Enclosure 4 to E-53168

Report of 10 CFR 72.48 Evaluations Performed for the NUHOMS® EOS System for the Period 06/06/19 through 01/30/20

REPORT OF 10 CFR 72.48 EVALUATIONS PERFORMED FOR THE NUHOMS® EOS SYSTEM FOR THE PERIOD 06/07/19 to 01/10/20

LR 721042-032, Revision 0 – (incorporated into UFSAR Revision 2)

Change Description

A flat plate support (FPS) structure is an option in the EOS-HSM or EOS-HSMS for storing only the medium length NUHOMS® EOS-37PTH and EOS-89BTH dry shielded canisters (DSCs), which allows for use of a DSC support structure that is built up from a flat plate. The alternate design introduces an FPS option comprised of two flat plates supported at the back end and at two mid-span locations. The FPS rail is supported by the EOS-HSM base wall in the front.

This evaluation assesses the proposed change in DSC support structure and its weld configuration for the medium sized NUHOMS® EOS-Horizontal Storage Module.

The following proposed changes are being made to UFSAR Drawing EOS01-3000-SAR to facilitate fabrication to the FPS design and are addressed in the Evaluation Summary section below.

1. Detail AA - Change 5/16-inch weld from a continuous weld to a 4-inch on 6-inch stitch weld and move the stiffeners away from the edge to a distance of 5/8 inch.

   UFSAR Drawing EOS01-3000-SAR, Sheet 34 of 40 reflects the change.

2. Sheet 2 - Reduce weld that attaches Items 1 and 10 from 1/2 inch to 3/8 inch.

   UFSAR Drawing EOS01-3000-SAR, Sheet 33 of 40 reflects the change.

3. Bill of materials (BOM) Items 4 and 11, 2-inch plates, add note to procure 2-inch thick plate to ASTM A572 Grade 55 or greater. Add Note 14 to require 2-inch material Grade 55 or greater to meet chemical composition and tensile requirements.

   UFSAR Drawing EOS01-3000-SAR, Sheet 1 of 40, # 25 added and item # 109 and 116 of BOM on UFSAR Drawing EOS01-3000-SAR, Sheet 2 of 40 reflects the changes.

The following proposed changes are being made to facilitate fabrication, to the FPS design and are addressed in the Evaluation Summary below.

1. Reduce the length of hollow structural section tube from 11.25 inches to 8.75 inches to facilitate the installation of stiffeners.

   UFSAR Drawing EOS01-3000-SAR, sheet 32 of 40 reflects the change.

2. Allow stiffeners to be added to the main DSC support plate (Part #1 on Drawing EOS01-3109, Revision 3) as an alternate design.

   UFSAR Drawing EOS01-3000-SAR, Sheet 32 of 40, adds the alternate support plate detail.

3. Change number of welds on rail extension baseplate to 12-inch x 1-inch plate and baseplate extension welds from 3/8 inch to 1/4 inch.

   UFSAR Drawing EOS01-3000-SAR, Sheet 34 of 40, Detail 14 weld sizes 40 reflects the change.

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Evaluation Summary

The EOS-HSM flat plate support rail structure provides structural support for the DSC during loading and unloading operations of the DSC into the NUHOMS® EOS-HSM.

The proposed changes 1 and 2 allow weld modifications. The evaluation results for the FPS demonstrate that the EOS-HSM-FPS demand to capacity ratios remain below 1.0 and are acceptable for all load combinations provided in Chapter 3 of the EOS UFSAR.

The proposed changes 1 and 2, allow for "Alternate Tube Support Design." This is similar to the original design except, there are additional stiffeners welded underneath the support plate and the tubes are reduced in length. The alternate tube support design is well within the original tube steel design calculated results.

