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November 30, 2021
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U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Rockville, MD 20852

Subject: Application for Amendment 3 to NUHOMS® EOS Certificate of Compliance No. 1042, Revision 4 (Docket 72-1042, CAC No. 001028, EPID: L-2021-LLA-0055) – Response to Request for Additional Information

References: [1] Letter from Christian Jacobs to Prakash Narayanan, "TN Americas LLC Application for Certificate of Compliance No. 1042, Amendment No. 3, to NUHOMS® EOS System (Docket No. 72-1042, CAC No. 001028, EPID: L-2021-LLA-0055) – Request for Additional Information," dated October 28, 2021

[2] Letter E-59394, dated September 3, 2021, from Prakash Narayanan, Application for Amendment 3 to NUHOMS® EOS Certificate of Compliance No. 1042, Revision 3 (Docket 72-1042, CAC No. 001028, EPID: L-2021-LLA-0055) – Revised Response to OBS 4-5 and Revised UFSAR Pages

[3] Letter from Christian Jacobs to Prakash Narayanan, "Acceptance Review Completed for TN Americas LLC Application for Certificate of Compliance No. 1042, Amendment No. 3, to NUHOMS® EOS System (Docket No. 72-1042, CAC No. 001028, EPID: L-2021-LLA-0055) – Request for Supplemental Information," dated May 20, 2021

[4] Letter E-58329, dated March 31, 2021, from Prakash Narayanan, Application for Amendment 3 to NUHOMS® EOS Certificate of Compliance No. 1042, Revision 0 (Docket 72-1042)

This submittal provides responses to the Request for Additional Information (RAI) forwarded by the letter, Reference [1] above.

Enclosure 2 herein provides a proprietary version of the RAI responses. Each RAI response has a section stating the impact of the response on the application, both Technical Specifications (TS) and updated final safety analysis report (UFSAR), indicating which sections, tables, etc., have been changed. Enclosure 3 provides a public version of these responses.

Enclosures transmitted herein contain SUNSI. When separated from enclosures, this transmittal document is decontrolled.

Enclosure 4 provides a listing of CoC 1042 Amendment 3 TS changes resulting from the RAIs. Enclosure 5 provides a listing of changed TS and UFSAR pages resulting from the RAIs.

Enclosure 6 provides a complete revision to the TS, denoted as Revision 4 with changes indicated by italicized text and revision bars. The changes are further annotated with gray shading and an indication of the enclosure associated with the changes.

Enclosure 7 provides the UFSAR changed pages associated with this Revision 4 to the application for Amendment 3. Enclosure 8 provides the public version of the Enclosure 7 UFSAR changed pages.

Enclosure 9 provides changes and their associated justifications that are not associated with the RAI responses.

For the UFSAR, replacement and new Amendment 3, Revision 4 pages are provided. The pages include a footer on each replacement or new page annotated as "72-1042 Amendment 3, Revision 4, November 2021" with changes indicated by italicized text and revision bars. The changes associated with the RAI response are further demarcated with gray shading and an indication of the RAI associated with the changes.

Certain portions of this submittal include proprietary information, which may not be used for any purpose other than to support the NRC staff's review of the application. In accordance with 10 CFR 2.390, TN Americas LLC is providing an affidavit (Enclosure 1), specifically requesting that this proprietary information be withheld from public disclosure. The submittal also includes security-related information.

Should the NRC staff require additional information to support review of this application, please do not hesitate to contact Mr. Glenn Mathues at 410-910-6538, or by email at Glenn.Mathues@orano.group.

Sincerely,

A. Prakash

Prakash Narayanan
Chief Technical Officer

cc: Chris Jacobs (NRC), Senior Project Manager, Storage and Transportation Licensing Branch Division of Fuel Management

Enclosures:

1. Affidavit Pursuant to 10 CFR 2.390
2. RAIs and Responses (Proprietary)
3. RAIs and Responses (Public)
4. List of New CoC 1042 Amendment 3, Revision 4 Technical Specifications Changes and Justifications
5. List of TS and UFSAR Pages Involved in CoC 1042 Amendment 3, Revision 4
6. CoC 1042 Proposed Amendment 3, Revision 4 Technical Specifications
7. CoC 1042 Amendment 3, Revision 4 UFSAR Changed Pages (Proprietary)
8. CoC 1042 Amendment 3, Revision 4 UFSAR Changed Pages (Public)
9. Additional Changes Not Associated with the RAIs

AFFIDAVIT PURSUANT TO 10 CFR 2.390

TN Americas LLC)
State of Maryland) SS.
County of Baltimore)

I, Prakash Narayanan, depose and say that I am Chief Technical Officer of TN Americas LLC, duly authorized to execute this affidavit, and have reviewed or caused to have reviewed the information that is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.390 of the Commission's regulations for withholding this information.

The information for which proprietary treatment is sought is contained in Enclosures 2 and 7, as listed below:

- Enclosure 2 - RAIs and Responses
- Enclosure 7 - Portions of certain updated final safety analysis report (UFSAR) chapters

These documents have been appropriately designated as proprietary.

I have personal knowledge of the criteria and procedures utilized by TN Americas LLC in designating information as a trade secret, privileged or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1) The information sought to be withheld from public disclosure involves portions of certain RAI responses and portions of the UFSAR, all related to the design of the NUHOMS® EOS System, which are owned and have been held in confidence by TN Americas LLC.

2) The information is of a type customarily held in confidence by TN Americas LLC, and not customarily disclosed to the public. TN Americas LLC has a rational basis for determining the types of information customarily held in confidence by it.

3) Public disclosure of the information is likely to cause substantial harm to the competitive position of TN Americas LLC, because the information consists of descriptions of the design and analysis of dry spent fuel storage systems, the application of which provide a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with TN Americas LLC, take marketing or other actions to improve their product's position or impair the position of TN Americas LLC's product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

Further the deponent sayeth not.

A. Prakash
Prakash Narayanan
Chief Technical Officer, TN Americas LLC

Subscribed and sworn before me this 29th day of November, 2021.

Diego Waines
Notary Public

My Commission Expires 07/30/2023

DIEGO WAINES
COMM. EXP.
NOTARY
PUBLIC
JULY 30, 2023
BALTIMORE COUNTY, MD

Principal Design Criteria RAIs:

RAI 2-1:

Provide the following additional information to describe and support the requested amendment Change #8 that waives the fabrication pressure test required in American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section III, NB-6000 for the EOS-37PTH dry shielded canister (DSC) and the EOS-89BTH DSC with a single piece bottom forging:

1. Revisions to the NUHOMS® EOS Updated Final Safety Analysis Report (UFSAR) Section 1.2.1.1 to describe the ASME NB-6000 code alternative for the EOS-37PTH DSC similar to those provided in UFSAR, Section 1.2.1.2 for the EOS-89BTH DSC.

2. Revisions to drawing EOS01-1001-SAR that identifies the requested code alternative for the EOS-37PTH DSC with a single piece bottom forging.

3. Revisions to drawing EOS01-1006-SAR that identifies the requested code alternative for the EOS-89BTH DSC with a single piece bottom forging.

4. Revisions to UFSAR Section 2.4.1 which states that the DSC shell and bottom end assembly confinement boundary weld made during fabrication of the DSC is in accordance with the subsection NB of the ASME code.

   UFSAR Section 2.4.1 states, "The confinement boundary weld between the DSC shell and inner top cover (including drain port cover and vent port plug welds) and structural attachment weld between the DSC shell and outer top cover plate are in accordance with alternatives to the ASME code as described in Section 4.4.4 of the Technical Specifications." However, the application did not include revisions to UFSAR Section 2.4.1 to address the requested code alternative to the NB-6000 pressure test for the EOS-37PTH and the EOS-89BTH DSCs with a single piece bottom forging.

5. A description of the NDE requirements for the single piece bottom forging to shell weld, including the required radiographic testing (RT) image quality indicator (IQI) used and the RT acceptance criteria. Indicate whether the root pass is examined by penetrant testing (PT) and provide the PT acceptance criteria.

This information is needed to determine compliance with 10 CFR 72.236(b), (f) and (l).

Response to RAI 2-1:

The following information is provided to support and describe the requested amendment Change #8 to waive the fabrication pressure test required by ASME B&PV Code, Section III, NB-6000 for EOS 37PTH DSC and EOS-89BTH DSC with a single-piece bottom forging:

Response to Item 1:

UFSAR Section 1.2.1.1 has been updated to similarly reflect the changes made in 1.2.1.2 for the single plate bottom forging option.

Response to Items 2 and 3:

The single bottom forging plate option is shown in Drawings EOS01-1001-SAR and EOS01-1006-SAR for the EOS-37PTH and EOS-89BTH, respectively. Clarification has been added to allow for an exemption to the pneumatic test requirement when using this option, consistent with the Technical Specifications, Section 4.4.4.

Response to Item 4:

UFSAR Section 2.4.1 has been updated to reflect the code exception to ASME III Subsection NB-6000 for the single plate bottom forging option.

Response to Item 5:

The single forging plate to DSC shell weld is shown in Drawings EOS01-1001-SAR and EOS01-1006-SAR, Sheet 2, Detail 1-Alternate 1 (excerpted below). [

] These are categorized as Category B welds per NB-3351.2, which are full penetration butt joints per NB-4242 and are examined by radiographic examination (RT) and liquid penetrant testing (PT) in accordance with NB-5220. Acceptance standards of these welds are governed by ASME NB Subsection NB-5300. The weld is placed in two passes, with PT performed after each pass, including the root pass. The PT results are evaluated against the acceptance standards of NB-5352. Any indications detected are removed, the weld is repaired, and PT re-performed. Following the last PT, the forging-to-shell weld undergoes a film radiography test performed in accordance with NB-5320. The RT IQI selection is in accordance with ASME V, Section T-276 for a 0.5-inch material thickness. This is consistent with Section 5.1.3 of the UFSAR; however, the nomenclature of that section is revised to explicitly refer to the single bottom forging-to-DSC weld.

[ ]

Impact:

UFSAR Section 1.2.1.1, 2.4.1, 5.1.3 have been revised as described in the response.

Drawings EOS01-1001-SAR and EOS01-1006-SAR have been revised as described in the response.

RAI 2-2:

Provide revisions to UFSAR Chapter 2 to describe and support the requested amendment Change #6 that reduces the transfer time to 8 hours for the EOS-37PTH with heat load zoning configuration (HLZC) 1 and 2. The application included changes to UFSAR Section 2.4.3 that references Technical Specifications (TS) limiting condition of operation (LCO) 3.1.3 which specifies transfer time limits for the EOS-89BTH DSC. UFSAR Section 2.4.3 does not include revisions that address the reduced transfer time for the EOS-37PTH DSC identified in TS LCO 3.1.3.

This information is needed to determine compliance with 10 CFR 72.236(b) and (f).

Response to RAI 2-2:

The time limits discussed in updated final safety analysis report (UFSAR) Section 2.4.3 are applicable to the EOS-89BTH DSC HLZCs subject to the maximum heat load configuration (MHLC). This methodology is currently only applicable to the EOS-89BTH DSCs transferred in the EOS-TC125. The EOS-37PTH HLZCs and time limits are not afforded the flexibility the MHLC provides in this amendment.

Section 4.5.4 of the UFSAR calculates the minimum time for transfer for the EOS-37PTH HLZCs, and concludes that 10 hours is sufficient for EOS-37PTH HLZCs 1 and 2. This was not revised in Amendment 3. However, the proposed change in this amendment revises the time limit to a more stringent 8 hours from 10 hours. Reducing the time limit for HLZCs 1 and 2, increases the margin to the maximum allowable fuel cladding temperature limit and provides greater flexibility to accommodate any changes/non-conformances during fabrication. It also makes the EOS-37PTH transfer times consistent among all HLZCs (except HLZC 3, which has no limit), which also promotes consistency for operators.

Impact:

No change as a result of this RAI.

Structural RAIs:

RAI 3-1:

Provide the following information with respect to the applicant's proposed two changes, (1) heat load capacity increases, and (2) additional heat load zone configurations (HLZCs):

(i) Identify any changes made (i.e., design functions and criteria, mechanical and thermal properties, stress and strain criteria with associated limits, methodologies, and assumptions) due to the heat load capacity increases or temperature changes based on additional applicant developed HLZCs to the structural design and analysis of the dry shielded canisters (DSCs), transfer casks (TCs), fuel baskets (FBs) and fuel cladding (FC);

(ii) If changes are made as described in (i), indicate whether safety evaluations for the structural design and analysis of the DSCs, TCs, FBs and FC with those changes are performed;

(iii) If no such safety evaluations as described in (ii) are performed, provide justification for not evaluating the DSCs, TCs, FBs and FC with any changes in (i) above in Chapter 3, "STRUCTURAL EVALUATION," of the UFSAR; and

(iv) Elaborate on the structural design functions that shall be considered based on the methodology in Chapter 3 of the UFSAR when there is an impact of temperature changes on the structural system, and specify the methodologies that are used from Chapter 3 of the updated final safety analysis report (UFSAR).

The applicant provided a statement in Section 2.4.3.1, "Methodology for Evaluating Additional HLZCs in EOS-89BTH DSC," in Chapter 2, "PRINCIPAL DESIGN CRITERIA," of the UFSAR, "Based on the thermal evaluation in Step 2 and Step 3 (if applicable), the impact of temperature changes on structural design functions shall be considered based on the methodology in Chapter 3." There are no DSC structural design function changes reported in Chapter 3 due to the heat load capacity increases or the temperature changes based on additional applicant developed HLZCs.

This information is needed to determine compliance with 10 CFR 72.122(b) and 72.236(b).

Response to RAI 3-1:

Item (i):

No changes have been made to design functions and criteria, mechanical and thermal properties, stress and strain criteria with associated limits, methodologies, and assumptions due to the heat load capacity increases or temperature changes based on additional HLZCs to the structural design and analysis of the DSCs, TCs, FBs and FC.

Item (ii):

No changes have been made as described in Item (i), and no additional safety evaluations for the structural design and analysis of the DSCs, TCs, FBs and FC are performed.

Item (iii):

The increase of the maximum heat load for the EOS-89BTH DSC from 43.6 kW to 48.2 kW does not affect the safety evaluations in the UFSAR for the structural design and analysis of the DSCs, TCs, FBs and FC. This is because the initial design of the EOS-89BTH system was based on the heat load of 50 kW, which still remains bounding. As described in UFSAR Section 4.4.8 for the EOS-89BTH DSC in the EOS-HSM, Section 4.5.6.2 for the EOS-89BTH DSC in the EOS-TC125, and Section 4.6.1 for the EOS-89BTH DSC in the EOS-TC108, although the maximum heat load for the EOS-89BTH system was limited to 43.6 kW, the maximum temperatures based on the heat load of 50 kW from the EOS-37PTH DSC were conservatively used for all evaluations. In UFSAR Section 3.6.2, the thermal heat load for the EOS-89BTH DSC has been changed from 43.6 kW to 48.2 kW. Details of the justifications for each of the components are presented below.

DSC: The maximum temperature of the EOS-37PTH DSC shell and the EOS-89BTH DSC shell, based on additional HLZCs, is 495 °F (per UFSAR Table 4-29) and 478 °F (per UFSAR Table 4.9.8-14), respectively. Per UFSAR Section 3.9.1, allowable stresses of the EOS-DSC shell are based on the temperature of 500 °F and the thermal stress analysis of the EOS-DSC is based on the bounding temperature profiles for the EOS-37PTH DSC.

TC: As noted above, the EOS-TC is designed for a heat load of 50 kW. A comparison of the maximum temperatures in UFSAR Table 4.9.8-12 with the bounding temperatures in Chapter 4 shows that the maximum temperatures remain bounded for the EOS-TC. Therefore, the temperature profile considered in the thermal analysis of the TC bounds the temperature profile based on additional HLZCs. Also, per Section 3.9.5 of the UFSAR, allowable stresses of the TC are based on the temperature of 400 °F. The maximum TC component temperatures as noted in Chapter 4, Section 4.9.8 is 368 °F for the inner shell (see Table 4.9.8-12) and remains below the temperature used for the allowables.

FB: The maximum basket grid plate and transition rail temperature of the EOS-89BTH DSC based on additional HLZCs are 701 °F and 536 °F, respectively (per UFSAR Table 4.9.8-14). Per UFSAR Section 3.9.2.1.6.2, the allowable stresses for basket plates are based on material properties at 700 °F for the grid plates and 550 °F for the transition rails. Note that a temperature exceedance of 1 °F has no impact on the basket plate stress allowable to within the relevant number of significant digits. Also, the stress ratios in UFSAR Table 3.9.2-4 for the grid plates are low, indicating a great deal of margin. Per UFSAR Section 3.9.2.2.4, the thermal stress analysis of the EOS-89BTH basket is based on a bounding temperature gradient applicable to the EOS-37PTH basket.

FC: The maximum temperature of the fuel cladding within the EOS-89BTH DSC prior to increasing the heat load from 43.6 kW to 48.2 kW was 733 °F during steady-state transfer operations in the EOS-TC108 as noted in UFSAR Table 4-42. At the 48.2 kW heat load, steady-state transfer operations are not permitted and a time limit is imposed as noted in LCO 3.1.3 of the Technical Specification. Based on this, the maximum fuel cladding temperature based on additional HLZCs is 718 °F as noted in UFSAR Table 4.9.8-14 and is bounded by the previous temperatures. Therefore, the evaluation in UFSAR Section 3.9.6 remains bounding.

Item (iv):

The EOS system provides for dry storage of spent fuel assemblies, and the storage system components are designed to withstand the loading conditions due to normal, off-normal and accident conditions. To demonstrate these design functions, in UFSAR Chapter 3, the stresses in the system are shown to be below the allowables determined at the temperature that bounds the maximum temperature of the system. When there is an impact of temperature changes on the structural system, the following need to be confirmed:

- The temperature profile considered in the thermal stress analysis still bounds the updated temperature profile, and
- The temperature at which mechanical properties, including the allowable stresses, of the system are evaluated still bounds the updated maximum temperature.

For the EOS-89BTH DSC, the temperature resulting from any new HLZCs qualified per UFSAR Section 2.4.3.1 will be verified to satisfy the above criteria.

Impact:

UFSAR Section 3.6.2 has been revised as described in the response.

Proprietary Information on Pages 7 and 8
Withheld Pursuant to 10 CFR 2.390

Thermal RAIs:

RAI 4-1:

Clarify how the ATRIUM-11 fuel assembly thermal properties are bounded by the bounding EOS-89BTH fuel assembly properties.

The staff reviewed the thermal properties (i.e., axial, and transverse thermal conductivity, specific heat, and density) for the ATRIUM-11 fuel assembly that were provided in the Standardized NUHOMS® Updated Final Safety Analysis Report (UFSAR) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17094A720), as described in Section 4.9.1.2 of the EOS UFSAR. The Standardized NUHOMS UFSAR Section T.4.8.1.6 described that because the effective thermal conductivities were greater for the ATRIUM-11 fuel assembly than for the bounding fuel assembly, the bounding fuel assembly remained applicable. Similarly, as described in Section T.4.8.2 of the Standardized NUHOMS® UFSAR, the specific heat and effective density for the ATRIUM-11 fuel assembly were either the same as, or greater than that of the bounding fuel assembly, and therefore, the bounding fuel assembly remained appliable.

The staff compared the ATRIUM-11 fuel assembly properties to the EOS-89BTH bounding fuel assembly properties. The staff found that the ATRIUM-11 fuel assembly transverse thermal conductivity on page T.4-45a of the Standardized NUHOMS® UFSAR was not consistently greater than the EOS-89BTH bounding fuel assembly transverse thermal conductivity on page 4-16 of the UFSAR over the entire temperature range. The staff also found that the ATRIUM-11 axial thermal conductivity was not greater than the EOS-89BTH bounding fuel assembly axial thermal conductivity over the entire temperature range. The staff also found that the ATRIUM-11 effective specific heat in the Standardized NUHOMS® UFSAR on page T.4-46 was not consistently higher than the temperature dependent bounding effective specific heat values in the EOS Amd. 3 Table 4.9.1-7. Therefore, it is not clear how the ATRIUM-11 fuel assembly thermal properties are bounded by the bounding EOS-89BTH fuel assembly properties.

This information is needed to determine compliance with 10 CFR 72.236(f).

Response to RAI 4-1:

Section 4.9.1.2 of the UFSAR has been updated to add the ATRIUM-11 fuel assembly (FA) thermal properties. Table 4.9.1-8 and Table 4.9.1-9 of the UFSAR have been added to compare the bounding boiling water reactor (BWR) FA thermal properties with those of the ATRIUM-11 FAs. The thermal properties for ATRIUM-11 within the EOS-89BTH dry shielded canister (DSC) are slightly different compared to those presented in Section T.4.8.1.6 of the Standardized NUHOMS® UFSAR for the 61BTH DSC [1], since they are also impacted by the physical characteristics of the fuel compartment as shown in the methodology in Section T.4.8.1.4 of [1].

As added in Section 4.9.1.2 of the UFSAR, the comparisons in Table 4.9.1-8 and Table 4.9.1-9 of the UFSAR show that the bounding BWR FA thermal properties bound those of the ATRIUM-11 FAs.

References

1. CoC 1004, Standardized NUHOMS® System UFSAR, Revision 20.

Impact:

UFSAR Section 4.9.1.2 has been revised as described in the response.

UFSAR Table 4.9.1-8 and Table 4.9.1-9 have been added as described in the response.

RAI 4-2:

Clarify that for HLZCs that are asymmetric about the x-axis, the corresponding structural analyses are also addressed in item 1b) of Section 2.4.3.1 of the UFSAR.

As a follow-up to observation 4-6 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21126A036), and the clarification call on July 14, 2021 (ADAMS Accession No. ML21195A370), item 1b) of Section 2.4.3.1 of the UFSAR addresses thermal models for asymmetric HLZCs about the x-axis, but does not address the corresponding structural analyses. Depending on the degree of heat load asymmetry, asymmetric loading patterns could create unanalyzed thermal stresses in the basket and DSC. Addressing the corresponding structural analyses within item 1b) of Section 2.4.3.1, in addition to the impact of temperatures changes on the structural design functions that shall be considered based on the methodology in Chapter 3 as is already described within item 4) of Section 2.4.3.1, would provide reasonable assurance that the thermal models and corresponding structural analyses, e.g., basket and DSC stresses, capture the impact of the asymmetric HLZC on the EOS system.

This information is needed to determine compliance with 10 CFR 72.236(f).

Response to RAI 4-2:

Item 1b of UFSAR Section 2.4.3.1 has been updated to ensure that the impact of the temperature profiles resulting from the asymmetric HLZCs about the X-axis on the structural design function is verified.

Impact:

UFSAR Section 2.4.3.1 has been revised as described in the response.

RAI 4-3:

Clarify the minimum blocked vent accident condition durations in item 2b) in Section 2.4.3.1 of the UFSAR, and the minimum transfer time limits in item 2c) in Section 2.4.3.1 of the UFSAR.

Section 5.1.3.1 of the NUHOMS® EOS System Technical Specifications (TS) specifies in multiple locations that: the EOS-HSM air vents are not blocked for more than 40 hours; the duration of a damaged or lost wind deflector will not exceed periods longer than 40 hours; and if measurements or other evidence indicate that the EOS-HSM concrete temperatures have exceeded the concrete accident temperature limit of 500 °F for more than 40 hours, the user shall perform an analysis and/or tests. This is similarly described in Section 5.1.3.2 of the TS for the EOS-HSM-MX, but for 32 hours. However, Section 2.4.3.1 of the UFSAR specifies that in item 2b) that the thermal evaluations based on the storage and transfer configuration described in item 1) of Section 2.4.3.1 of the UFSAR shall be performed for each new HLZC to demonstrate that the <u>minimum blocked vent accident condition durations</u> specified in Section 5.1.3.1 of the TS for EOS-HSM and Section 5.1.3.2 of the TS for EOS-HSM-MX are satisfied. Satisfying the minimum blocked vent accident condition durations could be interpreted as being longer than 40 hours for the EOS-HSM, or longer than 32 hours for the EOS-HSM-MX, which would not meet the TS. Therefore, the language in Section 2.4.3.1 of the UFSAR item 2b) should be clarified to avoid confusion within the methodology.

Similarly, in Section 2.4.3.1 of the UFSAR item 2c), it should be clear that the transfer time limit required per limiting condition for operation (LCO) 3.1.3 of the TS are satisfied (at the maximum heat load allowed per each HLZC). According to note 1 of LCO 3.1.3, if the decay heat is less than the 48.2 kW for the EOS-89BTH, a new transfer time limit can be calculated, using the same methodology in the UFSAR, to provide additional time for transfer operations; however, the calculated transfer time should not be less than the transfer time limit specified in LCO 3.1.3. Provided the decay heat is less than the maximum decay heat (given there are no other design changes to the DSC or transfer cask, or content changes), a transfer time limit for the HLZC that is greater than the transfer time limits in LCO 3.1.3 satisfies LCO 3.1.3; however, a transfer time limit that is less than the transfer time limits in LCO 3.1.3 does not satisfy LCO 3.1.3. Therefore, the language in Section 2.4.3.1 of the UFSAR item 2c) should also be clarified to avoid confusion within the methodology. Note, consideration should be given to Section B.4.5.6.4 of the UFSAR, in which the choice of transfer time limit considered additional margin to the temperature limit when determining the appropriate LCO 3.1.3 transfer time limit; this is especially relevant when a new HLZC shows allowable temperatures would be reached near the current LCO 3.1.3 8 hour transfer time limit using Figure 11 of the TS.

This information is needed to determine compliance with 10 CFR 72.236(f).

Response to RAI 4-3:

Updated final safety analysis report (UFSAR) Item 2b of Section 2.4.3.1 has been updated to clarify that the calculated duration for the blocked vent accident condition is equal to or greater than the durations specified in Technical Specifications (TS) Section 5.1.3.1 for the EOS-HSM and Section 5.1.3.2 for HSM-MX. Clarification has also been added to establish that the duration determined in this step does not alter the temperature monitoring requirements of the EOS-HSM or the HSM-MX.

Item 2c of Section 2.4.3.1 in the UFSAR has been updated to clarify that the calculated "Total Time for Transfer," as defined in UFSAR Section 4.9.8.3.4 at the maximum allowable heat load for each heat loading zone configuration (HLZC) qualified per Figure 11 of the TS, shall not be less than the sum of the transfer time limit (8 hours) and the duration for recovery actions (5 hours) listed in Limiting Condition for Operation (LCO) 3.1.3 of the TS. In addition, since Item 2c of UFSAR Section 2.4.3.1 requires that, for each HLZC, the minimum transfer time limit required per LCO 3.1.3 of the TS is satisfied at the maximum heat load, any further reduction in decay heat will also meet the minimum time limit. This is also required per Note 1 in LCO 3.1.3 of the TS, which specifies that "The calculated time limit shall not be less than the time limit specified in LCO 3.1.3." Item 2c of Section 2.4.3.1 in the UFSAR has been updated to emphasize this requirement.

Impact:

Section 2.4.3.1 of the UFSAR has been updated as described in the response.

RAI 4-4:

Clarify in Section 2.4.3.1 of the UFSAR how content changes that do not appear in the CoC or TS but do explicitly affect the thermal model would warrant a thermal review.

Content changes that do appear in the TS and/or the CoC would result in an amendment request and a thermal review with justification necessary to be provided by the applicant to demonstrate that the methodology in Section 2.4.3.1 is valid for the content changes. However, content changes that do not appear in the TS or CoC could also necessitate a thermal review; although, as Section 2.4.3.1 of the UFSAR is currently written, would not necessarily result in a thermal review. For example, if the fuel assembly effective thermal conductivity, density, or specific heat for an existing approved content is changed, that could affect the thermal model beyond changing the HLZC, and it is not clear from Section 2.4.3.1 of the UFSAR whether that content change would be thermally reviewed in an amendment request. Therefore, specifying in broad terms within the methodology described in Section 2.4.3.1 of the UFSAR how content changes would lead to a thermal review would provide reasonable assurance that the methodology in Section 2.4.3.1 is not obviating the need for a thermal review.

This information is needed to determine compliance with 10 CFR 72.236(f).

Response to RAI 4-4:

For this amendment application, only intact fuel assemblies are permitted as contents for the EOS-89BTH DSC. These intact fuel assemblies are represented as homogenized fuel assemblies within the EOS-89BTH DSC thermal model as presented in Section 4.9.1.2 of the UFSAR. The homogenized fuel assemblies are characterized by the following properties:

1. Effective Transverse Thermal Conductivity, See Table 4.9.1-5 of UFSAR
2. Effective Axial Thermal Conductivity, See Table 4.9.1-5 of UFSAR
3. Effective Specific Heat, See Table 4.9.1-7 of UFSAR
4. Effective Density, See Table 4.9.1-7 of UFSAR

The methodology used to determine these properties is presented within Sections T.4.8.1.3 and T.4.8.1.4 of the Standardized NUHOMS® System UFSAR [1] for the effective axial and transverse thermal conductivities, respectively. Similarly, the methodology used to determine the effective specific heat and density is presented in Section T.4.8.2 of the Standardized NUHOMS® System UFSAR [1]. Based on these methodologies, Section 4.9.1.2 of the CoC 1042 UFSAR presents the bounding thermal properties for intact BWR spent fuel assemblies in the EOS-89BTH DSC.

Section 2.2 of the Technical Specification (TS) requires TN to re-evaluate the thermal properties for the fuel assemblies if the active fuel length is less than 144 inches. This is to ensure that the thermal properties for the fuel assemblies remain bounded by the design basis properties listed in Section 4.9.1.2 of the UFSAR. If the thermal properties are not bounding, Section 2.2 of TS provides a methodology to reduce the maximum allowable heat load using a scaling factor described in Section 4.9.1.3 of the UFSAR.

Similar to this requirement, any changes to the contents will be evaluated in a 10 CFR 72.48 process using the same methodology documented in Section 4.9.1.2 of the UFSAR. These thermal properties will be used in the bounding analysis identified in Section 2.4.3.1 of the UFSAR to evaluate the impact on the heat load zoning configurations (HLZCs).

Section 2.4.3.1 of the UFSAR has been updated to clarify that the methodology to evaluate new HLZCs for the EOS-89BTH DSC is limited to the contents specified in Section 2.2 of the TS. In addition, it has also been clarified that any modifications to the contents should be evaluated based on the methodology presented in Section 4.9.1.2 of the UFSAR.

Based on this discussion, no additional discussion is presented on content changes leading to a thermal review since the TS already presents an approach to resolve them. However, any additional modifications to these contents (e.g., accommodating damaged/failed assemblies or new fuel assembly classes) cannot be accommodated in a 10 CFR 72.48 process, since they are limited by the TS and will require an NRC review and approval. These modifications will be justified as appropriate within the thermal chapters in future amendment requests. The justification will also include discussions on the applicability of the approach presented in Section 2.4.3.1 of the UFSAR to the new contents within those amendment requests.

References

1. CoC 1004, Standardized NUHOMS® System UFSAR, Revision 20.

Impact:

UFSAR Section 2.4.3.1 has been updated as described in the response.

RAI 4-5:

Clarify in Section 2.4.3.1 of the UFSAR and in the TS Figure 11 whether each new applicant developed HLZC will be evaluated by the applicant for a specific basket type based on the methodology in Section 2.4.3.1 of the UFSAR, and address if the thermally bounding neutron poison option is used in Section 2.4.3.1 of the UFSAR.

Table 1-2 and page 1-4 of the UFSAR each specify the basket type that is evaluated along with the specific HLZC (i.e., basket Type 1). It is not clear in Section 2.4.3.1 whether a specific basket type is also evaluated with a specific applicant developed HLZC as part of the methodology. The basket type does have a thermal influence on the thermal analysis model results, and therefore, not specifying a basket type for each applicant developed HLZC would be an unanalyzed condition. The basket type appears to be indicated by the use of the number 1 in the TS Figure 11, "Maximum Heat Load Configuration 1 for EOS-89BTH DSC (MHLC-89-1) Transferred in the EOS-TC125," however, that could be more explicitly clarified.

For example, for the EOS-89BTH Type 1, 2, and 3 baskets there are three types of neutron poison options (as shown on page 1-4 of the UFSAR), and it should be clear in Section 2.4.3.1 of the UFSAR that the bounding option is used. Also, for example, the Type 4 basket in the EOS-37PTH has high and low emissivity and poison conductivity values (that does not appear to impact this amendment request); however, this specificity might be necessary to consider in a future amendment request.

This information is needed to determine compliance with 10 CFR 72.236(f).

Response to RAI 4-5:

Each new applicant developed heat load zoning configuration (HLZC) qualified per Figure 11 of the technical specifications (TS) for the EOS-89BTH DSC will be evaluated by the applicant for Basket Type 1 only. This was stated on Section 1.1, Page 1-4 of the updated final safety analysis report (UFSAR).

Section 2.4.3.1 of the UFSAR has been modified to clarify that each new applicant developed HLZC will be evaluated for Basket Type 1 of the EOS-89BTH DSC, which includes the coated steel plate for high emissivity as indicated in Section 4.9.1.2 and high conductivity poison plate as indicated in Section 4.2.2 of UFSAR.

