields provide thermal protection for the HSM-HB concrete. Finally, attenuation pipes are added to the inlet vent screens to improve the shielding capabilities of the module.

While the HSM-HB module design is similar to the design of the existing HSMs, the following is a summary of the design differences which provide improved heat rejection and shielding capabilities discussed above:

- Use of a thicker roof (3 feet 8 inches vs. 3 feet) provides improved shielding
- Door is inset in DSC opening, with increased thickness to provide improved shielding
- Use of slotted plates and holes in the DSC support rails to increase airflow at the bottom portion of canister
- Increased dose rates near inlet vent and inside doorway; decreased in most other locations
- Increased height of the module to increase module cavity height and to minimize air flow resistance in the module cavity
- Outlet vents repositioned from top front and back to top sides (opening shared by adjacent modules)
- Inlet vents repositioned from front bottom center to front bottom sides (opening shared by adjacent modules). Use of attenuation pipes improves inlet vent shielding

New DSC Design

The proposed NUHOMS®-32PHB DSC design is similar to the NUHOMS®-32P DSC design currently in use at Calvert Cliffs. The NUHOMS®-32PHB DSC will accommodate up to 32 intact CE 14x14 Standard, Westinghouse VAP CE 14x14, and/or AREVA CE 14x14 pressurized water reactor or equivalent spent fuel assemblies (including fuel assemblies with stainless steel replacement rods) with and without axial blankets. Fuel assemblies with missing rods are not allowed to be loaded into a NUHOMS®-32PHB DSC. The NUHOMS®-32PHB DSC is designed for a maximum heat load of 29.6 kW. These DSCs and HSMs are designed for high burnup fuel assemblies, up to 62 GWd/MTU, with a maximum fuel assembly average initial enrichment of 5 weight percent U-235.

The NUHOMS®-32PHB DSC consists of a shell assembly of the same outside dimensions as the NUHOMS®-32P DSC, which provides confinement and shielding; and an internal basket assembly (two different types) which locates and supports the fuel assemblies, transfers the heat to the cask body wall, and provides for criticality control as necessary to satisfy nuclear criticality safety requirements. The basket is a tube assembly, with aluminum and poison plates in between the tubes for heat transfer and criticality control. Except for the solid aluminum rails added to support the increased heat load, and the change in poison plate material, the NUHOMS®-32PHB DSC basket is identical to the NUHOMS®-32P DSC basket.

While the NUHOMS®-32PHB DSC design is similar to the design of the existing NUHOMS®-32P DSC, the following is a summary of the design differences which provide improved performance capabilities discussed above:

- Supports storage of all Westinghouse and AREVA variations of the CE 14x14 fuel assembly
- Increased maximum fuel assembly burnup
- Increased maximum gamma and neutron source
- Decreased maximum fuel assembly weight
- Increased maximum fuel assembly heat loads
- Time limits on vacuum drying (if nitrogen is used for blow down) and transfer
- Poison plate material changed and includes increased B^{10} areal density
- Solid aluminum rails used to support the fuel basket

The NUHOMS®-32PHB DSC is handled, loaded, and sealed in the same manner as the NUHOMS®-32P DSC, before being transported to the ISFSI. The NUHOMS®-32PHB DSC is stored only in the HSM-HB at the ISFSI, and is not placed into one of the original HSMs due to higher heat load of the NUHOMS®-32PHB DSC. The same transfer cask is used for the NUHOMS®-32PHB, NUHOMS®-24P, and NUHOMS®-32P DSCs. When utilized with the NUHOMS®-32PHB DSC, the transfer cask may be used in the forced-cooling configuration due to the higher heat load. The forced-cooling configuration consists of a new cask lid which contains small openings around the periphery that vent out forced air that is injected at the bottom of the cask (through the ram access opening). A 0.5 inch thick spacer disc with wedge shaped protrusions is installed at the bottom of the transfer cask to facilitate air flow coming through the ram access opening to the annular space around the DSC.

Additional HSMs

The minimum distance between the fronts of the future 2x12 phases of modules is reduced from 72 feet to 52 feet based on the maneuverability of the transfer cask transporter, creating room for an additional 1x12 array of HSM-HB modules at the south end of the existing ISFSI site. In this manner, the size of the facility may be increased from the current 120 modules (shown in Figure 2) to the 132 modules required for 60 years of power plant operation (shown in Figure 3).

Proposed changes to the Calvert Cliffs ISFSI Technical Specifications needed to accommodate the above changes are described below and shown on the marked up pages in Attachment (2).

- ISFSI License SNM-2505 Section 6, Byproduct, Source, and/or Special Nuclear Material – The proposed amendment would increase the maximum allowable enrichment from 4.5 percent U-235 to 5.0 percent U-235 to allow for storage of higher enriched fuel assemblies.

- ISFSI License SNM-2505 Section 8, Maximum Amount That Licensee May Possess at Any One Time Under This License – The proposed amendment would increase this amount from the current 1,111.68 TeU to 1,558.27 TeU to allow for storage of fuel generated over the 60 year licensed lifetime of the Calvert Cliffs Units.

- ISFSI License SNM-2505 Section 16 – The proposed amendment would add acceptance standards for liquid pentrant tests of the double closure seal welds at the bottom end of the DSC for the NUHOMS®-32PHB DSC. The acceptance standards for the NUHOMS®-24P DSC and the NUHOMS®-32P DSC remain the same.

- Technical Specification 2.1, Fuel to be Stored at ISFSI – This Technical Specification ensures that the fuel assembly radiation source is below design values. To accomplish this, the Technical Specification provides limits on the neutron and gamma sources allowed in each fuel assembly. The proposed change would add a new neutron and gamma source for fuel assemblies stored in NUHOMS®-32PHB DSCs. The new neutron and gamma sources for the NUHOMS®-32PHB DSC were selected to bound fuel assemblies that reach the Technical Specification Limiting Condition for Operation 3.1.1(5) thermal limit to be loaded.

- Technical Specification 3.1.1, Fuel to be Stored at ISFSI – This Technical Specification ensures that the fuel assemblies stored in the DSCs meet the design requirements of the canisters. The proposed amendment would make the following changes:

  - Technical Specification 3.1.1(2) – The current maximum initial enrichment limit is 4.5 weight percent U-235. The proposed amendment would add new maximum initial enrichment limits of 4.75 and 5.0 weight percent U-235 for a NUHOMS®-32PHB DSC, based on internal DSC basket design. The current maximum initial enrichment limit of 4.5 weight percent U-235 for the NUHOMS®-24P and NUHOMS®-32P DSCs remains the same.

  - Technical Specification 3.1.1(3) – The current maximum fuel assembly average burnup limit is 47,000 MWd/MTU) for the NUHOMS®-24P DSCs and 52,000 MWd/MTU for the NUHOMS®-32P DSCs. The proposed amendment would add a new maximum fuel assembly average burnup limit of 62,000 MWd/MTU for fuel stored in NUHOMS®-32PHB DSCs. The current burnup limits for the NUHOMS®-24P and NUHOMS®-32P DSCs remain the same.

  - Technical Specification 3.1.1(5) – The current maximum heat generation rate limit is 0.66 kilowatt per fuel assembly. The proposed amendment would add a new maximum heat generation rate of 0.8 kilowatt per fuel assembly for NUHOMS®-32PHB DSC basket zones 1 and 4, and a maximum heat generation rate of 1.0 kilowatt per fuel assembly for NUHOMS®-32PHB DSC basket zones 2 and 3. The current maximum heat generation rate for the NUHOMS®-24P and NUHOMS®-32P DSCs remain the same.

  - Technical Specification 3.1.1(7) – Currently, the maximum fuel assembly mass to be placed in the NUHOMS®-24P and NUHOMS®-32P DSCs, including control components, shall not exceed 1450 lb. (658 kg). This proposed amendment adds a new requirement that the maximum fuel assembly mass to be placed in the NUHOMS®-32PHB DSC shall not exceed 1375 lb. (625 kg.) excluding control components. The current maximum fuel assembly mass limit remains the same for the NUHOMS®-24P and NUHOMS®-32P DSCs.

