Enclosure 3 to E-42059

RAIs and Responses

(Public Version)

A. Dry Shielded Canisters (DSCs)

A.1 DSC RAIs

DSC-RAI-1: Provide clarification on the classification of the important to safety components for the 24PT2 DSC:

- Basket assembly spacer sleeves are not in Table 3.4-1 of the Updated Final Safety Analysis Report (UFSAR) (FSAR, Rev. 14 NUH-003, September 2014). However, the basket assembly spacer sleeves are identified in Drawing NUH-03-1070, Rev. 2 for the 24PT2S and Drawing NUH-03-1071, Rev. 1 for the 24PT2L. The basket assembly spacer sleeves identified as Safety Classification A item in Table 2A-1 of the CoC renewal application both the 24PT2S and the 24PT2L. Explain why the basket assembly spacer sleeves are not included in Table 3.4-1 of the FSAR, or make them consistent, as necessary.
- Neutron absorber sheets are not in Table 3.4-1 of the UFSAR. However, the neutron absorber sheets are identified in Drawing NUH-03-1070, Rev. 2 for the 24PT2S, and Drawing NUH-03-1071, Rev. 1 for the 24PT2L. The neutron absorber sheet identified as Safety Classification A item in Table 2A-1 of the CoC renewal application both the 24PT2S and the 24PT2L. Explain why the neutron absorber sheets are not included in Table 3.4-1 of the FSAR, or make them consistent, as necessary.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-1

A UFSAR Change Notice has been approved to change UFSAR Table 3.4-1 to add the following subcomponents of the 24PT2 DSC to reflect their important to safety classification:

- Spacer sleeves
- Neutron absorber sheets

This UFSAR change notice makes these changes effective now, against the current UFSAR revision (Revision 14). These changes will be incorporated into the next 24-month UFSAR update submittal to the NRC (Revision 15).

Renewal Application Impact:

No changes as a result of this question.

DSC-RAI-2: Clarify the classification of the important to safety components for the 24PHB Long Cavity DSC:

- The top cap plate and liner and the bottom cap plate and liner for damaged fuel cell are not in Table 3.4-1 of the UFSAR. The top cap plate and liner and the bottom cap plate and liner are identified in Drawing NUH-HBU-1001-SAR, Rev. 0, and identified as Safety Classification A. The top cap plate and liner and the bottom cap plate and liner are included in Table 2A-1 of the CoC renewal application for the 24PHBS and the 24PHBL. Explain why the top cap plate and liner and the bottom cap plate and liner for damaged fuel cell are not included in Table 3.4-1 of the FSAR, or make them consistent, as necessary.
- The inner grapple ring support is not in Table 3.4-1 of the UFSAR. The inner grapple ring support is identified in Drawing NUH-HBU-1000-SAR, Rev. 3. The inner grapple ring support is identified as a Safety Classification A item in Table 2A-1 of the CoC Renewal Application for the 24PHBS and the 24PHBL. . Explain why the inner grapple ring support is not included in Table 3.4-1 of the FSAR, or make them consistent, as necessary.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-2

A UFSAR Change Notice has been approved to change UFSAR Table 3.4-1 to add the following subcomponents of the 24PHB Dry Shielded Canister (DSC) to reflect their important to safety classification:

- Top and bottom cap plates and liners
- Inner grapple ring support

This UFSAR change notice makes these changes effective now, against the current UFSAR revision (Revision 14). These changes will be incorporated into the next 24-month UFSAR update submittal to the NRC (Revision 15).

Renewal Application Impact:

No changes as a result of this question.

DSC-RAI-3: Clarify the classification of the important to safety components for the 32PT Dry Shielded Canister (DSC):

- The shear key is not in Table M.2-18 of the UFSAR. The shear key is included in Drawing NUH-32PT-1002-SAR, Rev. 5 as a Safety Classification B item. The shear key is also included in Table 2A-1 of the CoC Renewal Application as an important to safety component. Explain why the shear key is not included in Table 3.4-1 of the FSAR, or make them consistent, as necessary.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-3

A UFSAR Change Notice has been approved to change UFSAR Table M.2-18 to add the shear key subcomponent of the 32PT DSC to reflect its important to safety classification.

This UFSAR change notice makes these changes effective now, against the current UFSAR revision (Revision 14). These changes will be incorporated into the next 24-month UFSAR update submittal to the NRC (Revision 15).

Renewal Application Impact:

No changes as a result of this question.

DSC-RAI-4: Clarify the classification of the important to safety components for the 32PTH1 Dry Shielded Canister (DSC):

- Hardware including spacers and washers are not in Table U.2-19 of the UFSAR. Basket hardware items are included in Drawing NUH-32PTH1-1003-SAR, Rev. 2 and NUH-32PTH1-1004-SAR, Rev. 1 as not important to safety (NITS) but are included as a Category 2 item. These items are also included in Table 2A-1 of the CoC Renewal Application as NITS but included in the scope of the review as a category 2 item. Provide clarification, or edit for consistency, as appropriate.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-4

A UFSAR Change Notice has been approved to change UFSAR Table U.2-19 to add 32PTH1 DSC subcomponents “spacers and washers” as suggested for consistency.

This UFSAR change notice makes these changes effective now, against the current UFSAR revision (Revision 14). These changes will be incorporated into the next 24-month UFSAR update submittal to the NRC (Revision 15).

Renewal Application Impact:

No changes as a result of this question.