The proposed change 3, number of welds on rail extension 12-inch x 1-inch baseplate was changed from four welds to three bevel welds on each spacer. The impact on the EOS-HSM demand to capacity ratios is evaluated for the proposed change. The structural impact of the EOS-HSM FPS rail structure welds on the EOS FPS DSC support structure accessories is evaluated for the proposed change. The evaluation results for the FPS demonstrate that the EOS-HSM-FPS demand to capacity ratios remain below 1.0 and are acceptable for all load combinations provided in Chapter 3 of the EOS UFSAR.

The results from structural analyses demonstrate that the proposed FPS design for the EOS-HSM is structurally adequate for all the design basis loads. Therefore, the proposed changes of the EOS-HSM is structurally adequate for all storage conditions, DSC transfer operations and DSC insertion into HSM, and would not affect the intended structural design function as described in the UFSAR.

a) Other Design Functions:

Thermal, Shielding, Criticality, and Confinement design functions were not adversely affected.

All eight 72.48 evaluation criteria were met.

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LR 721042-080, Revision 0 – (incorporated into UFSAR Revision 2)

Change Description

The purpose of this change is to update UFSAR Table 6-54 to correct fuel material and source term input errors in the EOS-89BTH Dry Shielded Canister (DSC) accident dose rates. Fuel material and source term input errors have been corrected in the UFSAR included in the application for CoC 1042 Amendment 1, which is currently under review by the NRC. The accident dose rates for the EOS-89BTH DSC in the EOS-TC125 Transfer Cask (TC) and in the EOS-TC108 TC have increased due to this error correction. The associated UFSAR text is updated as necessary in Chapters 6, 11, and 12, since the text references the bounding results from Table 6-54 is updated.

Evaluation Summary

The fuel assembly does not have a design function other than self-shielding provided by the fuel itself, and the self-shielding is credited in the shielding calculation. The self-shielding has been altered by correcting the fuel assembly material composition. Any containment function provided by the fuel assembly cladding is out of the scope of this licensing review because it is unrelated to the shielding calculation.

The source term input represents the bounding source term for the EOS-89BTH DSC accident shielding calculation, which is part of the design bases to demonstrate the shielding function of the EOS systems.

The self-shielding has been altered by correcting the fuel assembly material composition. This change causes the accident dose rate to increase for the EOS-89BTH DSC in the EOS-TC125 and EOS-TC108. Also, correcting the neutron source term results in an increase in the accident dose rate for the EOS-89BTH DSC in the EOS-TC125 and EOS-TC108. As a result, the bounding accident dose rate of the EOS system described in the UFSAR has increased.

The reported bounding accident dose rate increases from 2.15 mrem/hr to 2.26 mrem/hr. This value is used as input to an accident exposure assessment where an 8-hour exposure is assumed (see UFSAR Section 6.4.3). The accident exposure increases from 17 mrem to 18 mrem, while the 10 CFR 72.106 accident dose limit is 5 rem (5000 mrem). The accepted definition of “minimal” is less than 10% of the margin to the limit. The allowed minimal dose increase is 0.1*(5000-17) = 498 mrem. The actual dose increase is 18 mrem – 17 mrem = 1 mrem, which is less than 498 mrem.

All eight 72.48 evaluation criteria were met.

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LR 721042-095 Revision 0 – (no associated UFSAR change)

Change Description

The purpose of this change is to address the removal of material from the EOS-TC125/135 TC inner shell inner diameter (ID) in order to meet the cask free path requirements. The cask ID was measured during fabrication and found to be out-of-tolerance. The requirement specifies the inner shell to be 0.75-inch thick plate. The tolerance on the plate thickness only allows the plate to be .01-inch undersize or 0.74-inch thick. The maximum material removal was calculated as 0.150-inch.

Evaluation Summary

The inner shell provides structural support for lifting, radiological shielding and is involved with heat transfer through the TC. The TC inner shell is not credited with criticality or confinement design functions.