- Technical Specification 3.2.2.1 - The proposed amendment would add acceptance standards for liquid penetrant tests of the top shield plug closure weld, the siphon and vent port cover welds, and the top cover plate weld for the NUHOMS®-32PHB DSC. The acceptance standards for the NUHOMS®-24P and NUHOMS®-32P DSCs remain the same.

- Technical Specification 3.2.2.2 and 4.2.2.1, DSC Closure Welds – Currently, the standard helium leak rate for the top shield plug closure weld, and the siphon and vent port cover welds shall not exceed 10^{-4}atm-cc/s for the NUHOMS®-24P and NUHOMS®-32P DSCs. The proposed amendment will add a new requirement that the standard helium leak rate for the NUHOMS®-32PHB DSC top shield plug closure weld, and the siphon and vent port cover welds shall not exceed 10^{-7}ref-cc/s. The maximum helium leak rate for the NUHOMS®-24P and NUHOMS®-32P DSCs remains the same.

- Technical Specification 3.3.2.1, Time Limit for Completion of NUHOMS 32 PHB Transfer Operations – The proposed amendment would establish a new Technical Specification for the time to complete the transfer of the NUHOMS®-32PHB DSC from the cask handling area to the HSM. This new Technical Specification does not apply to the NUHOMS®-24P or NUHOMS®-32P due to their lower heat load. The time limit for completion of the transfer is as follows:

  - No time limit for a DSC with a total heat load of 21.12 kW or less,
  - 72 hours for a DSC with a total heat load greater than 21.12 kW but less than or equal to 23.04 kW,
  - 48 hours for a DSC with a total heat load greater than 23.04 kW but less than or equal to 25.6 kW,
  - 20 hours for a DSC with a total heat load greater than 25.6 kW but less than or equal to 29.6 kW

- Technical Specification 3.3.3.1, Time Limit for Completion of NUHOMS 32PHB DSC Vacuum Drying Operation - The proposed amendment would establish a new Technical Specification limiting the time to complete the NUHOMS®-32PHB DSC blowdown and vacuum drying process if nitrogen is used for blowdown. The time limit for completion of vacuum drying of a loaded NUHOMS®-32PHB DSC following blowdown with nitrogen is as follows:
  - 56 hours for a DSC with a total heat load of 23.04 kW or less,
  - 40 hours for a DSC with a total heat load greater than 23.04 kW but less than or equal to 25.6 kW,
  - 32 hours for a DSC with a total heat load greater than 25.6 kW but less than or equal to 29.6 kW

- Technical Specification 3.4.1.1, Maximum Air Temperature Rise – This Technical Specification limits the temperature rise from the HSM inlet to the outlet. This provides assurance that the fuel is being adequately air cooled while in the HSM. The current limit is a maximum 64°F temperature rise. The proposed amendment would add a new maximum allowable temperature rise from the HSM-HB inlet to the HSM-HB outlet of 80°F. The Action is also changed to address the additional temperature limit and the verification of the appropriate heat load for the fuel assemblies. The maximum temperature rise limit will remain 64°F for the existing HSMs.

- Design Feature 5.2, NUHOMS-32P Dry Shielded Canister (DSC) – The proposed amendment would add the required minimum areal density for the NUHOMS®-32PHB DSC poison plates. The NUHOMS-32PHB DSC poison plates shall have a minimum B^{10} areal density of 0.019 g/cm^2 for basket type A and 0.0270 g/cm^2 for basket type B. The minimum areal density for the NUHOMS®-32P DSC poison plates remains the same.

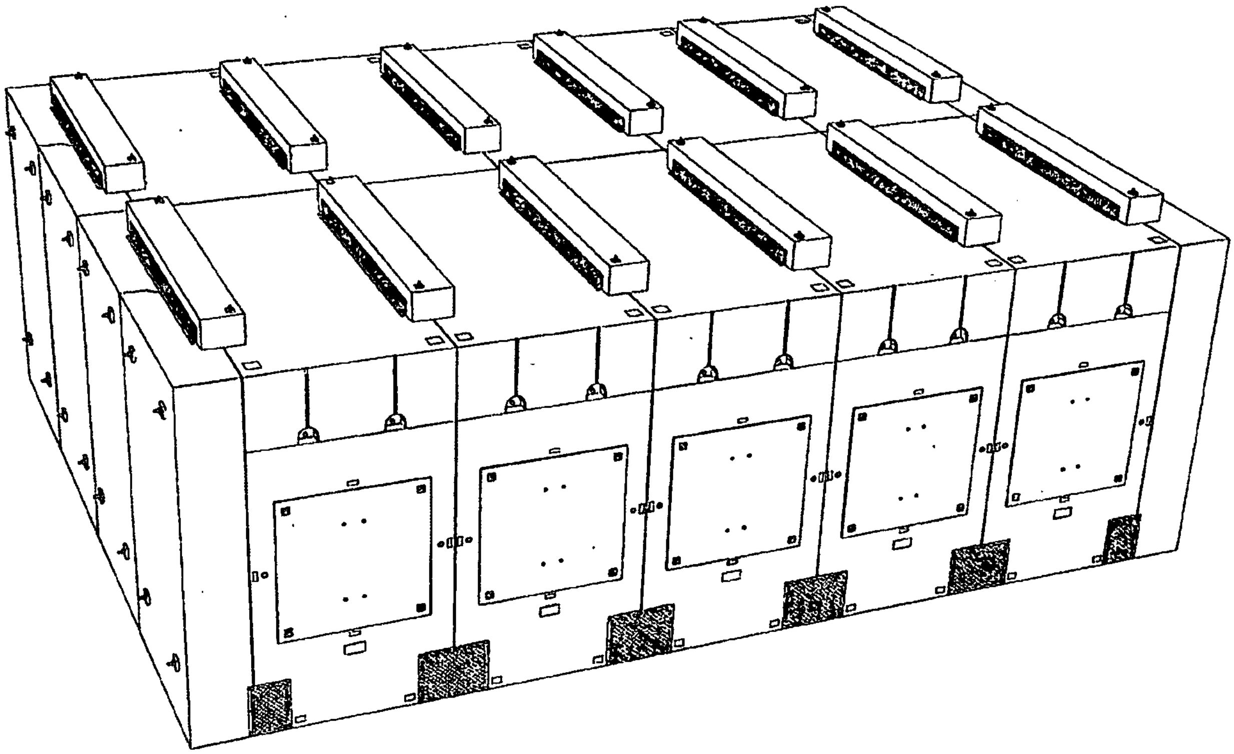

Figure 1, General Arrangement of Proposed HSM-HB modules (2x5 shown, 2x12 planned)

