Enclosure 5 to E-49353

Public Versions of Proprietary and Security-Related Portions of Proposed Amendment 4 Changes to the Standardized Advanced NUHOMS® Updated Final Safety Analysis Report

3.5.3.3 WE 14X14 (MOX) Fuel

Using the geometric and material properties in Table 3.5-4 through Table 3.5-6 and the methodology in Section 3.5.3.1, analysis of the MOX fuel Zircaloy-4 clad fuel assemblies for 75g side and 25g corner drops gives the following results. The side drop allowable g-loading is calculated to be 165g which exceeds the postulated 75g load. For the corner drop, the critical buckling load is calculated to be 71.5g which, when combined with the side drop component, results in a ratio of 0.32. This provides a factor of safety of greater than 3 against fuel rod failure in a corner drop.

3.5.3.4 Results

The fuel cladding for both the WE 14x14 stainless steel clad and Zircaloy-4 clad MOX assemblies will maintain structural integrity for both side and corner drop events.

3.5.4 Fuel Unloading

For unloading operations *during the time period when the spent fuel pool is available*, the 24PT1-DSC will be filled with spent fuel pool water through the siphon port. During this filling operation, the 24PT1-DSC vent port is maintained open with effluents routed to the plant's off-gas monitoring system. The NUHOMS® operating procedures recommend that the 24PT1-DSC cavity atmosphere be sampled first before introducing any reflood water in the 24PT1-DSC cavity.

When the pool water is added to a 24PT1-DSC cavity containing hot fuel and basket components, some of the water will flash to steam causing internal cavity pressure to rise. This steam pressure is released through the vent port. The procedures also specify that the flow rate and temperatures of the reflood water be controlled to ensure that the internal pressure in the 24PT1-DSC cavity is maintained at less than or equal to 20 psig. The reflood for the 24PT1-DSC is considered as a Service Level D event. The 24PT1-DSC is also evaluated for a Service Level D pressure of 60 psig. Therefore, there is sufficient margin in the 24PT1-DSC internal pressure during the reflooding event to assure that the 24PT1-DSC will not be over pressurized.

The maximum fuel cladding temperature during the reflooding will be significantly less than the vacuum drying condition due to the presence of water/steam in the 24PT1-DSC cavity. The analysis presented in Chapter 4 shows that the maximum cladding temperature during steady state vacuum drying operation is 751 °F. Therefore, the maximum cladding temperature during the reflooding operation will be less than 751 °F. This is still considerably below the short term cladding temperature limit of 806 °F. Therefore, no cladding damage is expected due to the reflood event. This is also substantiated by the operating experience gained with the loading and unloading of transportation packages like the IF-300 [3.35] which show that fuel cladding integrity is maintained during these operations and fuel handling and retrieval is not impacted.

Table 4.4-12
Technical Specifications 5.2.5.*b* Temperature Monitoring Limits for the 24PT1-DSC 72.48

	Max Temp (°F)	Max Temp Rise (°F) (in 24 hours)
Single Thermocouple (y = 34.5", x = 0, z = 4.75")	225	80[1]
Dual Thermocouple (y = 60", x = +/-15", z = -11.25")	175	8[2]

1. Based on a 24 kW DSC heat load, as noted in Technical Specification Section 5.2.5.*b* at the analyzed location in the AHSM base.
2. Based on a 14 kW DSC heat load, at the dual "as-built" thermocouple locations provided in the AHSM roof. A limit of 3 °F applies if the surveillance period is 12 hours instead of 24 hours.

4.7 Thermal Evaluation for Loading/Unloading Conditions

All *individual* fuel *assembly* transfer operations occur when the 24PT1-DSC is in the spent fuel pool. The fuel is always submerged in free-flowing pool water permitting heat dissipation. After fuel loading is complete, the 24PT1-DSC is removed from the pool, drained, dried, and backfilled with helium.

The two loading conditions evaluated for the Advanced NUHOMS® System are the heatup of the 24PT1-DSC before its cavity can be backfilled with helium and the vacuum drying transient. Transient thermal analyses are performed to predict the heatup time history for the 24PT1-DSC components during these events.

The unloading operation considered is the reflood of the 24PT1-DSC with water.

4.7.1 Vacuum Drying Thermal Analysis

Analyses were performed for the vacuum drying condition in order to ensure that the fuel cladding and 24PT1-DSC structural component temperatures remain below the maximum allowable limits shown in Table 4.7-1. For every component except the spacer disc, steady state temperature distributions gave satisfactory results. To show compliance with the ASME B&PV Code [4.7] temperature limits for the spacer disc material, transient analyses were performed to determine the time to reach 700 °F, the temperature limit for SA-537, Class 2 plate. These time limits for the vacuum drying case are shown in Table 4.7-2.

For the steady state analysis, the model is similar to the model described in Section 4.4.2.5 and shown in Figure 4.4-6, Figure 4.4-7, and Figure 4.4-8. The exception is that the helium regions are replaced with air. Assuming that the cavity is filled with air during the vacuum drying operation provides conservative results since during the majority of the vacuum drying operation, the 24PT1-DSC cavity void volume is filled with a mixture of air, water and water vapor, and no credit is taken for evaporation of water, which is a strong cooling mechanism that takes place during this operation. Air thermal conductivity does not change significantly at lower pressures, therefore, the use of a thermal conductivity for a pressure higher than 3 Torr is acceptable. In accordance with Chapter 8, water is required to be in the annulus between the 24PT1-DSC and the transfer cask during the vacuum drying process. Therefore, the 24PT1-DSC shell boundary is set to a temperature of 230 °F as a conservative estimate of the shell wall temperature during this operation. A heat load of 14 kW is considered in computing the maximum fuel cladding temperature. The 14 kW heat load is also used to calculate the maximum 24PT1-DSC component temperatures. The resulting maximum temperatures are tabulated in Table 4.4-6 and Table 4.4-7 for the basket structural components and fuel cladding respectively.

For the transient analysis, the model from Section 4.4.4 is used with the constant temperature boundary condition described above and the change to the helium regions described above. The density and specific heat of the basket materials and fuel assembly from Section 4.2 are also used in the HEATING7 model. The time transient is measured from the beginning of the blowdown procedure to the beginning of the final helium backfill procedure. Therefore, the initial temperature of the basket is conservatively set to the saturation temperature of water as an initial condition. The transient vacuum drying case is performed for heat loads of 13 and 14 kW.

The results of the transient analysis are presented in Table 4.7-2 and Figure 4.7-1. The resulting time limitations are incorporated into Chapter 12.

4.7.2 Pressure During Unloading of Cask

To unload the fuel from the 24PT1-DSC *during the time period when the spent fuel pool is available*, reflooding of the 24PT1-DSC cavity is required. This occurs by first reducing the pressure in the 24PT1-DSC to atmospheric conditions followed by introducing water into the 24PT1-DSC through the drain port and venting through the vent port. Since fuel temperatures are expected to be significantly higher than the saturation temperature of water, flooding of the hot 24PT1-DSC will result in steam being generated which, if not vented, will result in a higher cavity pressure.

The flow rate of water into the 24PT1-DSC during reflood is controlled during this operation such that the pressure within the 24PT1-DSC stays below the design pressure of 20 psig for this condition.

4.7.3 Cask Heatup Analysis

Heatup of the water within the 24PT1-DSC cavity prior to blowdown and backfilling with helium occurs as operations are being performed to decon the cask and drain and dry the 24PT1-DSC. Prevention of boiling in the Advanced NUHOMS® System is not required to ensure public health and safety for the following reasons:

1. The criticality analysis already considers a wide range of moderator densities which include that of steam (Chapter 6). Criticality limits were shown to be met even at conditions of low moderator density (boiling water).

2. The cavity is always vented during the water heatup transient.

3. Although steam may be produced through boiling of the water in the 24PT1-DSC, its presence in the weld joint area during inner cover plate installation operations will be essentially blocked at the interface between the shield plug and the support ring. What little steam that may be present is displaced by the argon shielding gas used in the GTAW process. This shielding gas is heavier than air (and steam) and is delivered at a sufficiently high rate (usually 30 – 50 ft^3/hr) to assure that the steam will be effectively excluded from the weld joint. Finally, if moisture somehow did enter the weld area, the resulting weld bead porosity would be readily detectable by the visual inspection of each pass performed by the welding operator and the dye penetrant (PT) examination performed on the surface of the root pass.