Structural:

The EOS cask structural evaluation was performed after taking into account the effect of inner shell thickness reduction by 0.20 inch. All the bounding load cases were analyzed using ANSYS 14.0. The maximum stress ratio is 97.91% and it can be concluded that the inner shell with a thickness of 0.55 inch is structurally adequate to withstand loads in normal, off-normal, and accident conditions.

Shielding:

The EOS-TC125/135 shielding evaluation is performed after taking into account the effect of inner shell thickness reduction by 0.20 inch from the bottom to the top of the lead (top flange excluded). The nonconformance of the inner shell thickness will not affect the existing maximum TC125/135 dose rates under normal and off-normal conditions, beyond the uncertainty of the Monte Carlo N-Particle (MCNP) computer code employed for the shielding analysis. The nonconformance of the inner shell thickness will not affect the maximum accident dose rate since the loss of neutron shield and lead slump considered for accident condition results in a maximum total dose rate dominated 80% by the neutron component.

Thermal:

During transfer operations, heat generated within the DSC is dissipated primarily via a combination of conduction and radiation through the annulus gap between the outer surface of the DSC and the inner surface of the TC inner shell. From the inner shell to the outer surface of the TC, heat is dissipated via conduction through the various layers (inner shell, lead, and neutron shield) of the TC before dissipated to the ambient via convection and radiation. Within the TC, heat dissipation is primarily impacted by the thickness of the various layers, gaps between the various layers and the thermal conductivity of the materials. The thermal evaluations for the EOS-TC125 loaded with the EOS-37PTH DSC and loaded with the EOS-89BTH DSC consider a nominal inner diameter of 76.25 inches and a thickness of 0.75 inch for the inner shell.

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During fabrication, the thickness of the inner shell is reduced locally to ensure that there is no interference between the TC and the DSC during loading operations. Since the annulus gaps between the DSC and the inner shell is reduced or unchanged, a reduction in the thickness of the inner shell reduces the local thermal resistance, which improves the thermal performance and also reduces the thermal mass available to the overall system. The maximum reduction in the inner shell thickness is approximately 0.15 inch. Conservatively assuming the thickness of the inner shell is reduced by 0.20 inch over the entire length (conservatively 192 inches), the maximum reduction in the weight is 3.1416 x 0.283 lb/in^3 x 192 inches x 0.2 inch x (76.25 inch + t) = 2610 lb. This minor reduction in weight is negligible compared to the total weight of the DSC and the TC (~250,000 lb or 125 tons). Considering the positive impacts of lower thermal resistance and potential reduced annulus gaps between the DSC and inner shell, this nonconformance will not impact the thermal performance of the EOS-TC125 when loaded with either the EOS-37PTH or the EOS-89BTH DSCs.

Criticality and Containment:

The TC inner shell is not credited with criticality or confinement design functions; therefore, there is no effect on these design functions described in the UFSAR for the TC.

All eight 72.48 evaluation criteria were met.

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LR 721042-101 Revision 1 – (incorporated into UFSAR Revision 2)

Change Description

The purpose of this change is to accept an out-of-tolerance top cover plate bolt-threaded hole, for the EOS 125-tonTC. The cask top cover plate bolt hole at the 123.75° location has a damaged portion of thread to the tapped hole for the helicoil insert.

Evaluation Summary

The EOS cask top cover is a non-pressure retaining component designed to American Society of Mechanical Engineers (ASME) Section III, Subsection NF standard. Table 3-4 of the UFSAR describes the stress criteria of the bolts under normal and accident conditions.

Structural

The damaged portion of the threads could weaken this threaded connection; however, a calculation was prepared to demonstrate that with one bolt completely removed, the stress in the closure bolts, top coverplate, and top ring do not exceed design allowable stresses under any condition.

Stress in the closure bolts is not changed for normal conditions with only 15 bolts installed. Likewise, the closure bolt fatigue analysis, which is based on normal stress, is not affected by removal of one of the sixteen bolts. Thus, calculational evaluations bound the condition created by removal of one bolt under normal conditions.