For future amendment applications, similar to the EOS-37PTH DSC, new basket types of the EOS-89BTH DSC can be introduced with different physical requirements including poison plate conductivity, emissivity of the steel plate coating, and physical arrangements of the different layers of basket plates. Specifications of the basket types will be included in the future amendment applications.

Impact:

UFSAR Section 2.4.3.1 has been revised as described in the response.

Proprietary Information on Pages 17 through 19
Withheld Pursuant to 10 CFR 2.390

Confinement RAI:

RAI 5-1:

Clarify and update the NUHOMS® EOS Safety Analysis Report (SAR) language that references the pressure test according to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Subarticle NB-6300.

There are a number of instances in the NUHOMS® EOS SAR where the new text for Amendment 3 does not convey a clear intent as to the type of acceptance test that is referenced. For example, the new text in SAR Section 10.1.1.1 stated that "… the fabrication leak test may be waived." However, the next sentence refers to a "pressure test." The sentence that follows is clear and explicitly mentions the "… helium leak test of Section 10.1.2." Another example is found in the table entitled, "EOS-37PTH and EOS-89BTH DSC ASME Code Alternatives, Subsection NB," in Technical Specification Section 4.4.4 (page 4-7), which refers to a "fabrication leak test" and "pressure test." Likewise, the new text in SAR Section 3.9.1.2.7.2 entitled, "Fabrication Pressure and Leak Testing," focuses on a "pressure test." The differentiation between a helium leak test according to the American National Standards Institute (ANSI) N14.5 versus a "fabrication leak test" and "pressure test" is not easily discernible among these select SAR sections; this is to be corrected because the important to safety confinement boundary's pressure test and helium leak test per ANSI N14.5 are distinct acceptance tests with different purposes and sensitivities.

This information is needed to determine compliance with 10 CFR 72.236(d), (j), and (l).

Response to RAI 5-1:

During the fabrication process, ASME III Subsection NB requires a pressure test per NB-6300. Additionally, a leak test is conducted of the confinement boundary welds to the ANSI N14.5 leaktight acceptance criteria of 1×10^{-7} ref. cm^3/sec. When using the single forging bottom cover plate, the weld between the forging and the DSC shell serves as the confinement boundary and would, therefore, be subject to both requirements. Amendment 3 proposes to remove the pneumatic test requirement per NB-6300 only when using the single bottom forging option. Chapters 3.9.1 and 10 have been revised to clarify this intent.

Impact:

UFSAR Sections 3.9.1.2.7.2 and 10.1.1.1 have been revised as described in the response.

Shielding RAIs:

RAI 6-1:

Provide the design parameters for the ATRIUM 11 boiling water reactor (BWR) fuel assembly used in the source term and shielding calculations.

The applicant states that the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately. However, the applicant did not provide information about the ATRIUM 11 fuel assembly class in the Shielding Chapter.

This information is needed for the staff to confirm compliance with 10 CFR 72.236(b) and 10 CFR 72.236(d).

Response to RAI 6-1:

The statement, "the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately" is taken from the criticality evaluation. For criticality analysis, fuel assembly geometry can have a strong effect on optimum moderation when determining maximum reactivity. The above statement regarding bounding properties of GNF2, ABB-10-C, and ATRIUM 11 fuel is not applicable to the shielding analysis, which is developed with a methodology different from the criticality analysis.

No source term or shielding calculations are performed for ATRIUM 11 fuel because the GE 7x7 fuel assembly type is used as the design basis fuel assembly for all shielding calculations. Additional justification for this approach is provided in RAI 6-3, RAI 6-4, and UFSAR Section 6.2.

The fuel assembly design data is provided in Chapter 2, Table 2-2, Table 2-3, and Table 2-4. A cross-reference to these tables has been added to UFSAR Section 6.2.

Impact:

UFSAR Section 6.2 has been revised as described in the response.

RAI 6-2:

Provide an ATRIUM 11 fuel assembly drawing or a picture showing the locations of the water rods and partial length rods.

The applicant states that the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately. However, the applicant did not provide information about the ATRIUM 11 fuel assembly class in the Shielding Chapter.

This information is needed for the staff to confirm compliance with 10 CFR 72.236(b) and 10 CFR 72.236(d).

Response to RAI 6-2:

The statement, "the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately" is taken from the criticality evaluation, as discussed in the response to RAI 6-1.

A figure showing the locations of the partial-length rods is included in Chapter 7, Figure 7-31. For clarity, a cross-reference has been added between the fuel data provided in Chapter 2, Table 2-2, and Figure 7-31. In addition, a cross-reference to Figure 7-31 has been added to UFSAR Section 6.2.

Impact:

UFSAR Table 2-2 and Section 6.2 have been revised as described in the response.

RAI 6-3:

Demonstrate that the ATRIUM 11 fuel assembly is bounded by the design basis BWR 7x7 fuel assembly.

The applicant states that the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately. However, the applicant did not provide information about the ATRIUM 11 fuel assembly class in the Shielding Chapter.

This information is needed for the staff to confirm compliance with 10 CFR 72.236(b) and 10 CFR 72.236(d).

Response to RAI 6-3:

The statement, "the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately" is taken from the criticality evaluation, as discussed in the response to RAI 6-1.

The design basis BWR GE 7x7 fuel has a uranium loading of 0.198 MTU, and ATRIUM 11 fuel has a uranium loading of 0.183 MTU. Therefore, for the same burnup, enrichment, and cooling time, the design basis BWR GE 7x7 fuel will result in larger sources than ATRIUM 11 fuel because the design basis BWR GE 7x7 fuel has a larger uranium loading. This justification has been added to UFSAR Section 6.2.

Also see the response to RAI 6-4.

Impact:

UFSAR Section 6.2 has been revised as described in the response.

RAI 6-4:

Provide burnup profile used for the ATRIUM 11 fuel assembly source term calculation and how partial length rods were treated in this calculation.

The applicant states that the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately. However, the applicant did not provide information about the ATRIUM 11 fuel assembly class in the Shielding Chapter. The applicant should clarify what axial profile assumptions were used in the depletion analysis for the ATRIUM 11 fuel assembly, including how the short and long partial length rods were treated in the source term analysis.

This information is needed for the staff to confirm compliance with 10 CFR 72.236(b) and 10 CFR 72.236(d).

Response to RAI 6-4:

The statement, "the GNF2 fuel assembly type is used to bound all fuel assembly types except for ABB-10-C and ATRIUM 11 class fuel, which are treated separately" is taken from the criticality evaluation, as discussed in the response to RAI 6-1.

No source term or shielding calculations are performed for ATRIUM 11 fuel because the design basis BWR GE 7x7 fuel assembly type is used as the design basis fuel assembly for all shielding calculations. Justification for this approach is provided in UFSAR Section 6.2. This approach is unchanged from previous Amendments. In particular, the design basis BWR GE 7x7 fuel has a uranium loading of 0.198 MTU, and ATRIUM 11 fuel has a uranium loading of 0.183 MTU. Therefore, for the same burnup, enrichment, and cooling time, the design basis BWR GE 7x7 fuel will result in larger sources than ATRIUM 11 fuel because the design basis BWR GE 7x7 fuel has a larger uranium loading.

Because no source term calculations are performed for ATRIUM 11 fuel, no ATRIUM 11 axial burnup profiles are employed. It is expected that the ATRIUM 11 axial burnup profile would be similar to the axial burnup profile provided in UFSAR Table 6-31. However, because ATRIUM 11 fuel has three distinct axial regions, with the highest uranium loading at the bottom and the lowest uranium loading at the top, the axial source distribution of ATRIUM 11 fuel is a function of both the axial mass distribution and axial burnup distribution.

The design basis boiling water reactor (BWR) GE 7x7 fuel has 0.198 MTU. Therefore, for an active fuel length of 144 inches (365.76 cm), the UO_2 linear density is 614 g/cm. ATRIUM 11 fuel has three different axial regions; a lower region with 112 fuel rods, a middle region with 100 fuel rods, and an upper region with 92 fuel rods. As indicated in Table RAI 6-4-1, the linear UO_2 density in the lower, middle, and upper regions is 622 g/cm, 555 g/cm, and 511 g/cm, respectively. Therefore, for the same burnup, enrichment, and cooling time, the design basis BWR GE 7x7 and ATRIUM 11 sources are approximately the same in the lower region (within ~1%), while the design basis BWR GE 7x7 source is bounding in the middle and upper regions due to the larger uranium masses (i.e., 614 g/cm for the design basis BWR GE 7x7 fuel vs. 555 or 511 g/cm for ATRIUM 11 fuel). Therefore, the design basis BWR GE 7x7 fuel bounds ATRIUM 11 fuel.

A discussion of the axial mass distributions for the design basis BWR GE 7x7 and ATRIUM 11 fuel has been added to UFSAR Section 6.2.

Table RAI 6-4-1
ATRIUM 11 Linear Density per Region

Parameter	Lower Region	Middle Region	Upper Region
Number of rods per axial region	112	100	92
Region length (cm)	141.9	81.7	157.4
Pellet outer diameter (cm)	0.8128		
Pellet theoretical density (g/cm^3)	10.96		
Pellet density (% of theoretical)	97.6		
Pellet density (g/cm^3)	10.697		
Mass UO_2 (g)	88,210	45,346	80,373
Linear density UO_2 (g/cm)	622	555	511

Impact:

UFSAR Section 6.2 has been revised as described in the response.

Acceptance Tests RAIs:

RAI 10-1:

Provide the following additional information on the proposed phased array ultrasonic testing (UT) system for the detection of flaws in the multi-pass gas tungsten arc welding (GTAW) and single pass high amperage gas tungsten arc welding (HA-GTAW) outer top cover plate (OTCP) welds:

1. Clarify whether the proposed phased array ultrasonic testing (UT) system would be used to inspect the multi-pass gas tungsten arc welding (GTAW) as an alternative to the multi-level PT examination.

2. Describe the type, size, and orientation of the flaws that may be present in the OTCP weld(s) examined using the phased array UT system.

3. Describe the UT demonstration procedure including the mockup(s) for the OTCP weld(s) including the single-pass HA-GTAW weld and, if applicable, the multi-pass GTAW weld, a description of the type, size, and orientation of flaws in the that will be inserted into the OTCP weld mockup(s) to represent the flaws that may be present in the OTCP weld(s), the required probability of detection (POD) for the phased array UT of the OTCP weld(s), and how the POD will be determined.

It is not clear whether the phased array UT examination, conducted from the external surface of the OTCP, will be able to detect and size weld flaws such as lack of fusion. For the multi-pass GTAW OTCP weld, phased array UT was shown to be an acceptable method for lack of fusion flaws when the examination was conducted from the outer diameter of the DSC shell (ML16159A227). The phased array UT application reviewed by the NRC in ML16159A227 was determined to be acceptable because the procedure was qualified using a blind performance demonstration in accordance with ASME B&PV Code Section V, Article 14, T-1424(b) with Intermediate Rigor that qualifies the equipment, procedure, and data analysis personnel for the detection and dimensioning of welding fabrication flaws. The previous demonstration does not appear to be applicable to the phased array UT described in the current application because the proposed phased array UT would be conducted from the outer surface of the OTCP rather than the external surface of the DSC shell. Further, the weld joint geometry of the single-pass HA-GTAW OTCP weld appears to be a narrow grove weld. Lack of fusion flaws in the single pass HA-GTAW OTCP weld are likely to be oriented perpendicular to the exterior surface of the OTCP. Because of this likely flaw orientation, it is not clear that the proposed phased array UT method from the exterior of the OTCP will be able to detect and adequately size a lack of fusion flaw in the single-pass HA-GTAW OTCP weld.

This information is needed to determine compliance with 10 CFR 72.236(l).

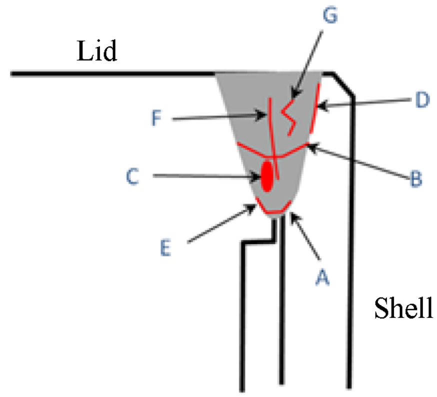
Response to RAI 10-1:

1. Even though the HA-GTAW weld is a narrow groove the as-welded cross-sectional dimensions are similar to multi-pass GTAW welds. Thus, the phased array automated ultrasonic testing (PA-AUT) procedure can be qualified for HA-GTAW weld and multi-pass GTAW welds.

2. Minimum detectable and assessable flaw type and size width (w) /height (h)

   Minimum length of detectable flaw will be the dimension shown for each flaw type.

	Flaw type	**Size (in.)**
A	Inadequate penetration (IP)	0.08 h
B	Interpass lack of fusion (cold lap)	0.13 w
C	Trapped gas (not porosity)	0.13 h/w
D	Lack of side wall fusion	0.08 h
E	Lack of root fusion	0.08 h/w
F	Hot cracking (center vertical)	0.08 h/w
G	Solidification cracks	0.08 h/w



3. Flaw types A through G, listed above, are typical of multi-pass GTAW.

PA-AUT examinations will be performed with a transducer positioned on the top surface of the lid. Flaws types C, F, and G will be detected by direct scan. Flaw types A and E will be detected by direct and reflected scan (reflecting off the bottom surface of the lid). Due to the nature of the HA-GTAW process, flaw types B and D are not expected, but these flaw types are still detectable by the PA-AUT examination by direct scan.

The PA-AUT will be qualified in accordance with ASME Section V, Article 4, Ultrasonic Examination Methods of Welds

Additionally, the PA-AUT process will be demonstrated by use of a calibration block(s) with machined holes representing flaws in the weld. The calibration block will be created from the same materials, welding process, and filler metal that are used in the fabrication and closure of the DSC. The machined holes are a series of flat bottom and side drilled holes with locations selected by the PA-AUT Level III. All machined holes must be detected by the PA-AUT process to provide assurance that the equipment and procedures are able to scan the full area of interest. There will be at least double the safety factor in the machined hole size versus the maximum allowable defect during closure operations. In other words, the PA-AUT process and equipment must be capable of detecting a flaw size that is less than half the size of an allowable defect during closure operations. This safety factor corresponds to a probability of detection (POD) greater than 90% when calculated per ASTM E3023 or similar standard.

Calibration blocks will be required for both the multi-pass GTAW and HA-GTAW processes.

Impact:

No change as a result of this RAI.

List of New CoC 1042 Amendment 3, Revision 4 Technical Specifications
Changes and Justifications

Changed Technical Specifications (TS) Area and Page Number	Justification
Table of Contents, List of Tables, and List of Figures	Updated
Table 8 Page T-9	As described in Enclosure 9, Item 1, editorial nomenclature changes have been made to Table 8.

List of TS and UFSAR Pages
Involved in CoC 1042 Amendment 3, Revision 4

Technical Specifications Pages
T-9

UFSAR Pages
1-8
Dwg. EOS01-1001-SAR, sheet 1
Dwg. EOS01-1001-SAR, sheet 2
Dwg. EOS01-1006-SAR, sheet 1
Dwg. EOS01-1006-SAR, sheet 2
2-18
2-22
2-23
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3-19
3.9.1-14
3.9.1-15
3.9.6-11
4.9.1-3
4.9.1-5
4.9.1-18
4.9.1-19
4.9.8-31
5-3
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10-2

Enclosure 6 to E-59795

CoC 1042 Proposed Amendment 3, Revision 4

Technical Specifications

Revision 4 to Amendment 3 Proposed Technical Specifications

CoC 1042

APPENDIX A

NUHOMS® EOS SYSTEM GENERIC TECHNICAL SPECIFICATIONS

Amendment *3*

List of Tables

List of Figures

1.0 USE AND APPLICATION

1.1 Definitions

-- NOTE --

The defined terms of this section appear in capitalized type and are applicable throughout these Technical Specifications and Bases.

Term	Definition
ACTIONS	ACTIONS shall be that part of a Specification that prescribes Required Actions to be taken under designated Conditions within specified Completion Times.
BLEU FUEL	Blended Low Enriched Uranium (BLEU) FUEL material is generated by down-blending high enriched uranium (HEU). Because the feedstock contains both unirradiated and irradiated HEU, fresh BLEU fuel has elevated concentrations of U-232, U-234, and U-236.
CONTROL COMPONENTS (CCs)	Authorized CCs include Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Assemblies (TPAs), Control Rod Assemblies (CRAs), Control Element Assemblies (CEAs), Control Spiders, Rod Cluster Control Assemblies (RCCAs), Axial Power Shaping Rod Assemblies (APSRAs), Orifice Rod Assemblies (ORAs), Peripheral Power Suppression Assemblies (PPSAs), Vibration Suppression Inserts (VSIs), Flux Suppression Inserts (FSIs), Burnable Absorber Assemblies (BAAs), Neutron Source Assemblies (NSAs) and Neutron Sources. CCs not explicitly listed are also authorized as long as external materials are limited to zirconium alloys, nickel alloys, and stainless steels. Non-fuel hardware that are positioned within the fuel assembly after the fuel assembly is discharged from the core such as Guide Tubes or Instrument Tube Tie Rods or Anchors, Guide Tube Inserts, BPRA Spacer Plates or devices that are positioned and operated within the fuel assembly during reactor operation such as those listed above are also considered to be authorized CCs.

(continued)

1.1 Definitions (continued)

DAMAGED FUEL	DAMAGED FUEL assemblies are fuel assemblies containing fuel rods with known or suspected cladding defects greater than hairline cracks or pinhole leaks. The extent of damage in the fuel assembly, including non-cladding damage, is to be limited so that a fuel assembly maintains its configuration for normal and off-normal conditions. The extent of cladding damage is also limited so that no release of pellet material is observed during inspection and handling operations in the pool prior to loading operations. DAMAGED FUEL assemblies shall also contain top and bottom end fittings. DAMAGED FUEL assemblies may also contain missing or partial fuel rods.
DRY SHIELDED CANISTER (DSC)	An EOS-37PTH DSC, EOS-89BTH DSC, and 61BTH Type 2 DSC are sealed containers that provide confinement of fuel in an inert atmosphere.
FAILED FUEL	FAILED FUEL is defined as ruptured fuel rods, severed fuel rods, loose fuel pellets, fuel fragments, or fuel assemblies that may not maintain configuration for normal or off-normal conditions. FAILED FUEL may contain breached rods, grossly breached rods, or other defects such as missing or partial rods, missing grid spacers, or damaged spacers to the extent that the assembly may not maintain configuration for normal or off-normal conditions. FAILED FUEL shall be stored in a failed fuel canister (FFC).
FUEL BUILDING	The FUEL BUILDING is the site-specific area or facility where the LOADING OPERATIONS take place.
FUEL CLASS	A FUEL CLASS includes fuel assemblies of the same array size for a particular type of fuel design. For example, WEV 17x17, WEO 17x17, and ANP Advanced MK BW 17x17 fuel assemblies are part of a WE 17x17 FUEL CLASS.

(continued)

1.1 Definitions (continued)

HORIZONTAL STORAGE MODULE (HSM)	An HSM is a reinforced concrete structure for storage of a loaded DSC at a spent fuel storage installation. Where the term "HSM" is used without distinction, this term shall apply to both the EOS-HSM and HSM-MX. The term EOS-HSM refers to the base unit for storage of a single DSC as a single piece (EOS-HSM) or as a split base (EOS-HSMS). The term MATRIX (HSM-MX) refers to the two-tiered staggered structure for storage of the DSCs.
INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)	The facility within a perimeter fence licensed for storage of spent fuel within HSMs.
INTACT FUEL	Fuel assembly with no known or suspected cladding defects in excess of pinhole leaks or hairline cracks, and with no missing rods.
LOADING OPERATIONS	LOADING OPERATIONS include all licensed activities on a DSC in a TC while it is being loaded with fuel assemblies. LOADING OPERATIONS begin when the first fuel assembly is placed in the DSC and end when the TC is ready for TRANSFER OPERATIONS (i.e., when the cask is in a horizontal position on the transfer trailer.) LOADING OPERATIONS do not include DSC transfer between the TC and the HSM.
LOW-ENRICHED OUTLIER FUEL (LEOF)	LOW-ENRICHED OUTLIER FUEL is PWR and BWR fuel with enrichments below the minimum enrichment specified in Table 7A and Table 18, respectively.
RECONSTITUTED FUEL ASSEMBLY	A RECONSTITUTED FUEL ASSEMBLY is a fuel assembly where one or more fuel rods are replaced by low enriched uranium or natural uranium fuel rods or non-fuel rods.
SAFE CONDITION AND FORECAST	*A SAFE CONDITION AND FORECAST is considered to be the absence of: Tornado and Severe Thunderstorm Watches, Tornado and Severe Thunderstorm Warnings, and Hazardous Weather Outlook indicating a moderate or high risk of severe thunderstorms for the current date (Day One at the NOAA website).*

(continued)

1.1 Definitions (continued)

STORAGE OPERATIONS	STORAGE OPERATIONS include all licensed activities that are performed at the ISFSI, while a DSC containing fuel assemblies is located in an HSM on the storage pad within the ISFSI perimeter. STORAGE OPERATIONS do not include DSC transfer between the TC and the HSM.
TRANSFER CASK (TC)	A TRANSFER CASK (TC) (EOS-TC108, EOS-TC125, EOS-TC135, and OS197/OS197H/OS197FC-B/OS197HFC-B) consists of a licensed NUHOMS® System TC. When used without distinction, the term EOS-TC includes the EOS-TC108, EOS-TC125, and EOS-TC135. The term OS197 includes the OS197/OS197H/OS197FC-B/OS197HFC-B. The TC is placed on a transfer trailer for movement of a DSC to the HSM.
TRANSFER OPERATIONS	TRANSFER OPERATIONS include all licensed activities involving the movement of a TC loaded with a DSC containing fuel assemblies. TRANSFER OPERATIONS begin after the TC has been placed horizontal on the transfer trailer ready for TRANSFER OPERATIONS and end when the DSC is at its destination and/or no longer horizontal on the transfer trailer. TRANSFER OPERATIONS include DSC transfer between the TC and the HSM.
UNLOADING OPERATIONS	UNLOADING OPERATIONS include all licensed activities on a DSC to unload fuel assemblies. UNLOADING OPERATIONS begin when the DSC is no longer horizontal on the transfer trailer and end when the last fuel assembly has been removed from the DSC. UNLOADING OPERATIONS do not include DSC transfer between the HSM and the TC.

1.0 USE AND APPLICATION

1.2 Logical Connectors

PURPOSE

The purpose of this section is to explain the meaning of logical connectors.

Logical connectors are used in Technical Specifications (TS) to discriminate between, and yet connect, discrete Conditions, Required Actions, Completion Times, Surveillances, and Frequencies. The only logical connectors that appear in TS are AND and OR. The physical arrangement of these connectors constitutes logical conventions with specific meanings.

BACKGROUND

Several levels of logic may be used to state Required Actions. These levels are identified by the placement (or nesting) of the logical connectors and by the number assigned to each Required Action. The first level of logic is identified by the first digit of the number assigned to a Required Action and the placement of the logical connector in the first level of nesting (i.e., left justified with the number of the Required Action). The successive levels of logic are identified by additional digits of the Required Action number and by successive indentions of the logical connectors.

When logical connectors are used to state a Condition, Completion Time, Surveillance, or Frequency, only the first level of logic is used, and the logical connector is left justified with the statement of the Condition, Completion Time, Surveillance, or Frequency.

EXAMPLES

The following examples illustrate the use of logical connectors:

EXAMPLE 1.2-1

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO (Limiting Condition for Operation) not met.	A.1 Verify… AND A.2 Restore…	

In this example the logical connector AND is used to indicate that when in Condition A, both Required Actions A.1 and A.2 must be completed.

(continued)

1.2 Logical Connectors (continued)

EXAMPLES (continued)

EXAMPLE 1.2-2

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO not met.	A.1 Stop… OR A.2 A.2.1 Verify… AND A.2.2 A.2.2.1 Reduce… OR A.2.2.2 Perform… OR A.3 Remove…	

This example represents a more complicated use of logical connectors. Required Actions A.1, A.2, and A.3 are alternative choices, only one of which must be performed as indicated by the use of the logical connector OR and the left justified placement. Any one of these three Actions may be chosen. If A.2 is chosen, then both A.2.1 and A.2.2 must be performed as indicated by the logical connector AND. Required Action A.2.2 is met by performing A.2.2.1 or A.2.2.2. The indented position of the logical connector OR indicates that A.2.2.1 and A.2.2.2 are alternative choices, only one of which must be performed.

1.0 USE AND APPLICATION

1.3 Completion Times

PURPOSE

The purpose of this section is to establish the Completion Time convention and to provide guidance for its use.

BACKGROUND

Limiting Conditions for Operation (LCOs) specify the lowest functional capability or performance levels of equipment required for safe operation of the facility. The ACTIONS associated with an LCO state Conditions that typically describe the ways in which the requirements of the LCO are not met. Specified with each stated Condition are Required Action(s) and Completion Times(s).

DESCRIPTION

The Completion Time is the amount of time allowed for completing a Required Action. It is referenced to the time of discovery of a situation (e.g., equipment or variable not within limits) that requires entering an ACTIONS Condition unless otherwise specified, providing the facility is in a specified condition stated in the Applicability of the LCO. Required Actions must be completed prior to the expiration of the specified Completion Time. An ACTIONS Condition remains in effect and the Required Actions apply until the Condition no longer exists or the facility is not within the LCO Applicability.

Once a Condition has been entered, subsequent subsystems, components, or variables expressed in the Condition, discovered to be not within limits, will not result in separate entry into the Condition unless specifically stated. The Required Actions of the Condition continue to apply to each additional failure, with Completion Times based on initial entry into the Condition.

EXAMPLES

The following examples illustrate the use of Completion Times with different types of Conditions and Changing Conditions.

EXAMPLE 1.3-1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required Action and associated Completion Time not met.	B.1 Perform Action B.1 AND B.2 Perform Action B.2	12 hours 36 hours

(continued)

1.3 Completion Times (continued)

EXAMPLES (continued)

Condition B has two Required Actions. Each Required Action has its own separate Completion Time. Each Completion Time is referenced to the time that Condition B is entered.

The Required Actions of Condition B are to complete action B.1 within 12 hours AND complete action B.2 within 36 hours. A total of 12 hours is allowed for completing action B.1 and a total of 36 hours (not 48 hours) is allowed for completing action B.2 from the time that Condition B was entered. If action B.1 is completed within 6 hours, the time allowed for completing action B.2 is the next 30 hours because the total time allowed for completing action B.2 is 36 hours.

EXAMPLES

EXAMPLE 1.3-2

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One system not within limit.	A.1 Restore system to within limit.	7 days
B. Required Action and associated Completion Time not met.	B.1 Perform Action B.1. AND B.2 Perform Action B.2.	12 hours 36 hours

When a system is determined to not meet the LCO, Condition A is entered. If the system is not restored within 7 days, Condition B is also entered and the Completion Time clocks for Required Actions B.1 and B.2 start. If the system is restored after Condition B is entered, Condition A and B are exited, and therefore, the Required Actions of Condition B may be terminated.

(continued)

1.3 Completion Times (continued)

EXAMPLES (continued)

EXAMPLE 1.3-3

ACTIONS

--NOTE--

Separate Condition entry is allowed for each component.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LCO not met.	A.1 Restore compliance with LCO.	4 hours
B. Required Action and associated Completion Time not met.	B.1 Perform Action B.1.	6 hours
	AND	
	B.2 Perform Action B.2.	12 hours

The Note above the ACTIONS Table is a method of modifying how the Completion Time is tracked. If this method of modifying how the Completion Time is tracked was applicable only to a specific Condition, the Note would appear in that Condition rather than at the top of the ACTIONS Table.

The Note allows Condition A to be entered separately for each component, and Completion Times tracked on a per component basis. When a component is determined to not meet the LCO, Condition A is entered and its Completion Time starts. If subsequent components are determined to not meet the LCO, Condition A is entered for each component and separate Completion Times start and are tracked for each component.

IMMEDIATE COMPLETION TIME

When “Immediately” is used as a Completion Time, the Required Action should be pursued without delay and in a controlled manner.

1.0 USE AND APPLICATION

1.4 Frequency

PURPOSE	The purpose of this section is to define the proper use and application of Frequency requirements
DESCRIPTION	Each Surveillance Requirement (SR) has a specified Frequency in which the Surveillance must be met in order to meet the associated Limiting Condition for Operation (LCO). An understanding of the correct application of the specified Frequency is necessary for compliance with the SR. The "specified Frequency" is referred to throughout this section and each of the Specifications of Section 3.0, Limiting Condition for Operation (LCO) and Surveillance Requirement (SR) Applicability. The "specified Frequency" consists of the requirements of the Frequency column of each SR, as well as certain Notes in the Surveillance column that modify performance requirements. Situations where a Surveillance could be required (i.e., its Frequency could expire), but where it is not possible or not desired that it be performed until sometime after the associated LCO is within its Applicability, represent potential SR 3.0.4 conflicts. To avoid these conflicts, the SR (i.e., the Surveillance or the Frequency) is stated such that it is only "required" when it can be and should be performed. With a SR satisfied, SR 3.0.4 imposes no restriction.

(continued)

1.4 Frequency (continued)

EXAMPLES

The following examples illustrate the various ways that Frequencies are specified:

EXAMPLE 1.4-1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Verify pressure within limit.	12 hours

Example 1.4-1 contains the type of SR most often encountered in the Technical Specifications (TS). The Frequency specifies an interval (12 hours) during which the associated Surveillance must be performed at least one time. Performance of the Surveillance initiates the subsequent interval. Although the Frequency is stated as 12 hours, an extension of the time interval to 1.25 times the stated Frequency is allowed by SR 3.0.2 for operational flexibility. The measurement of this interval continues at all times, even when the SR is not required to be met per SR 3.0.1 (such as when the equipment is determined to not meet the LCO, a variable is outside specified limits, or the unit is outside the Applicability of the LCO). If the interval specified by SR 3.0.2 is exceeded while the facility is in a condition specified in the Applicability of the LCO, the LCO is not met in accordance with SR 3.0.1.

If the interval as specified by SR 3.0.2 is exceeded while the facility is not in a condition specified in the Applicability of the LCO for which performance of the SR is required, the Surveillance must be performed within the Frequency requirements of SR 3.0.2 prior to entry into the specified condition. Failure to do so would result in a violation of SR 3.0.4.

(continued)

1.4 Frequency (continued)

EXAMPLES (continued)

EXAMPLE 1.4-2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Verify flow is within limits.	Once within 12 hours prior to starting activity AND 24 hours thereafter

Example 1.4-2 has two Frequencies. The first is a one-time performance Frequency, and the second is of the type shown in Example 1.4-1. The logical connector "AND" indicates that both Frequency requirements must be met. Each time the example activity is to be performed, the Surveillance must be performed prior to starting the activity.

The use of "once" indicates a single performance will satisfy the specified Frequency (assuming no other Frequencies are connected by "AND"). This type of Frequency does not qualify for the 25% extension allowed by SR 3.0.2.

"Thereafter" indicates future performances must be established per SR 3.0.2, but only after a specified condition is first met (i.e., the "once" performance in this example). If the specified activity is canceled or not performed, the measurement of both intervals stops. New intervals start upon preparing to restart the specified activity.

(continued)

1.4 Frequency (continued)

EXAMPLES (continued)

EXAMPLE 1.4-3

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
------------------- NOTE-------------------- Not required to be met until 96 hours after verifying the helium leak rate is within limit. --	
Verify EOS DSC vacuum drying pressure is within limit.	Once after verifying the helium leak rate is within limit.

As the Note modifies the required performance of the Surveillance, it is construed to be part of the “specified Frequency.” Should the vacuum drying pressure not be met immediately following verification of the helium leak rate while in LOADING OPERATIONS, this Note allows 96 hours to perform the Surveillance. The Surveillance is still considered to be performed within the “specified Frequency.”

Once the helium leak rate has been verified to be acceptable, 96 hours, plus the extension allowed by SR 3.0.2, would be allowed for completing the Surveillance for the vacuum drying pressure. If the Surveillance was not performed within this 96 hour interval, there would then be a failure to perform the Surveillance within the specified Frequency, and the provisions of SR 3.0.3 would apply.