Therefore, the only potential concern associated with steam generation is shielding. An unexpectedly high loss of water within the 24PT1-DSC cavity during these loading operations could result in increased occupational exposure. The following analysis is presented to identify to the license holders the time for the water in the 24PT1-DSC cavity to boil so that corrective action can be planned and implemented as necessary to address ALARA concerns.

8.2.2 Removal of Fuel from the 24PT1-DSC

When the 24PT1-DSC has been removed from the AHSM, there are several potential options for off-site shipment of the fuel. These options include, but are not limited to, shipping the 24PT1-DSC with fuel assemblies or removing the fuel from the 24PT1-DSC as described below. It is preferred to ship the 24PT1-DSC intact to a reprocessing facility, monitored retrievable storage facility or permanent geologic repository in a compatible shipping cask, such as the MP187, licensed under 10 CFR Part 71. However, there are several reasons why it may be necessary to remove fuel assemblies from the 24PT1-DSC *during the time period when the spent fuel pool is available*. These include off-site transport in a transport cask requiring an alternate canister configuration, return of fuel assemblies to a spent fuel pool, or placement of fuel assemblies in a different 24PT1-DSC. Other reasons might include removing fuel assemblies at the end of service life or for inspection following an accident as discussed in Chapter 12.

If it becomes necessary to remove fuel from the 24PT1-DSC prior to off-site shipment, there are two basic options available at the ISFSI or reactor site. The fuel assemblies could be removed and reloaded into a shipping cask using dry transfer techniques, or if the applicant so desires, the initial fuel loading sequence could be reversed and the plant's spent fuel pool utilized, *if available*. Procedures for unloading the 24PT1-DSC in a fuel pool are presented here, however wet or dry unloading procedures are essentially identical to those of 24PT1-DSC loading through the weld removal process (beginning of preparation to placement of the transfer cask in the fuel pool). Prior to opening the 24PT1-DSC, the following operations are to be performed.

1. The transfer cask may now be transferred to the cask handling area inside the plant's fuel handling building.

2. Position and ready the trailer for access by the crane.

3. Attach the lifting yoke to the crane hook.

4. Engage the lifting yoke with the trunnions of the transfer cask.

5. Visually inspect the yoke lifting hooks to insure that they are properly aligned and engaged onto the transfer cask trunnions.

6. Lift the transfer cask approximately one inch off the trunnion supports. Visually inspect the yoke lifting hooks to insure that they are properly positioned on the trunnions.

7. Move the crane in a horizontal motion while simultaneously raising the crane hook vertically and lift the transfer cask off the trailer. Move the transfer cask to the cask decontamination area.

8. Lower the transfer cask into the cask decontamination area in the vertical position.

9. Wash the transfer cask to remove any dirt which may have accumulated during the 24PT1-DSC unloading and transfer operations.

10. Place scaffolding around the transfer cask so that any point on the surface of the transfer cask is easily accessible to handling personnel.

11. Unbolt the transfer cask top cover plate.

12. Connect the rigging cables to the transfer cask top cover plate and lift the cover plate from the transfer cask. Set the transfer cask cover plate aside and disconnect the lid lifting cables.

13. Install temporary shielding to reduce personnel exposure as required. Fill the transfer cask/24PT1-DSC annulus with clean demineralized water and seal the annulus.

The process of unloading the 24PT1-DSC *into the spent fuel pool* is similar to that used for loading. Operations that involve opening the 24PT1-DSC described below are to be carefully controlled in accordance with plant procedures. These operations are to be performed under the site's standard health physics guidelines for welding, grinding, and handling of potentially highly contaminated equipment. These are to include the use of prudent housekeeping measures and monitoring of airborne particulates. Procedures may require personnel to perform the work using respirators or supplied air.

If fuel needs to be removed from the 24PT1-DSC, precautions must be taken for the presence of damaged or oxidized fuel and to prevent radiological exposure to personnel during this operation. If degraded fuel is suspected, additional measures appropriate for the specific conditions are to be planned, reviewed, and implemented to minimize exposures to workers and radiological releases to the environment. A sampling of the atmosphere within the 24PT1-DSC should be taken prior to inspection or removal of fuel.

If the work is performed outside the fuel handling building, a tent may be constructed over the work area which may be kept under a negative pressure to control airborne particulates. Any radioactive gas release will be Kr-85, which is not readily captured. Whether the krypton is vented through the plant stack or allowed to be released directly depends on the plant operating requirements.

Following opening of the 24PT1-DSC, it is filled with demineralized or pool water prior to placement in the spent fuel pool to prevent a sudden inrush of pool water. Parameters related to reflooding the 24PT1-DSC cavity are addressed in Chapter 3. Place transfer cask into the pool. *The f*uel unloading procedures *listed below* will be governed by the plant operating license under 10 CFR Part 50, *if this license is still active*. The generic procedures for these operations are as follows:

1. Locate the siphon and vent port using the indications on the top cover plate. Place a portable drill press on the top of the 24PT1-DSC. Align the drill over the siphon port.

exposure of personnel in the vicinity. The actual local and off-site dose rates, recovery time and operations needed to retrieve the cask, and the required actions to be performed following the event, depend upon the severity of the event, site characteristics and the resultant cask and trailer/skid damage.

11.2.5.4 Corrective Actions

The DSC *and transfer cask* will be inspected for damage.

For recovery of the cask and contents, it may be necessary to develop a special sling/lifting apparatus to move the transfer cask. This may require several weeks of planning to ensure all steps are correctly organized. During this time, lead blankets may be added to the transfer cask to minimize on-site exposure to site operations personnel. The transfer cask would be roped off to ensure the safety of the site personnel.

The recovery operations listed in this section assume the cask drop occurs during initial transfer and loading of the DSC into the AHSM, when the spent fuel pool is still operational and available. If a drop of the transfer cask with a loaded DSC occurs during transfer to a transportation cask and an inspection determines that the DSC is damaged and a spent fuel pool is not available onsite, the DSC shall be placed into a safe condition. If required, the DSC could be transported offsite to a site licensed for either dry or wet unloading of the DSC.

11.2.6 Lightning

11.2.6.1 Cause of Accident

Lightning striking the AHSM and causing an off-normal condition is not considered credible.

Lightning protection system requirements are site specific and depend upon the frequency of occurrence of lightning storms in the proposed ISFSI location and the degree of protection offered by other grounded structures in the proximity of the AHSMs. The addition of simple lightning protection equipment, if required by plant criteria, to AHSM structures (i.e., grounded handrails, ladders, etc.) is considered a miscellaneous attachment and is allowed by the AHSM drawing (Dwg. No. NUH-03-4011), Section 1.5.2.

11.2.6.2 Accident Analysis

Should lightning strike in the vicinity of the AHSM the normal storage operations of the AHSM will not be affected. The current discharged by the lightning will follow the low impedance path offered by the surrounding structures. Therefore, the AHSM will not be damaged by the heat or mechanical forces generated by current passing through the higher impedance concrete. Since the AHSM requires no electrical equipment for its continued operation, the resulting current surge from the lightning will not affect the normal operation of the AHSM.

11.2.6.3 Accident Dose Calculations

Since no off-normal condition will develop as the result of lightning striking in the vicinity of the AHSM, no radiological consequences are expected.

12.3.0 Limiting Condition for Operation (LCO) and Surveillance Requirements (SR) Applicability

BASES

LCOs

LCO 3.0.1, 3.0.2, 3.0.4 and 3.0.5 establish the general requirements applicable to all Specifications and apply at all times, unless otherwise stated.

LCO 3.0.1

LCO 3.0.1 establishes the Applicability statement within each individual Specification as the requirement for when the LCO is required to be met (i.e., when the canister is in the specified conditions of the Applicability statement of each Specification).

LCO 3.0.2

LCO 3.0.2 establishes that upon discovery of a failure to meet an LCO, the associated ACTIONS shall be met. The Completion Time of each Required Action for an ACTIONS Condition is applicable from the point in time that an ACTIONS Condition is entered. The Required Actions establish those remedial measures that must be taken within specified Completion Times when the requirements of an LCO are not met. This Specification establishes that:

a. Completion of the Required Actions within the specified Completion Times constitutes compliance with a Specification; and

b. Completion of the Required Actions is not required when an LCO is met within the specified Completion Time, unless otherwise specified.