The associated calculation provides stresses for the closure bolts, top cover plate, and top ring during an accident condition. Those stresses compared to the same stresses with 16 bolts installed are tabulated below.

Component Stress Ratios Before and After Change Accident Conditions		
Component	**Stress Ratio 16 Bolts**	**Stress Ratio 15 Bolts**
Closure Bolt	58%	81%
Top Cover Plate	89%	96.04%
Top Ring	95%	95.97%

As shown above, the stress ratios in the cask remain below design limits.

Other Design Functions

Thermal, Shielding, Criticality, and Confinement design functions remain unaffected by this condition.

All eight 72.48 evaluation criteria were met.

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LR 721042-103 Revision 0 – (incorporated into UFSAR Revision 2)

Change Description

The purpose of this change is to develop an acceptance criterion for the damaged coating area on the EOS-TC125/135 TC internal and external surfaces below which the effects on the thermal performance of the cask are insignificant. During handling and operation of the TC, the coated surfaces of the inner shell (TC internal surface) and neutron shield panel (TC external surface) can be scratched, peeled off, or physically damaged.

Evaluation Summary

The proposed activity is to determine an allowable damaged coating area on the TC coated surfaces within the acceptance criteria. Physical damages on the TC internal and external coated surfaces would affect the emissivity and absorptivity on the inner shell and exterior of the neutron shield, which may affect the thermal and structural evaluation of the EOS-TC125/135 with the loaded EOS-37PTH/EOS-89BTH DSC.

Thermal

The acceptance criteria allowed for the damaged coating area on the EOS-TC125/135 coated surfaces is determined by a temperature increase within 1 °F for the maximum fuel cladding temperature as compared to the design basis evaluation without EOS-TC125/135 coated surface damage as evaluated in Section 4.5 of the UFSAR. The proposed coating damage acceptance criteria determined in the associated calculation is being added as Section 4.5.12 of the UFSAR.

Within the proposed coating damage acceptance criteria, the evaluation results from the calculation demonstrate that there is no measurable temperature increase for maximum temperatures of the EOS-TC125 and EOS-37PTH DSC components except for the DSC shell maximum temperature increase of 7 °F as compared to the design basis evaluation without damaged coating TC surfaces reported in Section 4.5 of the UFSAR. This analysis is conservatively applied to the EOS-89BTH DSC and the EOS-TC135. Therefore, the proposed coating damage acceptance criteria has no measurable impact on the intended thermal design function of the EOS-TC125/135 loaded with the EOS-37PTH or the EOS-89BTH DSC as described in the UFSAR.

Structural

As discussed above, within the proposed coating damage acceptance criteria, there is up to 7 °F increase for design basis DSC shell maximum temperature as reported in Section 4.5 of the UFSAR for the 50 kW condition with no air circulation. As discussed in Section 3.9.1.2.1 of the UFSAR, the material properties used for the shell evaluation are conservatively taken at 500 °F. The maximum DSC shell temperatures are provided in Table 4-24 of the UFSAR. For normal conditions, the maximum temperature occurs in the vertical orientation (Load Case #1) at 484 °F. During off-normal hot conditions, the maximum DSC shell temperature occurs during the off-normal hot horizontal case (Load Case #3) at 483 °F. In both cases, a 7 °F increase still maintains DSC shell temperatures below the 500 °F used in the DSC shell evaluation. Therefore, the proposed coating damage acceptance criteria for the EOS-TC125/135 remains structurally adequate for the EOS-37PTH or the EOS-89BTH DSC transfer operations in the

EOS-TC125/135, and would not affect the intended structural design function as described in the UFSAR.

Other Design Functions

Shielding, criticality, and confinement design functions are independent of the component temperature, and the coating is not considered in the UFSAR evaluation so there is no adverse effect on these functions.

All eight 72.48 evaluation criteria were met.