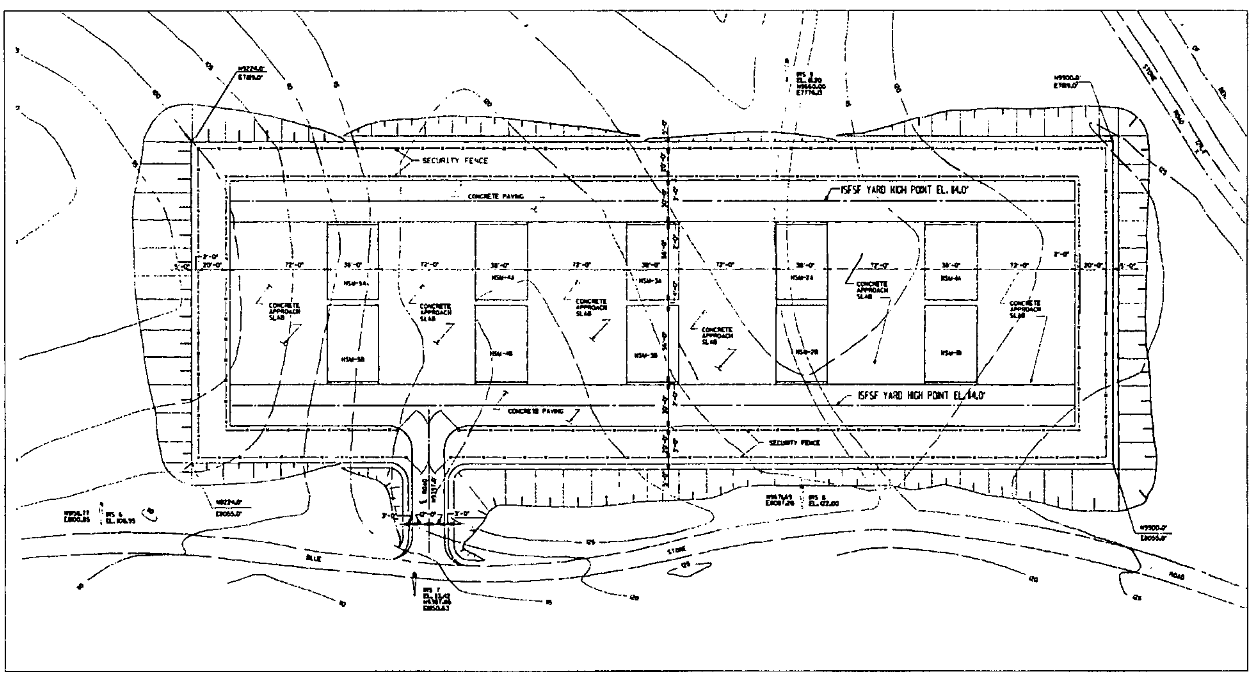

Figure 2, Currently Approved 120 HSM ISFSI Arrangement

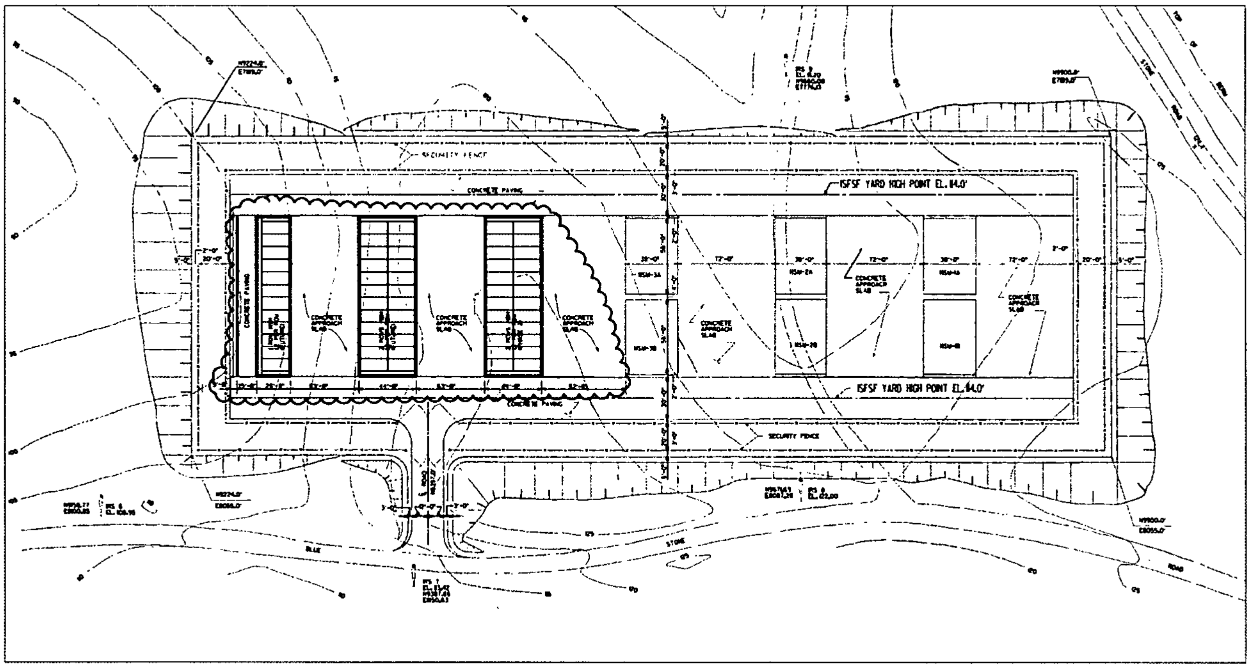

Figure 3, Proposed 132 HSM ISFSI Arrangement

3.0 TECHNICAL EVALUATION

A. Revision to ISFSI License SNM-2505 Section 6

Independent Spent Fuel Storage Installation License SNM-2505 Section 6, Byproduct, Source, and/or Special Nuclear Material – The proposed amendment would increase the maximum allowable enrichment from 4.5 weight percent U-235 to 5.0 weight percent U-235 to allow for storage of higher enriched fuel assemblies as permitted by Calvert Cliffs Nuclear Power Plant Technical Specification 4.3.1.1.a. The increase in the maximum allowable enrichment limit is discussed below in Section 3.0.E.

B. Revision to ISFSI License SNM-2505 Section 8

Independent Spent Fuel Storage Installation License SNM-2505 Section 8, Maximum Amount That Licensee May Possess at Any One Time Under This License – The proposed amendment would increase the amount of uranium that may be possessed under this license from the current 1,111.68 TeU to 1,558.27 TeU. This increase reflects the change in the licensed life of the Calvert Cliffs Nuclear Power Plant Units from an initial 40 years of operation to 60 years of operation. The original amount of uranium that may be possessed under this license was based on 40 years of operation of the Calvert Cliffs Nuclear Power Plant Units. One hundred and twenty HSMs were planned to accommodate these fuel assemblies. However, additional spent fuel assemblies will be generated during the additional 20 years of licensed operation. As a result of various events, a federal repository remains unavailable at the time of this amendment request. There remains uncertainty regarding when Department of Energy (DOE) will be able to take possession of the spent fuel assemblies. Given the delays in developing a permanent repository, Calvert Cliffs has utilized its existing spent fuel pools to the extent practicable and provided a separate dry fuel storage facility in order to maintain safe storage of the spent fuel assemblies until their acceptance by DOE for transportation offsite. To ensure adequate fuel storage for the remainder of the licensed operating life of the Calvert Cliffs Nuclear Power Plant Units, additional HSMs need to be added to the original number. Therefore, a total of 132 HSMs are planned. The 132 HSMs are composed of 48 modules containing 24 assemblies (NUHOMS®-24P DSC), and 84 modules containing 32 assemblies (NUHOMS®-32P DSCs and NUHOMS®-32PHB DSCs) are to be placed on the existing ISFSI site. The total metric tons of uranium for all fuel assemblies stored in the 132 HSMs is calculated in Table 1 as follows:

Table 1, Total Metric Tons Uranium Stored in 132 HSMs

Type of DSCs	Total Number of DSCs	Total Number of Fuel Assemblies	Design Metric Tons Uranium/Assembly	Metric Tons Uranium
NUHOMS®-24P DSCs	48	1152	0.386	444.67
NUHOMS®-32P DSCs	24*	768	0.4	307.2
NUHOMS®-32PHB DSCs	60*	1920	0.42	806.4
Total	**132**	**3840**		**1558.27**

* Additional NUHOMS®-32P DSCs may be used instead of an equal number of NUHOMS®-32PHB DSCs. This would decrease the metric tons of uranium stored.

C. Revision to ISFSI License SNM-2505 Section 16

The proposed amendment would add acceptance standards for liquid penetrant tests of the double closure seal welds at the bottom end of the DSC for the NUHOMS®-32PHB DSC. The cylindrical shell and the inner bottom cover plate boundary welds are fully compliant with American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section III, Subsection NB-5350, 1998 (with addenda up to and including 1999) edition, and are made during fabrication. Therefore, the acceptance standard proposed for the NUHOMS®-32PHB DSC is the ASME Boiler & Pressure Vessel Code, Section III, Subsection NB-5350, 1998 (with addenda up to and including 1999) edition. This is an administrative change to adopt a later version of an acceptable standard. This acceptance standard is the same as is currently used for the approved Transnuclear, Inc. Certification of Conformance (CoC)-1030 DSCs. The acceptance standards for the NUHOMS®-24P and NUHOMS®-32P DSC welds remain the same.

D. Revision to Technical Specification 2.1

The changes proposed to Technical Specification 2.1 were modeled after those previously approved in References 1 and 2. Technical Specification 2.1 is currently met for the NUHOMS®-32P DSCs by requiring that fuel assemblies selected for loading also meet certain minimum required cooling times. We are maintaining the current format for Technical Specification 2.1 to avoid altering the licensing basis of the previous NUHOMS®-24P and NUHOMS®-32P DSCs loaded at Calvert Cliffs.