There are two basic types of Required Actions. The first type of Required Action specifies a time limit in which the LCO must be met. This time limit is the Completion Time to restore a system or component or to restore variables to within specified limits. If this type of Required Action is not completed within the specified Completion Time, the canister may have to be placed in the spent fuel pool, *if available,* and unloaded. (Whether stated as a Required Action or not, correction of the entered Condition is an action that may always be considered upon entering ACTIONS.) The second type of Required Action specifies the remedial measures that permit continued operation of the unit that is not further restricted by the Completion Time. In this case, compliance with the Required Actions provides an acceptable level of safety for continued operation.

Completing the Required Actions is not required when an LCO is met or is no longer applicable, unless otherwise stated in the individual Specifications.

14. DECOMMISSIONING

This chapter addresses decommissioning for the NUHOMS® 24PT1 system. Decommissioning for the NUHOMS® 24PT4 system is addressed in Appendix A, Chapter A.14. Decommissioning for the NUHOMS® 32PTH2 system is addressed in Appendix B, Chapter B.14.

14.1 Decommissioning Considerations

The Advanced NUHOMS® System design features inherent ease and simplicity for decommissioning by providing easily decontaminable surfaces and isolating the external surfaces of the 24PT1-DSC from contact with the fuel pool. At the end of its service life, the 24PT1-DSC decommissioning could be performed by one of the options listed below:

- Option 1, the 24PT1-DSC, including stored spent fuel, could be shipped to either a monitored retrievable storage system (MRS) or a geological repository for final disposal, or
- Option 2, the spent fuel could be removed from the 24PT1-DSC *in the spent fuel pool, if still available onsite, or using dry transfer techniques or other means, and the fuel shipped offsite* in an NRC approved transportation cask.

The first option requires that the 24PT1-DSC be upgraded to current Part 71 regulations. An amendment to C of C 71-9255 [14.2] has been approved by the NRC to allow for transport of this 24PT1-DSC using the MP187 cask.

The first option does not require any decommissioning of the 24PT1-DSC. No residual contamination is expected to be left behind on the concrete AHSM. The AHSM, fence, and peripheral utility structures will require no decontamination or special handling after the last 24PT1-DSC is removed. The AHSM, fence, and peripheral utility structures could be demolished and recycled with normal construction techniques.

The second option, *which assumes the availability of a spent fuel pool onsite,* would require decontamination of the 24PT1-DSC and transfer cask (if applicable). The sources of contamination in the interior of the 24PT1-DSC or transfer cask would be the primary contamination left from the spent fuel pool water *if unloading using the spent fuel pool*; or crud, hot particles and fines from the spent fuel pins. This contamination could be removed with a high pressure water spray. If further surface decontamination of the 24PT1-DSC or transfer cask is necessary, electropolishing or chemical etching can be used to clean the contaminated surface. After decontamination, the 24PT1-DSC and/or transfer cask could be cut up for scrap, partially scrapped, or refurbished for reuse. Any activated metal would be shipped as low level radioactive waste to a near surface disposal facility.

A review of cask activation analyses previously performed for similar systems (TN-32 cask [14.4] and NUHOMS® site license storage system) indicates that the levels of activation of the 24PT1-DSC, AHSM and transfer cask would be orders of magnitude below the specific activity of the isotopes listed in Tables 1 and 2 of 10 CFR 61.55 [14.3]. A detailed analysis is not considered necessary based on the significant margins determined from these analyses. A comparison of the source terms for this application to those referenced above including the activation analysis summary for the above applications is provided below:

Comparison of Source Terms for Activation Analyses

Source Term (including Control Components)	24PT1-DSC	TN-32 (Metal Cask)	NUHOMS® Site License HSM
γ (γ/sec/assy)	3.4×10^{15}	5.3×10^{15}	1.53×10^{15}
n (n/sec/assy)	2.8×10^{8}	3.3×10^{8}	2.23×10^{8}

TN 32 and NUHOMS® Site License HSM Activation Analysis Results

Nuclide	Activity Ci/m^3			
	HSM Concrete	HSM Steel	TN-32	10 CFR 61.55 Limit
H-3			8.3×10^{-11}	40
C-14			2.3×10^{-10}	8
Co-60	4.4×10^{-5}	8.1×10^{-2}	7.7×10^{-6}	700
Ni-59	1.4×10^{-10}	3.1×10^{-6}	2.5×10^{-6}	220
Ni-63	8.3×10^{-8}	3.2×10^{-4}	3.4×10^{-4}	3.5
Nb-94		3.9×10^{-8}		.2
<5 year half life	4.6×10^{-3}	2.0×10^{-1}	2.3×10^{-2}	700

Following surface decontamination, the radiation levels in the 24PT1-DSC or transfer cask due to activation will be below the acceptable limits of Regulatory Guide 1.86 [14.1]. The activation levels of the 24PT1-DSC or transfer cask materials will be far below the specific activity limits for both short and long lived nuclides for Class A waste. A detailed evaluation will be performed at the time of decommissioning to determine the appropriate mode of disposal, should refurbishment not be elected.

The procedure for decommissioning a 24PT1-DSC or transfer cask not being returned to service is summarized below:

- Remove fuel in accordance with the unloading procedures of Chapter 8.
- Survey interior of 24PT1-DSC or transfer cask. *If the spent fuel pool is available, wash* down the inside of the 24PT1-DSC or transfer cask. Pump out and filter contaminated water and cleaning agent. Survey interior of 24PT1-DSC or transfer cask again, decontaminate as required. It is expected that surface decontamination will be minimal. If so, dispose of the 24PT1-DSC or transfer cask body as scrap metal. If unable to decontaminate to acceptable levels, the 24PT1-DSC and/or transfer cask body can be disposed of as low level radioactive waste.
- Decontaminate the top inner and outer cover plates until able to dispose of as scrap metal. If unable to achieve acceptable levels, dispose of them as low level radioactive waste.

The fuel unloading and decontamination steps for 24PT1-DSC, AHSM, or cask refurbishment are as outlined for the scrap choices, discussed above. However, the only pieces discarded are components damaged by unloading or that are considered to be difficult to decontaminate. Following a comprehensive survey to confirm continued 24PT1-DSC, AHSM or transfer cask water-filled cask annulus. Therefore, this case results in the bounding thermal growth for all operating conditions.

There is adequate space within the 24PT4-DSC cavity for thermal and irradiation growth of the fuel assemblies. The minimum calculated gap is given in Table A.3.5-1.

A.3.5.3 Fuel Rod Integrity During Drop Scenario

Fuel assembly properties are provided in Table A.3.5-2; material properties are provided in Table A.3.5-3 and fuel assembly loads are identified in Table A.3.5-4 for the calculation of fuel rod stresses and critical buckling loads due to cask side and end drop incidents.

A.3.5.3.1 Methodology

A.3.5.3.1.1 Drop

The drop analysis methodology is the same as presented in Section 3.5.3.1 for both side and corner drops.

A.3.5.3.2 Results

Using the geometric and material properties in Table A.3.5-2 through Table A.3.5-4 and the methodology in Section 3.5.3.1, the analysis of the Westinghouse-CENP, Combustion Engineering 16x16 Zircaloy-4 clad fuel assemblies for 75g side and 25g corner drops and the methodology described above gives the following results:

The side drop allowable g-load is calculated to be 154g which exceeds the postulated 75g side load. For the corner drop, the critical axial buckling load is calculated to be 61.2g which, when combined with the side drop component, results in an interaction ratio of 0.36. This provides a factor of safety greater than 2 against fuel rod failure in a corner drop.

A.3.5.4 Fuel Unloading

For unloading operations *during the time period when the spent fuel pool is available*, the 24PT4-DSC will be filled with spent fuel pool water through the siphon port. During this filling operation, the 24PT4-DSC vent port is maintained open with effluents routed to the plant's off-gas monitoring system. The NUHOMS® operating procedures recommend that the 24PT4-DSC cavity atmosphere be sampled before introducing any reflood water into the 24PT4-DSC cavity.