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LR 721042-147 Revision 0 – (no associated UFSAR change)

Change Description

The purpose of this change is an evaluation resulting from a site-specific customer request to allow the draining of up to approximately 24 inches of water from the TC/DSC annulus below the top edge of the DSC shell for the EOS-37PTH DSC in the EOS-TC125.

Evaluation Summary

The UFSAR, Section 9.3.1, allows the draining of approximately12 inches of water from TC/DSC annulus below the top edge of the DSC shell.

A review of the CoC and the Technical Specifications (TS) shows that LCO 3.1.3 and Administrative Control 5.1.2.e specify the requirements with regards to draining of the TC/DSC annulus water. The proposed activity to drain an additional 12 inches of water does not impact compliance with these requirements and remains fully compliant with LCO 3.1.3 and Administrative Control 5.1.2.e.

Water within the TC/DSC annulus is relied on to maintain the maximum fuel cladding and other component temperatures below their allowable limits as noted in Chapter 4, Section 4.5.11 of the UFSAR.

As described in Chapter 6, Section 6.4.3, of the UFSAR, the dose rate calculations are performed for the EOS-37PTH DSC / EOS-TC125 configuration to determine the dose rate fields around the TC during loading, decontamination, welding, drying and transfer operations. EOS-TC dose rates are computed for three generalized operational configurations: loading/decontamination, welding/drying, and downending/transfer and used as inputs to the occupational dose assessment documented in Chapter 11, Section 11.2, of the UFSAR. The calculation models for the welding/drying configuration (Table 6-49 of the UFSAR) consider a drain-down of 12 inches of water from the DSC/TC annulus, while those for the transfer operations consider a full drain-down of water from the DSC/TC annulus.

TN performed a calculation that evaluates the thermal impact of the proposed activity and concludes that the maximum fuel cladding temperature increases to 649 °F from the design basis value of 648 °F presented in Table 4-32 of the UFSAR. Considering the large margin to the maximum fuel cladding temperature limit of 752 °F for loading operation, 1 °F cladding temperature increase has a negligible effect on the design basis thermal evaluation in Section 4.5.11 of the UFSAR.

TN performed a calculation that was performed to determined the effect of a drain-down of 24 inches of water from the DSC/TC annulus on the dose rate fields around the TC for welding and drying operations. The maximum surface dose rates at the cask Top and the cask Side for the "new" welding/drying configuration are increased to 1.31E+03 mrem/hr and 1.08E+03 mrem/hr respectively, compared to 1.30E+03 mrem/hr and 9.98E+02 mrem/hr respectively reported in Table 6-53 of the UFSAR for the welding/drying configuration with a drain-down of 12 inches of water from the DSC/TC annulus.

The dose rates for the new welding/drying configuration are used as inputs to the occupational dose assessment. The dose rate at the location "DRL3" for the new welding/drying configuration is 126 mrem/hr, compared to 120 mrem/hr reported in Table 11-1 of the UFSAR.

The overall occupational exposure will increase about 1 %, to 2103 man-mrem, compared to the reported 2081 man-mrem in Table 11-4 of the UFSAR.

With regards to dose consequences (i.e., dose to the public) there are no consequences as there are no changes to the normal or accident condition dose rates during transfer or storage as a result of the proposed activity.

Other Design Functions

Structural, criticality, and confinement design functions remain unaffected by this condition.

All eight 72.48 evaluation criteria were met.

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LR 721042-148 Revision 2 – (no associated UFSAR change)

Change Description

The purpose of this change is an evaluation resulting from a site-specific customer request to allow the draining of up to approximately 33 inches of water from the TC/DSC annulus below the top edge of the DSC shell for the EOS-37PTH DSC in the EOS-TC125 . LR 721042-147 performed an evaluation to allow the draining up to approximately 24 inches of water TC/DSC annulus below the top edge of the DSC shell.