Addition of Design Basis New Gamma Source-Term

Limiting Condition for Operation 3.1.1 currently limits fuel assemblies to be loaded in the ISFSI to certain enrichments, fuel assembly average burnup, heat output, and a minimum cooling time. Technical Specification 2.1 permits a fuel assembly not specifically meeting the requirements of Technical Specification 3.1.1 for maximum burnup and post-irradiation time to be stored if it meets the minimum cooling time listed in USAR Table 9.4-1 and the neutron and gamma source requirements of this specification. The proposed change would add a new gamma source for fuel assemblies stored in NUHOMS®-32PHB DSCs. An evaluation was performed using the same methods approved in Reference 2 that determined that a fuel assembly gamma source strength of 2.56 E+15 MeV/sec would bound fuel assemblies in the spent fuel pool for the cooling time required to reach a heat output of 1.0 kW. Table 2 lists the new gamma source spectrum for the NUHOMS®-32PHB DSC using the previously approved 18-group structure. This gamma source was based on a fuel assembly with an enrichment of 4.25 weight percent U-235, a fuel assembly average burnup of 42,000 MWd/MTU, a cooling time of 4.2 years and a heat output of 1.0 kW.

Table 2, Proposed Gamma Source Terms (MeV/sec) per Fuel Assembly

Emin (MeV)		Emax (MeV)	MeV/sec
0.00E+00	to	2.00E-02	1.83E+13
2.00E-02	to	3.00E-02	1.03E+13
3.00E-02	to	4.50E-02	1.80E+13
4.5E-02	to	7.00E-02	1.85E+13
7.00E-02	to	1.00E-01	1.96E+13
1.00E-01	to	1.50E-01	3.23E+13
1.50E-01	to	3.00E-01	4.67E+13
3.00E-01	to	4.50E-01	4.29E+13
4.50E-01	to	7.00E-01	1.61E+15
7.00E-01	to	1.00E+00	5.46E+14
1.00E+00	to	1.50E+00	1.88E+14
1.50E+00	to	2.00E+00	8.64E+12
2.00E+00	to	2.50E+00	8.59E+12
2.50E+00	to	3.00E+00	2.76E+11
3.00E+00	to	4.00E+00	4.34E+10
4.00E+00	to	6.00E+00	3.42E+07
6.00E+00	to	8.00E+00	5.52E+06
8.00E+00	to	1.10E+01	8.62E+05
		TOTAL	**2.56E+15**

Revision of the existing neutron source-term

Limiting Condition for Operation 3.1.1 currently limits the fuel assemblies to be loaded in the ISFSI to certain enrichments, fuel assembly average burnup, heat output, and a minimum cooling time. Technical Specification 2.1 permits a fuel assembly not specifically meeting the requirements of Technical Specification 3.1.1 for maximum burnup and post-irradiation time to be stored if it meets the minimum cooling time listed in USAR Table 9.4-1 and the neutron and gamma source requirements of this Technical Specification. With the proposed increase in fuel assembly burnup requested in this license amendment request, the allowed neutron source term for these higher burnup fuel assemblies must also be increased to ensure that it bounds fuel assemblies at the cooling time required to reach 1.0 kW. An evaluation was performed using the same methods approved in Reference 2 that determined a fuel assembly neutron source strength of 6.66E+08 neutrons/sec would bound the fuel assemblies in the spent fuel pool for the cooling time required to reach 1.0 kW. The bounding neutron source was based on a fuel assembly with a maximum initial enrichment of 4.0 weight percent U-235, a maximum fuel assembly average discharge burnup of 58,000 MWd/MTU, a cooling time of 9.4 years and a heat output of 1.00 kW. Table 3 lists the proposed neutron source spectrum per fuel assembly for the NUHOMS®-32PHB DSC using the previously approved 44 energy group structure.

Table 3, Proposed Neutron Source Term per Fuel Assembly

Emin (MeV)	Emax (MeV)	n/sec/assy	Emin (MeV)	Emax (MeV)	n/sec/assy
1.40E+01	2.00E+01	0.00E+00	1.44E+00	1.50E+00	1.24E+07
1.20E+01	1.40E+01	1.18E+05	1.33E+00	1.44E+00	2.49E+07
			1.20E+00	1.33E+00	3.08E+07
1.00E+01	1.20E+01	7.20E+05	1.00E+00	1.20E+00	4.78E+07
8.00E+00	1.00E+01	2.44E+06	8.00E-01	1.00E+00	4.65E+07
7.50E+00	8.00E+00	1.97E+06	7.00E-01	8.00E-01	2.69E+07
7.00E+00	7.50E+00	2.64E+06	6.00E-01	7.00E-01	2.68E+07
6.50E+00	7.00E+00	3.90E+06	5.12E-01	6.00E-01	2.31E+07
6.00E+00	6.50E+00	5.83E+06	5.10E-01	5.12E-01	5.25E+05
5.50E+00	6.00E+00	8.74E+06	4.50E-01	5.10E-01	1.57E+07
5.00E+00	5.50E+00	1.18E+07	4.00E-01	4.50E-01	1.31E+07
4.50E+00	5.00E+00	1.63E+07	3.00E-01	4.00E-01	2.53E+07
4.00E+00	4.50E+00	2.13E+07	2.00E-01	3.00E-01	5.23E+03
3.50E+00	4.00E+00	3.42E+07	1.50E-01	2.00E-01	2.61E+03
3.00E+00	3.50E+00	4.24E+07	1.00E-01	1.50E-01	2.61E+03
2.50E+00	3.00E+00	5.51E+07	7.50E-02	1.00E-01	0.00E+00
2.35E+00	2.50E+00	2.08E+07	7.00E-02	7.50E-02	0.00E+00
2.15E+00	2.35E+00	2.92E+07	6.00E-02	7.00E-02	0.00E+00
2.00E+00	2.15E+00	2.32E+07	4.50E-02	6.00E-02	0.00E+00
1.80E+00	2.00E+00	3.39E+07	3.00E-02	4.50E-02	0.00E+00
1.66E+00	1.80E+00	2.62E+07	2.00E-02	3.00E-02	0.00E+00
1.57E+00	1.66E+00	1.74E+07	1.00E-02	2.00E-02	0.00E+00
1.50E+00	1.57E+00	1.45E+07	**Total**		**6.66E+08**

Additionally, dose rates for the design basis conditions were calculated for the added neutron and gamma source terms for the NUHOMS®-32PHB system (Enclosure1) using the same methods approved in Reference 2. Table 4 shows that ISFSI dose limits remain satisfied for the HSM-HBs and there are no Technical Specification changes required for a change in dose rates. Dose rates at the ISFSI site fence remain within the limits of 10 CFR 20.1301 for an individual during loading operations. The effects of both neutron and gamma radiation on the HSM–HB concrete were determined to be negligible for the NUHOMS®-32PHB DSC.

Table 4, Radiation Dose Rates

Location	HSM with NUHOMS®-32P DSC	HSM-HB with NUHOMS®-32PHB DSC	Technical Specification Limit
HSM wall or roof	13.5 mrem/hr	6.27 mrem/hr	20 mrem/hr
HSM air outlet	75.4 mrem/hr	47.1 mrem/hr	-
HSM door center	13.9 mrem/hr	0.98 mrem/hr	100 mrem/hr
HSM open door (1 ft inside)	4.66E+3 mrem/hr	1.76E+4 mrem/hr	-
HSM air inlet	61.0 mrem/hr	121 mrem/hr (w/o inserts) 73 mrem/hr (with inserts)	-
HSM (1 m from the closed door)	8.9 mrem/hr	1.01 mrem/hr	-

Of the design basis accidents listed in the USAR, those potentially impacted by the NUHOMS®-32PHB DSC neutron and gamma sources are the transfer cask drop, blockage of HSM-HB air inlets/outlets, and the forest fire event. The evaluation of the impact of the NUHOMS®-32PHB DSC neutron and gamma sources determined that accident doses for all of these events are minimal and the 10 CFR 72.106 regulatory limit continues to be met.