When the pool water is added to a 24PT4-DSC cavity containing hot fuel and basket components, some of the water will flash to steam causing internal cavity pressure to rise. This steam pressure is released through the vent port. The procedures also specify that the flow rate and temperatures of the reflood water be controlled to ensure that the internal pressure in the 24PT4-DSC cavity is maintained at less than or equal to 20 psig. The reflood for the 24PT4-DSC is considered as a Service Level D event. The 24PT4-DSC is also evaluated for a Service Level D pressure of 100 psig. Therefore, there is sufficient margin in the 24PT4-DSC internal pressure during the reflooding event to assure that the 24PT4-DSC will not be over pressurized.

Figure A.4.4-6 illustrates the temperature profile of the heat shields within the AHSM. The variation in temperature from back to front on the heat shield reflects the computed distribution of airflow over the DSC.

Figure A.4.4-7 illustrates the flow profile along a y-z plane through the center of the module. The figure depicts the expected regions of flow recirculation within the inlet duct and in the plenum below the DSC. The figure also shows that, despite interior obstructions, the airflow is relatively evenly distributed along the length of the DSC. A maximum flow velocity of approximately 5.6 feet per second is seen to occur in the vertical exhaust duct at the rear of the module.

Table A.4.4-1 and Table A.4.4-2 summarize the results of the AHSM thermal analysis performed. Table A.4.4-3 summarizes the peak temperatures for the AHSM components based on this model. Table A.4.4-4 summarizes the peak DSC shell surface temperatures as a function of its geometry (from bottom to top) for the normal and off-normal conditions.

A.4.4.2.4 Monitoring of AHSM Temperature

AHSM temperature monitoring is provided to alert operators to a possible blocked vent condition. *The temperature rise of the as-built dual thermocouple locations is obtained by CFD analysis using the ANSYS FLUENT code as described in Section A.4.11.2. The corresponding Technical Specifications temperature limits for this location are provided in Table A.4.4-11.*

A.4.4.3 Thermal Analysis of 24PT4-DSC in the TC

The thermal analysis of the 24PT4-DSC in the TC is also split into separate models for the 24PT4-DSC and TC. This allows for independent calculation of 24PT4-DSC internal temperatures, using the 24PT4-DSC shell temperatures calculated in the TC model as input.

The purpose of the TC analysis is to determine the 24PT4-DSC shell temperatures to be used as boundary conditions in a subsequent 24PT4-DSC basket thermal analysis described in Section A.4.4.4. The thermal analysis of the TC with total heat load of 24 kW is presented in Section 4.4.3. The shell temperatures were provided for the 24PT1-DSC for the required range of ambient conditions with a 24 kW heat load. These shell temperatures are directly applicable for 24PT4-DSC since the shell outside diameter, wall thickness, and materials are the same for both designs. Since the thermal analysis of the TC is based on a homogenized DSC model, a small difference in basket dimensions between 24PT1-DSC and 24PT4-DSC will have a negligible affect on the results.

A.4.4.3.1 TC Model Description

See Section 4.4.3.1.

Table A.4.4-11
Technical Specifications 5.2.5.*b* Temperature Monitoring Limits for the 24PT4 DSC 72.48

	Max Temp (°F)	Max Temp Rise (°F) (in 12 hours)
Dual Thermocouple (y = 60", x = +/-15", z = -11.25")	200	*8.5*[(1)]

1. Based on a 24 kW DSC heat load, as noted in Technical Specification Section 5.2.5.*b*. at the "as-built" dual thermocouple locations provided in the AHSM roof.

A.4.7 Thermal Evaluation for Loading/Unloading Conditions

All *individual* fuel *assembly* transfer operations occur when the 24PT4-DSC is in the spent fuel pool. The fuel is always submerged in free-flowing pool water permitting heat dissipation. After fuel loading is complete, the 24PT4-DSC is removed from the pool, drained, dried, and backfilled with helium.

The three bounding loading conditions evaluated are (1) the heatup of the 24PT4-DSC before the cavity can be backfilled with helium (i.e., prior to blowdown), (2) the vacuum drying transient, and (3) steady state temperatures subsequent to helium backfill. Transient thermal analyses are performed to predict the heatup time history for the 24PT4-DSC components during these events.

The unloading operation considered is the reflood of the 24PT4-DSC with water.

A.4.7.1 Vacuum Drying Thermal Analysis

Analyses were performed for the vacuum drying condition in order to ensure that the steady state fuel cladding and 24PT4-DSC structural component temperatures remain below the maximum allowable material limits shown in Table A.4.7-2. In addition, a transient analysis was performed to ensure the requirements defined by ISG-11 [A4.21] for short-term operations (including vacuum during and helium backfilling operating conditions) are satisfied. According to ISG-11, the maximum fuel cladding temperature cannot exceed $T_{ISG\ limit}$ = 400 °C (752 °F) and the temperature difference during the thermal cycling of the cladding cannot exceed $\Delta T_{ISG\ limit}$ = 65 °C (117 °F).

During vacuum drying operation, water in the DSC cavity is forced out of the cavity (blowdown operation) before the start of vacuum drying. Two alternate options for the gas medium used for the water blowdown operation are evaluated.

In the first option, air is used as the gas medium to remove water and subsequent vacuum drying occurs with air environment in the DSC cavity. In the second option, helium is used as the medium to remove water and subsequent vacuum drying occurs with helium environment in the DSC cavity.

In the thermal analysis for the vacuum drying transient, either air or helium is used as the medium present in the DSC cavity during vacuum drying process. Details of the thermal analysis performed for these two alternate options are described in the following sections.

A.4.7.1.1 Analysis Model

For the vacuum drying thermal analysis, a three-dimensional slice of the 24PT4-DSC basket assembly and fuel is modeled near the center of the active fuel region using the ANSYS computer code. This case has little convection due to low pressure environment and therefore does not justify the use of a resource intensive CFD based code. The 3-D slice spans from center to center of two spacer discs to account for the radial effect of conduction through the spacer discs. Heat transfer effects along the axis of the 24PT4-DSC (third dimension) outside hottest section between two adjacent spacer disc mid-planes are conservatively neglected by applying

[A4.31] FLUENT™, Version 6.1, FLUENT, Inc., Lebanon, NH, 2003.

[A4.32] ICEPAK™, Version 4.1, FLUENT, Inc., Lebanon, NH, 2003.

[A4.33] "Characteristics of Spent Fuel, High Level Waste, And Other Radioactive Wastes Which May Require Long-Term Isolation," DOE/RW-0184, Volume 3 of 6, dated December 1987.

[A4.34] "Domestic Light Water Reactor Fuel Design Evolution, Volume III," Nuclear Assurance Corporation, September 1981, DOE/ET/47912-3.

[A4.35] NUREG/CR-0497, A Handbook of Materials Properties for Use in the Analysis of Light Water Reactor Fuel Rod Behavior, MATPRO - Version 11 (Revision 2), EG&G Idaho, Inc., TREE-1280, September 1981.

[A4.36] SAND90-2406, Sanders, T. L., et al., A Method for Determining the Spent-Fuel Contribution to Transport Cask Containment Requirements, TTC-1019, UC-820, November 1992.

[A4.37] "Spent Nuclear Fuel Effective Thermal Conductivity Report", prepared TRW Environmental Safety Systems, Inc. for DOE Civilian Radioactive Waste Management System (CRWMS), Report BBA000000-01717-5705-00010, Rev. 0, July 1996.

[A4.38] "SONGS Unit 2/3 Fuel Assembly Materials and Masses" SCE No. N-1020-162. Transnuclear, Inc. No. SCE-23.0100-11.

[A4.39] K. Minato, et. al., "Thermal Conductivities of Irradiated UO_2 and (U, Gd)O_2", Journal of Nuclear Materials, 300 (2002) 57-64.

[A4.40] Ronchi, et. al., "Effect of Burn-up on the Thermal Conductivity of Uranium Dioxide up to 100,000 MWdt", Journal of Nuclear Materials, 327 (2004) 58-76.

[A4.41] ANSYS FLUENT, Version 17.1, ANSYS, Inc..

[A4.42] ANSYS ICEM CFD, Version 17.1, ANSYS, Inc.

[A4.43] USNRC, "Computational Fluid Dynamics Best Practice Guidelines for Dry Cask Applications," NUREG-2152, March 2013.