2.0 FUNCTIONAL AND OPERATING LIMITS

2.1 Fuel to be Stored in the EOS-37PTH DSC

<u>PHYSICAL PARAMETERS:</u>	
FUEL CLASS	Unconsolidated B&W 15x15, WE 14x14, WE 15x15, WE 17x17, CE 14x14, CE 15x15 and CE 16x16 FUEL CLASS PWR fuel assemblies (with or without CCs) that are enveloped by the fuel assembly design characteristics listed in Table 1.
Number of FUEL ASSEMBLIES with CCs	≤ 37
Maximum Assembly plus CC Weight	1900 lbs
<u>DAMAGED FUEL ASSEMBLIES:</u>	
Number and Location of DAMAGED FUEL Assemblies	Maximum of 8 DAMAGED FUEL Assemblies. Balance may be INTACT FUEL, empty slots, or dummy assemblies. Number and Location of DAMAGED FUEL assemblies are shown in Figures 1F, 1H, 1J, and 1K. The DSC basket cells which store DAMAGED FUEL assemblies are provided with top and bottom end caps.
<u>FAILED FUEL:</u>	
Number and Location of FAILED FUEL	Maximum of 4 FAILED FUEL locations. Balance may be INTACT FUEL assemblies, empty slots, or dummy assemblies. Number and Location of FAILED FUEL assemblies are shown in Figures 1F, 1H, 1J, and 1K. FAILED FUEL shall be stored in a failed fuel canister (FFC).
Maximum Uranium Loadings per FFC for FAILED FUEL	Per Table 2
<u>RECONSTITUTED FUEL ASSEMBLIES:</u>	
• Number of RECONSTITUTED FUEL ASSEMBLIES per DSC	≤ 37
<u>BLENDED LOW ENRICHED URANIUM (BLEU) FUEL Assemblies:</u>	
• Number of BLEU FUEL Assemblies per DSC	≤ 37

(continued)

2.1 Fuel to be Stored in the EOS-37PTH DSC (continued)

THERMAL PARAMETERS:	
Heat Load Zone Configuration and Decay Heat Calculations	Limitations on decay heats are presented in the respective HLZC tables in Figures 1A through 1K. The maximum allowable heat loads may be reduced based on the thermal analysis methodology in the UFSAR. However, the maximum decay heat for each FA shall not exceed the values specified in the aforementioned figures. The licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for in the decay heat calculations. For FAs with active fuel length shorter than 144 inches, reduce the maximum heat load per FA in each loading zone of the HLZCs using a scaling factor (SF) as shown below. $q_{Short\ FA} = q_{Bounding\ FA} \cdot SF,$ $SF = \frac{L_{a,Short\ FA}}{L_{a,Bounding\ FA}} \cdot \frac{k_{eff,Short\ FA}}{k_{eff,Bounding\ FA}}.$ Where, k_{eff}= Effective conductivity for FA, q = Decay heat load per assembly defined for each loading zone, L_a= Active fuel length, SF= Scaling factor (SF) for short FAs. The effective conductivity for the shorter FA should be determined using the same methodology documented in the UFSAR. For FAs with active fuel length greater than 144 inches, no scaling is required and the maximum heat loads listed for each HLZC are applicable.
Decay Heat per DSC	≤ 50.0 kW and as specified for the applicable heat load zone configuration

(continued)

2.1 Fuel to be Stored in the EOS-37PTH DSC (continued)

RADIOLOGICAL PARAMETERS:	
Maximum Assembly Average Burnup	62 GWd/MTU
Minimum Cooling Time	For all fuel, minimum cooling time as a function of burnup and enrichment per Table 7B.
Minimum Assembly Average Initial Fuel Enrichment	As specified in Table 7A as a function of assembly average burnup.
Maximum Planar Average Initial Fuel Enrichment	As specified in Table 4 as a function of minimum soluble boron concentration
Minimum B-10 Concentration in Poison Plates	As specified in Table 5
Number and location of LOW-ENRICHED OUTLIER FUEL (LEOF)	≤ 4 LEOF in the peripheral locations. A minimum of three non-LEOFs shall circumferentially separate LEOFs within the peripheral locations. No limitation for LEOF in the inner locations. The peripheral and inner locations are defined in Figure 3.
CONTROL COMPONENTS (CCs)	
Maximum Co-60 equivalent activity for the CCs.	As specified in Table 3

2.0 FUNCTIONAL AND OPERATING LIMITS

2.2 Fuel to be Stored in the EOS-89BTH DSC

PHYSICAL PARAMETERS: FUEL CLASS	INTACT unconsolidated 7x7, 8x8, 9x9, 10x10, *and 11x11* FUEL CLASS BWR assemblies (with or without channels) that are enveloped by the fuel assembly design characteristics listed in Table 6.
NUMBER OF INTACT FUEL ASSEMBLIES	≤ 89
Channel Hardware	*Channeled fuel may be stored with or without associated channel hardware.*
Maximum Uranium Loading	198 kg/assembly
Maximum Assembly Weight with a Channel	705 lb
RECONSTITUTED FUEL ASSEMBLIES:	
• *Limits for transfer in the EOS-TC125*	*Per Table 22*
• *Limits for transfer in the EOS-TC108*	*Per Table 23*
BLENDED LOW ENRICHED URANIUM (BLEU) FUEL ASSEMBLIES:	
• Number of BLEU FUEL Assemblies per DSC	≤ 89

(continued)

THERMAL PARAMETERS:	
Maximum Heat Load Configuration (MHLC) and *Decay Heat Calculations*	*Per Figure 2 for transfer in the EOS-TC108.* *Per Figure 11, which specifies maximum allowable heat loads in a six-zone configuration, for transfer in the EOS-TC125.* *Heat load zoning configurations (HLZCs) enveloped by the MHLC in Figure 11 are allowed for transfer in the EOS-TC125 and storage in the EOS-HSM or HSM-MX. Chapter 2, Section 2.4.3.2 of the UFSAR provides the specific HLZCs.* The maximum allowable heat loads may be reduced based on the thermal analysis methodology in the UFSAR. However, the maximum decay heat for each FA shall not exceed the values specified in *Figure 11*. The licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for *in the decay heat calculations*. For FAs with active fuel length shorter than 144 inches, reduce the maximum decay heat for each FA in each loading zone of the HLZCs using a scaling factor (SF) as shown below. $q_{Short\ FA} = q_{Bounding\ FA} \cdot SF,$ $SF = \frac{L_{a,Short\ FA}}{L_{a,Bounding\ FA}} \cdot \frac{k_{eff,Short\ FA}}{k_{eff,Bounding\ FA}}.$ Where, k_{eff} = Effective conductivity for FA, q = Decay heat load per assembly defined for each loading zone, L_a = Active fuel length, SF = Scaling factor for short FAs. The effective conductivity for the shorter FA should be determined using the same methodology documented in the UFSAR. For FAs with active fuel length greater than 144 inches, no scaling is required and the maximum heat loads listed for each HLZC are applicable.
Decay Heat per DSC	*≤ 48.2 kW for EOS-TC125* *≤ 41.6 kW for EOS-TC108*

(continued)

<u>*RADIOLOGICAL PARAMETERS:*</u>	
Maximum Assembly Average Burnup	62 GWd/MTU
Minimum Cooling Time	*As specified as a function of burnup and enrichment per Table 21.* *1.0 year for EOS-TC125* *3.0 years for EOS-TC108; See Figure 2 for additional cooling times for HLZC 2 and 3 transferred in the EOS-TC108.*
Maximum Lattice Average Initial Fuel Enrichment	Per Table 8
Minimum B-10 Concentration in Poison Plates	Per Table 8
Minimum Assembly Average Initial Fuel Enrichment	*As specified in Table 18 as a function of assembly average burnup.*
Number and location of LOW-ENRICHED OUTLIER FUEL (LEOF)	*≤ 4 LEOF in the peripheral locations. A minimum of six non-LEOFs shall circumferentially separate LEOFs within the peripheral locations. No limitation for LEOF in the inner locations. The peripheral and inner locations are defined in Figure 8.*

2.0 FUNCTIONAL AND OPERATING LIMITS

2.3 Fuel to be stored in the 61BTH Type 2 DSC

PHYSICAL PARAMETERS:	
FUEL CLASS	INTACT or DAMAGED or FAILED 7x7, 8x8, 9x9, 10x10 or 11x11 BWR assemblies *(with or without channels)* that are enveloped by the fuel assembly design characteristics listed in Table 13
Number of INTACT FUEL ASSEMBLIES	≤ 61
Channel Hardware	*Chaneled fuel may be stored with or without associated channel hardware.*
Maximum Uranium Loading	198 kg/ assembly
Maximum Assembly Weight with a Channel	705 lbs
DAMAGED FUEL ASSEMBLIES:	
Number and Location of DAMAGED FUEL Assemblies	Maximum of 61 DAMAGED FUEL assemblies as shown in Figure 5. Balance may be INTACT FUEL, empty slots, or dummy assemblies. The DSC basket cells which store DAMAGED FUEL assemblies are provided with top and bottom end caps.
FAILED FUEL:	
Number and Location of FAILED FUEL	Maximum of 4 FAILED FUEL locations as shown in Figure 5 Balance may be INTACT FUEL assemblies, empty slots, or dummy assemblies. FAILED FUEL shall be stored in a failed fuel canister (FFC)
Maximum Uranium Loadings per FFC for FAILED FUEL	Table 14
RECONSTITUTED FUEL ASSEMBLIES:	
• Number of RECONSTITUTED FUEL ASSEMBLIES per DSC	≤ 61
• Maximum number of irradiated stainless steel rods per DSC	120

(continued)

• Maximum number of irradiated stainless steel rods per RECONSTITUTED FUEL ASSEMBLY	10
• Loading restrictions for locations within the basket	Inner and peripheral loading locations are defined in Figure 6. Inner Loading Locations: • RECONSTITUTED FUEL ASSEMBLIES may be loaded in any compartment within the inner locations. Peripheral Loading Locations: • RECONSTITUTED FUEL ASSEMBLIES with ≤ 5 irradiated stainless steel rods per fuel assembly may be loaded into all peripheral locations (i.e., not restricted). • RECONSTITUTED FUEL ASSEMBLIES with > 5 and ≤ 10 irradiated stainless steel rods per fuel assembly shall have at least one fuel assembly that does not contain irradiated stainless steel rods on each peripherally adjacent location (see Figure 7).
<u>BLENDED LOW ENRICHED URANIUM (BLEU) FUEL Assemblies:</u>	
• Number of BLEU FUEL Assemblies per DSC	≤ 61
THERMAL/RADIOLOGICAL PARAMETERS:	
Heat Load Zone Configuration and Fuel Qualification	Limitations on decay heats are presented in the respective HLZC tables in Figures 4A through 4J.
Maximum Assembly Average Burnup	62 GWd/MTU
Minimum Cooling Time	For all fuel, minimum cooling time as a function of burnup and enrichment per Table 19. For the peripheral fuel of HLZC 2, 4, 5, 6, 7, and 8 only, minimum cooling time as a function of burnup and enrichment per Table 20. The peripheral and inner locations are defined in Figure 6.

(continued)

Minimum Assembly Average Initial Fuel Enrichment	As specified in Table 18 as a function of assembly average burnup.
Decay Heat per DSC	≤ 31.2 kW
Maximum Lattice Average Initial Enrichment	Per Table 9, Table 10, Table 11 or Table 12
Minimum B-10 Concentration in Poison Plates	Per Table 9, Table 10, Table 11 or Table 12
Number and location of LOW-ENRICHED OUTLIER FUEL (LEOF)	≤ 4 LEOF in the peripheral locations. A minimum of five non-LEOFs shall circumferentially separate LEOFs within the peripheral locations. No limitation for LEOF in the inner locations. The peripheral and inner locations are defined in Figure 6.

2.0 FUNCTIONAL OPERATING LIMITS

2.4 Functional and Operating Limits Violations

If any Functional and Operating Limit of 2.1 or 2.2 or 2.3 is violated, the following ACTIONS shall be completed:

2.4.1 The affected fuel assemblies shall be placed in a safe condition.

2.4.2 Within 24 hours, notify the NRC Operations Center.

2.4.3 Within 60 days, submit a special report which describes the cause of the violation and the ACTIONS taken to restore compliance and prevent recurrence.

3.0 LIMITING CONDITION FOR OPERATION (LCO) AND SURVEILLANCE REQUIREMENT (SR) APPLICABILITY

LIMITING CONDITION FOR OPERATION

LCO 3.0.1	LCOs shall be met during specified conditions in the Applicability, except as provided in LCO 3.0.2.
LCO 3.0.2	Upon discovery of a failure to meet an LCO, the Required Actions of the associated Conditions shall be met, except as provided in LCO 3.0.5. If the LCO is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated.
LCO 3.0.3	Not applicable to a spent fuel storage cask.
LCO 3.0.4	When an LCO is not met, entry into a specified condition in the Applicability shall not be made except when the associated ACTIONS to be entered permit continued operation in the specified condition in the Applicability for an unlimited period of time. This Specification shall not prevent changes in specified conditions in the Applicability that are required to comply with ACTIONS, or that are related to the unloading of a DSC. Exceptions to this Specification are stated in the individual Specifications. These exceptions allow entry into specified conditions in the Applicability when the associated ACTIONS to be entered allow operation in the specified condition in the Applicability only for a limited period of time.
LCO 3.0.5	Equipment removed from service or not in service in compliance with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate it meets the LCO or that other equipment meets the LCO. This is an exception to LCO 3.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate that the LCO is met.
LCO 3.0.6	Not applicable to a spent fuel storage cask.
LCO 3.0.7	Not applicable to a spent fuel storage cask.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.0.1	SRs shall be met during the specified conditions in the Applicability for individual LCOs, unless otherwise stated in the SR. Failure to meet a Surveillance, whether such failure is experienced during the performance of the Surveillance or between performances of the Surveillance, shall be failure to meet the LCO. Failure to perform a Surveillance within the specified Frequency shall be failure to meet the LCO except as provided in SR 3.0.3. Surveillances do not have to be performed on equipment or variables outside specified limits.
SR 3.0.2	The specified Frequency for each SR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met. For Frequencies specified as “once,” the above interval extension does not apply. If a Completion Time requires periodic performance on a “once per . . .” basis, the above Frequency extension applies to each performance after the initial performance. Exceptions to this Specification are stated in the individual Specifications.
SR 3.0.3	If it is discovered that a Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the LCO not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified Frequency, whichever is less. This delay period is permitted to allow performance of the Surveillance. If the Surveillance is not performed within the delay period, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered. When the Surveillance is performed within the delay period and the Surveillance is not met, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered.
SR 3.0.4	Entry into a specified condition in the Applicability of an LCO shall not be made unless the LCO's Surveillances have been met within their specified Frequency. This provision shall not prevent entry into specified conditions in the Applicability that are required to comply with ACTIONS or that are related to the unloading of a DSC.

3.1 DSC Fuel Integrity

3.1.1 Fuel Integrity during Drying

LCO 3.1.1 Medium:

Helium shall be used for cover gas during drainage of bulk water (blowdown or draindown) from the DSC.

Pressure:

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.

APPLICABILITY: During LOADING OPERATIONS but before TRANSFER OPERATIONS.

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. If the required vacuum drying pressure cannot be obtained.	A.1	30 days
	A.1.1 Confirm that the vacuum drying system is properly installed. Check and repair the vacuum drying system as necessary. <u>OR</u>	
	A.1.2 Establish helium pressure of at least 0.5 atm and no greater than 15 psig in the DSC. <u>OR</u>	
	A.2 Flood the DSC with spent fuel pool water or water meeting the requirements of LCO 3.2.1, if applicable, submerging all fuel assemblies.	30 days

(continued)

3.1 DSC Fuel Integrity (continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1	Verify that the DSC vacuum drying pressure is less than or equal to 3 Torr (3 mm Hg) absolute for at least 30 minutes following evacuation.	Once per DSC, after an acceptable NDE of the inner top cover plate to DSC shell weld.

(continued)

3.1 DSC Fuel Integrity (continued)

3.1.2 DSC Helium Backfill Pressure

LCO 3.1.2 DSC helium backfill pressure shall be 2.5 ± 1 psig (stable for 30 minutes after filling) after completion of vacuum drying.

APPLICABILITY: During LOADING OPERATIONS but before TRANSFER OPERATIONS.

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
---NOTE--- Not applicable until SR 3.1.2 is performed. ---	A.1	30 days
A. The required backfill pressure cannot be obtained or stabilized.	A.1.1 Maintain helium atmosphere in the DSC cavity. AND A.1.2 Confirm, check and repair or replace as necessary the vacuum drying system, helium source and pressure gauge. AND A.1.3 Check and repair, as necessary, the seal weld between the inner top cover plate and the DSC shell.	
	OR A.2 Establish the DSC helium backfill pressure to within the limit. If pressure exceeds the criterion, release a sufficient quantity of helium to lower the DSC cavity pressure within the limit.	30 days
	OR	

(continued)

3.1 DSC Fuel Integrity (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
	A.3	Flood the DSC with spent fuel pool water or water meeting the requirements of LCO 3.2.1, if applicable, submerging all fuel assemblies.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.2	Verify that the DSC helium backfill pressure is 2.5 ± 1 psig stable for 30 minutes after filling.	Once per DSC, after the completion of SR 3.1.1 requirement.

(continued)

3.1 DSC Fuel Integrity (continued)

3.1.3 Time Limit for Completion of DSC Transfer

LCO 3.1.3 The time to transfer the DSC to the HSM shall be within the limits.

Additionally, if the DSC and HLZC combination result in a time limit for completion of transfer from the table below, the air circulation system shall be assembled and be verified to be operable within 7 days before commencing the TRANSFER OPERATIONS of the loaded DSC.

DSC MODEL	APPLICABLE HLZC	TIME LIMITS (HOURS)
EOS-37PTH	HLZC 1 or 2	*8*(1)
EOS-37PTH	HLZC 3	No Limit
EOS-37PTH	HLZC 4-11	8(1)
EOS-89BTH	*HLZCs qualified per Figure 11*	*8*(1)
EOS-89BTH	*HLZC 2*	*10*(1)(2)
EOS-89BTH	*HLZC 3*	*No Limit*(2)
61BTH Type 2	HLZC 1, 2, 3, 4, or 9	No limit
61BTH Type 2	5, 6, or 8	23
61BTH Type 2	7 or 10	10

--- NOTE ---

1. The time limit for completion of a DSC transfer is defined as the time elapsed in hours after the initiation of draining of TC/DSC annulus water until the completion of insertion of the DSC into the HSM. For transfer of an EOS-DSC, the time limit for transfer operations is determined based on the EOS-37PTH DSC in EOS-TC125 with the maximum allowable heat load of 50 kW *or EOS-89BTH DSC in EOS-TC125 with the maximum allowable heat load of 48.2 kW*. If the maximum heat load of a DSC is less than 50 kW *for EOS-37PTH DSC or 48.2 kW for the EOS-89BTH DSC*, a new time limit can be determined to provide additional time for transfer operations. The calculated time limit shall not be less than the time limit specified in LCO 3.1.3. The calculation should be performed using the same methodology documented in the UFSAR.
2. *HLZC 2 and 3 (shown in Figure 2) time limits apply for the EOS-89BTH transferred in the EOS-TC108 only. If transferring the EOS-89BTH with HLZC 2 or 3 in the EOS-TC125, the limits for Figure 11 apply.*

(continued)

3.1 DSC Fuel Integrity (continued)

APPLICABILITY: During LOADING OPERATIONS AND TRANSFER OPERATIONS.

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
------------------- NOTE ------------------ Not applicable until SR 3.1.3 is performed. --- A. The required time limit for completion of a DSC transfer not met.	A.1 If the TC is in the cask handling area in a vertical orientation, remove the TC top cover plate and fill the TC/DSC annulus with clean water. <u>OR</u>	2 hours
	A.2 If the TC is in a horizontal orientation on the transfer skid, initiate air circulation in the TC/DSC annulus by starting one of the redundant blowers. <u>OR</u>	1 hour (1) (2)
	A.3 Return the TC to the cask handling area and follow required action A.1 above.	5 hours (1) (2)

1. For EOS-37PTH and EOS-89BTH DSCs: If Required Action A.2 is initiated, run the blower for a minimum of 8 hours. After the blower is turned off, the time limit for completion of DSC transfer is 4 hours. If Required Action A.2 fails to complete within one hour, follow Required Action A.3 for the time remaining in the original Required Action A.3 completion time of 5 hours. The minimum duration of 8 hours to run the blower and the time limit of 4 hours after the blower is turned off for completion of the transfer operations are determined based on the EOS-37PTH DSC in EOS-TC125 with the maximum allowable heat load of 50 kW *or EOS-89BTH DSC in EOS-TC125 with the maximum allowable heat load of 48.2 kW*. If the maximum heat load of a DSC is less than 50 kW *for EOS-37PTH DSC or 48.2 kW for the EOS-89BTH DSC*, new time limits can be determined to provide additional time for these transfer operations. The calculated time limits shall not be less than 4 hours for completion of transfer operation after the blower is turned off. The calculation should be performed using the same methodology documented in the UFSAR.

2. For 61BTH Type 2 DSC: If Required Action A.2 is initiated, run the blower for a minimum of 8 hours. After the blower is turned off, the time limit for completion of DSC transfer is 4 hours. If Required Action A.2 fails to complete within one hour, follow Required Action A.3 for the time remaining in the original Required Action A.3 completion time of 5 hours. The minimum duration of 8 hours to run the blower and the time limit of 4 hours after the blower is turned off for completion of the transfer operations are determined based on the 61BTH Type 2 DSC in OS197FC-B TC with the maximum allowable heat load of 31.2 kW. If the maximum heat load of a DSC is less than 31.2 kW, new time limits can be determined to provide additional time for these transfer operations. The calculated time limits shall not be less than 4 hours for completion of transfer operation after the blower is turned off. The calculation should be performed using the same methodology documented in the UFSAR.

(continued)

3.1 DSC Fuel Integrity (continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.3	Verify that the time limit for completion of DSC transfer is met.	Once per DSC, after the initiation of draining of TC/DSC annulus water.

3.2 Cask Criticality Control

3.2.1 Soluble Boron Concentration

LCO 3.2.1 The boron concentration of the spent fuel pool water and the water added to the cavity of a loaded EOS-37PTH DSC shall be at least the boron concentration shown in Table 4 for the basket type and fuel enrichment selected.

APPLICABILITY: During LOADING and UNLOADING OPERATIONS with fuel and liquid water in the EOS-37PTH DSC cavity.

ACTIONS:

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Soluble boron concentration limit not met.	A.1 Suspend loading of fuel assemblies into DSC. AND A.2	Immediately
	A.2.1 Add boron and re-sample, and test the concentration until the boron concentration is shown to be at least that required. OR	Immediately
	A.2.2 Remove all fuel assemblies from DSC.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.1.1	Verify soluble boron concentration limit in spent fuel pool water and water to be added to the DSC cavity is met using two independent measurements (two samples analyzed by different individuals) for LOADING OPERATIONS.	Within 4 hours before insertion of the first fuel assembly into the DSC. AND Every 48 hours thereafter while the DSC is in the spent fuel pool or until the fuel has been removed from the DSC.
SR 3.2.1.2	Verify soluble boron concentration limit in spent fuel pool water and water to be added to the DSC cavity is met using two independent measurements (two samples analyzed by different individuals) for UNLOADING OPERATIONS.	Once within 4 hours prior to flooding DSC during UNLOADING OPERATIONS. AND Every 48 hours thereafter while the DSC is in the spent fuel pool or until the fuel has been removed from the DSC.

3.3 Radiation Protection

3.3.1 DSC and TRANSFER CASK (TC) Surface Contamination

LCO 3.3.1 Removable surface contamination on the outer top 1 foot surface of the DSC AND the exterior surfaces of the TC shall not exceed:

a. 2,200 dpm/100 cm^2 from beta and gamma sources; and

b. 220 dpm/100 cm^2 from alpha sources.

APPLICABILITY: During LOADING OPERATIONS

ACTIONS:

-- NOTE --
Separate condition entry is allowed for each DSC and TC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Top 1 foot exterior surface of the DSC removable surface contamination limits not met.	A.1 Decontaminate the DSC to bring the removable contamination to within limits.	Prior to TRANSFER OPERATIONS
B. TC removable surface contamination limits not met.	B.1 Decontaminate the TC to bring the removable contamination to within limits	Prior to TRANSFER OPERATIONS

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1	Verify that the removable contamination on the top 1 foot exterior surface of the DSC is within limits.	Once, prior to TRANSFER OPERATIONS.
SR 3.3.1.2	Verify by either direct or indirect methods that the removable contamination on the exterior surfaces of the TC is within limits.	Once, prior to TRANSFER OPERATIONS.

4.0 DESIGN FEATURES

The specifications in this section include the design characteristics of special importance to each of the physical barriers and to the maintenance of safety margins in the NUHOMS® EOS System design.

4.1 Site

4.1.1 Site Location

Because this UFSAR is prepared for a general license, a discussion of a site-specific ISFSI location is not applicable.

4.2 Storage System Features

4.2.1 Storage Capacity

The total storage capacity of the ISFSI is governed by the plant-specific license conditions.

4.2.2 Storage Pad

For sites for which soil-structure interaction is considered important, the licensee is to perform site-specific analysis considering the effects of soil-structure interaction. Amplified seismic spectra at the location of the HSM center of gravity (CG) is to be developed based on the soil-structure interaction (SSI) responses. EOS-HSM seismic analysis information is provided in UFSAR Appendix 3.9.4, Section 3.9.4.9.2. HSM-MX seismic analysis information is provided in UFSAR Appendix A.3.9.4, Section A.3.9.4.9.2.

The storage pad location shall have no potential for liquefaction at the site-specific safe shutdown earthquake (SSE) level.

Additional requirements for the pad configuration are provided in Technical Specification 4.5.2.

4.3 Canister Criticality Control

The NUHOMS® EOS-37PTH DSC is designed for the storage of PWR fuel assemblies with a maximum planar average initial enrichment of less than or equal to 5.0 wt. % U-235 taking credit for soluble boron during LOADING OPERATIONS and the boron content in the poison plates of the DSC basket. The EOS-37PTH DSC uses a boron carbide/aluminum metal matrix composite (MMC) poison plate material. The EOS-37PTH DSC has two different neutron poison loading options, A and B, based on the boron content in the poison plates as listed in Table 5. Table 4 also defines the requirements for boron concentration in the DSC cavity water as a function of the DSC basket type for the various FUEL CLASSES authorized for storage in the EOS-37PTH DSC.

The NUHOMS® EOS-89BTH DSC is designed for the storage of BWR fuel assemblies with a maximum lattice average initial enrichment of less than or equal to *5.00* wt. % U-235 taking credit for the boron content in the poison plates of the DSC basket. There are three neutron poison loading options specified for the EOS-89BTH DSC depending on the type of poison material and the B-10 areal density in the plates, as specified in Table 8.

(continued)

4.0 Design Features (continued)

The 61BTH Type 2 DSC is designed for the storage of BWR fuel assemblies with a maximum lattice average initial enrichment of less than or equal to 5.0 wt. % U-235 taking credit for the boron content in the poison plates of the DSC basket. The 61BTH Type 2 DSC has multiple basket configurations based on the absorber material type (borated aluminum alloy, metal matrix composite (MMC), or Boral®) and boron content in the absorber plates as listed in Table 9 through Table 12.

4.3.1 Neutron Absorber Tests

The neutron absorber used for criticality control in the DSC baskets may be one of the following materials:

- Boron carbide/MMC
- BORAL® (EOS-89BTH or 61BTH Type 2 DSCs only)
- Borated aluminum (61BTH Type 2 DSC only)

Acceptance Testing (MMC, BORAL®, and borated aluminum)

B-10 areal density is verified by neutron attenuation testing or by chemical analysis of coupons taken adjacent to finished panels, and isotopic analysis of the boron carbide powder. The minimum B-10 areal density requirements are specified in Table 5 for EOS-37PTH, Table 8 for EOS-89BTH, and Table 9 through Table 12 for 61BTH Type 2 DSCs.

Finished panels are subject to visual and dimensional inspection.

Qualification Testing (MMC only)

MMCs are qualified for use in the NUHOMS® EOS System by verification of the following characteristics.

- The chemical composition is boron carbide particles in an aluminum alloy matrix.
- The form is with or without an aluminum skin.
- The median boron carbide particle size by volume is ≤ 80 microns with no more than 10% over 100 microns.
- The boron carbide content is ≤ 50% by volume.
- The porosity is ≤ 3%.

4.3.2 High Strength Low Alloy Steel for Basket Structure for EOS-37PTH and EOS-89BTH DSCs.

The basket structural material shall be a high strength low alloy (HSLA) steel meeting one of the following requirements A, B, or C:

A. ASTM A829 Gr 4130 or AMS 6345 SAE 4130, quenched and tempered at not less than 1050°F, 103.6 ksi minimum yield strength and 123.1 ksi minimum ultimate strength at room temperature.

B. ASME SA-517 Gr A, B, E, F, or P.

(continued)

4.0 Design Features (continued)

C. Other HSLA steel, with the specified heat treatment, meeting these qualification and acceptance criteria:

i. If quenched and tempered, the tempering temperature shall be at no less than 1000 °F,

ii. Qualified prior to first use by testing at least two lots and demonstrating that the fracture toughness value K_{JIc} ≥ 150 ksi √in at ≤ -40 °F with 95% confidence.

iii. Qualified prior to first use by testing at least two lots and demonstrating that the 95% lower tolerance limit of yield strength and ultimate strength ≥ the values in UFSAR Table 8-10.

iv. Meet production acceptance criteria based on the 95% lower tolerance limit of yield strength and ultimate strength at room temperature as determined by qualification testing described in Section 4.3.2.C.iii.

The basket structural material shall also meet one of the following production acceptance criteria for impact testing at ≤ -40 °F:

a. Charpy testing per ASTM A370, minimum absorbed energy 25 ft-lb average, 20 ft-lb lowest of three (for sub-size specimens, reduce these criteria per ASTM A370-17 Table 9), or

b. Dynamic tear testing per ASTM E604 with acceptance criterion minimum 80% shear fracture appearance.

4.4 Codes and Standards

4.4.1 HORIZONTAL STORAGE MODULE (HSM)

The reinforced concrete HSM is designed in accordance with the provisions of ACI 349-06. Code alternatives are discussed in Technical Specification 4.4.4. Load combinations specified in ANSI 57.9-1984, Section 6.17.3.1 are used for combining normal operating, off-normal, and accident loads for the HSM.

4.4.2 DRY SHIELDED CANISTER (DSC) (EOS-37PTH, EOS-89BTH, and 61BTH Type 2)

The DSC confinement boundary is designed, fabricated and inspected to the maximum practical extent in accordance with ASME Boiler and Pressure Vessel Code Section III, Division 1, Subsection NB, NF, and NG, for Class 1 components. The ASME code edition years and any addenda for the various DSC types and relevant subsections are provided in the table below. Code alternatives are discussed in Technical Specification 4.4.4.

DSC Type	Applicable Code	Edition/Year
EOS-37PTH, EOS-89BTH	ASME B&PV Code, Section III, Division 1, Subsection NB	2010 Edition with Addenda through 2011
61BTH Type 2	ASME B&PV Code, Section III, Division 1, Subsections NB, NG and NF	1998 Edition with Addenda through 2000

(continued)

4.0 Design Features (continued)

4.4.3 TRANSFER CASK

The EOS-TC design stress analysis and OS197 design stress analysis and fabrication, exclusive of the trunnions and the neutron shield enclosures, is performed in accordance with applicable codes as provided in the table below. The stress allowables for the upper trunnions for the EOS-TCs and the upper and lower trunnions for the OS197 conform to ANSI N14.6-1993 for single-failure-proof lifting.

TC	**Applicable Code**	**Edition/Year**
EOS-TC	ASME B&PV Code, Section III, Division 1, Subsection NF for Class 1 supports	2010 Edition with Addenda through 2011
OS197	ASME B&PV Code, Section III, Division 1, Subsection NC for Class 2 vessels	1983 Edition with Winter 1985 Addenda

4.4.4 Alternatives to Codes and Standards

ASME Code alternatives for the EOS-37PTH, EOS-89BTH DSC, and 61BTH Type 2 DSC are listed below:

(continued)

4.0 Design Features (continued)

EOS-37PTH and EOS-89BTH DSC ASME Code Alternatives, Subsection NB

REFERENCE ASME CODE SECTION/ARTICLE	CODE REQUIREMENT	JUSTIFICATION AND COMPENSATORY MEASURES
NCA	All	Not compliant with NCA
NB-1100	Requirements for Code Stamping of Components	The canister shell, the inner top cover, the inner bottom cover or bottom forging assembly, the outer top cover, and the drain port cover and vent port plug are designed and fabricated in accordance with the ASME Code, Section III, Subsection NB to the maximum extent practical. However, Code Stamping is not required. As Code Stamping is not required, the fabricator is not required to hold an ASME “N” or “NPT” stamp, or to be ASME Certified.
NB-2121	Permitted Material Specifications	Type 2205 and UNS S31803 are duplex stainless steels that provide enhance resistance to chloride-induced stress corrosion cracking. They are not included in Section II, Part D, Subpart 1, Tables 2A and 2B. UNS S31803 has been accepted for Class 1 components by ASME Code Case N-635-1, endorsed by NRC Regulatory Guide 1.84. Type 2205 falls within the chemical and mechanical requirements of UNS S31803. Normal and off-normal temperatures remain below the 600 °F operating limit. Accident conditions may exceed this limit, but only for durations too short to cause embrittlement.
NB-2130 NB-4121	Material must be supplied by ASME approved material suppliers Material Certification by Certificate Holder	Material is certified to meet all ASME Code criteria but is not eligible for certification or Code Stamping if a non-ASME fabricator is used. As the fabricator is not required to be ASME certified, material certification to NB-2130 is not possible. Material traceability and certification are maintained in accordance with the NRC approved QA program associated with CoC 1042.
NB-2300	Fracture toughness requirements for material	Type 2205 and UNS S31803 duplex stainless steels are tested by Charpy V-notch only per NB-2300. Drop weight tests are not required. Impact testing is not required for the vent port plug.
NB-2531	Drain port cover; straight beam ultrasonic testing (UT) per SA-578 for all plates for vessel	SA-578 applies to 3/8" and thicker plate only; allow alternate UT techniques to achieve meaningful UT results.
NB- 2531 and NB-2541	Vent port plug UT and liquid penetrant testing (PT)	This plug may be made from plate or bar. Due to its small area, it has no structural function. It is leak tested along with the inner top cover plate after welding. Therefore, neither UT nor PT are required.