E. Revision to Technical Specification 3.1.1(2)

The current maximum initial fuel assembly enrichment limit is 4.5 weight percent U-235. The proposed change to Technical Specification 3.1.1(2) would add a new maximum initial fuel assembly enrichment limit of 4.75 weight percent U-235 for a NUHOMS®-32PHB DSC basket type A and 5.0 weight percent U-235 for a NUHOMS®-32PHB DSC basket type B. This change matches the enrichment allowance contained in Calvert Cliffs Nuclear Power Plant Technical Specification 4.3.1.1.a. The current maximum initial fuel assembly enrichment limit of 4.5 weight percent U-235 for the NUHOMS®-24P and NUHOMS®-32P DSCs remains the same.

A criticality analysis was performed (Enclosure 2) to determine the bounding K_{eff} value for the NUHOMS®-32PHB system loaded with fuel assemblies containing uranium dioxide fuel enriched up to 5.0 weight percent U-235. Criticality is controlled by taking credit for 2,450 ppm soluble boron present in the spent fuel pool (Technical Specification 3.2.1.1) and fixed neutron absorbers present in the NUHOMS®-32PHB DSC baskets. The fixed poison inside the basket is based on an aluminum boron carbide metal matrix composite design. Credit for 90% of the absorber material (B^{10}) is assumed in the analysis. This results in conservatism in the calculated K_{eff}.

To support a demonstration of compliance with storage regulations, parametric studies were performed to maximize reactivity for the normal and off-normal storage conditions. These conditions include fuel geometry based on the arrangement of fuel assemblies (centered or inward) relative to the center of the basket, geometrical tolerances, variation in guide sleeve inner width, variation in borated water density, insert plate height, poison plate slot length, poison plate slot width, poison plate height, poison plate thickness, and temperature. Three fuel assembly types were considered, the CE 14x14 standard fuel assembly, the Westinghouse VAP 14x14 fuel assembly and the AREVA 14x14 fuel assembly. As a result of the parametric studies, the Westinghouse VAP fuel lattice is determined to be the most reactive fuel lattice and it is used in the criticality analysis with a maximum enrichment of 5.0 weight percent.

A series of 102 benchmark criticality calculations (Enclosure 3) were performed by Transnuclear, Inc. These calculations assumed unirradiated fuel in the criticality analysis and used the SCALE 6 computer code package. The upper subcritical limit as described in Section 4 of NUREG/CR-6361 (Reference 3) was determined using the results of these 102 benchmark calculations. The benchmark problems used to perform this verification are representative of benchmark arrays of commercial light water reactor fuels with the following characteristics: water moderation, boron neutron absorbers, unirradiated light water reactor type fuel, close reflection, and uranium oxide fuel. The 102 uranium oxide experiments were chosen to model a wide range of uranium enrichments, fuel pin pitches, fuel assembly separation, concentration of soluble boron, and control elements in order to test the code's ability to accurately calculate K_{eff}.

The minimum value of the upper subcritical limit for the NUHOMS®-32PHB system over the parameter range (in this case, the fuel assembly separation distance) is 0.9410. The limiting separation distance is determined using the inward fuel lattice position as a conservative approach. This upper subcritical limit value (0.9410) is based on a methodology bias and an administrative 5% margin on criticality. The criticality analysis for the NUHOMS®-32PHB DSC system demonstrates that the maximum K_{eff} value is below the upper subcritical limit of 0.9410 for a variety of loading configurations under normal and off-normal conditions. The maximum K_{eff} value based on an "inward" loading of the Westinghouse VAP fuel assemblies is 0.9363 for basket type A (with a maximum enrichment of 4.75 weight percent U-235) and 0.9358 for basket type B (with a maximum enrichment of 5.0 weight percent U-235). This configuration includes the minimum fuel compartment dimension of 8.47 inch, an internal moderator (soluble boron at 2,450 ppm) density of 75%, poison plate height of 8.01 inch, and poison plate slot width of 0.75 inch with a B^{10} areal density of 0.0171 g/cm^2 for basket type A and 0.0243 g/cm^2 for basket type B. It also conservatively includes allowances for uncertainties due to fuel positioning, compartment tube dimensioning, and poison plate thickness.

The criticality analysis takes credit for only 90% of the minimum physically available B^{10} areal density in the poison plates. Therefore, the basket type A is manufactured with 0.019 g/cm^2 of B^{10} and the basket type B is manufactured with 0.027 g/cm^2 of B^{10}.

Reconstituted fuel assemblies, where the fuel pins are replaced by lower enriched fuel pins or non-fuel pins that displace the same amount of borated water, are considered intact fuel assemblies. The reactivity of the fuel assemblies with reconstituted fuel pins is bounded by those without reconstituted fuel pins because fuel pins are modeled with the highest allowable enrichment while those with the reconstituted fuel pins will contain lower enriched UO^2 or other non-fuel material.

The impact of transfer cask drop accidents on the potential for a criticality event in a NUHOMS®-32PHB DSC was also evaluated. The rod pitch of some fuel rods may be reduced to the fuel clad outside diameter during a drop accident. The upper subcritical limit as a function of the rod pitch decreases from 0.9424 to 0.9422 under these conditions. Reduced rod pitch also leads to less neutron moderation and, subsequently, K_{eff} decreases. The separation distance of fuel assemblies may increase under these conditions. The upper safety limit as the function of separation distance increases with more fuel assembly separation, but the final upper safety limit is not affected. Thus, the criticality results are not adversely affected by the transfer cask drop accident.

In summary, Enclosure 2 documents a series of criticality calculations to determine a bounding K_{eff} for the NUHOMS®-32PHB DSC for normal and accident conditions of storage for intact fuel assemblies. The results of the criticality calculation support the requested maximum enrichment of 4.75 weight percent U-235 for basket type A and 5.0 weight percent U-235 for basket type B, and demonstrate compliance with the criticality related portions of 10 CFR Part 72 for storage of fuel in the NUHOMS®-32PHB DSC.

F. Revision to Technical Specification 3.1.1(3)

Spent fuel assemblies for the NUHOMS-32P DSCs currently meet a maximum fuel assembly average burnup of not more than 52,000 MWd/MTU. An evaluation has been performed for the NUHOMS®-32PHB DSCs to determine the effect of storing fuel assemblies with a fuel assembly average burnup of 62,000 MWd/MTU.

As fuel burnup increases, cladding wall thickness may decrease due to in-reactor formation of zirconium oxide or zirconium hydride. For design basis accidents, where the structural integrity of the cladding is evaluated, Reference 4 requires that cladding stress calculations use an effective cladding thickness that is reduced by those amounts (determined via oxide thickness measurements or use of an approved code). Review of oxide measurements for Calvert Cliffs fuel determined that a maximum oxide thickness of 125 microns would be bounding for fuel assemblies with a maximum fuel assembly average burnup of

60,000 MWd/MTU. The only NUHOMS®-32PHB design basis accident where structural integrity of the fuel cladding is evaluated is the transfer cask drop event. The integrity of fuel assemblies contained within a NUHOMS®-32PHB DSC, following postulated 75g side and end drops, was analyzed using the same methods approved in Reference 2. For AREVA fuel assemblies with M5 cladding, the acceptance criteria for maximum cladding stress during a NUHOMS®-32PHB DSC side drop was 67.3 ksi, reflecting the lower yield stress of M5 cladding at 750°F. Similarly, for an AREVA fuel assembly with M5 cladding, the acceptance criteria for maximum cladding strain during a NUHOMS®-32PHB DSC end drop was 0.927%. For the end drop, the maximum principal strain for Zircaloy-4 cladding on Standard and VAP CE 14x14 fuel assembly cladding is the same as reported in Reference 2. The maximum principal strain for the M5 clad AREVA fuel is 0.369%. For the side drop, the maximum stress is 44.5 ksi for the Zircaloy-4 clad Standard and VAP CE 14x14 fuel. The maximum stress for the AREVA fuel with M5 cladding is 47.1 ksi. The results of these analyses demonstrate that stress and strain remain well below the acceptance criteria for both cladding types and confirm that cladding integrity is maintained for Standard, VAP, and AREVA fuel assemblies during these drop accidents for fuel with a maximum fuel assembly average burnup of 62,000 MWd/MTU.