Evaluation Summary

The UFSAR, Section 9.3.1, allows the draining of approximately12 inches of water from TC/DSC annulus below the top edge of the DSC shell.

A review of the CoC and the TS shows that LCO 3.1.3 and Administrative Control 5.1.2.e specify the requirements for draining of the TC/DSC annulus water. The proposed activity to drain an additional 21 inches of water does not impact compliance with these requirements and remains fully compliant with LCO 3.1.3 and Administrative Control 5.1.2.e.

Water within the TC/DSC annulus is relied on to maintain the maximum fuel cladding and other component temperatures below their allowable limits as noted in Chapter 4, Section 4.5.11 of the UFSAR.

As described in Chapter 6, Section 6.4.3, of the UFSAR, the dose rate calculations are performed for the EOS-37PTH DSC / EOS-TC125 configuration to determine the dose rate fields around the TC during loading, decontamination, welding, drying and transfer operations. EOS-TC dose rates are computed for three generalized operational configurations: loading/decontamination, welding/drying, and downending/transfer and used as inputs to the occupational dose assessment documented in Chapter 11, Section 11.2, of the UFSAR. The calculation models for the welding/drying configuration (Table 6-49 of the UFSAR) consider a drain-down of 12 inches of water from the DSC/TC annulus while those for the transfer operations consider a full drain-down of water from the DSC/TC annulus.

TN performed a calculation that evaluates the thermal impact of the proposed activity and concludes that the maximum fuel cladding temperature increases to 649 °F from the design basis value of 648 °F presented in Table 4-32 of the UFSAR. Considering the large margin to the maximum fuel cladding temperature limit of 752 °F for loading operation, 1 °F cladding temperature increase has a negligible effect on design basis thermal evaluation in Section 4.5.11 of the UFSAR.

To conservatively bound the effect of the proposed activity, i.e., a drain-down of 33 inches of water from the DSC/TC annulus, on the dose rate fields around the TC for welding and drying operations, a calculation was performed considering a complete drain-down of the TC/DSC annulus. The maximum surface dose rates at the cask top and the cask side for the new welding/drying configuration are increased to 1.32E+03 mrem/hr and 1.14E+03 mrem/hr, respectively, compared to 1.30E+03 mrem/hr and 9.98E+02 mrem/hr, respectively, reported in Table 6-53 of the UFSAR for the welding/drying configuration with a drain-down of 12 inches of water from the DSC/TC annulus.

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The dose rates for the new welding/drying configuration are used as inputs to the occupational dose assessment. The dose rate at the location "DRL3" for the new welding/drying configuration is 140 mrem/hr, compared to 120 mrem/hr reported in Table 11-1 of the UFSAR. The overall occupational exposure will increase about 3.2 %, to 2148 man-mrem, compared to the reported 2081 man-mrem in Table 11-4 of the UFSAR.

With regards to dose consequences i.e., dose to the public, there are no consequences since there are no changes to the normal or accident condition dose rates during transfer or storage as a result of the proposed activity.

Other Design Functions

Structural, criticality, and confinement design functions remain unaffected by this condition.

All eight 72.48 evaluation criteria were met.

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LR 721042-155 Revision 0 – (no associated UFSAR change)

The purpose of this change is to provide operational guidance on implementing Technical Specification Limiting Condition of Operation (LCO) 3.1.1 regarding vacuum drying operation for a site-specific customer request. This guidance includes a limit on vacuum drying operations below 3 Torr, for a maximum duration of 3 hours.

Background:

LCO 3.1.1 specifies that the DSC vacuum drying pressure shall be sustained at or below 3 Torr (3 mm Hg) absolute for a period of at least 30 minutes following evacuation.

While this LCO requires that the vacuum drying pressure shall be less than or equal to 3 Torr, it does not specify the lowest vacuum drying pressure allowed. Similarly, while the LCO requires the vacuum drying pressure to be sustained for a period of at least 30 minutes, it does not limit the maximum duration at these low pressures.