(continued)

4.0 Design Features (continued)

EOS-37PTH and EOS-89BTH DSC ASME Code Alternatives, Subsection NB

(continued)

REFERENCE ASME CODE SECTION/ARTICLE	CODE REQUIREMENT	JUSTIFICATION AND COMPENSATORY MEASURES
NB-4243 and NB-5230	*Category C weld joints in vessels and similar weld joints in other components shall be full penetration joints. These welds shall be examined by UT or radiographic testing (RT) and either PT or magnetic particle testing (MT).*	*The shell to the outer top cover plate (OTCP) weld, the shell to the inner top cover weld, and the drain port cover and vent port plug welds are all partial penetration welds. The cover-to-shell welds are designed to meet the guidance provided in NUREG-1536, Revision 1 for the stress reduction factor. Nondestructive examination (NDE) is done by qualified personnel, in accordance with Section V and the acceptance standards of Section III, Subsection NB-5000, except as noted for OTCP weld option 2 ultrasonic examination.* *As an alternative to the NDE requirements of NB-5230 for Category C welds, all of these closure welds will be multi-layer welds and receive a root and final PT examination, except for the shell to the OTCP weld.* <u>*OTCP weld option 1*</u> *The shell to OTCP weld will be a multi-layer weld and receive multi-level PT examination in accordance with the guidance provided in NUREG 1536 Revision 1 for NDE. The multi-level PT examination provides reasonable assurance that flaws of interest will be identified.* <u>*OTCP weld option 2*</u> *The shell to the outer top cover plate weld will be examined by UT.*
NB-5330	*Ultrasonic Acceptance Standards*	*The UT acceptance criteria for OTCP weld option 2 are:* *1. Rounded flaws are evaluated by the acceptance criteria of NB-5331(a).* *2. Planar flaws are allowable up to the limit (W – Σhi) ≥ D at any location, where Σhi is the sum of the depth of aligned planar defects, W is the measured weld thickness, and D is the minimum weld depth required by NB-3000.* *3. Planar flaws that penetrate the surface of the weld are not allowable.*
NB-5520	NDE Personnel must be qualified to the *2006* edition of SNT-TC-1A	Permit use of the Recommended Practice SNT-TC-1A up to the edition as *cited in Table NCA-7000-1 of the latest ASME Code edition listed in 10 CFR 50.55a at the time of construction.*

(continued)

4.0 Design Features (continued)

EOS-37PTH and EOS-89BTH DSC ASME Code Alternatives, Subsection NB

(continued)

REFERENCE ASME CODE SECTION/ARTICLE	CODE REQUIREMENT	JUSTIFICATION AND COMPENSATORY MEASURES
NB-6000	All completed pressure retaining systems shall be pressure tested	The DSC is not a complete or "installed" pressure vessel until the top closure is welded following placement of fuel assemblies within the DSC. Due to the inaccessibility of the shell and lower end closure welds following fuel loading and top closure welding, as an alternative, the pressure testing of the DSC is performed in two parts. The DSC shell, shell bottom, including all longitudinal and circumferential welds, is pneumatically tested and examined at the fabrication facility *when using the three plate bottom assembly. If using a single piece bottom forging, the fabrication leak test may be waived. The low test pressure test does not stress a single piece bottom and bottom-to-shell weld sufficiently to cause pre-existing defects to propagate into leaks. For the purpose of finding leaks, the helium leak test is far more sensitive than the pressure test.* The shell to the inner top cover closure weld is pressure tested and examined for leakage in accordance with NB-6300 in the field. The drain port cover and vent port plug welds will not be pressure tested; these welds and the shell to the inner top cover closure weld are helium leak tested after the pressure test. Per NB-6324 the examination for leakage shall be done at a pressure equal to the greater of the design pressure or three-fourths of the test pressure. As an alternative, if the examination for leakage of these field welds, following the pressure test, is performed using helium leak detection techniques, the examination pressure may be reduced to 1.5 psig. This is acceptable given the significantly greater sensitivity of the helium leak detection method.
NB-7000	Overpressure Protection	No overpressure protection is provided for the EOS-37PTH or EOS-89BTH DSC. The function of the DSC is to contain radioactive materials under normal, off-normal, and hypothetical accident conditions postulated to occur during transportation. The DSC is designed to withstand the maximum internal pressure considering 100% fuel rod failure at maximum accident temperature.

(continued)

4.0 Design Features (continued)

EOS-37PTH and EOS-89BTH DSC ASME Code Alternatives, Subsection NB

(continued)

NB-8000	Requirements for nameplates, stamping and reports per NCA-8000	The EOS-37PTH and EOS-89BTH DSC are stamped or engraved with the information required by 10 CFR Part 72. Code stamping is not required for these DSCs. QA Data packages are prepared in accordance with requirements of the NRC approved QA program associated with CoC 1042.

(continued)

4.0 Design Features (continued)

61BTH Type 2 DSC ASME Code Alternatives for the Confinement Boundary

REFERENCE ASME CODE SECTION/ ARTICLE	CODE REQUIREMENT	ALTERNATIVES, JUSTIFICATION & COMPENSATORY MEASURES
NCA	All	Not compliant with NCA. Quality Assurance is provided according to 10 CFR Part 72 Subpart G in lieu of NCA-4000.
NCA-1140	Use of Code editions and addenda	Code edition and addenda other than those specified in Section 4.4.2 may be used for construction, but in no case earlier than 3 years before that specified in the Section 4.4.2 table. Materials produced and certified in accordance with ASME Section II material specification from Code Editions and Addenda other than those specified in Section 4.4.2 may be used, so long as the materials meet all the requirements of Article 2000 of the applicable Subsection of the Section III Edition and Addenda used for construction.
NB-1100	Requirements for Code Stamping of Components, Code reports and certificates, etc.	Code Stamping is not required. As Code Stamping is not required, the fabricator is not required to hold an ASME “N” or “NPT” stamp, or to be ASME Certified.
NB-1132	Attachments with a pressure retaining function, including stiffeners, shall be considered part of the component.	Bottom shield plug and outer bottom cover plate are outside code jurisdiction; these components together are much larger than required to provide stiffening for the inner bottom cover plate; the weld that retains the outer bottom cover plate and with it the bottom shield plug is subject to root and final PT examination.
NB-2130	Material must be supplied by ASME approved material suppliers.	Material is certified to meet all ASME Code criteria but is not eligible for certification or Code Stamping if a non-ASME fabricator is used. As the fabricator is not required to be ASME certified, material certification to NB-2130 is not possible. Material traceability and certification are maintained in accordance with TN’s NRC approved QA program.
NB-4121	Material Certification by Certificate Holder	
NB-4243 and NB-5230	Category C weld joints in vessels and similar weld joints in other components shall be full penetration joints. These welds shall be examined by UT or RT and either PT or MT.	The shell to the outer top cover weld, the shell to the inner top cover weld, the siphon and vent cover plate welds, and the vent and siphon block welds to the shell are all partial penetration welds. As an alternative to the NDE requirements of NB-5230 for Category C welds, all of these closure welds will be multi-layer welds and receive a root and final PT examination, except for the shell to the outer top cover weld. The shell to the outer top cover weld will be a multi-layer weld and receive multi-level PT examination in accordance with the guidance provided in NUREG-1536 Revision 1 for NDE. The multi-level PT Examination provides reasonable assurance that flaws of interest will be identified. The PT examination is done by qualified personnel, in accordance with Section V and the acceptance standards of Section III, Subsection NB-5000. All of these welds will be designed to meet the guidance provided in NUREG-1536 Revision 1 for stress reduction factor.

(continued)

4.0 Design Features (continued)

61BTH Type 2 DSC ASME Code Alternatives for the Confinement Boundary

REFERENCE ASME CODE SECTION/ ARTICLE	CODE REQUIREMENT	ALTERNATIVES, JUSTIFICATION & COMPENSATORY MEASURES
NB-6100 and 6200	All completed pressure retaining systems shall be pressure tested.	The 61BTH Type 2 DSC is not a complete or “installed” pressure vessel until the top closure is welded following placement of Fuel Assemblies with the DSC. Due to the inaccessibility of the shell and lower end closure welds following fuel loading and top closure welding, as an alternative, the pressure testing of the DSC is performed in two parts. The DSC shell and shell bottom (including all longitudinal and circumferential welds) is pressure tested and examined at the fabrication facility. The shell to the inner top cover closure weld are pressure tested and examined for leakage in accordance with NB-6300 in the field. The siphon/vent cover welds are not pressure tested; these welds and the shell to the inner top cover closure weld are helium leak tested after the pressure test. Per NB-6324, the examination for leakage shall be done at a pressure equal to the greater of the design pressure or three-fourths of the test pressure. As an alternative, if the examination for leakage of these field welds, following the pressure test, is performed using helium leak detection techniques, the examination pressure may be reduced to ≥ 1.5 psig. This is acceptable given the significantly greater sensitivity of the helium leak detection method.
NB-7000	Overpressure Protection	No overpressure protection is provided for the NUHOMS® DSCs. The function of the DSC is to contain radioactive materials under normal, off-normal and hypothetical accident conditions postulated to occur during transportation and storage. The DSC is designed to withstand the maximum possible internal pressure considering 100% fuel rod failure at maximum accident temperature.
NB-8000	Requirements for nameplates, stamping & reports per NCA-8000.	The NUHOMS® DSC nameplate provides the information required by 10 CFR Part 71, 49 CFR Part 173 and 10 CFR Part 72 as appropriate. Code stamping is not required for the DSC. QA data packages are prepared in accordance with the requirements of TN’s approved QA program.
NB-5520	NDE personnel must be qualified to a specific edition of SNT-TC-1A.	Permit use of the Recommended Practice SNT-TC-1A to include up to the most recent 2011 edition.

(continued)

4.0 Design Features (continued)

61BTH Type 2 DSC ASME Code Alternatives for the Basket

REFERENCE ASME CODE SECTION/ ARTICLE	CODE REQUIREMENT	ALTERNATIVES, JUSTIFICATION & COMPENSATORY MEASURES
NCA	All	Not compliant with NCA. Quality Assurance is provided according to 10 CFR Part 72 Subpart G in lieu of NCA-4000.
NCA-1140	Use of Code editions and addenda	Code edition and addenda other than those specified in Section 4.4.2 may be used for construction, but in no case earlier than 3 years before that specified in the Section 4.4.2 table. Materials produced and certified in accordance with ASME Section II material specification from Code Editions and Addenda other than those specified in Section 4.4.2 may be used, so long as the materials meet all the requirements of Article 2000 of the applicable Subsection of the Section III Edition and Addenda used for construction.
NG/NF-1100	Requirements for Code Stamping of Components, Code reports and certificates, etc.	Code Stamping is not required. As Code Stamping is not required, the fabricator is not required to hold an ASME “N” or “NPT” stamp, or to be ASME Certified.
NG/NF-2000	Use of ASME Material	Some baskets include neutron absorber and aluminum plates that are not ASME Code Class 1 material. They are used for criticality safety and heat transfer, and are only credited in the structural analysis with supporting their own weight and transmitting bearing loads through their thickness. Material properties in the ASME Code for Type 6061 aluminum are limited to 400 °F to preclude the potential for annealing out the hardening properties. Annealed properties (as published by the Aluminum Association and the American Society of Metals) are conservatively assumed for the aluminum transition rails for use above the Code temperature limits.
NG/NF-2130	Material must be supplied by ASME approved material suppliers.	Material is certified to meet all ASME Code criteria but is not eligible for certification or Code Stamping if a non-ASME fabricator is used. As the fabricator is not required to be ASME certified, material certification to NG/NF-2130 is not possible. Material traceability and certification are maintained in accordance with TN’s NRC approved QA program.
NG/NF-4121	Material Certification by Certificate Holder	
NG-3352	Table NG-3352-1 lists the permissible welded joints and quality factors.	The fuel compartment tubes may be fabricated from sheet with full penetration seam weldments. Per Table NG-3352-1, a joint efficiency (quality) factor of 0.5 is to be used for full penetration weldments examined in accordance with ASME Section V visual examination (VT). A joint efficiency (quality) factor of 1.0 is utilized for the fuel compartment longitudinal seam welds (if present) with VT examination. This is justified because the compartment seam weld is thin and the weldment is made in one pass; and both surfaces of the weldment (inside and outside) receive 100% VT examination. The 0.5 quality factor, applicable to each surface of the weldment, results is a quality factor of 1.0 since both surfaces are 100% examined. In addition, the fuel compartments have no pressure retaining function and the stainless steel material that comprises the fuel compartment tubes is very ductile.
NG/NF-8000	Requirements for nameplates, stamping & reports per NCA-8000.	The NUHOMS® DSC nameplate provides the information required by 10 CFR Part 71, 49 CFR Part 173 and 10 CFR Part 72 as appropriate. Code stamping is not required for the DSC. QA data packages are prepared in accordance with the requirements of TN’s approved QA program.
NG/NF-5520	NDE personnel must be qualified to a specific edition of SNT-TC-1A.	Permit use of the Recommended Practice SNT-TC-1A to include up to the most recent 2011 edition.

(continued)

4.0 Design Features (continued)

Code alternatives for the HSM concrete specifications are listed below:

REFERENCE ACI349-06 SECTION/ARTICLE	CODE REQUIREMENT	ALTERNATIVES, JUSTIFICATION AND COMPENSATORY MEASURES
Appendix E, Section E.4-Concrete Temperatures, Paragraph E.4.3	Paragraph E.4.3 requires testing of concrete for temperatures higher than those given in Paragraph E.4.1.	The concrete temperature limit criteria in NUREG-1536, Section 8.4.14.2 is used for normal and off-normal conditions. Alternatively, per ACI 349-13, Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary, Section RE.4, the specified compressive strength, which may be tested up to 56 days, is increased to 7,000 psi for HSM fabrication so that any losses in properties (e.g., compressive strength) resulting from long-term thermal exposure will not affect the safety margins based on the specified 5,000 psi compressive strength used in the design calculations. Additionally, also as indicated in Section RE.4, short, randomly oriented steel fibers may be used to provide increased ductility, dynamic strength, toughness, tensile strength, and improved resistance to spalling. The safety margin on compressive strength is 40% for a concrete temperature limit of 300 °F normal and off-normal conditions.

Proposed alternatives to the above-specified ASME and ACI codes, other than the aforementioned alternatives, may be used when authorized by the Director of the Office of Nuclear Material Safety and Safeguards, or designee. The applicant should demonstrate that:

1. The proposed alternatives would provide an acceptable level of quality and safety, or
2. Compliance with the specified requirements of above-specified ASME and ACI codes would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The applicant should also submit information regarding the environmental impact of such a request to support the NRC's NEPA regulations in 10 CFR Part 51. Any proposed alternatives must be submitted and approved prior to implementation.

Requests for exceptions in accordance with this section should be submitted in accordance with 10 CFR 72.4.

(continued)

4.0 Design Features (continued)

4.5 Storage Location Design Features

The following storage location design features and parameters shall be verified by the system user to assure technical agreement with the UFSAR.

4.5.1 Storage Configuration

EOS-HSMs and HSM-MXs are placed together in single rows or back to back arrays. A rear shield wall is placed on the rear of any single row loaded EOS-HSM.

4.5.2 Concrete Storage Pad Properties to Limit DSC Gravitational Loadings Due to Postulated Drops

The EOS-37PTH DSC and EOS-89BTH DSC have been evaluated for drops of up to 65 inches onto a reinforced concrete storage pad. The 61BTH Type 2 DSC has been evaluated for drops of up to 80 inches onto a reinforced concrete storage pad.

4.5.3 Site Specific Parameters and Analyses

The following parameters and analyses are applicable to all HSMs unless specifically noted and shall be verified by the system user for applicability at their specific site. Other natural phenomena events, such as lightning, tsunamis, hurricanes, and seiches, are site specific and their effects are generally bounded by other events, but they should be evaluated by the user.

1. Flood levels up to 50 ft and water velocity of 15 fps.
2. One-hundred year roof snow load of 110 psf.
3. Normal ambient temperature is based on the heat load of the DSC as follows:

   For the EOS-HSM:

   a. For the EOS-37PTH DSCs with a heat load less than or equal to 41.8 kW or for the EOS-89BTH DSCs with a heat load less than or equal to 41.6 kW, the minimum temperature is -20 °F. The maximum calculated normal average ambient temperature corresponding to a 24-hour period is 90 °F.
   b. For the EOS-37PTH DSCs with a heat load greater than 41.8 kW or for the EOS-89BTH DSCs with a heat load greater than 41.6 kW, the minimum temperature is -20 °F. The maximum calculated average yearly temperature is 70 °F.

   For the HSM-MX:

   c. The minimum temperature is -20 °F. The maximum calculated normal average ambient temperature corresponding to a 24-hour period is 90 °F.
4. Off-normal ambient temperature range of -40 °F without solar insolation to 117 °F with full solar insolation. The 117 °F off-normal ambient temperature corresponds to a 24-hour calculated average temperature of 103 °F.

(continued)

4.0 Design Features (continued)

5. The response spectra at the base of the HSMs shall be compared against the response spectra defined in UFSAR Section 2.3.4 for the EOS-HSM, and Section A.2.3.4 for the HSM-MX and shown to be enveloped by the UFSAR response spectra. If it is not enveloped, stability can be demonstrated by either static or dynamic analysis.

6. The potential for fires and explosions shall be addressed, based on site-specific considerations.

7. Supplemental Shielding: In cases where engineered features (i.e., berms, shield walls) are used to ensure that the requirements of 10 CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category.

8. If an INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) site is located in a coastal salt water marine atmosphere, then any load-bearing carbon steel DSC support structure rail components for the EOS-HSM, or front and rear DSC supports for the HSM-MX shall be procured with a minimum 0.20% copper content or stainless steel shall be used for corrosion resistance. For weld filler material used with carbon steel, 1% or more nickel bearing weld material would also be acceptable in lieu of 0.20% copper content.

9. If an ISFSI site is required to evaluate blockage of air vents for durations longer than evaluated in the UFSAR, a new duration can be determined based on site-specific parameters. The evaluation should be performed using the same methodology documented in the UFSAR.

5.0 ADMINISTRATIVE CONTROLS

5.1 Programs

Each user of the NUHOMS® EOS System will implement the following programs to ensure the safe operation and maintenance of the ISFSI:

- Radiological Environmental Monitoring Program (see 5.1.1 below)
- Radiation Protection Program (see 5.1.2 below)
- HSM Thermal Monitoring Program (see 5.1.3 below)

5.1.1 Radiological Environmental Monitoring Program

a. A radiological environmental monitoring program will be implemented to ensure that the annual dose equivalent to an individual located outside the ISFSI controlled area does not exceed the annual dose limits specified in 10 CFR 72.104(a).

b. Operation of the ISFSI will not create any radioactive materials or result in any credible liquid or gaseous effluent release.

5.1.2 Radiation Protection Program

The Radiation Protection Program will establish administrative controls to limit personnel exposure to As Low As Reasonably Achievable (ALARA) levels in accordance with 10 CFR Part 20 and Part 72.

a. As part of its evaluation pursuant to 10 CFR 72.212, the licensee shall perform an analysis to confirm that the limits of 10 CFR Part 20 and 10 CFR 72.104 will be satisfied under the actual site conditions and configurations considering the planned number of DSCs to be used and the planned fuel loading conditions. This analysis is also used to qualify fuel considered for loading, as outlined below:

   1. For the DSCs considered for loading, select HLZC(s) appropriate to store the spent fuel.
   2. Compute the decay heat of the fuel assemblies considered for loading. Methods include, but are not limited to, NRC Regulatory Guide 3.54, or the methodology described in the UFSAR (i.e., ORIGEN-ARP).
   3. Compute the source term for the fuel assemblies considered for loading. The design basis source terms provided in the UFSAR may be used for site-specific shielding analysis if they are shown to bound the site-specific source terms.
   4. Demonstrate computationally that the EOS-HSM or HSM-MX to be loaded meets the dose rate requirements of TS 5.1.2(c). This evaluation may be used as the basis for the dose rate limits established in TS 5.1.2(b).
   5. Demonstrate computationally that direct radiation from the ISFSI meets the requirements of 72.104.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

b. On the basis of the analysis in TS 5.1.2(a), the licensee shall establish a set of HSM dose rate limits which are to be applied to DSCs used at the site. Limits shall establish dose rates for:

   i. HSM front face,

   ii. HSM door centerline, and

   iii. End shield wall exterior for the EOS-HSM or exterior side wall of the HSM-MX monolith.

c. Notwithstanding the limits established in TS 5.1.2(b), the dose rate limits may not exceed the following values as calculated for a content of design basis fuel as follows:

   For EOS-HSM:

   i. *65* mrem/hr average over the front face,

   ii. *15* mrem/hr at the door centerline, and

   iii. 5 mrem/hr average at the end shield wall exterior.

   For HSM-MX:

   i. *165* mrem/hr average over the front face,

   ii. *15* mrem/hr at the door centerline, and

   iii. 5 mrem/hr average at the exterior side wall of the HSM-MX monolith.

   If the measured dose rates do not meet the limits of TS 5.1.2(b) or TS 5.1.2(c), whichever are lower, the licensee shall take the following actions:

   - Notify the U.S. Nuclear Regulatory Commission (Director of the Office of Nuclear Material Safety and Safeguards) within 30 days,
   - Administratively verify that the correct fuel was loaded,
   - Ensure proper installation of the HSM door,
   - Ensure that the DSC is properly positioned on the DSC supports, and
   - Perform an analysis to determine that placement of the as-loaded DSC at the ISFSI will not cause the ISFSI to exceed the radiation exposure limits of 10 CFR Part 20 and 10 CFR Part 72 and/or provide additional shielding to assure exposure limits are not exceeded.

d. A monitoring program to ensure the annual dose equivalent to any real individual located outside the ISFSI controlled area does not exceed regulatory limits is incorporated as part of the environmental monitoring program in the Radiological Environmental Monitoring Program of TS 5.1.1.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

e. When using the EOS-TC108 with a liquid neutron shield (NS), the NS shall be verified to be filled when DSC cavity draining or TC/DSC annulus draining operations are initiated and continually monitored during the first five minutes of the draining evolution to ensure the NS remains filled. The NS shall also be verified to be filled prior to the movement of the loaded TC from the decontamination area. Observation of water level in the expansion tank or some other means can be used to verify compliance with this requirement.

f. Following completion of the DSC shell assembly at the fabricator facility, the inner bottom cover plate, canister shell and all associated welds are leak-tested to demonstrate that these welds and components meet the “leak-tight” criterion (≤ 1.0×10^{-7} reference cm^3/sec) as defined in “American National Standard for Radioactive Materials – Leakage Tests on Packages for Shipment”, ANSI N14.5-1997. If the leakage rate exceeds 1.0×10^{-7} reference cm^3/sec, check and repair these welds or components.

Following completion of the welding of the DSC shell to the inner top cover and drain port cover and vent plug after fuel loading, these welds and components are leak-tested to demonstrate that they meet the “leak-tight” criterion (≤ 1.0×10^{-7} reference cm^3/sec) as defined in “American National Standard for Radioactive Materials - Leakage Tests on Packages for Shipment”, ANSI N14.5-1997. If the leakage rate exceeds 1.0×10^{-7} reference cm^3/sec, check and repair these welds or components.

5.1.3 HSM Thermal Monitoring Program

Two separate programs for the EOS-HSM and MATRIX HSM are described in Technical Specifications 5.1.3.1 and 5.1.3.2, respectively.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

5.1.3.1 EOS-HSM Thermal Monitoring Program

This program provides guidance for temperature measurements that are used to monitor the thermal performance of each EOS-HSM. The intent of the program is to prevent conditions that could lead to exceeding the concrete and fuel clad temperature criteria. Each user must implement either TS 5.1.3.1(a) OR 5.1.3.1(b).

a. Daily Visual Inspection of EOS-HSM Inlets and Outlets (Front Wall and Roof Birdscreens) and Wind Deflectors

   i. The user shall develop and implement procedures to perform visual inspection of EOS-HSM inlets and outlets on a daily basis.

   Perform a daily visual inspection of the air vents to ensure that EOS-HSM air vents are not blocked for more than 40 hours. If visual inspection indicates blockage, clear air vents and replace or repair birdscreens if damaged. If the air vents are blocked or could have been blocked for more than 40 hours, evaluate existing conditions in accordance with the site corrective action program to confirm that conditions adversely affecting the concrete or fuel cladding do not exist.

   ii. Daily Visual Inspection of Wind Deflectors

   If wind deflectors are required per TS 5.5, the user shall develop and implement procedures to perform visual inspection of the wind deflectors on a daily basis.

   There is a possibility that the wind deflectors could become damaged or lost by extreme winds, tornados, or other accidents. The condition caused by a damaged or lost wind deflector is bounded by the air vent blockage postulated and analyzed in the UFSAR accident analyses. The procedures shall ensure that the duration of a damaged or lost wind deflector will not exceed periods longer than 40 hours as assumed in the UFSAR analyses for vent blockage. If visual inspection indicates a damaged or lost wind deflector, replace or repair the wind deflector. If the wind deflectors are damaged or could have been damaged for more than 40 hours, evaluate existing conditions in accordance with the site corrective action program to confirm that conditions adversely affecting the concrete or fuel cladding do not exist.

b. Daily EOS-HSM Temperature Measurement Program

   i. The user shall develop a daily temperature measurement program to verify the thermal performance of each NUHOMS® EOS System. The user shall establish administrative temperature limits to (1) detect off-normal and accident blockage conditions before the EOS- HSM components and fuel cladding temperatures would exceed temperature design limits and (2) ensure the EOS-HSM air vents are not blocked for more than 40 hours. The daily temperature measurements shall include one of the following options:

      1. direct measurement of the EOS-HSM concrete temperature

      2. direct measurement of inlet and outlet air temperatures

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

If the direct measurement of the inlet and outlet air temperatures (option 2) is performed, the measured temperature differences of the inlet and outlet vents of each individual EOS-HSM must be compared to the predicted temperature differences for each individual EOS-HSM during normal operations. The measured temperature difference between the inlet and outlet vents shall not exceed 138 °F.

ii. The user shall establish in the program, measurement locations in the EOS-HSM that are representative of the EOS-HSM thermal performance and directly correlated to the predicted fuel cladding temperatures, air mass flow rates, and NUHOMS® EOS System temperature distributions that would occur with the off-normal and accident blockage conditions, as analyzed in the UFSAR. The administrative temperature limits shall employ appropriate safety margins that ensure temperatures would not exceed design basis temperature limits in the UFSAR, and be based on the UFSAR methodologies used to predict thermal performance of the NUHOMS® EOS System. If the direct measurement of the inlet and outlet air temperatures (option 2) is performed, the user must develop procedures to measure air temperatures that are representative of inlet and outlet air temperatures, as analyzed in the UFSAR. The user must also consider site-specific environmental conditions, loaded decay heat patterns, and the proximity of adjacent EOS-HSM modules in the daily air temperature measurement program. The user must ensure that measured air temperatures reflect only the thermal performance of each individual module, and not the combined performance of adjacent modules.

iii. The user shall establish in the program the appropriate actions to be taken if administrative temperature criteria are exceeded. If an administrative temperature limit is exceeded during a daily measurement, the user shall inspect the vents, wind deflectors if installed, and implement TS 5.1.3.1(a) for the affected system, until the cause of the excursion is determined and necessary corrective actions are completed under the site corrective action program.

iv. If measurements or other evidence indicate that the EOS-HSM concrete temperatures have exceeded the concrete accident temperature limit of 500 °F for more than 40 hours, the user shall perform an analysis and/or tests of the concrete in accordance with TS 5.3. The user shall demonstrate that the structural strength of the EOS-HSM has an adequate margin of safety and take appropriate actions to return the EOS-HSM to normal operating conditions.

v. If measurements or other evidence indicate that off-normal or accident temperature limits for fuel cladding have been exceeded, verify that canister confinement is maintained and assess analytically the condition of the fuel. Additionally, within 30 days, take appropriate actions to restore the spent fuel to a safe configuration.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

5.1.3.2 HSM-MX Thermal Monitoring Program

This program provides guidance for temperature measurements that are used to monitor the thermal performance of each HSM-MX. There are no credible scenarios that could block both the inlet and outlet vents. Therefore, only blockage of inlet vent is considered in the UFSAR. The intent of the program is to prevent conditions that could lead to exceeding the concrete and fuel clad temperature criteria. Each user must implement either TS 5.1.3.2(a) OR 5.1.3.2(b).

a. Daily Visual Inspection of HSM-MX Inlets and Outlets (Front Wall and Roof Birdscreens)

The user shall develop and implement procedures to perform visual inspection of HSM-MX inlets and outlets on a daily basis.

Perform a daily visual inspection of the air vents to ensure that HSM-MX air vents are not blocked for more than 32 hours. If visual inspection indicates blockage, clear air vents and replace or repair birdscreens if damaged. If the air vents are blocked or could have been blocked for more than 32 hours, evaluate existing conditions in accordance with the site corrective action program to confirm that conditions adversely affecting the concrete or fuel cladding do not exist.

b. Daily HSM-MX Temperature Measurement Program

i. The user shall develop a daily temperature measurement program to verify the thermal performance of each HSM-MX System through direct measure of the HSM-MX concrete temperature. The user shall establish administrative temperature limits to (1) detect off-normal and accident blockage conditions before the HSM components and fuel cladding temperatures would exceed temperature design limits and (2) ensure the HSM-MX air vents are not blocked for more than 32 hours.

ii. The user shall establish in the program measurement locations in the HSM-MX that are representative of the HSM-MX thermal performance and directly correlated to the predicted fuel cladding temperatures, air mass flow rates, and NUHOMS® MATRIX System temperature distributions that would occur with the off-normal and accident blockage conditions, as analyzed in the UFSAR. The administrative temperature limits shall employ appropriate safety margins that ensure temperatures would not exceed design basis temperature limits in the UFSAR, and be based on the UFSAR methodologies used to predict thermal performance of the NUHOMS® MATRIX System.

iii. The user shall establish in the program the appropriate actions to be taken if administrative temperature criteria are exceeded. If an administrative temperature limit is exceeded during a daily measurement, the user shall inspect the vents and implement TS 5.1.3.2(a) for the affected system, until the cause of the excursion is determined and necessary corrective actions are completed under the site corrective action program.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

iv. If measurements or other evidence indicate that the HSM-MX concrete temperatures have exceeded the concrete accident temperature limit of 500 °F for more than 32 hours, the user shall perform an analysis and/or tests of the concrete in accordance with TS 5.3. The user shall demonstrate that the structural strength of the HSM-MX has an adequate margin of safety and take appropriate actions to return the HSM-MX to normal operating conditions.

v. If measurements or other evidence indicate that off-normal or accident temperature limits for fuel cladding have been exceeded, verify that canister confinement is maintained and assess analytically the condition of the fuel. Additionally, within 30 days, take appropriate actions to restore the spent fuel to a safe configuration.

5.2 Lifting Controls

5.2.1 TC/DSC Lifting Height and Temperature Limits

The requirements of 10 CFR 72 apply to TC/DSC lifting/handling height limits outside the FUEL BUILDING. The requirements of 10 CFR Part 50 apply to TC/DSC lifting/handling height limits inside the FUEL BUILDING. Confirm the surface temperature of the TC before TRANSFER OPERATIONS of the loaded TC/DSC.

The lifting height of a loaded TC/ DSC is limited as a function of low temperature, the type of lifting/handling device, *and weather,* as follows:

- No lifts or handling of the TC/DSC at any height are permissible at TC surface temperatures below 0 °F
- The maximum lift height of the TC/DSC shall be 65 inches for the EOS-DSCs or 80 inches for the 61BTH Type 2 DSC if the surface temperature of the TC is above 0 °F and a non-single-failure-proof lifting/handling device is used.
- No lift height restriction is imposed on the TC/DSC if the TC surface temperature is higher than 0 °F, a single-failure-proof lifting/handling system is used, *and (for lifting/handling outside the FUEL BUILDING) a SAFE CONDITION AND FORECAST is verified.*

The requirements of 10 CFR Part 72 apply when the TC/DSC is in a horizontal orientation on the transfer trailer. The requirements of 10 CFR Part 50 apply when the TC/DSC is being lifted/handled using the cask handling crane/hoist. (This distinction is valid only with respect to lifting/handling height limits.)