Proprietary Information on Pages A.4.11-4 through A.4.11-11
Withheld Pursuant to 10 CFR 2.390

Table A.4.11.2-1
AHSM Insolation

Component	Averaged over 24 hrs, Btu/(hr-in^2)	Averaged over 24 hrs, Btu/(hr-ft^2)	Averaged over 24 hrs, W/m^2
AHSM Roof	0.852	122.7	696.3
AHSM Front Wall	0.213	30.7	174.2

Table A.4.11.2-2
Design Load Cases

Load Case No.	Operation Condition	Description	Daily Average Ambient Temperature (°F)	Insolation
1	Off-Normal	Off-Normal Hot, Steady-state	107	Yes
2 (1)	Accident	Blocked Inlet and Outlet Vents for 25 hours	107	Yes

Note:

(1) Initial temperatures are taken from steady-state results of LC #1.

Proprietary Information on Pages A.4.11-14 through A.4.11-23
Withheld Pursuant to 10 CFR 2.390

A.8.2 Procedures for Unloading the 24PT4-DSC

The following section outlines the procedures for retrieving the 24PT4-DSC from the AHSM and for removing the fuel assemblies from the 24PT4-DSC. These procedures are provided as a guide and are not intended to be limiting if the licensee determines that alternate means are available to accomplish the same operational objective. A process flow diagram for the Advanced NUHOMS® System retrieval is presented in Figure A.8.2-1.

A.8.2.1 24PT4-DSC Retrieval from the AHSM

No change to the 24PT1-DSC Retrieval from the AHSM section as described in Chapter 8, Section 8.2.1 of the UFSAR.

A.8.2.2 Removal of Fuel from the 24PT4-DSC

When the 24PT4-DSC has been removed from the AHSM, there are several potential options for off-site shipment of the fuel. These options include, but are not limited to, shipping the 24PT4-DSC with fuel assemblies or removing the fuel from the 24PT4-DSC as described below. It is preferred to ship the 24PT4-DSC intact to a reprocessing facility, monitored retrievable storage facility or permanent geologic repository in a compatible shipping cask, such as the MP197, licensed under 10 CFR Part 71. However, there are several reasons why it may be necessary to remove fuel assemblies from the 24PT4-DSC *during the time period when the spent fuel pool is available*. These include off-site transport in a transport cask requiring an alternate canister configuration, return of fuel assemblies to a spent fuel pool, or placement of fuel assemblies in a different 24PT4-DSC. Other reasons might include removing fuel assemblies at the end of service life or for inspection following an accident as discussed in Chapter A.12.

If it becomes necessary to remove fuel from the 24PT4-DSC prior to off-site shipment, there are two basic options available at the ISFSI or reactor site. The fuel assemblies could be removed and reloaded into a shipping cask using dry transfer techniques, or if the applicant so desires, the initial fuel loading sequence could be reversed and the plant's spent fuel pool utilized*, if available*. Procedures for unloading the 24PT4-DSC in a fuel pool are presented here, however wet or dry unloading procedures are essentially identical to those of 24PT4-DSC loading through the weld removal process (beginning of preparation to placement of the transfer cask in the fuel pool). Prior to opening the 24PT4-DSC, the following operations are to be performed.

1. Transfer the transfer cask to the cask handling area inside the plant's fuel handling building.

2. Position and ready the trailer for access by the crane.

3. Attach the lifting yoke to the crane hook.

4. Engage the lifting yoke with the trunnions of the transfer cask.

5. Visually inspect the yoke lifting hooks to insure that they are properly aligned and engaged onto the transfer cask trunnions.

6. Lift the transfer cask approximately one inch off the trunnion supports. Visually inspect the yoke lifting hooks to insure that they are properly positioned on the trunnions.

7. Move the crane in a horizontal motion while simultaneously raising the crane hook vertically and lift the transfer cask off the trailer. Move the transfer cask to the cask decontamination area.

8. Lower the transfer cask into the cask decontamination area in the vertical position.

9. Wash the transfer cask to remove any dirt which may have accumulated during the 24PT4-DSC unloading and transfer operations.

10. Place scaffolding around the transfer cask so that any point on the surface of the transfer cask is accessible to handling personnel.

11. Unbolt the transfer cask top cover plate.

12. Connect the rigging cables to the transfer cask top cover plate and lift the cover plate from the transfer cask. Set the transfer cask cover plate aside and disconnect the lid lifting cables.

13. Install temporary shielding to reduce personnel exposure as required. Fill the transfer cask/24PT4-DSC annulus with clean water and seal the annulus

The process of unloading the 24PT4-DSC *into the spent fuel pool* is similar to that used for loading. Operations that involve opening the 24PT4-DSC described below are to be carefully controlled in accordance with plant procedures. These operations are to be performed under the site's standard health physics guidelines for welding, grinding, and handling of potentially highly contaminated equipment. These are to include the use of prudent housekeeping measures and monitoring of airborne particulates. Procedures may require personnel to perform the work using respirators or supplied air.

If fuel needs to be removed from the 24PT4-DSC, precautions must be taken for the presence of damaged or oxidized fuel and to prevent radiological exposure to personnel during this operation. If degraded fuel is suspected, additional measures appropriate for the specific conditions are to be planned, reviewed, and implemented to minimize exposures to workers and radiological releases to the environment. A sampling of the atmosphere within the 24PT4-DSC should be taken prior to inspection or removal of fuel.

If the work is performed outside the fuel handling building, a tent may be constructed over the work area which may be kept under a negative pressure to control airborne particulates. Any radioactive gas release will be Kr-85, which is not readily captured. Whether the krypton is vented through the plant stack or allowed to be released directly depends on the plant operating requirements.

Following opening of the 24PT4-DSC, it is to be filled with demineralized or pool water prior to placement in the spent fuel pool to prevent a sudden inrush of pool water. Parameters related to reflooding the 24PT4-DSC cavity are addressed in Chapter A.3. Place transfer cask into the pool. *The f*uel unloading procedures *listed below* will be governed by the plant operating license under 10 CFR Part 50, *if this license is still active*. The generic procedures for these operations are as follows:

1. Locate the siphon and vent port using the indications on the top cover plate. Place a portable drill press on top of the 24PT4-DSC. Align the drill over the siphon port.

2. Place an exhaust hood or tent over the 24PT4-DSC, if necessary. The exhaust should be filtered or routed to the site radwaste system.

3. Drill a hole through the top cover plate to expose the siphon port quick connect.

4. Drill a second hole through the top cover plate to expose the vent port quick connect.

CAUTION: (a) The water fill rate must be regulated during this reflooding operation to ensure that the 24PT4-DSC vent pressure does not exceed 20 psig.

(b) Provide for continuous hydrogen monitoring of the 24PT4-DSC cavity atmosphere during all subsequent cutting operations to ensure that a safety limit of 2.4% hydrogen concentration is not exceeded. Purge with 2-3 psig helium (or any other inert medium) as necessary to maintain the hydrogen concentration safely below this limit.

5. Obtain a sample of the 24PT4-DSC atmosphere (confirm acceptable hydrogen concentration). Fill the 24PT4-DSC with water from the fuel pool through the siphon port with the vent port open and routed to the plant's off-gas system.

6. Place welding blankets around the transfer cask and scaffolding.

7. Using plasma arc-gouging, a mechanical cutting system or other suitable means, remove the weld from the outer top cover plate and 24PT4-DSC shell. A fire watch should be placed on the scaffolding with the welder, as appropriate. The exhaust system should be operating at all times.

8. The material or waste from the cutting or grinding process should be treated and handled in accordance with the plant's low level waste procedures unless determined otherwise.

9. Remove the top of the tent, if necessary.

10. Remove the exhaust hood, if necessary.

11. Remove the outer top cover plate.

A.12.3 Limiting Condition for Operation (LCO) and Surveillance Requirements (SR) Applicability

BASES

LCOs

LCO 3.0.1, 3.0.2 and 3.0.4 establish the general requirements applicable to all Specifications and apply at all times, unless otherwise stated.

LCO 3.0.1

LCO 3.0.1 establishes the Applicability statement within each individual Specification as the requirement for when the LCO is required to be met (i.e., when the DSC is in the specified conditions of the Applicability statement of each Specification).

LCO 3.0.2

LCO 3.0.2 establishes that upon discovery of a failure to meet an LCO, the associated ACTIONS shall be met. The Completion Time of each Required Action for an ACTIONS Condition is applicable from the point in time that an ACTIONS Condition is entered. The Required Actions establish those remedial measures that must be taken within specified Completion Times when the requirements of an LCO are not met. This Specification establishes that:

a. Completion of the Required Actions within the specified Completion Times constitutes compliance with a Specification; and

b. Completion of the Required Actions is not required when an LCO is met within the specified Completion Time, unless otherwise specified.