Evaluation Summary

A review of the CoC and the TS shows that TS 3.1.1 specifies the requirements with regards to vacuum drying. The proposed activity is to limit vacuum drying operations below 3 Torr in Step 17 and Step 24 of Section 9.1.3 of the UFSAR for a maximum duration of 3 hours, which does not alter the TS.

Based on a calculation performed, there is sufficient thermal conductivity in helium at the pressures to which the canister is vacuum dried. However, if the vacuum drying pressure is significantly reduced below 3 Torr for a sufficient duration, there might be a potential for reduction in the thermal conductivity of the helium within the DSC cavity.

To prevent this scenario and to ensure that there is sufficient helium within the DSC cavity, the proposed activity limits the vacuum drying operations below 3 Torr in Step 17 and Step 24 of Section 9.1.3 of the UFSAR to a maximum duration of 3 hours. At the end of the 3-hour period if the vacuum drying limits in TS 3.1.1 are not satisfied, helium should be introduced into the DSC cavity and the internal pressure should be at or above 3 Torr for a period of 3 hours before the cavity pressure is below 3 Torr.

Helium within the DSC cavity is relied on to maintain the maximum fuel cladding and other component temperatures below their allowable limits as noted in Section 4.5.11 of the UFSAR.

A calculation was performed to evaluate the thermal impact of the proposed activity and concludes that the maximum fuel cladding temperature increases to 700 °F at the end of the 3-hour vacuum drying operations below 3 Torr from the design basis value of 648 °F presented in Section 4.5.11 of the UFSAR for the EOS-37PTH DSC. It should be noted that lowering of water level as noted in LR 721042-148, Revision 2 has determined that the impact on thermal performance is negligible. Due to the adiabatic heat up considered in this calculation, the impact of lowering the water is already accounted for.

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The associated calculation conservatively assumes that steady-state conditions are achieved with water in the TC/DSC annulus before the thermal conductivity of the helium gas is sufficiently reduced due to vacuum drying operations below 3 Torr. To bound this condition, this calculation conservatively considers that for the duration of the vacuum drying operations below 3 Torr, there is no heat dissipation and that all heat generated within the fuel assemblies increases the maximum fuel cladding temperatures. Based on this assumption, the heat up rate of 17.44 °F/hr for the EOS-37PTH DSC (See Table 4-16 of the UFSAR at 600 °F) is considered for 3 hours wherein vacuum drying operations are permitted to be below 3 Torr. At the end of the 3 hour vacuum drying operations below 3 Torr, the maximum fuel cladding temperature is 648 °F + (3 hr * 17.44 °F/hr) = 700 °F.

The maximum fuel cladding temperature of 700 °F evaluated the associated calculation, Revision 0 is below the maximum fuel cladding temperature of 742 °F evaluated in Section 4.5.4 of the UFSAR for normal/off-normal transfer operations. Therefore, there is no impact of this temperature increase on the maximum fuel cladding temperature or the DSC components.

In addition, the maximum temperature increase observed in the associated calculation, Revision 0 is 52 °F from 648 °F to 700 °F in a period of 3 hours. At the end of this 3-hour period, helium should be introduced into the DSC cavity and the internal pressure should be at or above 3 Torr for a period of 3 hours before vacuum drying is re-started. This ensures that the maximum fuel cladding temperature is sufficiently reduced before vacuum drying operations below 3 Torr are resumed. The heatup/cooldown rate assumed does not consider any heat dissipation to the water within the TC/DSC annulus and that the entire transient impact is absorbed by the basket assembly including the fuel assemblies. Because no heat dissipation to the ambient is considered, the system heats up and cools down at the same rate during this transient event. As seen in Table 4-16 of the UFSAR, the heat up rate does not vary significantly between the temperature range of 600 °F (17.44 °F/hr) to 700 °F (17.10 °F/hr). Considering both the heatup and cooldown, the maximum temperature variation is 52 °F.