In addition, Reference 4, also places specific limits on peak cladding temperatures for high burnup fuel assemblies in NUHOMS®-32PHB DSC during normal loading and storage conditions, and off-normal and accident conditions. Reference 4 peak cladding temperature acceptance criteria (in italics) and discussion of how each is met for a NUHOMS®-32PHB DSC is provided below:

1. *The maximum calculated fuel cladding temperature should not exceed 400°C (752°F) for normal conditions of storage and short-term loading operations (e.g., drying, backfilling with inert gas, and transfer of the cask to the storage pad).*

   An analysis determined the maximum fuel rod cladding temperature and the maximum basket component temperatures for NUHOMS®-32PHB DSC storage in an HSM-HB during normal, off-normal, and accident operating conditions. The results from this analysis show that the maximum fuel cladding temperature does not exceed 724°F for normal storage conditions. During short-term loading conditions, the maximum fuel cladding temperature does not exceed 733°F. Therefore, both current design basis steady-state analyses and transient analyses demonstrate that peak cladding temperatures do not exceed the more restrictive Reference 4 limit of 752°F for normal storage and short-term loading operations. Note that while this limit was previously approved in Reference 2 for short-term operations with the NUHOMS®-32P DSCs, this request seeks to extend that approval to normal storage for the NUHOMS®-32PHB DSCs. Additionally, drying time limits and soak time limits assumed in Enclosure 4 are administratively applied when nitrogen is used as blowdown for the NUHOMS®-32PHB DSC.

2. *During loading operations, repeated thermal cycling (repeated heatup/cooldown cycles) may occur but should be limited to less than 10 cycles, with cladding temperature variations that are less than 65°C (117°F) each.*

   For the NUHOMS®-32PHB, Enclosure 4 provides a transient analysis of the blowdown with either helium or nitrogen, vacuum drying, and the helium backfill process for the NUHOMS®-32PHB DSC and demonstrates that this criteria is satisfied. Backfilling the NUHOMS®-32PHB DSC with helium after the first vacuum drying causes a one-time temperature drop, which is not considered repeated thermal cycling.

3. *For off-normal and accident conditions, the maximum cladding temperature should not exceed 570°C (1058°F).*

   An evaluation determined the maximum fuel rod cladding temperature and the maximum basket component temperatures for NUHOMS®-32PHB DSC storage in an HSM-HB during normal, off-normal, and accident operating conditions. The evaluation shows that during the forest fire event, which is the worst scenario condition considered in the calculation, the maximum cladding temperature does not exceed 932°F during this event.

In addition to the transfer cask drop event discussed above, other USAR design basis events potentially impacted by this proposed change are the accidental pressurization event and the DSC leakage event. The accidental pressurization event considers the failure of all fuel rods within a sealed NUHOMS®-32PHB DSC. Evaluation of this event using the previously approved methods and assuming all 32 fuel assemblies in the DSC had a fuel assembly average burnup of 62,000 MWd/MTU demonstrated that the internal pressure of the DSC would remain below the design limit of 100 psig. In addition, the NUHOMS®-32PHB DSC is designed and tested to meet the leak-tight criteria defined in Interim Staff Guidance (ISG)-18 (Reference 5) and American National Standards Institute N14.5 (Reference 6), and therefore, a DSC leakage dose analysis is not required per the requirements of Reference 7.

G. Revision to Technical Specification 3.1.1(5)

The current maximum heat generation rate limit is 0.66 kW per fuel assembly for the NUHOMS®-24P and NUHOMS®-32P DSCs. The proposed amendment would add a new maximum heat generation rate of 0.8 kW per fuel assembly for NUHOMS®-32PHB DSC basket zones 1 and 4, and a maximum heat generation rate of 1.0 kW per fuel assembly for NUHOMS®-32PHB DSC basket zones 2 and 3 (see Figure 4). Zoning is used in combination with time limits on certain loading operations to accommodate the maximum total NUHOMS®-32PHB DSC heat loads up to 29.6 kW while maintaining fuel cladding and DSC component temperatures below their respective design limits. NUHOMS®-32PHB DSCs with total heat loads of 25.6 kW (limit of 0.8 kW per fuel assembly for all zones) or 23.04 kW (limit of 0.72 kW per fuel assembly for all zones) may utilize longer time limits as discussed below. Appropriate discharge cooling times have been determined for fuel assemblies to be loaded into a NUHOMS®-32PHB DSC and will be added to USAR Table 9.4.1. The current maximum heat generation rate for the NUHOMS®-24P and NUHOMS®-32P DSCs remain the same.

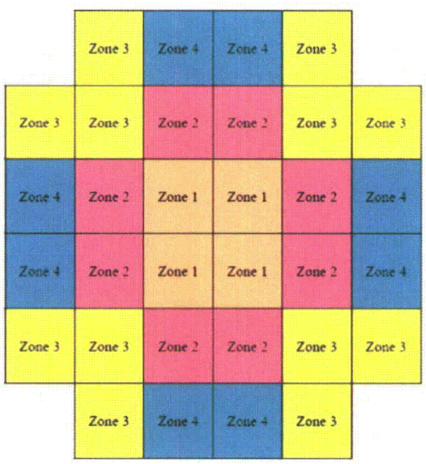

Figure 4 – NUHOMS®-32PHB DSC Maximum Heat Load Zone Configuration

H. Revision to Technical Specification 3.1.1(7)

The proposed addition of the irradiated fuel assembly weight limit of 1375 lbs is supported by the design basis calculation for the new transfer cask yoke. This new transfer cask yoke design limit applies only to the transfer of the NUHOMS®-32PHB DSCs. The remaining transfer cask and NUHOMS®-32PHB DSC calculations were performed using the existing weight limit of 1450 lbs per irradiated fuel assembly. A comparison of Westinghouse and AREVA fuel assembly weights determined that the AREVA fuel assembly is the bounding fuel assembly for this Technical Specification. The maximum weight of an AREVA fuel assembly without a control element assembly inserted is 1354 lbs (unirradiated). An irradiated fuel assembly is assumed to gain a maximum of 8.45 lbs as a result of corrosion and hydrogen absorption. Margin is also included to account for debris or other unknown issues. Control element assemblies, which are included in the existing weight limit (1450 lbs), are not included in this proposed weight limit (1375 lbs) since the length of the fuel assembly with the control element assembly inserted would physically preclude placement of the top shield plug and closure of the NUHOMS®-32PHB DSC. The structural integrity of the NUHOMS®-32PHB DSCs is evaluated at the higher weight limit of 1450 lbs. These evaluations were done for normal operations, off-normal operations, and accident conditions and the results are within the previously approved limits. The stresses imposed on the transfer cask, transfer equipment, and HSMs as a result of this change were evaluated at the higher fuel assembly weight of 1450 lbs (except the transfer cask yoke) and are within the previously approved limits. In addition, the transfer cask yoke analysis for the NUHOMS®-32PHB DSCs determined that the results are within the required structural limits. The current maximum fuel assembly weight limit for the NUHOMS®-24P DSC and the NUHOMS®-32P DSC remain the same.

I. Revision to Technical Specification 3.2.2.1

The proposed amendment would add acceptance standards for liquid penetrant tests of the top shield plug closure weld, the siphon and vent port cover welds, and the top cover plate weld for the NUHOMS®-32PHB DSC. The outer top cover plate is welded to the shell subsequent to the leak testing of the confinement boundary. The top closure confinement welds are multi-layer welds applied after fuel loading and comply with the guidance of ISG-15 and ASME Boiler & Pressure Vessel Code, Section III, Subsection NB-5350, 1998 (with addenda up to and including 1999) edition. Therefore, the acceptance standard proposed for the NUHOMS®-32PHB DSC is the ASME Boiler & Pressure Vessel Code, Section III, Subsection NB-5350, 1998 (with addenda up to and including 1999) edition. This is an administrative change to adopt a later version of an acceptable standard. This acceptance standard is the same as is currently used for the approved Transnuclear, Inc. CoC 1030 DSCs. The acceptance standard for the NUHOMS®-24P and NUHOMS®-32P DSCs remains the same.