5.2.2 Cask Drop

Inspection Requirement

The TC will be inspected for damage and the DSC will be evaluated after any TC with a loaded DSC side drop of 15 inches or greater.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

Background

TC/DSC handling and loading activities are controlled under the 10 CFR Part 50 license until a loaded TC/DSC is placed on the transporter, at which time fuel handling activities are controlled under the 10 CFR Part 72 license.

Safety Analysis

The analysis of bounding drop scenarios shows that the TC will maintain the structural integrity of the DSC confinement boundary from an analyzed side drop height of 65 inches for the EOS-DSCs and 80 inches for the 61BTH Type 2 DSC. This 65-inch/80-inch drop height envelopes the maximum height from the bottom of the TC when secured to the transfer trailer while en route to the ISFSI.

Although analyses performed for cask drop accidents at various orientations indicate much greater resistance to damage, requiring the inspection of the DSC after a side drop of 15 inches or greater ensures that:

1. The DSC will continue to provide confinement.
2. The TC can continue to perform its design function regarding DSC transfer and shielding.

5.3 Concrete Testing

HSM concrete shall be tested during the fabrication process for elevated temperatures to verify that there are no significant signs of spalling or cracking and that the concrete compressive strength is greater than that assumed in the structural analysis. Tests shall be performed at or above the calculated peak temperature and for a period no less than the permissible duration as specified in Technical Specification 5.1.3.

HSM concrete temperature testing shall be performed whenever:

- There is a change in the supplier of the cement, or
- There is a change in the source of the aggregate, or
- The water-cement ratio changes by more than 0.04.

(continued)

5.0 ADMINISTRATIVE CONTROLS (continued)

5.4 Hydrogen Gas Monitoring

For DSCs, while welding the inner top cover during LOADING OPERATIONS, and while cutting the inner top cover to DSC shell weld when the DSC cavity is wet during UNLOADING OPERATIONS, hydrogen monitoring of the space under the top shield plug in the DSC cavity is required, to ensure that the combustible mixture concentration remains below the flammability limit of 4%. If this limit is exceeded, all welding operations shall be stopped and the DSC cavity purged with helium to reduce hydrogen concentration safely below the limit before welding or cutting operations can be resumed.

5.5 EOS-HSM Wind Deflectors

If the heat load of an EOS-37PTH DSC loaded per HLZC 1, 4, 6, 10, or 11 during STORAGE OPERATIONS is greater than 41.8 kW, wind deflectors shall be installed on the EOS-HSM.

If the heat load of a fuel assembly loaded per HLZC 5 in the EOS-37PTH DSC during STORAGE OPERATIONS is greater than 1.625 kW, wind deflectors shall be installed on the EOS-HSM.

If the heat load of an EOS-89BTH DSC during STORAGE OPERATIONS is greater than 41.6 kW, wind deflectors shall be installed on the EOS-HSM.

Table 1
Fuel Assembly Design Characteristics for the EOS-37PTH DSC

PWR FUEL CLASS	B&W 15X15	WE 17X17	CE 15X15	WE 15X15	CE 14X14	WE 14X14	CE 16X16
Fissile Material	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2	UO_2
Maximum Number of Fuel Rods	208	264	216	204	176	179	236
Maximum Number of Guide/ Instrument Tubes	17	25	9	21	5	17	5

Table 2
Maximum Uranium Loading per FFC for Failed PWR Fuel

Fuel Assembly Class	Maximum Uranium Loading (MTU)
WE 17x17	0.550
CE 16x16	0.456
BW 15x15	0.492
WE 15x15	0.480
CE 15x15	0.450
CE 14x14	0.400
WE 14x14	0.410

Table 3
Co-60 Equivalent Activity for CCs Stored in the EOS-37PTH DSC

Fuel Region	Maximum Co-60 Equivalent Activity per DSC (Curies/DSC)[(2)]
Active Fuel	32,656
Plenum/Top Region	6,671

Notes:

1. Not Used.
2. NSAs and Neutron Sources shall only be stored in the inner zone of the basket. Figure 3 defines the compartments categorized as the Inner and Peripheral Zones.

Table 4
Maximum Planar Average Initial Enrichment for EOS-37PTH

(2 Pages)

PWR Fuel Class	Maximum Planar Average Initial Enrichment (wt. % U-235) as a Function of Soluble Boron Concentration and Basket Type (Fixed Poison Loading) With and Without CCs								
	Minimum Soluble Boron (ppm)	Basket Type							
		A1/A2/A3/A4H/A4L/A5				B1/B2/B3/B4H/B4L/B5			
		w/o CCs		w/ CCs		w/o CCs		w/ CCs	
		INTACT FUEL	DAMAGED/ FAILED FUEL(2)	INTACT FUEL	DAMAGED/ FAILED FUEL(2)	INTACT FUEL	DAMAGED/ FAILED FUEL(3)	INTACT FUEL	DAMAGED/ FAILED FUEL(3)
WE 17x17 Class	2000	4.35	4.20	4.35	4.15	4.50	4.15	4.45	4.25
	2100	4.50	4.20	4.45	4.20	4.65	4.25	4.60	4.40
	2200	4.60	4.40	4.55	4.35	4.75	4.45	4.70	4.55
	2300	4.70	4.45	4.65	4.50	4.85	4.65	4.85	4.60
	2400	4.85	4.45	4.80	4.60	5.00	4.65	4.95	4.75
	2500	4.95	4.65	4.90	4.70	5.00	5.00	5.00	4.95
CE 16x16 Class	2000	5.00	4.75	5.00	4.70	5.00	5.00	5.00	5.00
	2100	5.00	5.00	5.00	5.00	-	-	-	-
	2200	-	-	-	-	-	-	-	-
	2300	-	-	-	-	-	-	-	-
	2400	-	-	-	-	-	-	-	-
	2500	-	-	-	-	-	-	-	-
BW 15x15 Class	2000	4.25	4.05	4.20	4.00	4.40	4.10	4.35	4.15
	2100	4.40	4.10	4.30	4.15	4.55	4.20	4.45	4.25
	2200	4.50	4.25	4.45	4.15	4.65	4.35	4.60	4.30
	2300	4.60	4.35	4.55	4.30	4.80	4.40	4.70	4.50
	2400	4.75	4.40	4.65	4.45	4.90	4.55	4.85	4.50
	2500	4.85	4.55	4.75	4.65	5.00	4.75	4.90	4.75
	2600	(1)	(1)	(1)	(1)	5.00	5.00	(1)	(1)
WE 15x15	2000	4.45	4.10	4.40	4.10	4.55	4.30	4.55	4.25
	2100	4.60	4.15	4.55	4.15	4.65	4.50	4.65	4.35
	2200	4.70	4.25	4.65	4.35	4.80	4.55	4.80	4.45
	2300	4.85	4.35	4.75	4.45	5.00	4.50	4.95	4.50
	2400	4.95	4.50	4.90	4.50	5.00	4.90	5.00	4.80
	2500	5.00	4.75	5.00	4.65	5.00	5.00	5.00	5.00
CE 15x15 Assembly Class	2000	4.60	4.25	4.55	4.20	4.75	4.35	4.70	4.30
	2100	4.70	4.45	4.65	4.40	4.85	4.50	4.85	4.35
	2200	4.85	4.50	4.80	4.45	5.00	4.60	4.95	4.60
	2300	5.00	4.55	4.90	4.65	5.00	5.00	5.00	4.80
	2400	5.00	5.00	5.00	4.85	5.00	5.00	5.00	5.00
	2500	-	-	5.00	5.00	-	-	-	-
CE 14x14 Assembly Class	2000	5.00	5.00	5.00	4.50	5.00	5.00	5.00	4.95
	2100	-	-	5.00	4.95	-	-	5.00	5.00
	2200	-	-	5.00	5.00	-	-	-	-
	2300	-	-	-	-	-	-	-	-
	2400	-	-	-	-	-	-	-	-
	2500	-	-	-	-	-	-	-	-

Table 4
Maximum Planar Average Initial Enrichment for EOS-37PTH

(2 Pages)

PWR Fuel Class	Maximum Planar Average Initial Enrichment (wt. % U-235) as a Function of Soluble Boron Concentration and Basket Type (Fixed Poison Loading) With and Without CCs								
	Minimum Soluble Boron (ppm)	Basket Type							
		A1/A2/A3/A4H/A4L/A5				B1/B2/B3/B4H/B4L/B5			
		w/o CCs		w/ CCs		w/o CCs		w/ CCs	
		INTACT FUEL	DAMAGED/ FAILED FUEL(2)	INTACT FUEL	DAMAGED/ FAILED FUEL(2)	INTACT FUEL	DAMAGED/ FAILED FUEL(3)	INTACT FUEL	DAMAGED/ FAILED FUEL(3)
WE 14x14 Class	2000	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	2100	-	-	-	-	-	-	-	-
	2200	-	-	-	-	-	-	-	-
	2300	-	-	-	-	-	-	-	-
	2400	-	-	-	-	-	-	-	-
	2500	-	-	-	-	-	-	-	-

Notes:

1. Not analyzed.
2. May only be stored in basket types A4H and A4L
3. May only be stored in basket types B4H and B4L

Table 5
Minimum B-10 Content in the Neutron Poison Plates of the EOS-37PTH DSC

Basket Type	Minimum B-10 Content (areal density) for MMC (mg/cm^2)
A1/A2/A3/A4H/A4L/A5	28.0
B1/B2/B3/B4H/B4L/B5	35.0

Table 6
Fuel Assembly Design Characteristics for the EOS-89BTH DSC

BWR FUEL CLASS	BWR Fuel ID	Example Fuel Designs (1)(2)
7 x 7	*ENC-7-A*	*ENC-IIIA*
7 x 7	*ENC-7-B*	*ENC-III* *ENC-IIIE* *ENC-IIIF*
7 x 7	*GE-7-A*	*GE-1, GE-2, GE-3*
8 x 8	*ENC-8-A*	*ENC Va and Vb*
8 x 8	*ABB-8-A*	*SVEA-64*
8 x 8	*ABB-8-B*	*SVEA-64*
8 x 8	*FANP-8-A*	*FANP 8x8-2*
8 x 8	*GE-8-A*	*GE-4, XXX-RCN*
8 x 8	*GE-8-B*	*GE-5, GE-Pres* *GE-Barrier* *GE-8 Type 1*
8 x 8	*GE-8-C*	*GE-8 Type II*
8 x 8	*GE-8-D*	*GE-9, GE-10*
9 x 9	*FANP-9-A*	*FANP-9x9-79/2* *FANP-9x9-72* *FANP-9x9-80* *FANP-9x9-81*
9 x 9	*FANP-9-B*	*Siemens QFA* *ATRIUM 9*
9 x 9	*GE-9-A*	*GE-11, GE-13*
10 x 10	*ABB-10-A*	*SVEA-92* *SVEA-96Opt* *SVEA-100*
10 x 10	*ABB-10-B*	*SVEA-92* *SVEA-96* *SVEA-100*
10 x 10	*ABB-10-C*	*SVEA-96Opt2*
10 x 10	*FANP-10-A*	*ATRIUM 10* *ATRIUM 10XM*
10 x 10	*GE-10-A*	*GE-12, GE-14*
10 x 10	*GE-10-B*	*GNF2*
11 x 11	*FANP-11-A*	*ATRIUM 11*

Notes:

1. Any fuel channel average thickness up to 0.120 inch is acceptable on any of the fuel designs.
2. Example BWR fuel designs are listed herein and are not all-inclusive.

Table 7A
PWR Minimum Enrichments as a Function of Burnup

Burnup Range (GWd/MTU)	Minimum Enrichment (wt. % U-235)
1-6	0.7
7-16	1.3
17-30	1.8
31-62	Burnup/16[(1)]

Notes:

(1) Round enrichment down to the nearest 0.1%. Example: for 62 GWd/MTU, 62/16 = 3.875%, round down to 3.8%.

(2) Fuel below the minimum enrichment defined in this table is classified as LOW-ENRICHED OUTLIER FUEL. Number and location are specified in Section 2.1.

Table 7B
EOS-37PTH DSC Fuel Qualification Table, All Fuel

(Minimum required years of cooling time after reactor core discharge)

Burnup (GWd/FA)	Fuel Assembly Average Initial U-235 Enrichment (wt.%)												
	0.7	1.3	1.8	2.0	2.5	2.8	3.1	3.4	3.7	3.8	4.0	4.5	5.0
2.95	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
4.92		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
9.84			2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
14.76			2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
19.68					2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
22.14						2.16	2.12	2.09	2.05	2.04	2.02	2.00	2.00
24.60							2.35	2.31	2.28	2.26	2.24	2.18	2.14
27.06								2.55	2.51	2.49	2.47	2.41	2.35
29.52									2.76	2.75	2.71	2.64	2.58
30.50										2.85	2.82	2.74	2.67
34.10										3.22	3.20	3.11	3.03

Notes:

(1) The minimum cooling time is 2.0 years.

(2) The burnup in GWd/FA is the assembly average burnup in GWd/MTU multiplied by the MTU of the fuel assembly.

(3) Linear interpolation is allowed to obtain a cooling time within the specified range of burnup and enrichment values.

(4) Extrapolation is allowed to obtain a cooling time in the gray-shaded region.

Table 7C
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Table 8
Maximum Lattice Average Initial Enrichment and Minimum B-10 Areal Density for the EOS-89BTH DSC

Basket Type	***Loading Configuration - Number of Fuel Assemblies*** ***(1)***	***Maximum Lattice Average Initial Enrichment (wt. % U-235)***			***Minimum B-10 Areal Density (mg/cm²)***	
		All fuel Except ABB-10-C and ATRIUM 11	***ABB-10-C Fuel***	***ATRIUM 11 Fuel***	***MMC***	***BORAL®***
A1/A2/A3 *(2)*	*89*	*4.20*	*4.05*	*4.05*	*32.7*	*39.2*
	88	*4.45*	*4.25*	*4.25*		
	87	*4.60*	*4.40*	*4.35*		
	84	*5.00*	*4.90*	*4.80*		
B1/B2/B3 *(2)*	*89*	*4.55*	*4.35*	*4.30*	*41.3*	*49.6*
	88	*4.80*	*4.60*	*4.50*		
	87	*4.95*	*4.70*	*4.65*		
	84	*5.00*	*5.00*	*5.00*		
C1/C2/C3 *(2)*	*89*	*4.85*	*4.60*	*(3)*	*Not Allowed*	*60.0*

Note:

1. *See Figure 10 for 88-FA, 87-FA and 84-FA loading configurations.*
2. *Mixing fuel types in the same DSC is permissible based on the calculated enrichments for each fuel type for a given basket type and loading configuration. For example, when mixing GNF2 and ATRIUM 11 fuels in basket type A1/A2/A3 and 88-fuel-assembly loading configuration, the maximum enrichment for GNF2 fuels is 4.45wt% and the maximum enrichment for ATRIUM 11 fuels is 4.25wt%.*
3. *ATRIUM 11 fuel is not an allowed content for basket type C1/C2/C3.*

Table 9
Maximum Lattice Average Initial Enrichment and Minimum B-10 Areal Density for the 61BTH Type 2 DSC (Intact Fuel)

Basket Type	Maximum Lattice Average Initial Enrichment (wt. % U-235)(1)	Minimum B-10 Areal Density, (mg/cm^2)	
		Borated Aluminum/MMC	Boral®
A	3.7	22	27
B	4.1	32	38
C	4.4	42	50
D	4.6	48	58
E	4.8	55	66
F	5.0(1)	62	75

Note:

1) For ATRIUM 11 fuel assemblies, the U-235 wt. % enrichment is reduced by 0.55%. The ATRIUM 11 fuel assemblies are authorized for storage in the Type F basket only.

Table 10
Maximum Lattice Average Initial Enrichment and Minimum B-10 Areal Density for the 61BTH Type 2 DSC (Damaged Fuel)

Basket Type	Maximum Lattice Average Initial Enrichment (wt. % U-235)		Minimum B-10 Areal Density, (mg/cm^2)	
	Up to 4 Damaged Assemblies(1)	Five or More Damaged Assemblies(1) (16 Maximum)	Borated Aluminum/MMC	Boral®
A	3.7	2.80	22	27
B	4.1	3.10	32	38
C	4.4	3.20	42	50
D	4.6	3.40	48	58
E	4.8	3.50	55	66
F	5.0(2, 3)	3.60	62	75

Notes:

1) See Figure 5 for the location of damaged fuel assemblies within the 61BTH Type 2 DSC.
2) ATRIUM 11 fuel assemblies are authorized for storage only in the Type F basket only with a maximum of 4 damaged fuel assemblies.
3) For ATRIUM 11 fuel assemblies, the U-235 wt. % enrichment is reduced by 0.55%.

Table 11
Maximum Lattice Average Initial Enrichment and Minimum B-10 Areal Density for the 61BTH Type 2 DSC (Failed and Damaged Fuel)

Basket Type	Maximum Lattice Average Initial Enrichment (wt. % U-235)		Minimum B-10 Areal Density (mg/cm^2)	
	Up to 4 Failed Assemblies (Corner Locations)(1, 2)	Up to 4 Failed Assemblies (Corner Locations) and up to 12 Damaged Assemblies (Interior Locations)(1, 2)	Borated Aluminum/MMC	Boral®
A	3.7	2.8	22	27
B	4.0	3.1	32	38
C	4.4	3.2	42	50
D	4.6	3.4	48	58
E	4.8	3.4	55	66
F	5.0	3.5	62	75

Notes:

1) See Figure 5 for the locations of the failed and damaged assemblies within the 61BTH Type 2 DSC.
2) Failed ATRIUM 11 fuel assemblies are not authorized for storage in the 61BTH Type 2 DSC.

Table 12
Maximum Lattice Average Initial Enrichments and Minimum B-10 Areal Density for the 61BTH Type 2 DSC for > 16 Damaged Fuel Assemblies

Basket Type	Up to 57 Damaged Fuel at 3.30 wt. % U-235		Minimum B-10 Areal Density (mg/cm^2)	
	Remaining Four Intact Assemblies (1)	Remaining Four Damaged Assemblies (1)	Borated Aluminum/MMC	Boral®
A	-	-	-	-
B	-	-	-	-
C	-	-	-	-
D	5.00	4.20	48	58
E	5.00	4.20	55	66
F	5.00	4.20	62	75

Note:
1) See Figure 5 for the locations of the damaged assemblies within the 61BTH Type 2 DSC

Table 13
BWR Fuel Assembly Design Characteristics for the 61BTH Type 2 DSC

BWR FUEL CLASS	Initial Design or Reload Fuel Designation[(1) (3)]
7x7-49/0	GE1 GE2 GE3
8x8-63/1	GE4
8x8-62/2	GE-5 GE-Pres GE-Barrier GE8 Type I
8x8-60/4	GE8 Type II
8x8-60/1	GE9 GE10
9x9-74/2	GE11 GE13
10x10-92/2	GE12 GE14 GNF2
7x7-49/0	ENC-IIIA
7x7-48/1Z	ENC-III[(2)]
8x8-60/4Z	ENC Va ENC Vb
8x8-62/2	FANP 8x8-2
9x9-79/2	FANP9 9x9-2
Siemens QFA	9x9
10x10-91/1	ATRIUM-10 ATRIUM-10XM
11x11	ATRIUM-11

Notes:

(1) Any fuel channel average thickness up to 0.120 inch is acceptable on any of the fuel designs.

(2) Includes ENC-IIIE and ENC-IIIF.

(3) Initial designs or reload fuel designations belonging to a listed fuel class, but not listed herein may be qualified for storage using the same methodology as documented in the UFSAR.

Table 14
Maximum Uranium Loading per FFC for Failed 61BTH Type 2 Fuel

Fuel Assembly Class	Maximum MTU/Assembly
7x7	0.198
8x8	0.188
9x9	0.180
10x10	0.187

Table 15
System Configurations for EOS-37PTH HLZCs

HLZC	Storage Module	Transfer Cask
1	EOS-HSM	EOS-TC125 EOS-TC135
2	EOS-HSM	EOS-TC108 EOS-TC125 EOS-TC135
3	EOS-HSM	EOS-TC108 EOS-TC125 EOS-TC135
4	EOS-HSM	EOS-TC108 EOS-TC125 EOS-TC135
5	EOS-HSM	EOS-TC108 EOS-TC125 EOS-TC135
6	EOS-HSM	EOS-TC108 EOS-TC125 EOS-TC135
7	HSM-MX	EOS-TC108 EOS-TC125 EOS-TC135
8	HSM-MX	EOS-TC108 EOS-TC125 EOS-TC135
9	HSM-MX	EOS-TC108 EOS-TC125 EOS-TC135
10	EOS-HSM	EOS-TC125 EOS-TC135
11	EOS-HSM HSM-MX	EOS-TC125 EOS-TC135

Table 16
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Table 17
System Configurations for 61BTH Type 2 HLZCs

HLZC	Storage Module	Transfer Cask
1	HSM-MX	OS197/OS197H/ OS197FC-B/OS197HFC-B
2	HSM-MX	OS197/OS197H/ OS197FC-B/OS197HFC-B
3	HSM-MX	OS197/OS197H/ OS197FC-B/OS197HFC-B
4	HSM-MX	OS197/OS197H/ OS197FC-B/OS197HFC-B
5	HSM-MX	OS197FC-B/OS197HFC-B
6	HSM-MX	OS197FC-B/OS197HFC-B
7	HSM-MX	OS197FC-B/OS197HFC-B
8	HSM-MX	OS197FC-B/OS197HFC-B
9	HSM-MX	OS197/OS197H/ OS197FC-B/OS197HFC-B
10	HSM-MX	OS197FC-B/OS197HFC-B

Table 18
BWR Minimum Enrichments as a Function of Burnup (*EOS-89BTH DSC and* 61BTH Type 2 DSC)

Burnup Range (GWd/MTU)	Minimum Enrichment (wt. %)
1-6	0.7
7-19	0.9
20-35	Burnup/20(1)
36-62	Burnup/16(1)

Notes:

1) Round down to the nearest 0.1%. Example: for 62 GWd/MTU, 62/16 = 3.875%, round down to 3.8%.
2) Fuel below the minimum enrichment defined in this table is classified as LOW-ENRICHED OUTLIER FUEL. Number and location are specified in *Section 2.2 for the EOS-89BTH DSC and in* Section 2.3 *for the 61BTH Type 2 DSC*.

Table 19
61BTH Type 2 DSC Fuel Qualification Table, All Fuel

(Minimum required years of cooling time after reactor core discharge)

Burnup (GWd/FA)	Fuel Assembly Average Initial U-235 Enrichment (wt.%)														
	0.7	0.9	1.0	1.5	1.7	2.2	2.5	2.8	3.1	3.4	3.7	3.8	4.0	4.5	5.0
1.19	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1.39		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2.97		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
3.76		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
3.96			2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
5.94				2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
6.93					2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
7.13						2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
7.92							2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
8.91								2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
9.90									2.11	2.06	2.01	2.00	2.00	2.00	2.00
10.89										2.29	2.24	2.22	2.19	2.11	2.05
11.88											2.48	2.46	2.43	2.34	2.27
12.28												2.57	2.53	2.44	2.36

Notes:

1) The minimum cooling time is 2.0 years.
2) The burnup in GWd/FA is the assembly average burnup in GWd/MTU multiplied by the MTU of the fuel assembly.
3) Linear interpolation is allowed to obtain a cooling time within the specified range of burnup and enrichment values.
4) Extrapolation is allowed to obtain a cooling time in the gray-shaded region.

Table 20
61BTH Type 2 DSC Fuel Qualification Table, HLZC 2, 4, 5, 6, 7, and 8, Peripheral Locations

(Minimum required years of cooling time after reactor core discharge)

Burnup (GWd/FA)	Fuel Assembly Average Initial U-235 Enrichment (wt.%)														
	0.7	0.9	1.0	1.5	1.7	2.2	2.5	2.8	3.1	3.4	3.7	3.8	4.0	4.5	5.0
1.19	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1.39		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2.97		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
3.76		2.35	2.33	2.23	2.20	2.12	2.09	2.06	2.03	2.01	2.00	2.00	2.00	2.00	2.00
3.96			2.41	2.31	2.28	2.20	2.16	2.13	2.10	2.08	2.06	2.05	2.04	2.02	2.00
5.94				3.13	3.09	2.98	2.93	2.88	2.83	2.79	2.75	2.74	2.72	2.67	2.63
6.93					3.55	3.43	3.36	3.29	3.24	3.18	3.14	3.12	3.10	3.03	2.98
7.13						3.52	3.45	3.39	3.33	3.27	3.22	3.21	3.18	3.11	3.06
7.92							3.87	3.79	3.71	3.64	3.58	3.57	3.53	3.45	3.38
8.91								4.39	4.29	4.20	4.12	4.10	4.05	3.94	3.85
9.90									5.03	4.91	4.80	4.77	4.70	4.56	4.43
10.89										5.86	5.70	5.65	5.56	5.35	5.18
11.88											6.97	6.89	6.75	6.45	6.19
12.28												7.53	7.36	7.00	6.70

Notes:

1) The minimum cooling time is 2.0 years.
2) The burnup in GWd/FA is the assembly average burnup in GWd/MTU multiplied by the MTU of the fuel assembly.
3) Linear interpolation is allowed to obtain a cooling time within the specified range of burnup and enrichment values.
4) Extrapolation is allowed to obtain a cooling time in the gray-shaded region.
5) The peripheral locations are defined in Figure 6.

Table 21
EOS-89BTH DSC Fuel Qualification Table, All Fuel

(Minimum required years of cooling time after reactor core discharge)

Burnup (GWd/FA)	Fuel Assembly Average Initial U-235 Enrichment (wt.%)														
	0.7	0.9	1.0	1.5	1.7	2.2	2.5	2.8	3.1	3.4	3.7	3.8	4.0	4.5	5.0
1.19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.39		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2.97		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3.76		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3.96			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5.94				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6.93					1.11	1.06	1.03	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7.13						1.09	1.06	1.03	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7.92							1.17	1.14	1.11	1.08	1.06	1.05	1.04	1.00	1.00
8.91								1.28	1.25	1.22	1.19	1.18	1.16	1.12	1.09
9.90									1.40	1.36	1.33	1.32	1.30	1.25	1.21
10.89										1.51	1.48	1.46	1.44	1.39	1.34
11.88											1.63	1.62	1.59	1.53	1.48
12.28												1.68	1.66	1.60	1.54

Notes:

1) *The minimum cooling time is 1.0 year.*
2) *The burnup in GWd/FA is the assembly average burnup in GWd/MTU multiplied by the MTU of the fuel assembly.*
3) *Linear interpolation is allowed to obtain a cooling time within the specified range of burnup and enrichment values.*
4) *Extrapolation is allowed to obtain a cooling time in the gray-shaded region.*
5) *For fuel transferred in the EOS-TC108, additional cooling time restrictions are specified in Figure 2.*

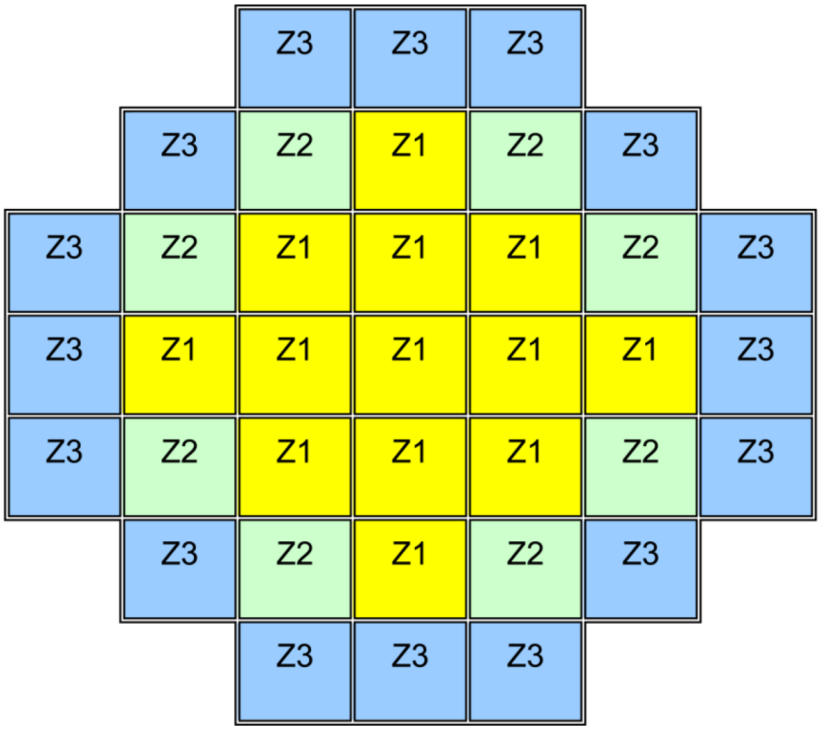
Table 22
EOS-89BTH DSC Reconstituted Fuel Limits for Transfer in the EOS-TC125

Parameter	*Limit*
Number of RECONSTITUTED FUEL ASSEMBLIES per DSC	*≤ 89*
Maximum number of irradiated stainless steel rods per RECONSTITUTED FUEL ASSEMBLY	*Per table below*
Minimum cooling time	*Per table below*

Number of Irradiated Stainless Steel Rods per Fuel Assembly										*Minimum Cooling Time (years)*
7x7 Class		*8x8 Class*		*9x9 Class*		*10x10 Class*		*11x11 Class*		
Min.	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	*Min.*	*Max.*	
0	*5*	*0*	*6*	*0*	*7*	*0*	*9*	*0*	*11*	*Per Table 21*
6	*15*	*7*	*18*	*8*	*22*	*10*	*26*	*12*	*34*	*2.00*
16	*20*	*19*	*24*	*23*	*29*	*27*	*34*	*35*	*46*	*2.25*
21	*25*	*25*	*30*	*30*	*37*	*35*	*43*	*47*	*57*	*2.50*
26	*30*	*31*	*36*	*38*	*44*	*44*	*51*	*58*	*69*	*2.75*
31	*35*	*37*	*42*	*45*	*51*	*52*	*60*	*70*	*80*	*3.00*
36	*49*	*43*	*64*	*52*	*81*	*61*	*100*	*81*	*112*	*3.25*

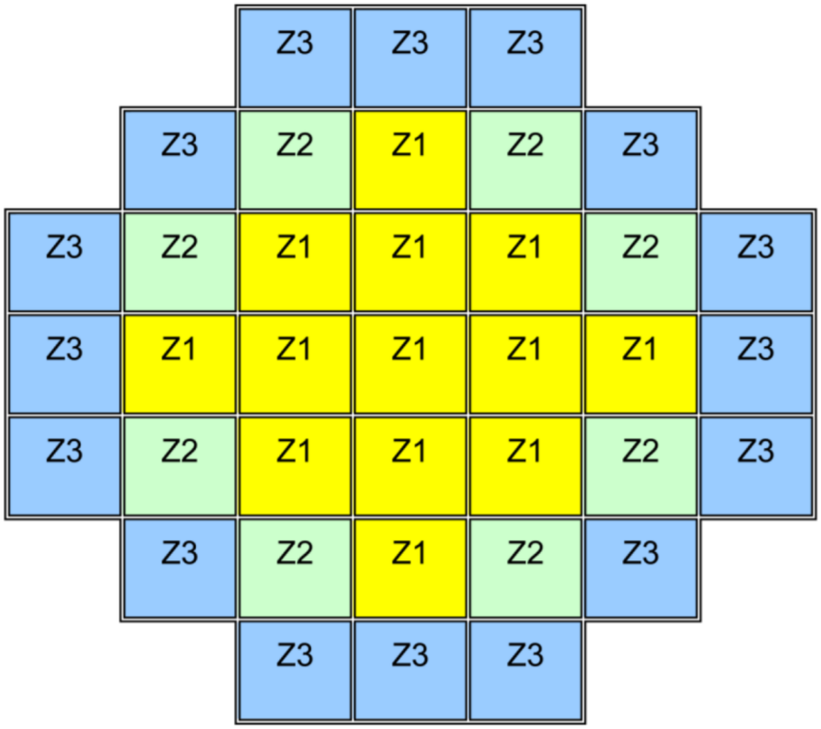
Table 23
EOS-89BTH DSC Reconstituted Fuel Limits for Transfer in the EOS-TC108

Parameter	*Limit*
Number of RECONSTITUTED FUEL ASSEMBLIES per DSC	• *≤ 89 (all types)* • *≤ 49 containing irradiated stainless steel rods*
Maximum number of irradiated stainless steel rods per DSC	• *100 for 7x7 Class* • *120 for 8x8 Class* • *140 for 9x9 Class* • *180 for 10x10 Class* • *220 for 11x11 Class*
Maximum number of irradiated stainless steel rods per RECONSTITUTED FUEL ASSEMBLY	• *5 for 7x7 Class* • *6 for 8x8 Class* • *7 for 9x9 Class* • *9 for 10x10 Class* • *11 for 11x11 Class*
Loading restrictions for locations within the basket	*Per Figure 9*
Minimum cooling time	*Per Table 21*