There are two basic types of Required Actions. The first type of Required Action specifies a time limit in which the LCO must be met. This time limit is the Completion Time to restore a system or component or to restore variables to within specified limits. If this type of Required Action is not completed within the specified Completion Time, the DSC may have to be placed in the spent fuel pool, *if available,* and unloaded. (Whether stated as a Required Action or not, correction of the entered Condition is an action that may always be considered upon entering ACTIONS.) The second type of Required Action specifies the remedial measures that permit continued operation of the unit that is not further restricted by the Completion Time. In this case, compliance with the Required Actions provides an acceptable level of safety for continued operation.

Completing the Required Actions is not required when an LCO is met or is no longer applicable, unless otherwise stated in the individual Specifications.

A.14 DECOMMISSIONING

A.14.1 Decommissioning Considerations

The Advanced NUHOMS® System design features include inherent ease and simplicity for decommissioning by providing easily decontaminable surfaces and isolating the external surfaces of the 24PT4-DSC from contact with the fuel pool. At the end of its service life, the 24PT4-DSC decommissioning could be performed by one of the options listed below:

- Option 1, the 24PT4-DSC, including stored spent fuel, could be shipped to either a monitored retrievable storage system (MRS) or a geological repository for final disposal, or
- Option 2, the spent fuel could be removed from the 24PT4-DSC *(in the spent fuel pool, if still available onsite, or using dry transfer techniques or other means) and the fuel shipped offsite* in an NRC approved transportation cask.

The first option requires that the Part 72 24PT4-DSC (i.e., designed for storage) be upgraded to current Part 71 regulations. An amendment to the MP197 CoC [A14.2] will be initiated to allow for transport of the 24PT4-DSC using the MP197 cask.

The first option does not require any decommissioning of the 24PT4-DSC. No residual contamination is expected to be left behind on the concrete AHSM. The AHSM, fence, and peripheral utility structures will require no decontamination or special handling after the last 24PT4-DSC is removed. The AHSM, fence, and peripheral utility structures could be demolished and recycled with normal construction techniques.

The second option, *which assumes the availability of a spent fuel pool onsite,* would require decontamination of the 24PT4-DSC and transfer cask (if applicable). The sources of contamination in the interior of the 24PT4-DSC or transfer cask would be the primary contamination left from the spent fuel pool water, *if unloading using the spent fuel pool*; or crud, hot particles and fines from the spent fuel pins. This contamination could be removed with a high pressure water spray. If further surface decontamination of the 24PT4-DSC or transfer cask is necessary, electro-polishing or chemical etching can be used to clean the contaminated surface. After decontamination, the 24PT4-DSC and/or transfer cask could be cut up for scrap, partially scrapped, or refurbished for reuse. Any activated metal would be shipped as low level radioactive waste to a disposal facility.

A review of cask activation analyses previously performed for similar systems (TN-32 cask [A14.4] and NUHOMS® site license storage system) indicates that the levels of activation of the 24PT4-DSC, AHSM and transfer cask would be orders of magnitude below the specific activity of the isotopes listed in Tables 1 and 2 of 10 CFR 61.55 [A14.3]. A detailed analysis is not considered necessary based on the significant margins determined from these analyses. A comparison of the source terms for this application to those referenced above including the activation analysis summary for the above applications is provided below:

Comparison of Source Terms for Activation Analyses

Source Term	24PT4-DSC	TN-32 (Metal Cask)	NUHOMS® Site License HSM
γ (γ/sec/assy)	7.501 x 10^{15}	5.3 x 10^{15}	1.53 x 10^{15}
n (n/sec/assy)	3.696 x 10^{8}	3.3 x 10^{8}	2.23 x 10^{8}

TN 32 and NUHOMS® Site License HSM Activation Analysis Results

Nuclide	Activity Ci/m^3			
	HSM Concrete	HSM Steel	TN-32	10 CFR 61.55 Limit
H-3			8.3 x 10^{-11}	40
C-14			2.3 x 10^{-10}	8
Co-60	4.4 x 10^{-5}	8.1 x 10^{-2}	7.7 x 10^{-6}	700
Ni-59	1.4 x 10^{-10}	3.1 x 10^{-6}	2.5 x 10^{-6}	220
Ni-63	8.3 x 10^{-8}	3.2 x 10^{-4}	3.4 x 10^{-4}	3.5
Nb-94		3.9 x 10^{-8}		0.2
<5 year half life	4.6 x 10^{-3}	2.0 x 10^{-1}	2.3 x 10^{-2}	700

Following surface decontamination, the radiation levels in the 24PT4-DSC or transfer cask due to activation will be below the acceptable limits of Regulatory Guide 1.86 [A14.1]. The activation levels of the 24PT4-DSC or transfer cask materials will be far below the specific activity limits for both short and long lived nuclides for Class A waste. A detailed evaluation will be performed at the time of decommissioning to determine the appropriate mode of disposal, should refurbishment not be elected.

The procedure for decommissioning a 24PT4-DSC or transfer cask not being returned to service is summarized below:

- Remove fuel in accordance with the unloading procedures of Chapter A.8.
- Survey interior of 24PT4-DSC or transfer cask. *If the spent fuel pool is available,* wash down the inside of the 24PT4-DSC or transfer cask. Pump out and filter contaminated water and cleaning agent. Survey interior of 24PT4-DSC or transfer cask again, decontaminate as required. It is expected that surface contamination will be minimal. If so, dispose of the 24PT4-DSC or transfer cask body as scrap metal. If unable to decontaminate to acceptable levels, the 24PT4-DSC and/or transfer cask body can be disposed of as low level radioactive waste.

B.4.8 Thermal Evaluation for Loading/Unloading Conditions

All *individual* fuel *assembly* loading operations occur when the 32PTH2 DSC and OS200FC TC are in the spent fuel pool. The fuel is always submerged in free-flowing pool water permitting heat dissipation. After completion of the fuel loading, the TC and DSC are removed from the pool and the DSC is drained, dried, sealed, and backfilled with helium. These operations occur when the annulus between the TC and DSC remains filled with water.

The water in the annulus is monitored and replenished with fresh water to prevent boiling and maintain the water level if excessive evaporation occurs as noted for the fuel loading operation procedures in Sections B.8.1.1.3 and B.8.1.1.4. Presence of water within the annulus maintains the maximum DSC shell temperature below the boiling temperature of water in open atmosphere (212 °F).

Water in the DSC cavity is forced out of the cavity (blowdown operation) before the start of vacuum drying. Helium is used as the medium to remove water and subsequent vacuum drying occurs with a helium environment in the DSC cavity. The vacuum drying operation does not reduce the pressure sufficiently to reduce the thermal conductivity of the helium in the DSC cavity as discussed in Appendix U, Section U.4.7.1 of the UFSAR for the Standardized NUHOMS® System [B4.22].

With helium being present during vacuum drying operations and a DSC shell temperature equal to water boiling temperature of 212 °F, the 32PTH2 DSC model described in Section B.4.6.2.1 is used in a steady-state analysis to determine the maximum fuel cladding temperature for vacuum drying operations. The maximum fuel cladding temperature for vacuum drying operations in the 32PTH2 DSC is 572 °F and 540 °F for 37.2 kW and 32.0 kW decay heat loads, respectively.

The presence of helium during blowdown and vacuum drying operations eliminates the thermal cycling of fuel cladding during helium backfilling of the DSCs subsequent to vacuum drying. Therefore, the thermal cycling limit of 65 °C (117 °F) for short-term operations set by NUREG-1536 [B4.3] is satisfied for vacuum drying operation.

The bounding unloading operation considered is the reflood of the 32PTH2 DSCs with water *during the time period when the spent fuel pool is available*. For unloading operations, the DSC is filled with the spent fuel pool water through its siphon port. During this filling operation, the 32PTH2 DSC vent port remains open with effluents routed to the plant's off-gas monitoring system.

The maximum fuel cladding temperature during the reflooding event is significantly less than the vacuum drying condition owing to the presence of water/steam in the DSC cavity. Based on the above rationale, the maximum cladding temperature during unloading operation is bounded by the maximum fuel cladding temperature for vacuum drying operation.