J. Revision to Technical Specification 3.2.2.2 and 4.2.2.1

Updated Safety Analysis Report Sections 8.2.8 and 12.8.2.8 evaluate a non-mechanistic release to the environment of the gap inventory of Kr-85 fission gas from all fuel rods contained in the NUHOMS®-24P and NUHOMS®-32P DSCs, respectively. However, this event is not analyzed for the NUHOMS®-32PHB DSC. Current Nuclear Regulatory Commission guidance on radionuclides which must be considered and their release fractions are specified in Reference 7. Section IV.3 of Reference 7 also offers the option of testing closure welds to be "leak tight," as defined in Reference 6, in lieu of performing a DSC leakage dose analysis. Reference 6 defines "leak tight" as a degree of package containment that in a practical sense precludes any significant release of radioactive materials, and is achieved by demonstration of a leakage rate less than or equal to $1x10^{-7}$ ref·cc/sec, of air at an upstream pressure of 1 atmosphere (atm) absolute and a downstream pressure of 0.01 atm absolute or less. Leak test methods currently in use for the NUHOMS®-32P are capable of testing to this sensitivity, and a review of several NUHOMS®-32P DSC leak test results shows that all have met the above requirement. Therefore, in place of performing the non-mechanistic fission gas release for the NUHOMS®-32PHB DSC it is proposed that a helium leak rate acceptance criteria of 10^{-7} ref-cc/sec be added to Technical Specifications 3.2.2.2 and 4.2.2.1 for the NUHOMS®-32PHB DSC. The proposed change would require that the standard helium leak rate for the NUHOMS®-32PHB DSC top shield plug closure weld, and the siphon and vent port cover welds be limited to 10^{-7}ref-cc/s. The current acceptance criteria would remain for the NUHOMS®-24P and NUHOMS®-32P DSCs.

K. New Technical Specification 3.3.2.1

The proposed amendment would establish a new Technical Specification for the time to complete the NUHOMS®-32PHB DSC transfer from the cask handling area to the HSM. For the NUHOMS®-32P DSC, thermal analyses performed to demonstrate that peak cladding temperatures remained below the 752°F cladding temperature limit during transfer of the NUHOMS®-32P DSC from the Auxiliary Building cask wash pit to the HSM were done using steady-state assumptions. As a result there were no time limits imposed on the transfer process for this canister design. For the NUHOMS®-32PHB DSC, thermal analyses of the transfer operation (Enclosure 5) impose time limits on the transfer of NUHOMS®-32PHB DSC from the Auxiliary Building cask wash pit (starting at time water is drained from the annulus) to the HSM-HB. Enclosure 5 establishes the maximum heat loads for NUHOMS®-32PHB DSC while it is in the transfer cask. The maximum heat load and transfer times are determined so that the maximum transfer cask component temperatures remain below the temperature evaluated for the currently approved transfer cask loaded with a NUHOMS®-32PHB DSC. Transient thermal analyses were performed to determine the maximum component temperatures of the transfer cask loaded with a NUHOMS®-32PHB DSC for the limiting heat loads and transfer times before initiation of a corrective action such as establishment of forced cooling or refilling the transfer cask/DSC annulus with water. Enclosure 5 also establishes a time to complete the transfer of the NUHOMS®-32PHB DSC to the HSM to ensure that the peak fuel cladding temperature remains below the temperature limit. There are no time limits associated with horizontal transfer operations once the forced air circulation is initiated. After initiation of forced cooling, if the fans are stopped for any reason, up to 8 hours are available to complete the transfer, restart the fans, or fill the transfer cask/DSC annulus with water (Enclosure 6). To minimize the occurrence of a malfunction of the forced cooling system, the transfer cask transporter is equipped with redundant industrial grade blowers, each of which is capable of supplying the required minimum air flow rate, as well as a redundant power supply for the blowers. For the transfer cask model, transient simulations are performed using ANSYS for the transfer cask as described in Enclosure 5. Table 8 summarizes the maximum temperatures for the transfer cask components and shows that the maximum component temperatures are below the allowable limits for transfer durations at the evaluated heat loads.

Table 8, NUHOMS®-32PHB Maximum Temperatures without Forced Cooling*

Heat Load	≤ 29.6 and > 25.6 kW	≤ 25.5 and > 23.04 kW	≤ 23.04 and > 21.12 kW	≤ 21.12 kW	Temperature Limit °F
Transfer Time Limit	**20 hours**	**48 hours**	**72 hours**	**No Limit**	
Component					
Fuel Cladding	728	728	705		752
Basket (Guide Sleeve)	709	709	686		-
Max. DSC Shell	407	451	456		620
Transfer Cask Inner Shell	313	356	365		-
Gamma Shield	308	351	360		-
Radial Neutron Shield-Bulk Avg. Temp	214	242	249		280
Top Neutron Shield-Bulk Avg. Temp	186	199	203		280
Bottom Neutron Shield-Bulk Avg. Temp	201	219	225		280
Transfer Cask Outer Shell	233	262	269		-
Transfer Cask Lid	216	240	246		-

* Off-normal hot transient condition: assumes an ambient temperature = 104°F and solar heat input = 127 Btu/hr-ft^2

In summary, if the transfer operations exceeds or are expected to exceed the above time limits, corrective actions such as forced cooling or refilling of the transfer cask/DSC annulus with water must be initiated. The time limit for completion of the NUHOMS®-32PHB transfer to the HSM is as follows:

- No time limit for a DSC with a total heat load of 21.12 kW or less,
- 72 hours for a DSC with a total heat load greater than 21.12 kW but less than or equal to 23.04 kW
- 48 hours for a DSC with a total heat load greater than 23.04 kW but less than or equal to 25.6 kW
- 20 hours for a DSC with a total heat load greater than 25.6 kW but less than or equal to 29.6 kW

Surveillance Requirement 4.3.2.1 is also proposed to monitor the time duration following draining of the transfer cask/DSC annulus until completion of the insertion of the NUHOMS®-32PHB DSC into the HSM.

L. New Technical Specification 3.3.3.1

The proposed amendment would establish a new Technical Specification for the time to complete the NUHOMS®-32PHB DSC blowdown and vacuum drying process only if nitrogen is used for blowdown. For the NUHOMS®-32P DSC, thermal analyses were performed using steady-state assumptions to demonstrate that the peak cladding temperatures remained below the 752°F cladding temperature limit during blow down and vacuum drying. As a result there were no time limits imposed on the blowdown and vacuum drying process. For the NUHOMS®-32PHB DSC, thermal analysis of blowdown and vacuum drying (Enclosure 4) also demonstrates that when helium is used for blowdown, peak cladding temperatures remain well below the 752°F cladding temperature limit for normal operation, with no limitation on completion of the blowdown and vacuum drying process. However, if nitrogen is used for blowdown of the NUHOMS®-32PHB DSC, time limits on the completion of the blowdown and vacuum drying process are imposed to ensure peak cladding temperatures remain below the limit. These time limits are summarized in Table 9.

Table 9 – NUHOMS®-32PHB Vacuum Drying Time Limits*

Heat Load		**25.6 - 29.6 kW**	**23.04 - 25.6 kW**	**≤ 23.04 kW**
Vacuum Drying Time Limit (h)		32	40	56
Peak Fuel Cladding Temperature (°F)	N_2 blowdown w/time limit	711	709	718
	He blowdown w/o time limit	592	555	524

* For nitrogen blowdown only

Therefore, the time limit for completion of vacuum drying of a loaded NUHOMS®-32PHB DSC following blowdown with nitrogen is as follows:

- 56 hours for a DSC with a total heat load of 23.04 kW or less
- 40 hours for a DSC with a total heat load greater than 23.04 kW but less than or equal to 25.6 kW
- 32 hours for a DSC with a total heat load greater than 25.6 kW but less than or equal to 29.6 kW

An additional time limit on draining water from the annulus following completion of vacuum drying is also administratively imposed when nitrogen is used for blowdown, and vacuum drying exceeds a specified time, to ensure that NUHOMS®-32PHB temperatures remain within the initial conditions assumed at the start of the operation to transfer the NUHOMS®-32PHB DSC to the HSM-HB.

Surveillance Requirement 4.3.3.1 is also established to monitor the time duration following initiation of NUHOMS®-32PHB DSC blowdown using nitrogen until the initiation of helium backfill to ensure it remains within the required time limits.

M. Revision to Technical Specification 3.4.1.1

This Technical Specification limits the temperature rise from the HSM inlet to the outlets. This provides assurance that the fuel is being adequately air cooled while in the HSM. The current limit is a maximum 64°F temperature rise for HSMs loaded with NUHOMS®-24P and NUHOMS®-32P DSCs. The proposed amendment would add a new maximum allowable temperature rise from the HSM-HB inlet to the HSM-HB outlet of 80°F. The maximum temperature rise limit will remain 64°F for the existing HSMs.