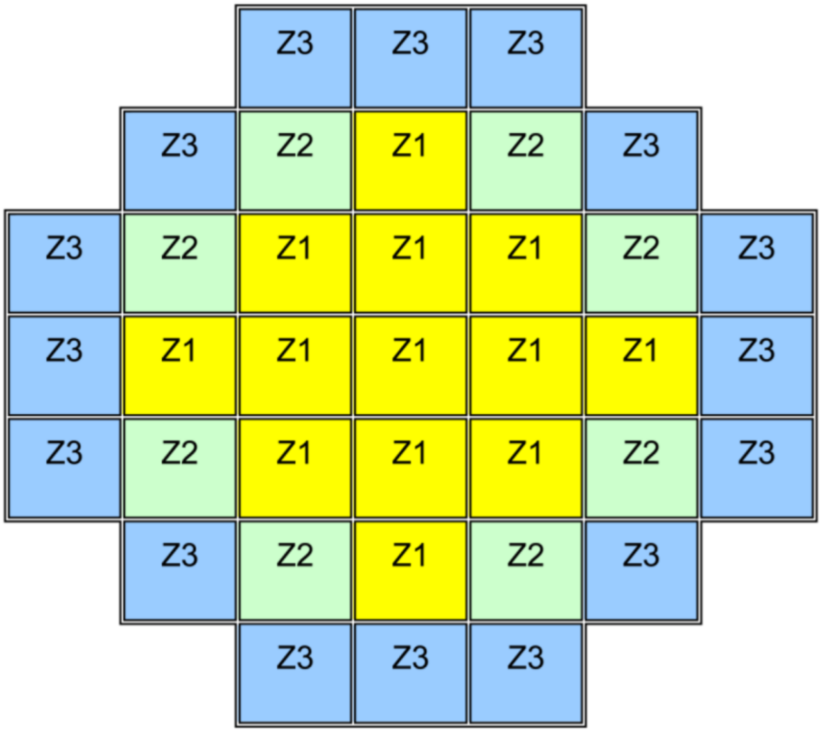
Zone Number	1	2	3
Maximum Decay Heat (kW/FA plus CCs, if included)	1.0	2.0	1.3125
Maximum Number of Fuel Assemblies	13	8	16
Maximum Decay Heat per DSC (kW)	50.0		

Figure 1A
Heat Load Zone Configuration 1 for the EOS-37PTH DSC



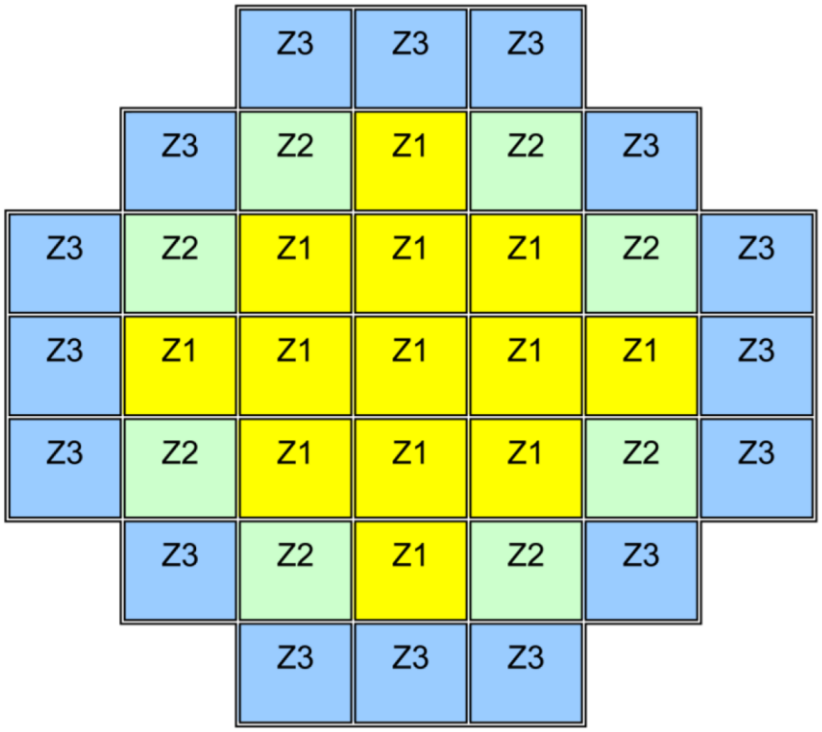
Zone Number	1	2	3
Maximum Decay Heat, (H), (kW/FA plus CCs, if included)	1.0	1.5	1.05
Maximum Number of Fuel Assemblies	13	8	16
Maximum Decay Heat per DSC (kW)	41.8		

Figure 1B
Heat Load Zone Configuration 2 for the EOS-37PTH DSC



Zone Number	1	2	3
Maximum Decay Heat (kW/FA plus CCs, if included)	0.95	1.0	1.0
Maximum Number of Fuel Assemblies	13	8	16
Maximum Decay Heat per DSC (kW)	36.35		

Figure 1C
Heat Load Zone Configuration 3 for the EOS-37PTH DSC

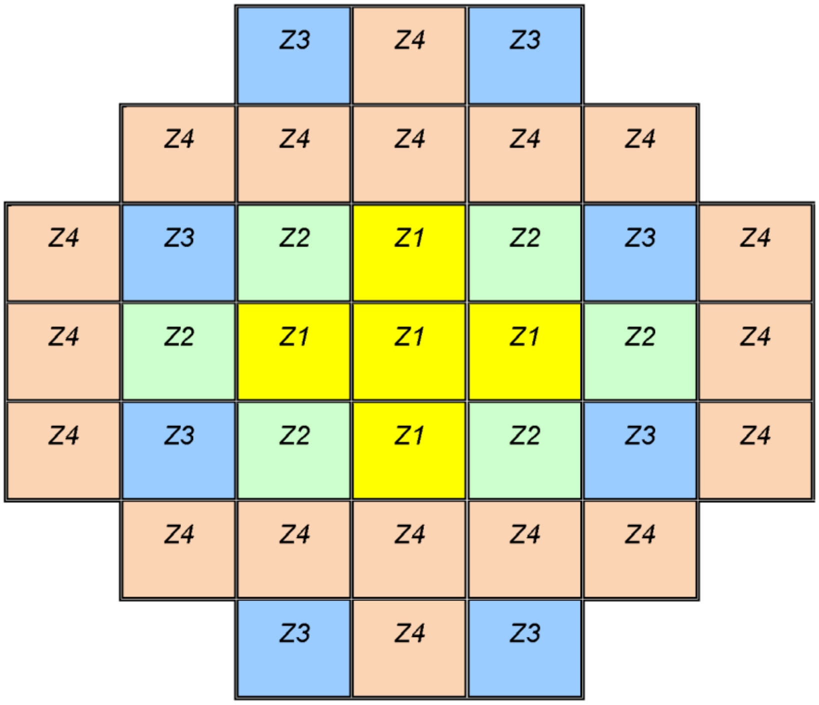


Zone Number	1	2	3
Maximum Decay Heat (kW/FA plus CCs, if included)	1.0	1.625	1.6
Maximum Number of Fuel Assemblies	13	8	16
Maximum Decay Heat per DSC (kW)	50.0^(1)		

Notes:

1. Adjust payload to maintain total canister heat load within the specified limit.

Figure 1D
Heat Load Zone Configuration 4 for the EOS-37PTH DSC



Zone Number	1	2	3	4
Maximum Decay Heat (kW/FA plus CCs, if included)	0.7	0.5	2.4	0.85
Maximum Number of Fuel Assemblies	5	6	8	18
Maximum Decay Heat per DSC (kW)	41.0			

Notes:

1. Adjust payload to maintain total canister heat load within the specified limit.

Figure 1E
Heat Load Zone Configuration 5 for the EOS-37PTH DSC

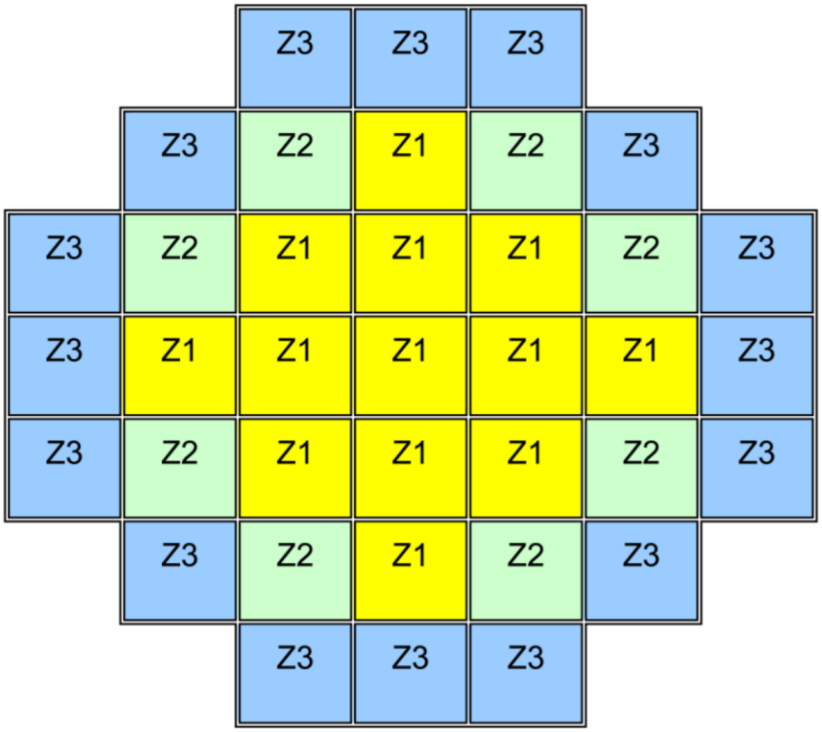
		Z3	Z3**	Z3		
	Z3	Z2*	Z1	Z2*	Z3	
Z3	Z2*	Z1	Z1	Z1	Z2*	Z3
Z3**	Z1	Z1	Z1	Z1	Z1	Z3**
Z3	Z2*	Z1	Z1	Z1	Z2*	Z3
	Z3	Z2*	Z1	Z2*	Z3	
		Z3	Z3**	Z3		

(*) denotes location where INTACT or DAMAGED FUEL can be stored.
(**) denotes location where INTACT or FAILED FUEL can be stored.

Zone Number	1	2(1)	3(1)
Maximum Decay Heat (kW/FA plus CCs, if included)	1.0	1.5	1.3125(2)
Maximum Number of Fuel Assemblies	13	8	16
Maximum Decay Heat per DSC (kW)	46.00		

1. DAMAGED FUEL and FAILED FUEL shall not be loaded in the same DSC.
2. The maximum allowable heat load per FAILED FUEL compartment is 0.8 kW.

Figure 1F
Heat Load Zone Configuration 6 for the EOS-37PTH DSC



Zone Number	1	2	3
Maximum Number of Fuel Assemblies	13	8	16
Upper Compartment			
Maximum Decay Heat (kW/FA plus CCs, if included)	1.0	1.60	1.3125
Maximum Decay Heat per DSC (kW)	41.8[(1)]		
Lower Compartment			
Maximum Decay Heat (kW/FA plus CCs, if included)	0.9	1.60	1.60
Maximum Decay Heat per DSC (kW)	50.0[(1)]		

Notes:

1. Adjust payload to maintain total canister heat load within the specified limit.

Figure 1G
Heat Load Zone Configuration 7 for the EOS-37PTH DSC

		Z3	Z3**	Z3		
	Z3	Z2*	Z1	Z2*	Z3	
Z3	Z2*	Z1	Z1	Z1	Z2*	Z3
Z3**	Z1	Z1	Z1	Z1	Z1	Z3**
Z3	Z2*	Z1	Z1	Z1	Z2*	Z3
	Z3	Z2*	Z1	Z2*	Z3	
		Z3	Z3**	Z3		

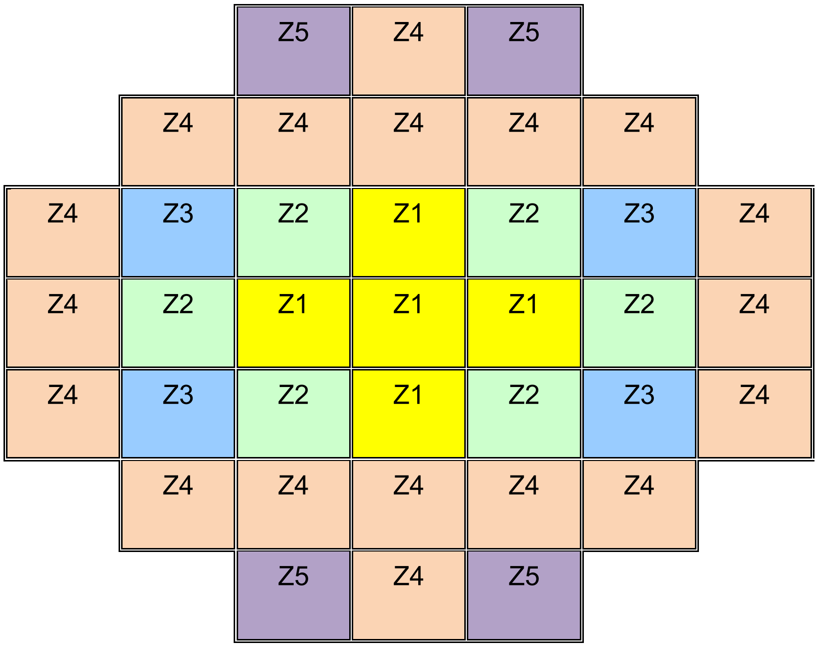
(*) denotes location where INTACT or DAMAGED FUEL can be stored.
(**) denotes location where INTACT or FAILED FUEL can be stored.

Zone Number	1	2[2]	3[2][3]
Maximum Number of Fuel Assemblies	13	8	16
Upper Compartment			
Maximum Decay Heat (kW/FA plus CCs, if included)	0.8	1.50	1.50
Maximum Decay Heat per DSC (kW)	41.8[1][4]		
Lower Compartment			
Maximum Decay Heat (kW/FA plus CCs, if included)	0.8	1.50	1.50
Maximum Decay Heat per DSC (kW)	46.4[1]		

Notes:

1. The maximum decay heat per DSC is limited to 41.8 kW when DAMAGED or FAILED FUEL is loaded.
2. DAMAGED FUEL and FAILED FUEL shall not be loaded in the same DSC.
3. The maximum allowable heat load per FAILED FUEL is 0.8 kW.
4. Adjust payload to maintain total canister heat load within the specified limit.

Figure 1H
Heat Load Zone Configuration 8 for the EOS-37PTH DSC



Zone Number	1	2	3	4	5
Maximum Decay Heat (kW/FA plus CCs, if included)	0.50	0.70	2.0	0.75	2.4
Maximum Number of Fuel Assemblies	5	6	4	18	4
Maximum Decay Heat per DSC (kW)	37.80				

Figure 1I
Heat Load Zone Configuration 9 for the EOS-37PTH DSC

		Z2*	Z1	Z2*		
	Z3	Z3	Z3	Z3	Z3	
Z2*/**	Z3	Z1	Z1	Z1	Z3	Z2*/**
Z1	Z3	Z1	Z1	Z1	Z3	Z1
Z2*	Z3	Z1	Z1	Z1	Z3	Z2*
	Z3	Z3	Z3	Z3	Z3	
		Z2	Z1	Z2		

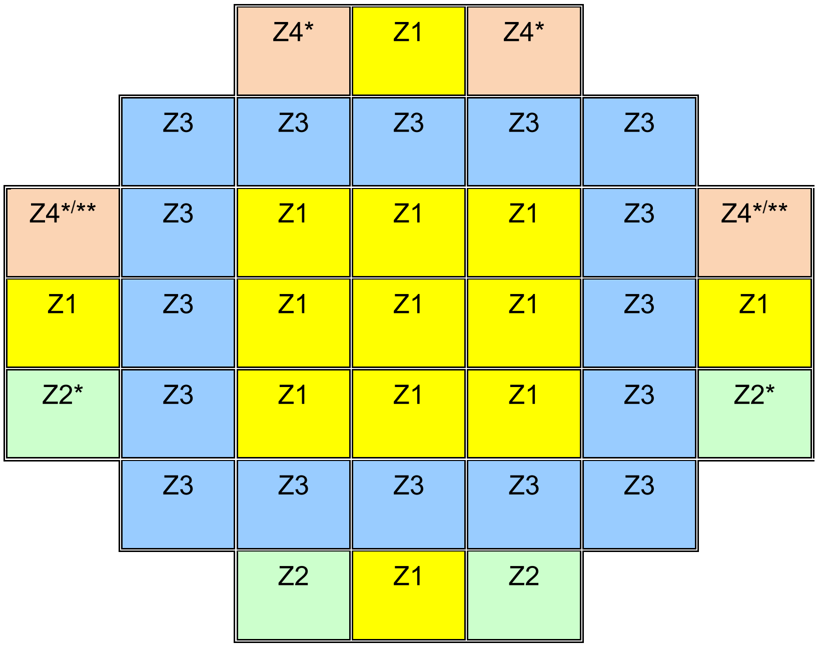
(*) denotes location where INTACT or DAMAGED FUEL ASSEMBLY can be stored.
(**) denotes location where INTACT or FAILED FUEL can be stored.

Zone Number	1	2(1)	3
Max Decay Heat (kW/ plus CCs, if included)	0.5	3.5(2)	0.7
Maximum Number of Fuel Assemblies	13	8	16
Maximum Decay Heat per DSC (kW)	45.7		

Notes:

1. DAMAGED FUEL and FAILED FUEL shall not be loaded in the same DSC.
2. The maximum allowable heat load per FAILED FUEL is 0.8 kW.

Figure 1J
Heat Load Zone Configuration 10 for the EOS-37PTH DSC



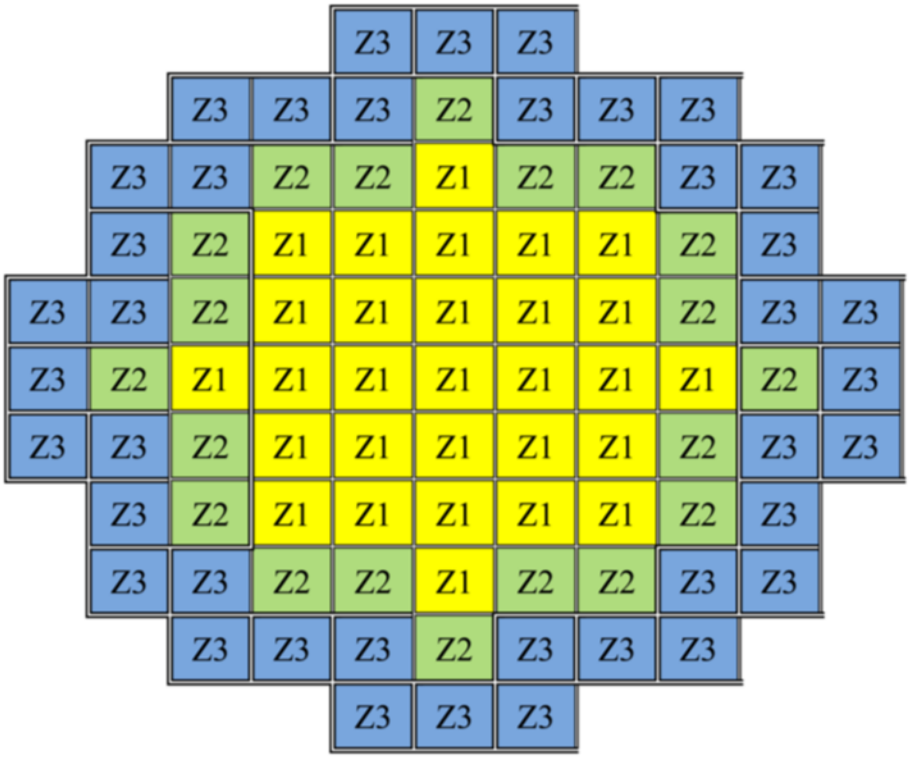
(*) denotes location where INTACT or DAMAGED FUEL ASSEMBLY can be stored.
(**) denotes location where INTACT or FAILED FUEL can be stored.

Zone Number	1	2(1)	3	4(1)
Maximum Number of Fuel Assemblies	13	4	16	4
Upper Compartment				
Maximum Decay Heat (kW/FA plus CCs, if included)	0.5	3.0	0.7	3.0(2)
Maximum Decay Heat per DSC (kW)	41.8			
Lower Compartment				
Maximum Decay Heat (kW/FA plus CCs, if included)	0.5	3.5	0.7	3.2(2)
Maximum Decay Heat per DSC (kW)	44.5			

Notes:

1. DAMAGED FUEL and FAILED FUEL shall not be loaded in the same DSC.
2. The maximum allowable heat load per FAILED FUEL is 0.8 kW.

Figure 1K
Heat Load Zone Configuration 11 for the EOS-37PTH DSC



Heat Load Zone Configuration 2

Zone Number	1	2	3(1)
Maximum Decay Heat (kW/FA plus channel, if included)	0.4	0.5	0.5
Maximum Number of Fuel Assemblies	29	20	40
Maximum Decay Heat per DSC (kW)	41.6		

Heat Load Zone Configuration 3

Zone Number	1	2	3(2)
Maximum Decay Heat (kW/FA plus channel, if included)	0.36	0.4	0.4
Maximum Number of Fuel Assemblies	29	20	40
Maximum Decay Heat per DSC (kW)	34.44		

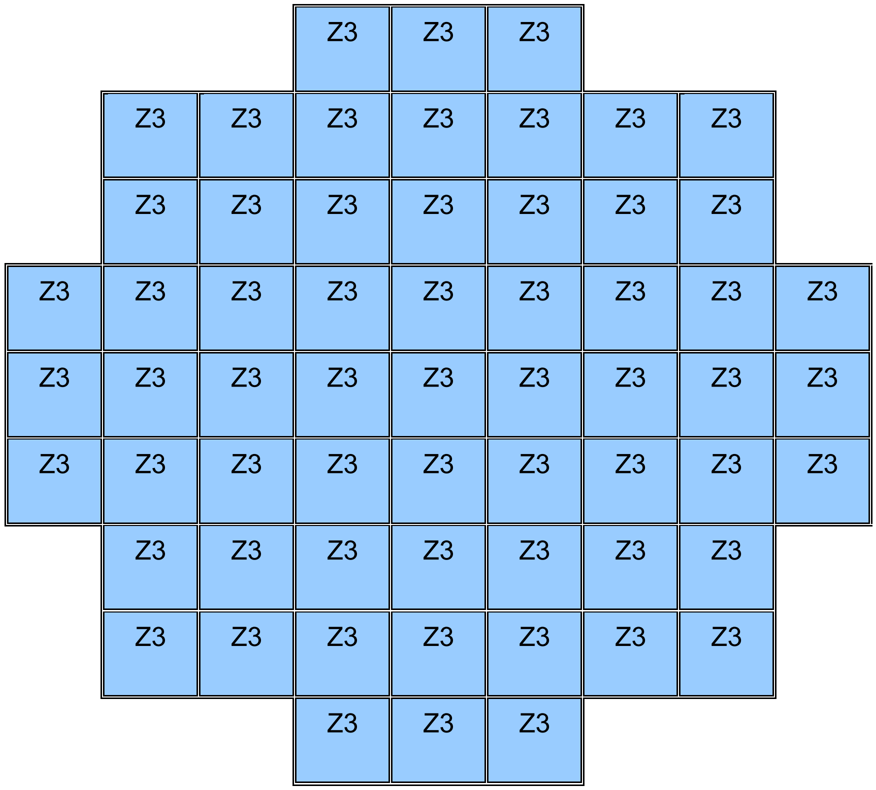
Notes:

1. The minimum cooling time for HLZC 2 Zone 3 in the EOS-TC108 is 9.7 years.
2. The minimum cooling time for HLZC 3 Zone 3 in the EOS-TC108 is 9.0 years.

Figure 2
EOS-89BTH DSC Heat Load Zone Configurations for transfer in the EOS-TC108

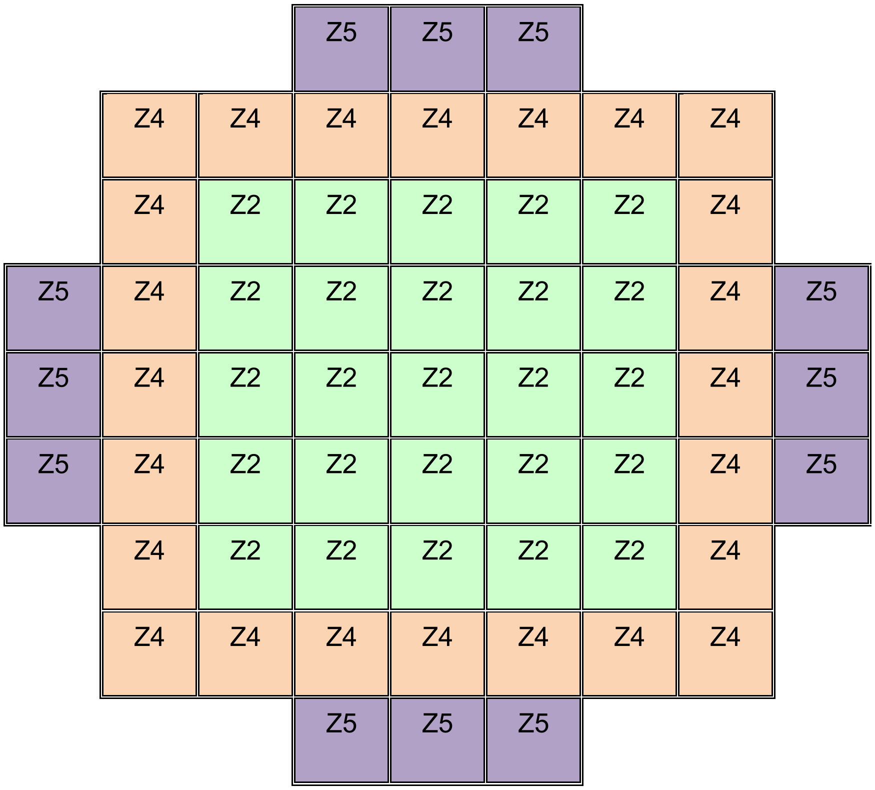
		P	P	P		
	P	I	I	I	P	
P	I	I	I	I	I	P
P	I	I	I	I	I	P
P	I	I	I	I	I	P
	P	I	I	I	P	
		P	P	P		

Figure 3
Peripheral (P) and Inner (I) Fuel Locations for the EOS-37PTH DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	NA	NA	0.393	NA	NA	NA
Maximum Decay Heat per Zone (kW)	NA	NA	22.0	NA	NA	NA
Maximum Decay Heat per DSC (kW)	22.0					

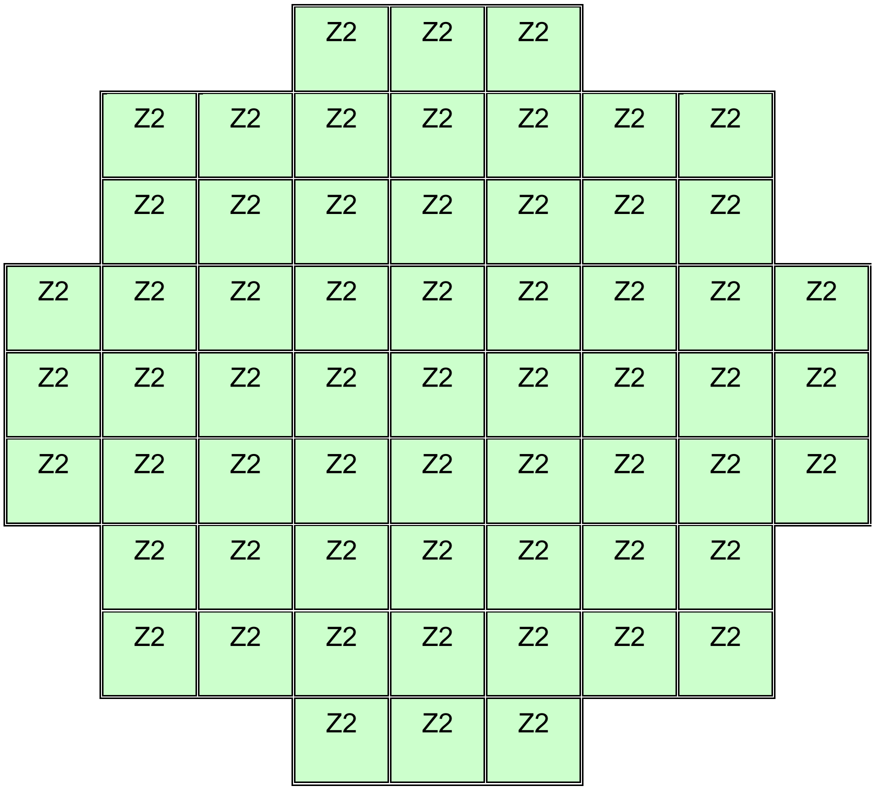
Figure 4A
Heat Load Zone Configuration 1 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	NA	0.35	NA	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	8.75	NA	11.52	6.48	NA
Maximum Decay Heat per DSC (kW)	22.0(1)					

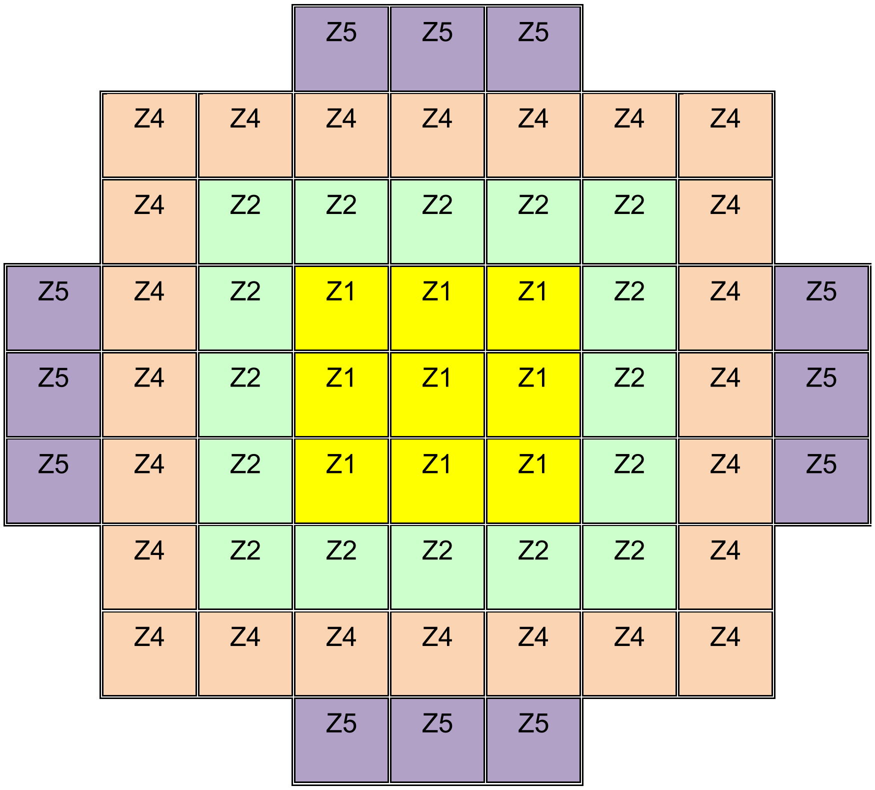
(1) Adjust payload to maintain total DSC heat load within the specified limit

Figure 4B
Heat Load Zone Configuration 2 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	NA	0.35	NA	NA	NA	NA
Maximum Decay Heat per Zone (kW)	NA	19.4	NA	NA	NA	NA
Maximum Decay Heat per DSC (kW)	19.4					

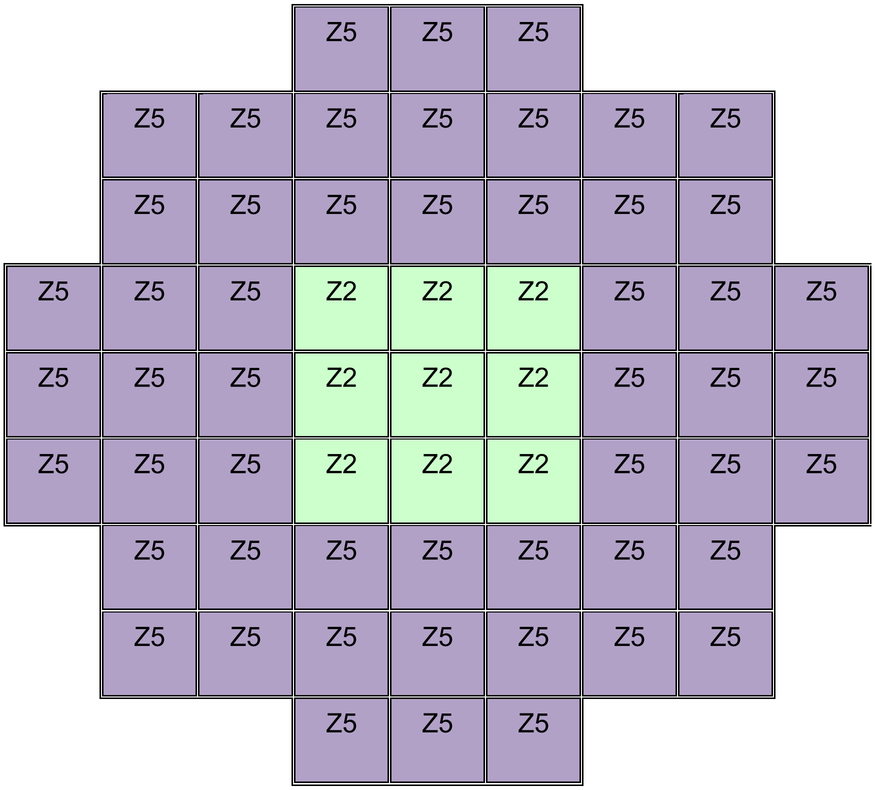
Figure 4C
Heat Load Zone Configuration 3 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	0.22	0.35	NA	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	1.98	5.60	NA	11.52	6.48	NA
Maximum Decay Heat per DSC (kW)	19.4(1)					

(1) Adjust payload to maintain total DSC heat load within the specified limit.