B.8.2 Procedures for Unloading the 32PTH2 DSC

The following section outlines the procedures for retrieving the 32PTH2 DSC from the AHSM-HS and for removing the fuel assemblies from the 32PTH2 DSC. These procedures are provided as a guide and are not intended to be limiting if the licensee determines that alternate means are available to accomplish the same operational objective. A flow chart of the unloading operations of the 32PTH2 system is provided in Figure B.8.2-1.

B.8.2.1 32PTH2 DSC Retrieval from the AHSM-HS

No change to the 24PT1-DSC retrieval from the AHSM section as described in Chapter 8, Section 8.2.1 or the 24PT4-DSC retrieval described in Appendix A, Section A.8.2.1.

The retrieval of the 32PTH2 DSC from the AHSM-HS is, however, outlined in Figure B.8.2-1 below.

B.8.2.2 Removal of Fuel from the 32PTH2 DSC

When the 32PTH2 DSC has been removed from the AHSM-HS, there are several potential options for off-site shipment of the fuel. These options include, but are not limited to, shipping the 32PTH2 DSC with fuel assemblies or removing the fuel from the 32PTH2 DSC as described below. It is preferred to ship the 32PTH2 DSC intact to a reprocessing facility, monitored retrievable storage facility or permanent geologic repository in a compatible transportation packaging licensed under 10 CFR Part 71.

If it becomes necessary to remove fuel from the 32PTH2 DSC prior to off-site shipment, there are two basic options available at the ISFSI or reactor site. The fuel assemblies could be removed and reloaded into a licensed transport packaging using dry transfer techniques, or if the applicant so desires, the initial fuel loading sequence could be reversed and the plant's spent fuel pool utilized, *if available*. Procedures for unloading the 32PTH2 DSC in a fuel pool are presented here, however wet or dry unloading procedures are essentially identical to those of 32PTH2 DSC loading through the weld removal process (beginning of preparation to placement of the TC in the fuel pool). Prior to opening the 32PTH2 DSC, the following operations are to be performed.

1. Transfer the TC to the TC handling area inside the plant's fuel handling building.
2. Position and ready the trailer for access by the crane.
3. Attach the lifting yoke to the crane hook.
4. Engage the lifting yoke with the trunnions of the TC.
5. Visually inspect the yoke lifting hooks to insure that they are properly aligned and engaged onto the TC trunnions.
6. Lift the TC approximately one inch off the upper trunnion supports.
7. Translate the crane horizontally while simultaneously raising the crane hook vertically and lift the TC off the trailer. Move the TC to the TC decontamination area.

8. Lower the TC into the TC decontamination area in the vertical position.

9. Wash the TC to remove any dirt which may have accumulated during the 32PTH2 DSC unloading and transfer operations.

10. Place scaffolding around the TC so that any point on the surface of the TC is accessible to handling personnel.

11. Unbolt the TC cover plate assembly.

12. Connect the rigging cables to the TC cover plate assembly and lift it from the TC. Set the TC cover plate assembly aside and disconnect the lid lifting cables.

13. Install temporary shielding to reduce personnel exposure as required. Fill the TC/32PTH2 DSC annulus with clean water and install a protective cover for the annulus.

The process of unloading the 32PTH2 DSC *into the spent fuel pool* is similar to that used for loading. Operations that involve opening the 32PTH2 DSC described below are to be carefully controlled in accordance with plant procedures. These operations are to be performed under the site's standard health physics guidelines for welding, grinding, and handling of potentially highly contaminated equipment. These are to include the use of prudent housekeeping measures and monitoring of airborne particulates. Procedures may require personnel to perform the work using respirators or supplied air.

If fuel needs to be removed from the 32PTH2 DSC, precautions must be taken for the presence of damaged or oxidized fuel and to prevent radiological exposure to personnel during this operation. If degraded fuel is suspected, additional measures appropriate for the specific conditions are to be planned, reviewed, and implemented to minimize exposures to workers and radiological releases to the environment. A sampling of the atmosphere within the 32PTH2 DSC is required prior to inspection or removal of fuel per Technical Specification 5.1.

If the work is performed outside the fuel handling building, a tent may be constructed over the work area which may be kept under a negative pressure to control airborne particulates. Any radioactive gas release will be Kr-85, which is not readily captured. Whether the krypton is vented through the plant stack or allowed to be released directly depends on the plant operating requirements.

Following opening of the 32PTH2 DSC, it is filled with demineralized water or pool water prior to placement in the spent fuel pool to prevent a sudden inrush of pool water. Parameters related to reflooding the 32PTH2 DSC cavity are addressed in Chapter 3. Place transfer cask into the pool. The fuel unloading procedures listed below will be governed by the plant operating license under 10 CFR Part 50, if this license is still active. The generic procedures for these operations are as follows:

1. Locate the siphon and vent ports using the indications on the outer top cover plate. Place a portable drill press on top of the 32PTH2 DSC. Align the drill over the siphon port.

2. Place an exhaust hood or tent over the 32PTH2 DSC, if necessary. The exhaust should be filtered or routed to the site radwaste system.

CAUTION: Radiation dose rates are expected to be high at the vent and siphon port location. Use proper ALARA practices (e.g., use of temporary shielding, appropriate positioning of personnel, etc.) to minimize personnel exposure.

3. Drill holes through the outer top cover plate and siphon port cover plate to expose the siphon port quick connect.

4. Drill holes through the outer top cover plate and vent port cover plate to expose the vent port quick connect.

5. Obtain a sample of the 32PTH2 DSC atmosphere per the requirements of Technical Specification 5.1 (confirm acceptable hydrogen concentration). Fill the 32PTH2 DSC with water from the fuel pool through the siphon port with the vent port open and routed to the plant's off-gas system.

   CAUTION:

   a. The water fill rate must be regulated during this reflooding operation to ensure that the 32PTH2 DSC vent pressure does not exceed 20 psig.

   b. Per Technical Specification 5.2.6, provide for continuous hydrogen monitoring of the 32PTH2 DSC cavity atmosphere during all subsequent cutting operations to ensure that a safety limit of 2.4% hydrogen concentration is not exceeded [B8.2] and [B8.3]. Purge with 1-3 psig helium as necessary to maintain the hydrogen concentration safely below this limit.

6. Using plasma arc-gouging, a mechanical cutting system or other suitable means, remove the weld from the outer top cover plate and the 32PTH2 DSC shell and remove the outer top cover plate. The exhaust system should be operating at all times.

7. The material or waste from the cutting or grinding process should be treated and handled in accordance with the plant's low level waste procedures unless determined otherwise.

8. Using plasma arc-gouging, a mechanical cutting system or other suitable means, remove the weld from the inner top cover plate and the 32PTH2 DSC shell in the same manner as the outer top cover plate. Remove the inner top cover plate. Remove any remaining excess material on the inside shell surface by grinding.

9. Clean the TC surface of dirt and any debris which may be on the TC surface as a result of the weld removal operation. Any other procedures which are required for the operation of the TC, including installation of the annulus seal, should take place at this point as necessary.

10. Engage the trunnions with the yoke, install eyebolts into the top shield plug and connect the rigging cables to the eyebolts.

11. Visually inspect the lifting hooks of the yoke to insure that they are properly positioned on the trunnions.

12. The TC should be lifted just high enough to allow the weight of the TC to be distributed onto the yoke lifting hooks. Inspect the lifting hooks to insure that they are properly positioned on the trunnions.

13. Install suitable protective material onto the bottom of the TC to minimize TC contamination, as appropriate. Move the TC to the spent fuel pool.

14. Prior to lowering the TC into the pool, adjust the pool water level, if necessary, to accommodate the volume of water which will be displaced by the TC during the operation.

15. Position the TC over the designated area in the fuel pool

16. Lower the TC into the pool. As the TC is being lowered, the exterior surface of the TC should be sprayed with clean demineralized water.

17. Lower the TC into the fuel pool leaving the top surface of the TC approximately one foot above the surface of the pool water. Verify correct connections of the annulus seal and annulus/neutron shield tanks if used.

18. Fill the top of the 32PTH2 DSC with water as needed and continue lowering the TC into the pool.

19. Disengage the lifting yoke from the TC and lift the top shield plug from the 32PTH2 DSC.

20. If the 32PTH2 DSC contains damaged fuel assemblies, remove the top end caps. Remove the fuel from the 32PTH2 DSC and place the fuel into the spent fuel racks.