This Technical Specification limit is revised based on an evaluation that determined the maximum fuel rod cladding and component temperatures of NUHOMS®-32PHB DSC in the HSM-HB storage module for normal, off-normal, and accident conditions. A maximum heat load of 29.6 kW per NUHOMS®-32PHB DSC was assumed along with the appropriate thermal limits for stored fuel assemblies. The results of these analyses show an 80°F temperature rise occurs from the HSM-HB inlet to the HSM-HB outlets and demonstrate that the peak fuel cladding temperature is equal or less than 724°F for a maximum air inlet temperature of 104°F for the normal and off-normal hot conditions. In addition, for the case of the blocked vent accident in HSM-HB, the maximum peak fuel cladding temperature is less than 868°F for a maximum air inlet temperature of 104°F while maintaining an 80°F temperature rise in HSM-HB. These peak fuel cladding temperatures for normal, off-normal, and vent block storage accident conditions are below the peak fuel cladding temperature limits for the NUHOMS®-32PHB fuel assemblies that form the basis for this Technical Specification. Table 10 shows the maximum peak fuel cladding temperatures for normal, off-normal and accident storage conditions.

Table 10, Maximum Fuel Cladding Temperature

Operation Condition		**Fuel Cladding**	**Fuel Cladding Limit**	**Max. Temp Rise Limit**
		T_{max} (°F)	T_{max} (°F)	T_{air} out – T_{air} in (°F)
Normal	Cold (T_{air} = -8°F)	648	752	80
	Hot (T_{air} = 104°F)	<724	752	80
Off-Normal	Cold (T_{air} = -8°F)	648	1058	80
	Hot (T_{air} = 104°F)	724	1058	80
Accident	Blocked Vent (40 hours, T_{air} = 104°F)	867	1058	80

In addition, the evaluation assumed that the dose reduction inserts were used for inlet vents of HSM-HB. The dose reduction inlet vent inserts consist of three staggered, schedule 10, stainless steel pipes with a nominal outer diameter of 14 inches, a wall thickness of 0.25 inches, and length of 6 inches. These pipes are welded to the back side of the inlet vent bird screen and the area around the pipes remains open for air flow. The dose reduction inserts introduce a flow resistance to the air flow through the HSM-HB and will have an effect on the air temperature used for evaluation of NUHOMS®-32PHB DSC in HSM-HB. The increase of the loss coefficient due to the dose reduction inserts constitutes approximately 1.3% of the overall loss coefficient in HSM-HB. This increase is a minor change to the overall loss coefficient and is bounded by other conservatisms. Therefore, the 80°F temperature rise in HSM-HB is acceptable even with the installation of the dose reduction inserts in the inlet vents of HSM-HB design.

N. Revision to Design Feature 5.2

The proposed amendment would add the required minimum areal density for the NUHOMS®-32PHB DSC poison plates. The NUHOMS®-32PHB DSC poison plates shall have a minimum B^{10} areal density of 0.019 g/cm^2 for basket type A and 0.027 g/cm^2 for basket type B. The basis for the poison plate areal density is discussed in Section 3.0.E. The minimum B^{10} areal density for the NUHOMS®-32P DSC poison plates remains the same.

4.0 ENVIRONMENTAL ASSESSMENT

Calvert Cliffs Nuclear Power Plant, LLC has reviewed the environmental impact of the proposed amendment and has determined that it meets the criteria for categorical exclusion set forth in 10 CFR 51.22(c)(11). Our determination for categorical exclusion is based on the following evaluation of the proposed amendment against the standards set forth in 10 CFR 51.22(c)(11):

1. *There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.*

   No effluents are released from the Independent Spent Fuel Storage Installation (ISFSI) during operation and the proposed changes have no impact to dry shielded canister (DSC) loading activities. Therefore, there is no significant change in the type or significant increase in the amounts of any effluents that may be released offsite from the proposed revisions to the ISFSI License.

2. *There is no significant increase in individual or cumulative occupational radiation exposure.*

   The proposed increase in the allowable enrichment results in a minor change in dose rates for some loading and transfer activities and horizontal storage module dose locations, but the analysis of the increases shows that dose rates and accumulated dose will remain below limits. Therefore, there is no significant increase in individual or cumulative occupational radiation exposure from the proposed revisions to the ISFSI License.

3. *There is no significant construction impact.*

   The existing 72 HSMs will be filled by the end of 2013. Therefore, it is necessary to construct additional HSMs to allow loadings to continue beyond that time and ensure that full core offload capability is maintained in the Calvert Cliffs spent fuel pool. The number of modules is proposed to be increased from the current 120 modules to the 132 modules required for 60 years of power plant operation. This construction activity will take place within the previously disturbed area already evaluated in the existing license.

   Therefore, there is no significant construction impact associated with the proposed revisions to the ISFSI license.

4. *There is no significant increase in the potential for or consequences from radiological accidents.*

   The proposed change would allow an increased neutron and gamma source for fuel assemblies stored in NUHOMS®-32PHB DSCs. The accident dose for the DSC with the proposed neutron and gamma source terms meets the 10 CFR 72.106 regulatory limits. Of the events listed in the ISFSI Updated Safety Analysis Report, those potentially impacted by the use of fuel assemblies with an increased source term are the transfer cask drop, DSC leakage, accidental pressurization of the DSC, blockage of HSM air inlets/outlets, and the forest fire event. The effect of an increased neutron and gamma source term on each event was evaluated. The evaluations determined that any increases in dose are not more than minimal. Therefore, the consequences from a radiological accident are not significantly increased.

   The proposed change would also allow increased heat generation limits for a fuel assembly. Evaluations have determined that the additional heat generation per fuel assembly will not affect the fuel cladding and result in any additional accident release. Therefore, the consequences from a radiological accident are not increased.

   The proposed change would also allow increased fuel assembly average burnup limits for a fuel assembly. Evaluations have determined that the increased fuel assembly average burnup limit results in minimal increases in the results of the applicable accident dose analyses and the dose remains below the limit. The structural integrity of the canisters and fuel has been evaluated for normal operations, off-normal operations, and accident conditions and remains acceptable. Of the events listed in the ISFSI Updated Safety Analysis Report, those potentially impacted by the use of fuel assemblies with a higher average burnup are the transfer cask drop, DSC leakage, accidental pressurization of the DSC, blockage of HSM air inlets/outlets, and the forest fire event. The effect of a higher average burnup for each event was evaluated. The evaluations determined that any increases in dose are not more than minimal. Therefore, the consequences from a radiological accident are not significantly increased.

Therefore, there is no significant increase in the potential for or consequences from radiological accidents from the proposed revisions to the ISFSI License.

5.0 PRECEDENCE

There is no identical DSC or HSM design that has been previously approved by the Nuclear Regulatory Commission. Similarities to previously approved design elements are discussed in the appropriate sections of this submittal.

6.0 REFERENCES

1. Letter from R. J. Lewis (NRC) to G. Vanderheyden (CCNPP), dated June 10, 2005, Amendment 6 to Material License No. SNM-2505 for the Calvert Cliffs Independent Spent Fuel Storage Installation (ML051010396)
2. Letter from J. Goshen (NRC) to G. H. Gellrich (CCNPP), dated September 14, 2010, Amendment 9 to Material License No. SNM-2505 for the Calvert Cliffs Independent Spent Fuel Storage Installation
3. NUREG/CR-6361, Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages, Oak Ridge National Laboratory, March 1997
4. Spent Fuel Project Office Interim Staff Guidance 11, Cladding Considerations for the Transportation and Storage of Spent Fuel, November 2003
5. Spent Fuel Project Office Interim Staff Guidance 18, The Design and Testing of Lid Welds on Austenitic Stainless Steel Canisters as the Confinement Boundary for Spent Fuel Storage, October 3, 2008
6. ANSI N14.5-1997, American National Standard for Radioactive Materials – Leakage Tests on Package for Shipment, American National Standards Institute, February 1998
7. Spent Fuel Project Office Interim Staff Guidance 5, Confinement Evaluation, May 1999