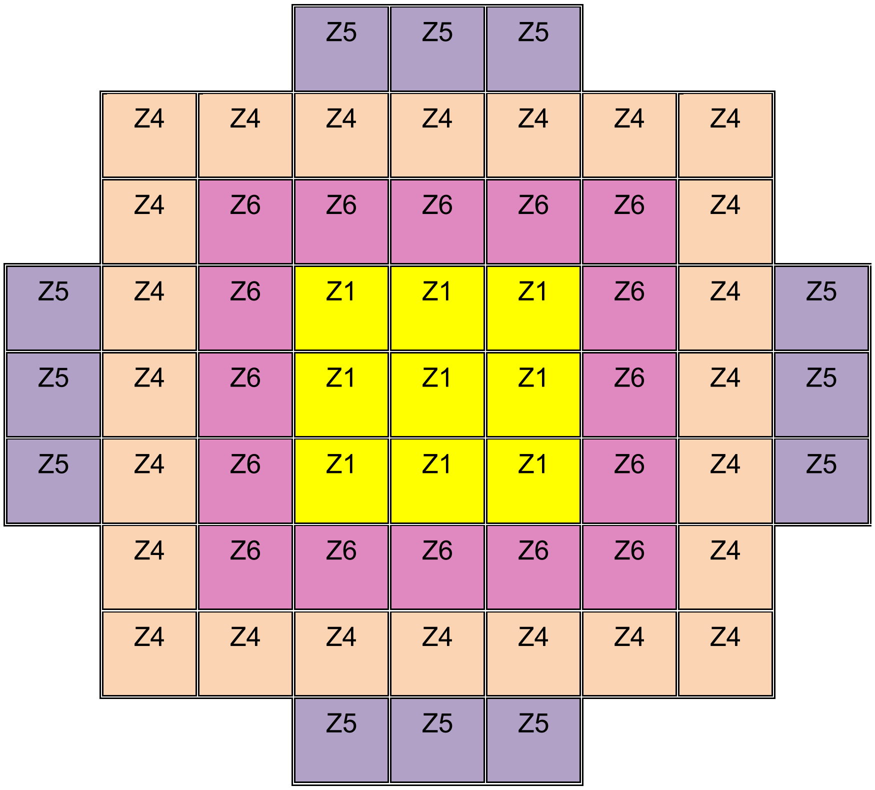
Figure 4D
Heat Load Zone Configuration 4 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	NA	0.35	NA	NA	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	3.15	NA	NA	28.08	NA
Maximum Decay Heat per DSC (kW)	31.2(1)					

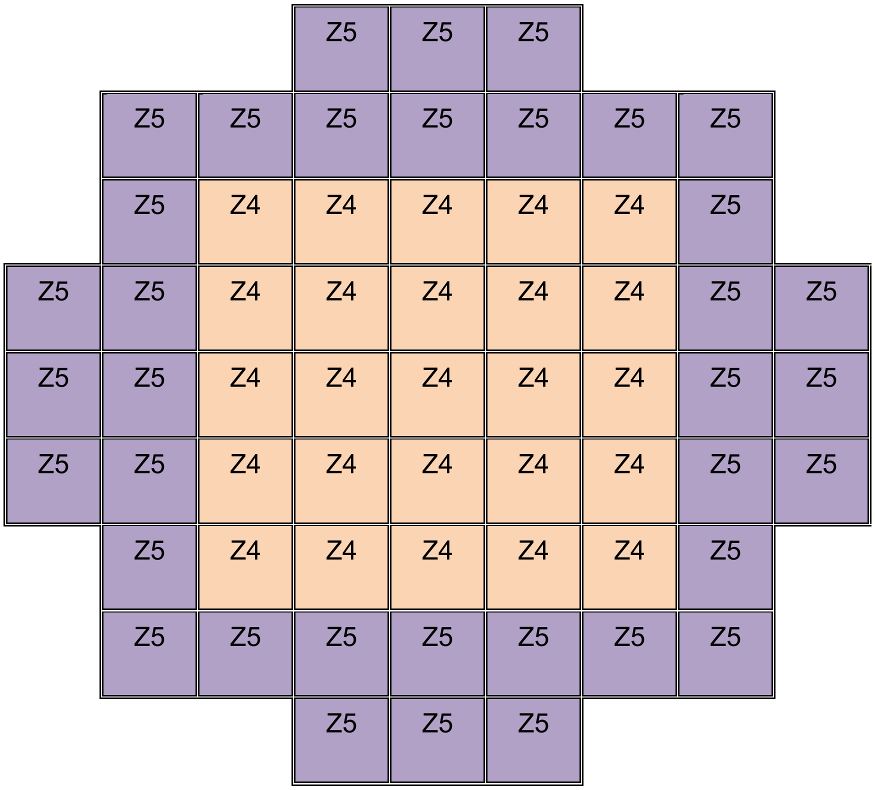
(1) Adjust payload to maintain total DSC heat load within the specified limit.

Figure 4E
Heat Load Zone Configuration 5 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	0.22	NA	NA	0.48	0.54	0.70
Maximum Decay Heat per Zone (kW)	1.98	NA	NA	11.52	6.48	11.20
Maximum Decay Heat per DSC (kW)	31.2					

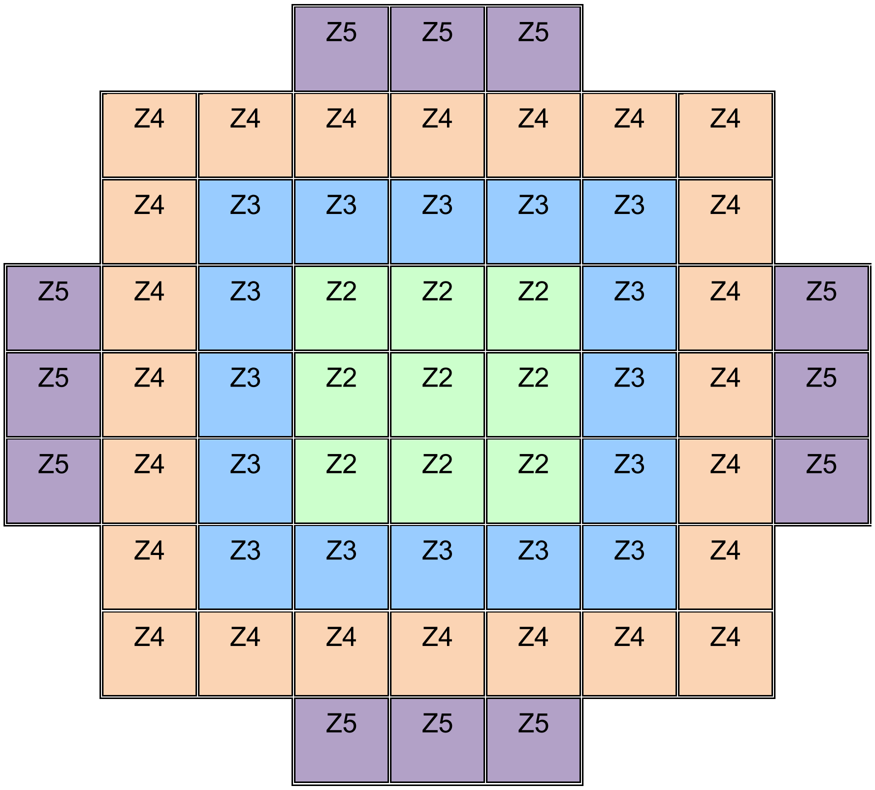
Figure 4F
Heat Load Zone Configuration 6 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	NA	NA	NA	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	NA	NA	12.00	19.44	NA
Maximum Decay Heat per DSC (kW)	31.2(1)					

(1) Adjust payload to maintain total DSC heat load within the specified limit.

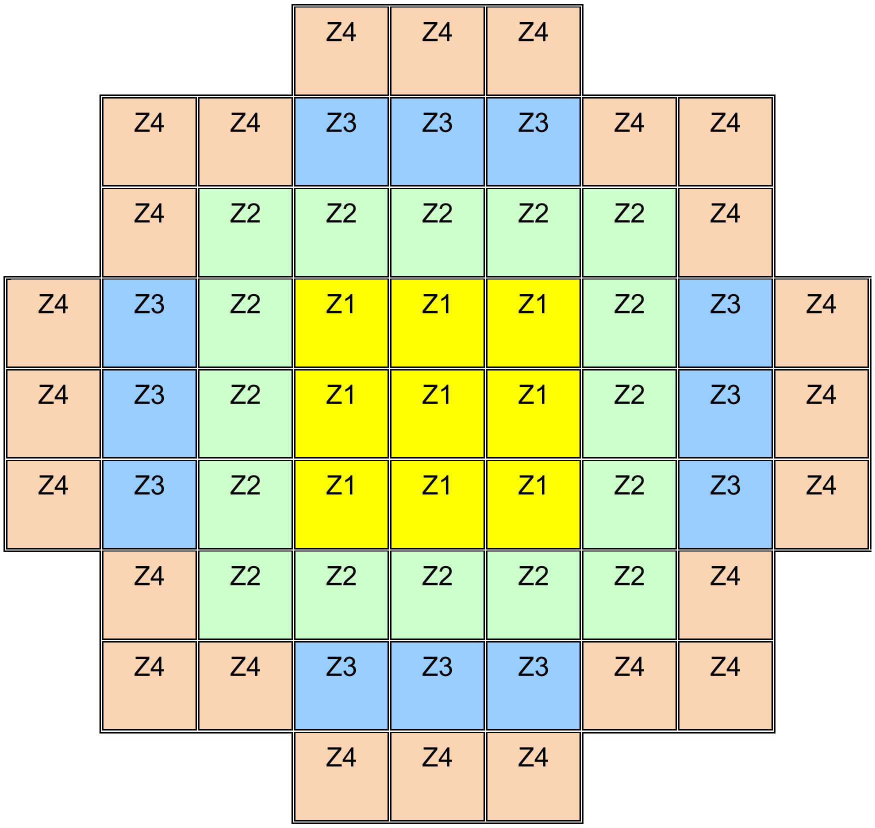
Figure 4G
Heat Load Zone Configuration 7 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Maximum Decay Heat (kW/FA)	NA	0.35	0.393	0.48	0.54	NA
Maximum Decay Heat per Zone (kW)	NA	3.15	6.288	11.52	6.48	NA
Maximum Decay Heat per DSC (kW)	27.4[(1)]					

[(1)] Adjust payload to maintain total DSC heat load within the specified limit.

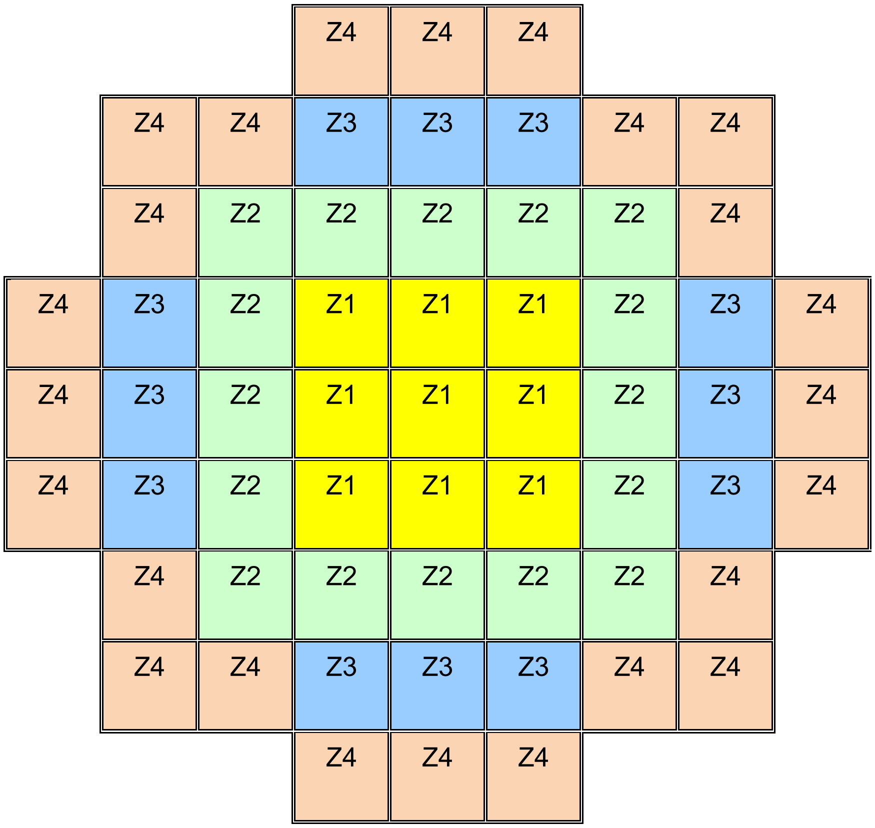
Figure 4H
Heat Load Zone Configuration 8 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4
Maximum Decay Heat (kW/FA)	0.393	0.48	0.35	0.35
Maximum Decay Heat per Zone (kW)	3.54	7.68	4.2	8.4
Maximum Decay Heat per DSC (kW)	22.0[1]			

Note 1: Adjust payload to maintain total canister heat load within the specified limit.

Figure 4I
Heat Load Zone Configuration 9 for the 61BTH Type 2 DSC



	Zone 1	Zone 2	Zone 3	Zone 4
Maximum Decay Heat (kW/FA)	0.393	0.48(2)	1.20(2)	0.48(2)
Maximum Decay Heat per Zone (kW)	3.54	7.68	14.4	11.52
Maximum Decay Heat per DSC (kW)	31.2(1)			

Note 1: Adjust payload to maintain total canister heat load within the specified limit.

Note 2: If the maximum decay heat per FA in Zone 3 is greater than 0.9 kW, the maximum decay heat per FA in Zone 2 and Zone 4 shall be less than or equal to 0.393 kW.

Figure 4J
Heat Load Zone Configuration 10 for the 61BTH Type 2 DSC

			C	C	C			
	A	B	C	C	C	B	A	
	B	B	C	C	C	B	B	
C	C	C	C	C	C	C	C	C
C	C	C	C	C	C	C	C	C
C	C	C	C	C	C	C	C	C
	B	B	C	C	C	B	B	
	A	B	C	C	C	B	A	
			C	C	C			

A	Corner Locations See Note 1	B	Interior Locations See Note 2
C	Interior/Edge Locations See Note 3		

Note 1: When loading up to 4 damaged or 4 failed assemblies, these must be placed in corner “A” locations, and the remaining locations “B” and “C” shall be loaded with intact fuel. If fewer than 4 damaged or 4 failed assemblies are to be stored, the remaining “A” locations may be loaded with intact fuel provided they meet the respective damaged or failed enrichment limits of Table 10 or Table 11. Damaged and failed fuel shall not be mixed, i.e., up to four damaged assemblies may be stored, or up to four failed assemblies may be stored in “A” locations.

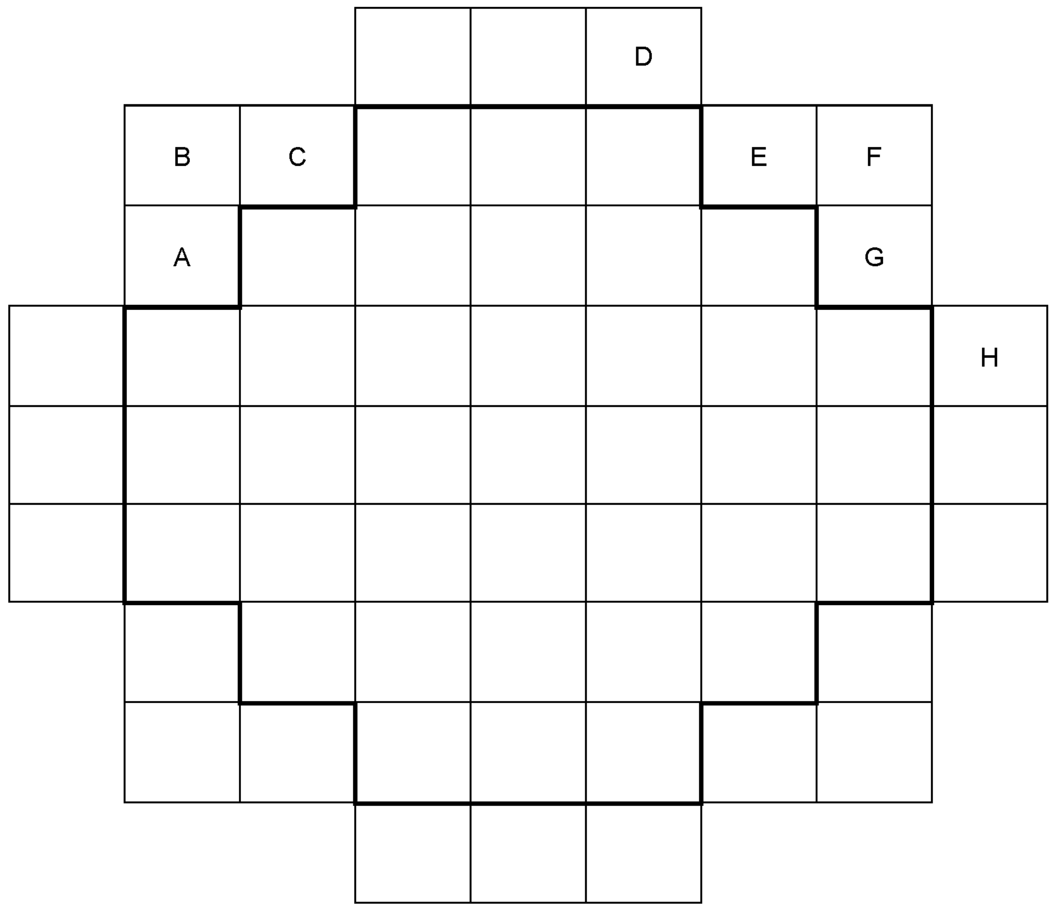
Note 2: If loading more than four damaged assemblies, place first four damaged assemblies in the corner “A” locations per Note 1, and up to 12 additional damaged assemblies in these interior “B” locations, with the remaining intact in a 61BTH Type 2 Basket. The maximum lattice average initial enrichment of assemblies (damaged or intact stored in the 2x2 cells) is limited to the “Five or More Damaged Assemblies” column of Table 10. For the 61BTH Type 2 DSC containing both damaged and failed fuel assemblies, this enrichment is limited to the “and up to 12 Damaged Assemblies” column of Table 11.

Note 3: If loading more than 16 damaged assemblies, place the first 57 damaged assemblies in the interior/edge "C" and the interior “B” locations. Place the remaining four intact or damaged assemblies in the corner "A" locations. The maximum lattice average initial enrichments of assemblies is limited to the “Remaining Four Intact Assemblies” or “Remaining Four Damaged Assemblies” column of Table 12.

Figure 5
Location of Damaged and Failed Fuel Assemblies inside the 61BTH Type 2 DSC

			P	P	P			
	P	P	I	I	I	P	P	
	P	I	I	I	I	I	P	
P	I	I	I	I	I	I	I	P
P	I	I	I	I	I	I	I	P
P	I	I	I	I	I	I	I	P
	P	I	I	I	I	I	P	
	P	P	I	I	I	P	P	
			P	P	P			

Figure 6
Peripheral (P) and Inner (I) Fuel Locations for the 61BTH Type 2 DSC



RECONSTITUTED FUEL ASSEMBLIES with ≤ 5 irradiated stainless steel rods may be loaded into all peripheral locations (i.e., not restricted). See Figure 6 for peripheral locations.

A RECONSTITUTED FUEL ASSEMBLY with > 5 and ≤ 10 irradiated stainless steel rods may be loaded in any peripheral location, with additional restrictions in accordance with Section 2.3. Examples:

- If Location B contains a RECONSTITUTED FUEL ASSEMBLY with > 5 irradiated stainless steel rods, peripherally adjacent Locations A and C shall contain fuel assemblies that do not contain irradiated stainless steel rods.
- If Locations E and G contain RECONSTITUTED FUEL ASSEMBLIES with > 5 irradiated stainless steel rods, peripherally adjacent Locations D, F, and H shall contain fuel assemblies that do not contain irradiated stainless steel rods.

Figure 7
Peripheral Location Restrictions for Reconstituted Fuel with Irradiated Stainless Steel Rods for the 61BTH Type 2 DSC

				P	*P*	*P*				
		P	*P*	*I*	*I*	*I*	*P*	*P*		
	P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*	
	P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*	
P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*
P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*
P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*
	P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*	
	P	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*P*	
		P	*P*	*I*	*I*	*I*	*P*	*P*		
				P	*P*	*P*				

Figure 8
Peripheral (P) and Inner (I) Fuel Locations for the EOS-89BTH DSC

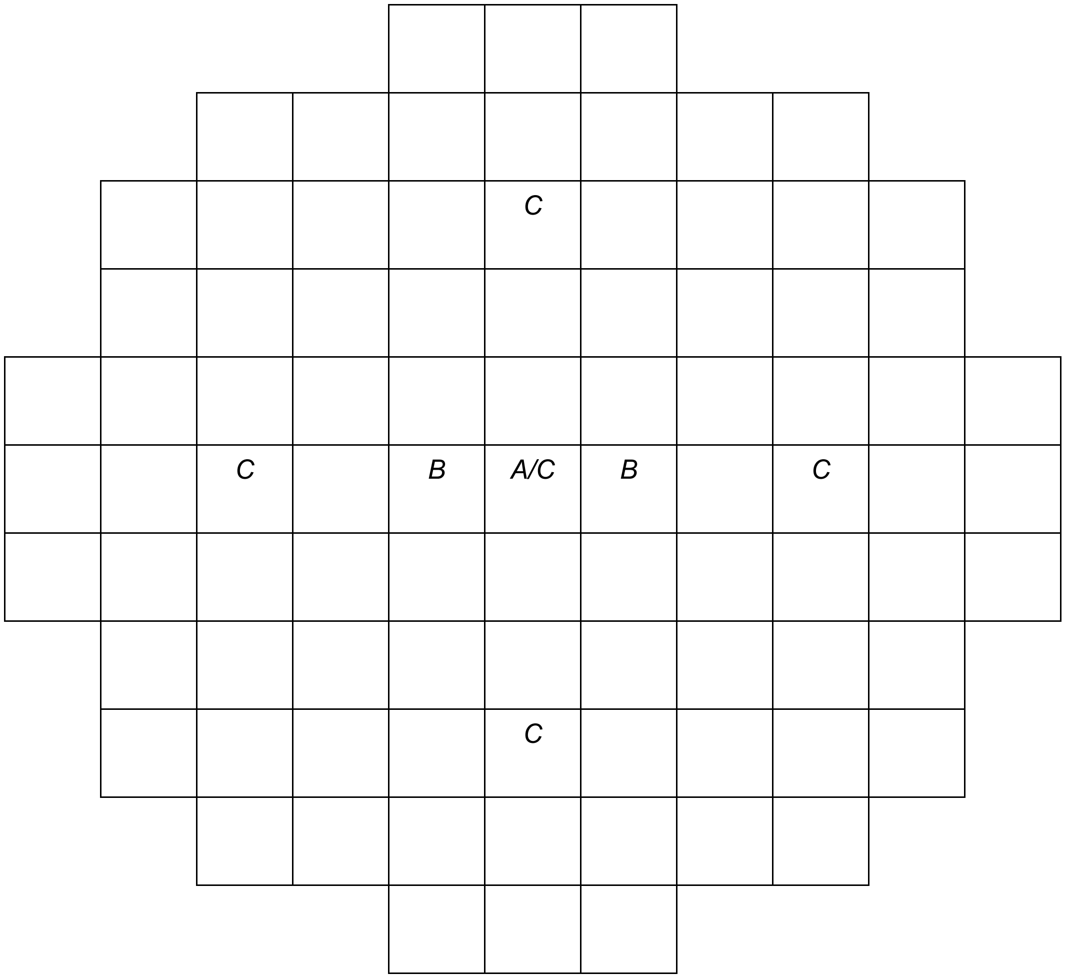
				X	X	X				
		X	X	X	R	X	X	X		
	X	X	R	R	R	R	R	X	X	
	X	R	R	R	R	R	R	R	X	
X	X	R	R	R	R	R	R	R	X	X
X	R	R	R	R	R	R	R	R	R	X
X	X	R	R	R	R	R	R	R	X	X
	X	R	R	R	R	R	R	R	X	
	X	X	R	R	R	R	R	X	X	
		X	X	X	R	X	X	X		
				X	X	X				

R = RECONSTITUTED FUEL ASSEMBLIES with irradiated stainless steel rods allowed at these locations.

X = RECONSTITUTED FUEL ASSEMBLIES with irradiated stainless steel rods not allowed at these locations.

Note: No restrictions on location for RECONSTITUTED FUEL ASSEMBLIES that do not contain irradiated stainless steel rods.

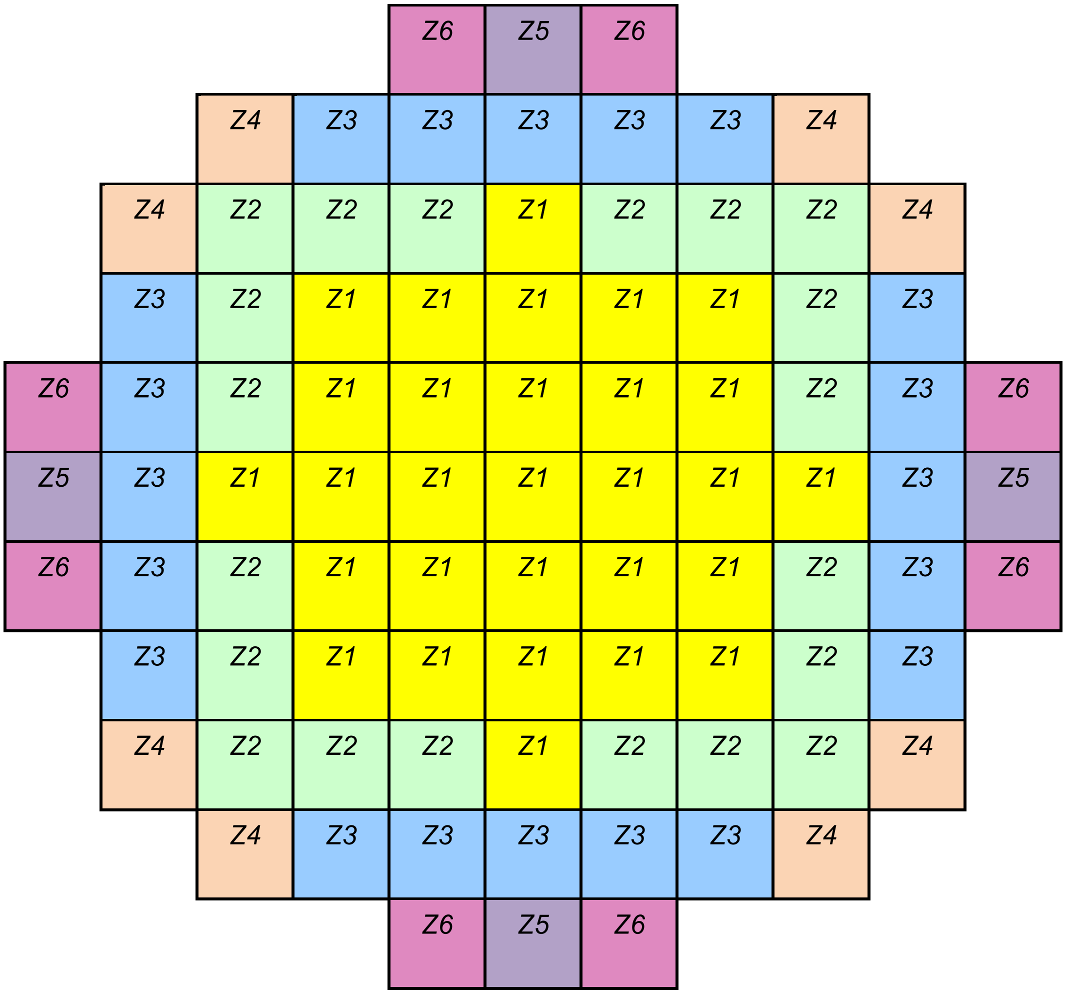
Figure 9
EOS-89BTH DSC Allowed Reconstituted Fuel Locations for Transfer in the EOS-TC108



Note:

1. *Location identified as “A” is for empty placement in 88-FA Loading*
2. *Locations identified as “B” are for empty placements in 87-FA Loading*
3. *Locations identified as “C” are for empty placements in 84-FA Loading*

Figure 10
Empty Locations in Short-Loading Configurations for the EOS-89BTH DSC



Zone No.	*Z1*	*Z2*	*Z3*	*Z4*	*Z5*	*Z6*
Max. Decay Heat per SFA (kW)	*0.40*	*0.60*	*1.30*	*1.70*	*1.30*	*1.70*
No. of Fuel Assemblies	*29*	*20*	*20*	*8*	*4*	*8*
Heat Load Per Zone	*11.6*	*12.0*	*26.0*	*13.6*	*5.2*	*13.6*
Max. Decay Heat per DSC (kW)	*See Note 1 for EOS-HSM and Note 2 for HSM-MX*					

Notes:

1. *Maximum heat load for EOS-89BTH DSC during Storage is 48.2 kW in EOS-HSM.*
2. *Maximum heat load for EOS-89BTH DSC during Storage is 48.2 kW in lower compartment of HSM-MX and 41.8 kW in upper compartment of HSM-MX.*

Figure 11
Maximum Heat Load Configuration 1 for EOS-89BTH DSC (MHLC-89-1) Transferred in the EOS-TC125

Enclosure 8 to E-59795

CoC 1042 Amendment 3, Revision 4 UFSAR Changed Pages
(Public)

1.2.1 NUHOMS® EOS System Characteristics

1.2.1.1 EOS-37PTH DSC

The key design parameters of the EOS-37PTH DSC are listed in Table 1-1. The primary confinement boundary for the EOS-37PTH DSC consists of the cylindrical shell, the top and bottom inner cover plates *or the optional Alternate 1-Bottom Forging*, the siphon/drain port cover plate, vent *port* plug, and the associated welds. 72.48 Note that the terms 'drain port' and 'siphon' are used interchangeably throughout the UFSAR and TS. The outer top cover plate and the test port plug provide the redundant sealing required by 10 CFR 72.236(e). The top and bottom shield plugs *or the optional Alternate 1-Bottom Forging* provide shielding for the EOS-37PTH DSC 72.48 so that occupational doses at the ends are minimized during drying, sealing, handling, and transfer operations. *To provide additional operational flexibility, the top shield plug may be integrated with the inner top cover plate. When used without distinction, the terms inner top cover plate or shield plug will also include the shield plug integrated inner top cover plate.*

The cylindrical shell and inner bottom cover plate *or the optional Alternate 1-Bottom Forging* confinement boundary welds are fully compliant with Subsection NB of the 72.48 ASME Code *with the exception of NB-6000 when the optional Alternate 1-Bottom Forging is used. These welds* are made during fabrication. The confinement boundary weld between the shell and the inner top cover (including drain port cover plate and vent *port* plug welds), and the structural attachment weld between the shell and the 72.48 outer top cover plate (including the test port weld) are in accordance with Alternatives to the ASME code as described in Section 4.4.4 of the Technical Specifications [1-7].

Both drain port cover plate and vent plug *port* welds are made after drying operations 72.48 are completed. There are no credible accidents that could breach the confinement boundary of the EOS-37PTH DSC, as documented in Chapters 3 and 12.

The EOS-37PTH DSC basket structure, shown schematically in Figure 1-2, consists of interlocking slotted plates to form an egg-crate type structure. The egg-crate structure forms a grid of 37 fuel compartments that house the PWR SFAs. The egg-crate grid structure is composed of one or more of the following: a steel plate, an aluminum plate and a neutron absorber plate. The steel plates are fabricated from high-strength low-alloy (HSLA) steels such as ASTM A829 Gr 4130 (AISI 4130) steel, hot rolled, heat-treated and tempered to provide structural support for the FAs. The poison plates are made of borated metal matrix composites (MMCs) and provide the necessary criticality control. The aluminum plates, together with the poison plates, provide a heat conduction path from the FAs to the DSC rails and shell.