Section 8.4.17.1 of NUREG 1536, Revision 1 states that "During loading operations, repeated thermal cycling (repeated heatup/cooldown cycles) may occur but should be limited to less than 10 cycles, where cladding temperature variations are more than 65 °C (117 °F) each."

Since the maximum temperature variation is limited to 52 °F and is less than the 117 °F limit, the criteria for thermal cycling is satisfied.

Other Design Functions

Structural, criticality, and confinement design functions remain unaffected by this condition.

All eight 72.48 evaluation criteria were met.

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LR 721042-164 Revision 1 – (no associated UFSAR change)

A TN nonconformance report indicated that the 1-1/4 Female National Pipe Thread (FNPT) drain port tap part 11 was not deep enough to achieve a seal with the male bushing part 14 (see Figure 1 below). The inner top cover plate had already been welded on the loaded DSC, and vacuum drying and pressure testing had been completed. The threads were repaired in place with a manual pipe tap. See Figure 1 below.

Because the vent port had already been welded, the repair operation was time limited rather than taking place under a helium purge. This aspect was determined to be an adverse effect on control of a design function described in the UFSAR, that is, the prevention of oxidation damage during loading of fuel (Reference NUREG 1536 Revision 1, Section 8.4.18).

Evaluation Summary

A calculation was performed which demonstrates that assuming instantaneous replacement of the internal helium by air,

1. it would require more than 5 hours before oxidation would cause damage to the fuel,
2. at three hours of air exposure, considering the initial condition and transient based on the heat load for this DSC, the maximum cladding temperature would be 640 °F, below the 648 °F reported in UFSAR Table 4-32, and well below the 752 °F (400 °C) limit, and
3. the cladding temperature change is below the 65 °C temperature cycling limit of NUREG 1536 Revision 1

Therefore, a 3-hour time limit was established for the repair, from the time that the quick-connect fitting item 13 was removed from the drain port, to the time that at least 200 torr helium was re-introduced into the DSC.

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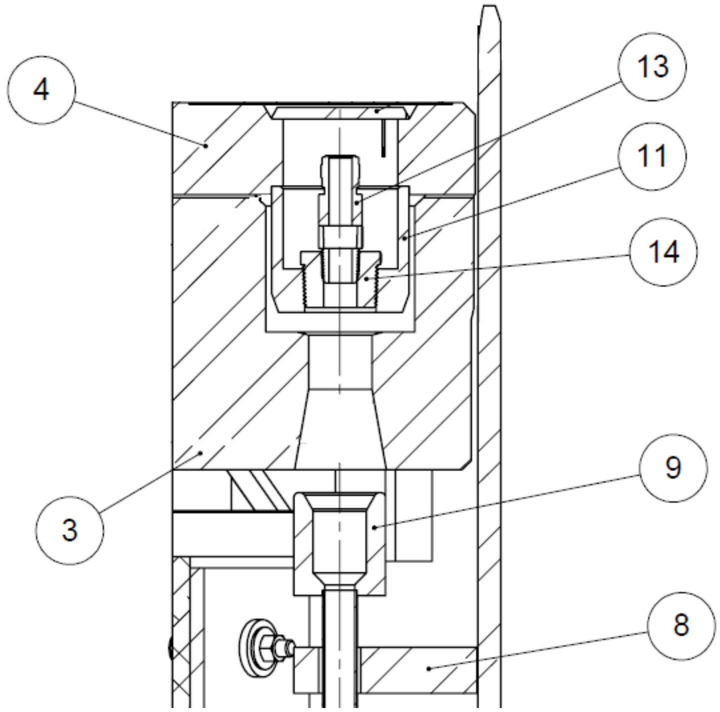

Figure 1
EOS 37PTH Drain Port

Other Design Functions

Structural, shielding, criticality, and confinement design functions remain unaffected by this condition.

All eight 72.48 evaluation criteria were met.