21. Lower the top shield plug into the empty 32PTH2 DSC (optional).

22. Visually verify that the top shield plug is properly positioned, if necessary.

23. Engage the lifting yoke onto the TC trunnions.

24. Visually verify that the yoke lifting hooks are properly engaged with the TC trunnions.

25. Lift the TC by a small amount and verify that the lifting hooks are properly engaged with the trunnions.

26. Lift the TC to the pool surface. Prior to raising the top of the TC above the water surface, stop vertical movement and inspect the top shield plug to ensure that it is properly positioned. If the top shield plug is not properly seated, lower the TC back to the fuel pool and reposition the plug.

27. As the TC is raised above the pool surface, drain the excess water from the 32PTH2 DSC above the top shield plug back into the fuel pool.

28. Lift the TC from the pool. As the TC is rising out of the pool, spray the exposed portion of the TC with demineralized water.

29. Move the TC to the TC decontamination area.

30. Check radiation levels around the perimeter of the TC. The TC exterior surface should be decontaminated, if necessary.

31. Place scaffolding around the TC so that any point on the surface of the TC is easily accessible to personnel.

32. Connect a water draining/pumping device to the siphon port of the 32PTH2 DSC and remove water from the 32PTH2 DSC cavity.

33. The top cover plates may be welded into place as required.

34. Decontaminate the 32PTH2 DSC, as necessary, and handle in accordance with low-level waste procedures. Alternatively, the 32PTH2 DSC may be repaired and recertified for reuse.

B.12.3 Limiting Condition for Operation (LCO) and Surveillance Requirement (SR) Applicability

BASES

LCOs	LCO 3.0.1, 3.0.2, and 3.0.4 establish the general requirements applicable to all Specifications and apply at all times, unless otherwise stated.
LCO 3.0.1	LCO 3.0.1 establishes the Applicability statement within each individual Specification as the requirement for when the LCO is required to be met (i.e., when the DSC is in the specified conditions of the Applicability statement of each Specification).

LCO 3.0.2

LCO 3.0.2 establishes that upon discovery of a failure to meet an LCO, the associated ACTIONS shall be met. The Completion Time of each Required Action for an ACTIONS Condition is applicable from the point in time that an ACTIONS Condition is entered. The Required Actions establish those remedial measures that must be taken within specified Completion Times when the requirements of an LCO are not met. This Specification establishes that:

a. Completion of the Required Actions within the specified Completion Times constitutes compliance with a Specification; and

b. Completion of the Required Actions is not required when an LCO is met within the specified Completion Time, unless otherwise specified.

There are two basic types of Required Actions. The first type of Required Action specifies a time limit in which the LCO must be met. This time limit is the Completion Time to restore a system or component or to restore variables to within specified limits. If this type of Required Action is not completed within the specified Completion Time, the DSC may have to be placed in the spent fuel pool, *if available,* and unloaded. (Whether stated as a Required Action or not, correction of the entered Condition is an action that may always be considered upon entering ACTIONS.) The second type of Required Action specifies the remedial measures that permit continued operation of the unit that is not further restricted by the Completion Time. In this case, compliance with the Required Actions provides an acceptable level of safety for continued operation.

Completing the Required Actions is not required when an LCO is met or is no longer applicable, unless otherwise stated in the individual Specifications.

B.14 DECOMMISSIONING

B.14.1 Decommissioning Considerations

The NUHOMS® 32PTH2 system design features include inherent ease and simplicity for decommissioning by providing easily decontaminated surfaces and isolating the external surfaces of the 32PTH2 DSC from contact with the fuel pool. At the end of its service life, the 32PTH2 DSC decommissioning could be performed by one of the options listed below:

- Option 1, the 32PTH2 DSC, including stored spent fuel, could be shipped to either a monitored retrievable storage system (MRS) or a geological repository for final disposal, or
- Option 2, the spent fuel could be removed from the 32PTH2 DSC *in the spent fuel pool, if still available onsite, or using dry transfer techniques or other means* and shipped in an NRC approved transportation cask.

The first option requires that the 32PTH2 DSC designed for storage under 10 CFR Part 72, be upgraded to current 10 CFR Part 71 regulations. An amendment to the MP197 CoC [B14.2] will be initiated to allow for transport of the 32PTH2 DSC using the MP197HB cask.

The first option does not require any decommissioning of the 32PTH2 DSC. No residual contamination is expected to be left behind on the concrete AHSM-HS. The AHSM-HS, fence, and peripheral utility structures will require no decontamination or special handling after the last 32PTH2 DSC is removed. The AHSM-HS, fence, and peripheral utility structures could be demolished and recycled with normal construction techniques.

The second option, *which assumes the availability of a spent fuel pool onsite,* would require decontamination of the 32PTH2 DSC and transfer cask (if applicable). The sources of contamination in the interior of the 32PTH2 DSC or transfer cask would be the primary contamination left from the spent fuel pool water *if unloading using the spent fuel pool.* Additionally, there could be crud, hot particles and fines from the spent fuel rods. This contamination could be removed with a high pressure water spray. If further surface decontamination of the 32PTH2 DSC or transfer cask is necessary, electro-polishing or chemical etching can be used to clean the contaminated surface. After decontamination, the 32PTH2 DSC and/or transfer cask could be cut up for scrap, partially scrapped, or refurbished for reuse. Any activated metal would be shipped as low level radioactive waste to a disposal facility.

A review of cask activation analyses previously performed for similar systems (TN-32 cask [B14.4] and NUHOMS® site license storage system) indicates that the levels of activation of the 32PTH2 DSC, AHSM-HS and transfer cask would be orders of magnitude below the specific activity of the isotopes listed in Tables 1 and 2 of 10 CFR 61.55 [B14.3]. A detailed analysis is not considered necessary based on the significant margins determined from these analyses. A comparison of the source terms for this application to those referenced above, including the activation analysis summary for the above applications, is provided below:

Comparison of Source Terms for Activation Analyses

Source Term	32PTH2 DSC	TN-32 (Metal Cask)	NUHOMS® Site License HSM
γ (γ/sec/assy)	6.3×10^{15}	5.3×10^{15}	1.53×10^{15}
n (n/sec/assy)	4.2×10^{8}	3.3×10^{8}	2.23×10^{8}

TN-32 and NUHOMS® Site License HSM Activation Analysis Results

Nuclide	Activity Ci/m³			
	HSM Concrete	HSM Steel	TN-32	10 CFR 61.55 Limit
H-3			8.3×10^{-11}	40
C-14			2.3×10^{-10}	8
Co-60	4.4×10^{-5}	8.1×10^{-2}	7.7×10^{-6}	700
Ni-59	1.4×10^{-10}	3.1×10^{-6}	2.5×10^{-6}	220
Ni-63	8.3×10^{-8}	3.2×10^{-4}	3.4×10^{-4}	3.5
Nb-94		3.9×10^{-8}		0.2
<5 year half life	4.6×10^{-3}	2.0×10^{-1}	2.3×10^{-2}	700

Following surface decontamination, the radiation levels in the 32PTH2 DSC or transfer cask due to activation will be below the acceptable limits of Regulatory Guide 1.86 [B14.1]. The activation levels of the 32PTH2 DSC or transfer cask materials will be far below the specific activity limits for both short and long lived nuclides for Class A waste. A detailed evaluation will be performed at the time of decommissioning to determine the appropriate mode of disposal, should refurbishment not be elected.

The procedure for decommissioning a 32PTH2 DSC or transfer cask not being returned to service is summarized below:

- Remove fuel in accordance with the unloading procedures of Chapter B.8.
- Survey interior of 32PTH2 DSC or transfer cask. *If the spent fuel pool is available,* wash down the inside of the 32PTH2 DSC or transfer cask. Pump out and filter contaminated water and cleaning agent. Survey interior of 32PTH2 DSC or transfer cask again, decontaminate as required. It is expected that surface contamination will be minimal. If so, dispose of the 32PTH2 DSC or transfer cask body as scrap metal. If unable to decontaminate to acceptable levels, the 32PTH2 DSC and/or transfer cask body can be disposed of as low level radioactive waste.
- Decontaminate the top shield plug assembly and top cover plates until able to dispose of as scrap metal. If unable to achieve acceptable levels, dispose of these items as low level radioactive waste.