The aluminum plates of the EOS-37PTH DSC may be offset vertically from the steel and poison plates. This configuration is termed the EOS-37PTH damaged/failed fuel basket. This configuration is used in conjunction with top and bottom end caps to allow for the storage of damaged FAs, as shown in Drawing EOS01-1010-SAR.

8 7 6 5 4 3 2 1

H G F E D C B A

Proprietary and Security Related Information
for Drawing EOS01-1001-SAR, Rev. 3B
Withheld Pursuant to 10 CFR 2.390

8 7 6 5 4 3 2 1

H G F E D C B A

8 7 6 5 4 3 2 1

H G F E D C B A

Proprietary and Security Related Information
for Drawing EOS01-1006-SAR, Rev. 2B
Withheld Pursuant to 10 CFR 2.390

H G F E D C B A

8 7 6 5 4 3 2 1

2.4 Safety Protection Systems

2.4.1 General

The NUHOMS® EOS System is designed to provide long-term storage of spent fuel. The DSC materials are selected for degradation to not be expected during the storage period. The DSC shell and bottom end assembly confinement boundary weld is made during fabrication of the DSC in accordance with *S*ubsection NB of the ASME code *with exceptions as specified in Section 4.4.4 of the Technical Specifications [2-18]*. The top and bottom shield plugs and covers provide shielding for the DSC so that occupational doses are minimized during drying, sealing, and handling operations. The confinement boundary weld between the DSC shell and inner top cover (including drain port cover and vent *port* plug welds) and structural attachment weld between the DSC shell and outer top cover plate are in accordance with alternatives to the ASME code as described in Section 4.4.4 of the Technical Specifications [2-18]. 72.48

The radioactive material stored in the NUHOMS® EOS System is the SFAs and the associated contaminated or activated materials.

During fuel loading operations, the radioactive material in the plant's fuel pool is prevented from contacting the DSC exterior by filling the TC/DSC annulus with uncontaminated, demineralized water prior to placing the cask and DSC in the fuel pool. In addition, the TC\DSC annulus opening at the top of the EOS-TC is sealed using an inflatable seal to prevent pool water from entering the annulus. This procedure minimizes the likelihood of contaminating the DSC exterior surface. The combination of the above operations ensures that the DSC surface loose contamination levels are within those required for shipping cask externals. Compliance with these contamination limits is ensured by taking surface swipes of the upper end of the DSC before transferring the cask from the fuel building.

Once inside the DSC, the contents are confined by the DSC confinement boundary. The fuel cladding integrity is ensured by maintaining the storage cladding temperatures below levels that are known to cause degradation of the cladding. In addition, the SFAs are stored in an inert atmosphere to prevent degradation of the cladding, specifically cladding rupture due to oxidation and its resulting volumetric expansion of the fuel. Thus, a helium atmosphere for the DSC is incorporated into the design to protect the fuel cladding integrity by inhibiting the ingress of oxygen into the cavity.

Helium is known to leak through valves, mechanical seals, and escape through very small passages because it has a small atomic diameter, is an inert element, and exists in a monatomic species. Helium will not, to any practical extent, diffuse through stainless or duplex steel. For this reason, the DSC has been designed as a welded confinement pressure vessel with no mechanical or electrical penetrations and meets the leak-tight criteria as described in Chapter 10. See Chapter 5 for a detailed discussion of the confinement boundary design.

All Indicated Changes are in response to RAI 2-1

2.4.3.1 <u>Methodology for Evaluating Additional HLZCs in EOS-89BTH DSC</u>

RAI 4-5

This section provides the detailed methodology to qualify a new HLZC for EOS-89BTH DSC. Each new HLZC qualified per Figure 11 of the TS will be evaluated for the Basket Type 1 of the EOS-89BTH DSC, which includes the coated steel plate for high emissivity, as indicated in Section 4.9.1.2, and high conductivity poison plate, as indicated in Section 4.2.2. HLZCs evaluated for use with the EOS-89BTH shall follow the same methodology as described in Chapter 4, Section 4.9.8.2 for EOS-HSM and/or Appendix A.4, Section A.4.5.6 for HSM-MX depending on the storage module. Similarly, the methodology laid out in Chapter 4, Section 4.9.8.3 shall be followed to ensure that the various design criteria for transfer operations are satisfied. The following steps present the methodology to qualify new HLZCs for EOS-89BTH DSC:

1. *HLZCs shall satisfy the maximum per DSC and per zone/compartment heat loads listed in Figure 11 of the TS.*
   a) *Similar to HLZC 5 and 6, a HLZC may require the total decay heat load per DSC to be adjusted to meet the requirements specified in Figure 11 of the TS. For these types of HLZCs, the same approach as presented in Section 4.9.8.1 and Appendix A.4 for HLZCs 5 and 6 shall be utilized to ensure the bounding temperatures and maximum internal pressure are determined.*

2. *Thermal evaluations based on the storage and transfer configuration described above shall be performed for each new HLZC to demonstrate that:*
   a) *Thermal design criteria specified in Section 4.2, Chapter 4 are satisfied.*
   b) *The calculated duration for the blocked vent accident condition is equal to or greater than the durations specified in Section 5.1.3.1 of the TS for EOS-HSM and Section 5.1.3.2 of the TS for HSM-MX.*
   The calculated duration should only be used to confirm that the new HLZCs are compliant with the TS for temperature monitoring. It cannot be used to reduce or increase the durations for blocked vent accident condition specified in the TS for temperature monitoring.

RAI 4-3

RAI 4-3

c) *The calculated "Total Time for Transfer," as defined in Section 4.9.8.3.4, at the maximum allowable heat load for each HLZC qualified per Figure 11 of the TS shall not be less than the sum of the transfer time limit (8 hours) and the duration for recovery actions (5 hours) listed in LCO 3.1.3 of the TS. This requirement also applies to a "Total Time for Transfer" calculated with less than the maximum allowable heat load allowed per each HLZC.*

RAI 4-4

RAI 4-6

3. *The thermal evaluations for the storage or transfer configurations as described in Step 2 represent the fuel assemblies as homogenized regions. The bounding effective properties for homogenized regions for the various fuel assembly classes listed in Section 2.2 of the TS are listed in Chapter 4, Appendix 4.9.1. If the thermal properties for the homogenized regions are updated, they shall be calculated based on the same methodology as presented in Section 4.9.1.2.*

4. *If design changes of the system result in updating the thermal evaluations of the storage or transfer configuration as described in Step 2, the impact of these design changes shall be evaluated. The design changes can be evaluated either based on the 10 CFR 72.48 process, or through a CoC No. 1042 amendment submitted to NRC for review and approval.*

Design changes cannot result in an alternation of the thermal physics, correlations, and submodels of the thermal model being outside of their applicable ranges from the baseline analyses in Chapter 4, Appendix 4.9.8 and Appendix A.4, Section A.4.5.6.

5. *Based on the thermal evaluation in Step 2 through Step 4 (if applicable), the impact of temperature changes on structural design functions shall be considered based on the methodology in Chapter 3.*

RAI 4-4

2.4.3.2 HLZCs for EOS-89BTH DSC

HLZCs 1 through 6 that are qualified for use with the EOS-89BTH DSC based on the methodology presented in Section 2.4.3.1 are presented in Figure 2-2a through Figure 2-2f. In addition to these HLZCs, additional HLZCs may be qualified based on the methodology presented in Section 2.4.3.1. Note that HLZCs 1-3 were previously approved by the NRC in Amendment 0.

2.4.4 Shielding/Confinement/Radiation Protection

As described earlier, the DSC shells are a welded stainless or duplex steel pressure vessel that includes thick shield plugs at both ends to maintain occupational exposures as low as reasonably achievable (ALARA). The top end of the DSC has nominally 10 inches of steel shielding and the bottom eight inches of steel shielding. The confinement boundary is designed, fabricated, and tested to ensure that it is leaktight in accordance with [2-15]. Section 2.4.2.1 provides a summary of the features of the DSCs that ensure confinement of the contents.

Table 2-3
BWR Fuel Assembly Design Characteristics
4 Pages

BWR Fuel ID /(Fuel Class)	**ABB-10-A (10 x 10)**	**ABB-10-C (10 x 10)**	
FA Design	**4x(5x5-3) 4x(5x5-1) Optima 1**	**4x(5x5-4) 4x(5x5-2) 4x(5x5-1) Optima2**	
Reload Fuel Designation[(1)(2)]	SVEA-96Opt[(4)(5)]	SVEA-96Op2[(4)(5)]	
Rod Pitch (in.)	0.496 - 0.500	0.484 - 0.512	
No of Fueled Rods	88, 96	84, 92, 96	
Maximum Active Fuel Length (in.)	150.42	150.42	
Fuel Rod OD (in.)	0.379-0.406	0.387	
Clad Thickness (in.)	0.0248 -0.0268	0.0238	
Fuel Pellet OD (in.)	0.323-0.346	0.334	
No of Water Rods	0	0	
Water Rod OD (in.)	---	---	
Water Rod ID (in.)	---	---	

Notes:
1. All dimensions shown are nominal.
2. Reload FAs from other manufacturers with these parameters are also acceptable.
3. Solid Zircaloy rod(s).
4. Fuel bundles designated as ABB or SVEA are typically assembled from four sub-assemblies. There is a cruciform internal water channel between the sub-assemblies. The thickness of the water channel is 0.8 mm, the inner width of the channel is 4 mm for most ABB or SVEA bundles, except 2.4 mm for SVEA-Optima 1 and SVEA-Optima 2.
5. There is one rod that occupies the four central fuel rod locations and four water bars/channels that divide the FA into four quadrants.
6. Includes ENC III-E and ENC III-F
7. *Integral water channel which occupies the 3x3 center of the fuel rod array.*
8. *The locations of the full, long partial, and short partial length rods are provided in Chapter 7, Figure 7-31.*

Component	Weight (kips)	Thermal Heat Load
EOS-37PTH DSC (Loaded Weight)	134	50 kW
EOS-89BTH DSC (Loaded Weight)	120	*48.2 kW*
Bounding EOS-HSM	135 (2)	50 kW (1)

Notes:

1. The thermal loading condition of the EOS-HSM is based on the most conservative thermal loading configuration.
2. For stability evaluation, several different combinations of DSC and HSM bounding weights are considered.

Detailed geometry descriptions, material properties, loadings, and structural evaluation for the EOS-HSM is presented in Appendix 3.9.4.

3.6.3 EOS-TC

Details of the structural analysis of the EOS-TC are provided in Appendices 3.9.3 and 3.9.5.

The details of the structural analyses of the EOS-TC body, including the cylindrical shell assembly and bottom assembly, the top cover, and the local stresses at the trunnion/cask body interface are presented in Appendix 3.9.5. The specific methods, models and assumptions used to analyze the cask body for the various individual loading conditions specified in 10 CFR Part 72 [3-13] are described in that appendix.

The EOS-TC body structural analyses use static or quasistatic linear elastic methods. The stresses and deformations due to the applied loads are determined using the ANSYS [3-12] computer program.

Appendix 3.9.5 presents the evaluation of the trunnion stresses in the EOS-TC due to all applied loads during fuel loading and transfer operations.

Based on the loading and transfer scenario, the top trunnions are analyzed per ANSI N14.6 [3-7] for vertical lifting loads.

The evaluations summarized in Appendix 3.9.5 show that all calculated trunnion stresses are less than their corresponding allowable stresses. Therefore, the EOS-TC top and bottom trunnions are structurally adequate to withstand loads during lifting and transfer operations.

Appendix 3.9.5 presents the evaluation of the stresses in the EOS-TC neutron shield shell due to all applied loads during fuel loading and transfer operations. An FEM was built for the structural analysis of the neutron shield shell, end closure, central plates and structural shell. These structural components were modeled with ANSYS shell elements.

Horizontal Position in EOS-HSM

When stored in the EOS-HSM, the DSC shell is supported by two, 3-inch wide EOS-HSM slide rails at ±30° from the bottom centerline. The inertial loads for DSC internals are accounted for by applying equivalent pressure onto the inner surface of DSC shell representing the EOS-HSM support rail or EOS-HSM-FPS support rail only. The magnitude of the pressure is determined based on the payload of 105 kips and projected area that are in interface with the EOS-HSM support rail.

The interface between the DSC and the EOS-HSM support rail is modeled through node-to-node contact elements (CONTA178). Nodes that interface with the EOS-HSM support rail are selected and copied, creating new nodes. Each row of nodes represents the width of the EOS-HSM support rail (there are three nodes across the width of the rail). Each node of the row is coupled with its neighboring node in all DOF using CERIG command, creating a rigid platform. Figure 3.9.1-7 and Figure 3.9.1-7a show the pressure load and boundary conditions applied to the FEM.

Each middle node of this platform is connected in the axial direction of the DSC through BEAM188 element. Finally, these new nodes representing the EOS-HSM are connected to the original nodes belonging to the DSC shell through the CONTA178 contact elements. Gaps are set to zero, placing the DSC shell and the EOS-HSM support rail in initial contact. Nodes representing the EOS-HSM support rail are constrained in all DOF along a length of 16.5 inches from bottom end and 20.5 inches from the top end. The BEAM188 elements have the properties of the wide-flange steel beam that supports the DSC when inside the EOS-HSM or the plate that supports the DSC when inside the EOS-HSM-FPS.

3.9.1.2.7.2 Fabrication Pressure and Leak Testing

Pressure testing and leak testing *are* performed on the DSC shell and IBCP during fabrication. *This pressure test is not required if the single piece forged bottom is used, although the helium leak test requirement remains in place. See Drawings EOS01-1001-SAR and EOS01-1006-SAR, sheet 2, detail 1, alternate 1.* No other DSC components are in place during this test. A seal plate is placed on the open top of the DSC shell and preloaded through the application of torque on eight bolts that are connected with a flange at the bottom of the DSC shell. The resulting preload to be considered in the evaluation is 155 kips. The DSC is then evacuated to a partial vacuum (simplified to full vacuum) and then re-pressurized with helium. Therefore, two load conditions are evaluated for the DSC shell and IBCP:

1. Leak Test: 155 kip axial compression + 14.7 psi external pressure (full vacuum) on the DSC shell between the top edge and the IBCP + 14.7 psi external pressure on the IBCP. Note that the vacuum will add axial load to the 155 kips preload.

2. Pressure Test *(if required)*: 155 kip axial compression + 23.0 psig internal pressure on the DSC shell between the top edge and the IBCP + 23.0 psig internal pressure on the IBCP. Note that the internal pressure will not affect the reaction on the DSC shell due to the preload.

In order to simulate the leak testing conditions, the OTCP, ITCP and OBCP, TSP and IBS, grapple ring and its support are removed from the FEM, including all contact pair elements.

The bottom surface of the DSC shell surface is constrained in the vertical direction. The 155 kips load is represented by equivalent pressure that is applied at the top surface of the DSC shell.

External pressure is applied at all external nodes of the DSC shell-IBCP assembly with the exception of the top surface of the DSC shell that is loaded with the 155 kips preload. Internal pressure is applied at all nodes on the inside surface of the DSC shell-IBCP assembly. Two load steps are performed, one for the internal pressure and the second one for the external pressure as stated above.

3.9.1.2.7.3 Internal and External Pressure

The DSC pressure boundary is defined by the DSC shell, the IBCP, the ITCP and the associated welds. Since there are no gaps between the top end plate components, the ITCP bears against the OTCP. Since the ITCP meets the leaktight requirements of ANSI N14.5, no leakage is feasible and, therefore, the pressure load is shared by the two plates according to their relative stiffness. Similarly, the absence of gaps between the bottom end components allows the IBCP to bear against the IBS, which, in turn, bears against the OBCP.

Normal (Level A)	15 psig (Elastic)
Off-Normal (Level B)	20 psig (Elastic)
Accident (Level D)	130 psig (Elastic-plastic)

The design pressure of the DSC is 15 psig. A bounding pressure of 20 psig was used in structural evaluations for normal and off-normal conditions. Two load cases were analyzed: one with an internal pressure of 20 psig and the second with an internal pressure of 130 psig.

The temperature range is widened by 30 °F on either side to a maximum of 732 °F at the middle of the fuel rod assembly and a minimum of 245 °F at end fittings as shown in Figure 3.9.6-23. This variation in temperature is applied as a second order polynomial variation presented in Figure 3.9.6-22. The induced bending stresses is compared against the material properties extracted at the temperature where maximum bending stresses occur.

All the FAs are evaluated for 75g side drop loads. These loads are applied as acceleration due to gravity. Fuel cladding axial stress due to internal gas pressure is added to the bending axial stress for comparison with the yield strength of the fuel cladding material.

3.9.6.5.2 Assumptions

1. The fuel pellets are assumed not to contribute to axial or bending stiffness. The fuel pellets weight is, however carried by the cladding tube during side drop events.

2. The maximum bounding temperature of the FA where the maximum bending stress occurs is determined to be *365.8* °F. The yield stress of high burnup fuel Zircaloy-2 cladding is conservatively taken at 400 °F. The yield stress includes a strain rate of $0.5s^{-1}$. The temperature profile (shown in Figure 3.9.6-23) is considered to be a second order polynomial variation (shown in Figure 3.9.6-22) in the axial direction of the fuel rod assembly being analyzed.

3. The fuel cladding thickness is reduced by 0.0027 inch to account for oxidation. Reference [3.9.6-9] gives an oxidation thickness range between 10µm-120µm; with 30µm as the nominal average for BWR fuel. Conservatively, to account for high burnup fuel, a nominal oxide thickness of 120µm is used. In order to calculate the actual thickness of the cladding, the oxide thickness accumulation needed to be corrected. This value along with a Pilling-Bedworth factor of 1.75 [3.9.6-2], is used to calculate the oxide thickness.

   $(120/1.75) \times 10^{-6}$ meter x 39.372 inch/meter = 0.0027 inch

4. The continuous beam model span lengths *for the 7x7, 8x8, 9x9, and 10x10 FAs* are taken from the FA drawings in [3.9.6-1] and unavailable data is estimated based on overall length and number of spacers in similar designs from the same fuel class.

5. The total weight of each end fitting (top and bottom) is equally divided amongst all full length fuel rods and applied at the ends of the rods.

6. The bounding FA for each class is determined from the bending stress of the longest span.

All Indicated Changes are in response to Enclosure 9, Item 2

The methodology to determine the axial conductivity is described in Section P.4.8.1.3 of the Standardized NUHOMS® System UFSAR [4.9.1-2] and is used in this evaluation based on the bounding FA and the properties described above. Similarly, the effective density and specific heat are determined based on the methodology presented in Section P.4.8.2 of the Standardized NUHOMS® System UFSAR, using the bounding FA and the properties described above.

Using the methodology presented in Appendix P, Section P.4.8.1.4 of the Standardized NUHOMS® System [4.9.1-2], a two-dimensional (2D) finite element model (FEM) of WE14x14 OFA FA is developed in ANSYS [4.9.1-3] to determine the transverse effective conductivity. The outer surfaces, representing the fuel compartment walls, are held at a constant temperature, and heat generating boundary condition is applied to the fuel pellets within the model. The models were run with a series of isothermal boundary conditions applied to the nodes representing the fuel compartment walls. The FEMs of WE14x14 OFA FA is shown in Figure 4.9.1-1. Figure 4.9.1-2 shows the heat generation rate and temperature boundary conditions.

The computed FA transverse and axial effective conductivities as functions of temperature for irradiated WE14x14 FA are listed in Table 4.9.1-3 and also summarized in Section 4.2.1. The effective specific heat and density for irradiated WE14x14 FA is shown is listed in Table 4.9.1-4 and also summarized in Section 4.2.1. The effective thermal conductivities for the FAs are also applicable for vacuum drying conditions since helium is used for water blowdown from the DSC.

4.9.1.2 <u>Effective Thermal Properties for BWR Spent Fuel Assemblies in EOS-89BTH DSC</u>

The FAs considered for storage in the EOS-89BTH DSC including the design data for each FA, are listed in Table 2-3 and Table 2-4. The FAs listed in Table 2-3 are previously studied in Section T.4.8 and Section Y.4.9 of the Standardized NUHOMS® System UFSAR[4.9.1-2], except for the GNF2 FA. However, the dimensions of GNF2 FA listed in Table 2-3 are very similar to the previously evaluated GE12/GE14 FAs from Section T.4.8 and Section Y.4.9 of the Standardized NUHOMS® System UFSAR. Therefore, the thermal properties for the GE12/GE14 FAs are also applicable to the GNF2 FA.

In addition to the FAs analyzed in Section T.4.8 and Section Y.4.9 of the Standardized NUHOMS® System UFSAR, the EOS-89BTH DSC allows for the storage of certain European and Japanese FAs as shown in Table 2-4.

A comparison of the FA characteristics of the European and Japanese FAs from Table 2-4 to those previously analyzed in Table 2-3 shows that they are either identical or very similar as described below.

The computed bounding fuel assembly transverse and axial effective conductivities as functions of temperature for the various FAs allowed for storage in EOS-89BTH DSC are listed in Table 4.9.1-5 and also summarized in Section 4.2.1. The effective thermal conductivities determined for the bounding FAs are also applicable for vacuum drying conditions since helium is used for water blowdown from the DSC.

The bounding effective specific heat based on GE1/2/3 FA and bounding effective density based on Switzerland- KKL BWR 10/15 FA are listed in Table 4.9.1-7 and also summarized in Section 4.2.1.

For ATRIUM-11 FAs, the effective thermal properties are determined using the same methodology to calculate the bounding BWR thermal properties listed in Table 4.9.1-5 and Table 4.9.1-7. Table 4.9.1-8 and Table 4.9.1-9 compare the computed thermal properties for ATRIUM-11 FAs with the bounding values calculated for all FAs except for ATRIUM-11 FAs.

Table 4.9.1-8 and Table 4.9.1-9 show that the effective axial thermal conductivity, specific heat and density for ATRIUM-11 FAs are always higher or equal to those for the bounding BWR FAs. The transverse thermal conductivity of ATRIUM-11 FAs is also higher or equal to those for the bounding BWR FAs except at temperatures above 1006 °F. The small temperature range from 1006 °F to 1058 °F (the maximum allowable accident temperature limit) in which ATRIUM-11 FAs transverse conductivity are lower will have no impact on thermal performances, since the maximum FA temperature for the EOS-89BTH DSC during accident conditions is 935 °F, as shown in Table 4.9.8-11. Since the thermal properties for ATRIUM-11 remain bounding over the entire calculated temperature range, there is no impact on the bounding thermal evaluation. In addition, even if the maximum fuel cladding temperature were to exceed 1006 °F and remain below 1058 °F, there would be no impact since only a small region within the center of the FAs is usually at the higher temperature while the majority of the FAs remain at a much lower temperature. Therefore, it is concluded that the bounding fuel properties listed in Table 4.9.1-5 and Table 4.9.1-7 remain applicable for the ATRIUM-11 FAs.

4.9.1.3 Scaling Factors for Short and Long Fuel Assemblies

The various heat load zone configuration (HLZCs) presented in Figure 1 of the Technical Specifications [4.9.1-6] for the EOS-37PTH DSC and *Figure 2-2a through Figure 2-2f in Chapter 2* for the EOS-89BTH DSC are evaluated in Sections 4.4, 4.5, 4.6*, and Appendix 4.9.8* at the maximum allowable heat loads for each HLZC, assuming that the FA has an active fuel length of 144 inches.

Table 4.9.1-8
Comparison of Effective Thermal Conductivities of ATRIUM-11 FA with Bounding BWR Fuel for EOS-89BTH DSC

	T (°F)	K_{eff} (Btu/(hr-in-°F))	
		ATRIUM-11	Bounding BWR FAs (Table 4.9.1-5)
Transverse	124	0.0183	0.0141
	220	0.0196	0.0165
	317	0.0224	0.0194
	415	0.0257	0.0228
	513	0.0294	0.0267
	611	0.0334	0.0312
	709	0.038	0.036
	808	0.0427	0.0414
	907	0.0476	0.0476
	1006	0.0533	0.0541
	1106	0.0592	0.0610
Axial	T (°F)	ATRIUM-11	Bounding BWR FAs (Table 4.9.1-5)
	200	0.0517	0.0427
	300	0.0545	0.0450
	400	0.0571	0.0472
	500	0.0597	0.0493
	600	0.0621	0.0514
	800	0.0672	0.0555

Table 4.9.1-9
Comparison of Specific Heat and Density of ATRIUM-11 FA with Bounding BWR Fuel for EOS-89BTH DSC

Temp (°C)	*$C_{p\ eff}$, kJ/kg-K*		*ρ_{eff}, kg/m³*	
	ATRIUM-11	*Bounding BWR FAs (Table 4.9.1-7)*	*ATRIUM-11*	*Switzerland – KKL BWR 10/15 SFA (Table 4.9.1-7)*
27	*0.243*	*0.243*	*3205*	*2592*
127	*0.272*	*0.271*		
367	*0.301*	*0.301*		
817	*0.327*	*0.327*		

Table 4.9.8-12
Maximum Temperatures of EOS-TC125 with EOS-89BTH DSC at 48.2 kW, Air Circulation Turned Off / Air Circulation Failure during Transfer Operations.

	Off-Normal, Hot, Outdoor, Horizontal, Transient, No Air Circulation (LC 7)	Max. Allowable Temperature
Heat Load	48.2 kW	
Time Limit	4 hrs	
Components Name	Temperature (°F)	
Fuel Cladding	710	1058
DSC Shell	448	-
Inner Shell	368	-
Gamma Shield	364	620
Structural Shell (TC Outer Shell)	*246*	-
Neutron Shield (Max/Avg(1))	245/191	259
Neutron Shield Outer Skin	235	-
Solid Neutron Shield Avg	187/161	262
Closure Lid	188	-
Top Ring	218	-
Bottom Ring	196	-

Notes:

(1) Bulk average temperature of water in the neutron shield is limited by the 20 psig pressure relief valves on the shield. The equivalent steam saturation temperature at this pressure is approximately 259 °F.

All Indicated Changes are in response to Enclosure 9, Item 3

Stringent design and fabrication requirements ensure that the confinement function of the DSC is maintained. The cylindrical shell and inner bottom cover are pressure tested in accordance with the ASME Code, Section III, Subarticle NB-6300. This pressure test is performed after installation of the inner bottom cover at the fabricator's facility and may be performed concurrently with the leak test, provided the requirements of NB-6300 are met. *This pressure test is not required if the single piece forged bottom is used. See drawing EOS01-1001-SAR, sheet 2, detail 1-alternate 1.*

A leak test of the shell assembly, including the inner bottom cover, is performed in accordance with ANSI N14.5 [5-1] and the ASME Code, Section V, Article 10. These tests are typically performed at the fabricator's facility. The acceptance criteria for the test are "leaktight" as defined in ANSI N14.5.

The process for leak testing the DSC involves temporarily sealing the shell from the top end. The gas-filled envelope and evacuated envelope testing methodologies have the required nominal test sensitivity for leaktight construction and are used for leak testing. A helium mass spectrometer is used to detect any leakage as defined in ANSI N14.5. During final drying and sealing operations of the DSC, the top closure confinement welds are applied to confine radioactive materials within the cavity.

The inner top cover weld is welded to the DSC shell using automated welding equipment. Once the DSC has been vacuum dried, a pressure test is performed by backfilling the DSC cavity with helium. Following the satisfactory completion of the pressure test, the drain port cover and vent *port* plug are welded, and a leak test is performed to verify that the weld between the DSC shell and the inner top cover, drain port cover and vent *port* plug meet the leaktight criteria of ANSI N14.5. The outer top cover plate is also welded in place using automated welding equipment. 72.48

5.1.2 Confinement Penetrations

All penetrations in the DSC confinement boundary are welded closed. The DSC is designed to have no credible leakage as described above.

5.1.3 Seals and Welds

The welds made during fabrication of the DSC that affect the confinement boundary include the weld applied to the *inner bottom cover plate or single plate bottom forging*, and the circumferential and longitudinal seam welds applied to the cylindrical shell. These welds are inspected (radiographic or ultrasonic inspection, and liquid penetrant inspection (PT)) according to the requirements of Subsection NB of the ASME Code.

All Indicated Changes are in response to RAI 2-1

6.2 Source Specification

Design basis source terms for PWR and BWR fuels are developed in this section. The source terms are developed to be reasonably bounding consistent with the limits on fuel qualification. A site-specific analysis must evaluate the site-specific used fuel to be stored and determine if the parameters utilized in the UFSAR analysis are bounding and appropriate. Site-specific source terms may be different than the source terms presented herein. However, the source terms presented in this chapter were developed to bound most used fuels and will result in reasonably bounding dose rates.

Fuel types that are authorized for storage are provided in Chapter 2. *Fuel assembly design details are provided in Table 2-2, Table 2-3, and Table 2-4.* These fuel types may be divided into PWR and BWR fuel types. The list of authorized fuels is summarized below.

PWR

- Westinghouse (WE) 14x14 class
- WE 15x15 class
- WE 17x17 class
- Babcock & Wilcox (B&W) 15x15 class
- Combustion Engineering (CE) 14x14 class
- CE 15x15 class
- CE 16x16 class

BWR

- 7x7 lattice array type
- 8x8 lattice array type
- 9x9 lattice array type
- 10x10 lattice array type
- *11x11 lattice array type*

[

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10.1 Acceptance Tests

10.1.1 Structural and Pressure Tests

10.1.1.1 DSC

The DSC confinement boundary is fabricated, inspected, and tested in accordance with American Society of Mechanical Engineers (ASME) Code Subsection NB [10-1] with alternatives specified in Section 4.4.4 of the Technical Specifications [10-32]. The shell and inner bottom cover plate *or the optional Alternate 1-Bottom Forging* assembly is pneumatically tested during fabrication in accordance with ASME Article NB-6300. *However, if using a single piece bottom forging, the fabrication pressure test may be waived. The pressure test at 18 to 23 psig does not stress a single piece bottom and bottom-to-shell weld sufficiently to cause pre-existing defects to propagate into leaks. For the purpose of finding leaks, the helium leak test of Section 10.1.2 is far more sensitive than the pressure test.* The inner top cover plate and its weld to the shell are pneumatically tested in the field, in accordance with the above-cited ASME Code alternatives. Per ASME Article NB-6300, the pneumatic test pressure shall be 1.1 times the design pressure, which results in a test pressure of 16.5 psig. For conservatism, a *minimum* test pressure of 18.0 psig is selected to bound potential conditions for transportation under 10 CFR Part 71. 72.48

DSC	Normal Pressure (psig)	Design Pressure (psig)	Test Pressure *Range* (psig)
EOS37PTH	10.5	15(1)	*18.0-23.0*
EOS89BTH	10.8	15(1)	*18.0-23.0*

72.48

(1) A pressure of 20 psig is used for structural evaluations under normal and off-normal conditions as noted in Section 3.9.1.2.7.3. *The DSC is backfilled with helium to more than 18 psig, but not to exceed 23 psig as noted in Section 9.1.3.19* 72.48

Mechanical properties of materials are tested in accordance with the American Society for Testing and Materials (ASTM), ASME, AMS, or other material specification called out on the drawings in Chapter 1. Weld procedures and welders are qualified in accordance with ASME Code Section IX. Additional material and welding requirements of ASME Code Articles NB-2000 and NB-4000 apply to the confinement boundary unless an ASME Code alternative governs.

Acceptance testing for the high-strength low-alloy steel used in the DSC baskets is specified in 10.1.7. There is no welding on the baskets.

All Indicated Changes are in response to RAI 5-1

Additional Changes Not Associated with the RAIs

TN Americas LLC is requesting changes to the proposed Amendment 3 Technical Specifications (TS) and Updated Final Safety Analysis Report (UFSAR) that are not related to the RAI questions. The requested changes are discussed in the following sections of this enclosure and include a description of the change, the impact on the design, and a summary of the impact on the TS and UFSAR.

1. Technical Specification Table 8 for EOS-89BTH DSC criticality enrichment limits.

An editorial nomenclature change has been made to Table 8 of the Technical Specifications to be consistent with UFSAR Drawing EOS01-1020-SAR. This change is non-technical and has been made for clarification and consistency.

- TS Impact: In TS Table 8,
  - The “Neutron Poison Loading Option” column label is changed to “Basket Type”
  - “M1-A” is changed to “A1/A2/A3.”
  - “M1-B” is changed to “B1/B2/B3.”
  - “M2-A” is changed to “C1/C2/C3.”
  - Footnotes 2 and 3 are also updated accordingly.
- UFSAR Impact: None

2. Change to the bounding temperature in Section 3.9.6.5.2

As shown in Table 3.9.6-10, ATRIUM-11 has the maximum combined stress for 75g side drop. However, the temperature was not updated to reflect this and was instead based on the previously bounding 10x10 assembly. The bounding temperature has been updated based on ATRIUM-11 results.

UFSAR Impact: Section 3.9.6.5.2 of the UFSAR has been updated as described.

3. Change to the Structural Shell temperature in Table 4.9.8-12

The structural shell (TC outer shell) temperature was incorrectly noted as the same temperature of the inner shell, i.e., 368 °F. The change corrects this and provides the temperature of the structural shell as 246 °F.

UFSAR Impact: Table 4.9.8-12 of the UFSAR has been updated as described.