DSC-RAI-5: Provide additional information on the Aging Management Review Results for the 24P Dry Shielded Canister (DSC):

- Clarify whether the spacer discs listed in CoC renewal application Table 1A-9 also include the top spacer disc shown as Item #2 in drawing NUH-03-1020-SAR.
- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1A-9. Drawing NUH-03-1023, Rev. 8, sheet 1 of 3, suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1A-9. Drawing NUH-03-1023, Rev. 8, sheet 1 of 3, suggests that the top side of the inner top cover plate is not in an inert gas environment.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-5

- The line item listed as “spacer disc” in Table 1A-9 includes all the 24P DSC spacer discs, including the top spacer disc. All of the 24P DSC spacer discs have an identical safety function, and material specification, and are exposed to the same environment. Hence, a separate callout for the top spacer disc is not necessary. This line item in Table 1A-9 has been revised to clarify that it includes all spacer discs, including the top spacer disc.
- The pressure boundary welds of the 24P DSC siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent port cover plates, shown in Table 1A-9 and Table 1C-9, has been updated accordingly to show the correct environment.
- The pressure boundary weld of the 24P DSC inner top cover plate with the 24P DSC shell prevents the top side of the inner top cover plate from exposure to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1A-9, has been updated accordingly to show the correct environment.

Renewal Application Impact:

Tables 1A-9 and 1C-9 have been revised as described in the response.

DSC-RAI-6: Provide additional information on the Aging Management Review Results for the 24P Long Cavity DSC:

- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1A-10. Drawing NUH-03-1053, Rev. 5, sheet 1 of 3 suggests that the siphon and vent port cover plates are not in an inert gas environment. Correct typographical error on material type: 304v.
- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1A-10. Drawing NUH-03-1063, Rev. 5, sheet 1 of 3 suggests that the top side of the inner top cover plate is not in an inert gas environment.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-6

- The pressure boundary welds of the 24P Long Cavity dry shielded canister (DSC) siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent port cover plate, shown in Table 1A-10 and Table 1C-10, have been updated accordingly to show the correct environment. Also, Table 1A-10 has been updated to correct the typographical error for the siphon and vent port cover plate material.
- The pressure boundary weld of the 24P Long Cavity DSC inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from being exposed to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the DSC inner top cover plate, shown in Table 1A-10, has been updated accordingly to show the correct environment.

Renewal Application Impact:

Tables 1A-10 and 1C-10 have been revised as described in the response.

DSC-RAI-7: Provide additional information on the Aging Management Review Results for the 24PT2 DSC:

- Clarify whether the support rod assembly with spacer sleeve in CoC renewal application Table 1C-12 includes all spacer sleeves shown in NUH-03-1070-SAR, Rev. 2, sheet 1 of 4.
- Clarify, and/or reconcile, the aging management review for the cylindrical shell listed in CoC renewal application Table 1C-12. The aging effect listed in Table 1C-12 only includes stress corrosion cracking. Drawing NUH-03-1070-SAR, Rev. 2, sheet 1 of 4, indicates the cylindrical shell is welded stainless steel. For other DSC cylindrical shells in the 1004 CoC renewal application, both the loss of material from localized corrosion and stress corrosion cracking are identified as aging effects requiring management.
- Clarify, and/or correct, the aging management review for the outer bottom cover plate listed in CoC renewal application Table 1C-12. The aging effect listed is stress corrosion cracking. Drawing NUH-03-1070-SAR, Rev. 2, sheet 1 of 4, indicates the outer bottom cover plate is welded stainless steel. For other DSC outer bottom cover plates in the 1004 CoC renewal application, the loss of material from localized corrosion is also identified as an aging effect requiring management.
- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1C-12. Drawing NUH-03-1070-SAR, Rev. 2, sheet 4 of 4, suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1C-12. Drawing NUH-03-1070-SAR, Rev. 2, sheet 4 of 4, suggests that the top side of the inner top cover plate is not in an inert gas environment.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-7

- The line item listed as “Support Rod Assembly with Spacer Sleeve” in Table 1C-12 includes all the 24PT2 dry shielded canister (DSC) spacer sleeves. All the 24PT2 DSC spacer sleeves have an identical material specification and are exposed to the same environment. Hence, a separate callout for each spacer sleeve is not necessary. This line item in Table 1C-12 has been updated to clarify that it includes all spacer sleeves.
- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 24PT2 DSC cylindrical shell assembly listed in Table 1C-12 is subject to loss of material and stress corrosion cracking aging effects, which require management. Accordingly, the aging effects for the 24PT2 DSC shell assembly in Table 1C-12 have been updated.

- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 24PT2 DSC outer bottom cover plate listed in Table 1C-12 has been updated to show that it is subject to loss of material and stress corrosion cracking as aging effects requiring management.
- The pressure boundary welds of the 24PT2 DSC siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent port cover plates shown in Table 1C-12 has been updated accordingly to show the correct environment.
- The pressure boundary weld of the 24PT2 DSC inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from exposure to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1C-12, has been updated accordingly to show the correct environment.

Renewal Application Impact:

Table 1C-12 has been revised as described in the response.

DSC-RAI-8: Provide additional information on the Aging Management Review Results for the 52B DSC:

- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1A-11. Drawing NUH-03-1031-SAR, Rev. 8, Sheet 1 of 3, suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1A-11. Drawing NUH-03-1031-SAR, Rev. 8, Sheet 1 of 3, suggests that the top side of the inner top cover plate is not in an inert gas environment.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-8

- The pressure boundary welds of the 52B dry shielded canister (DSC) siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from being exposed to the inert gas environment. The operating environment for the siphon and vent port cover plates, shown in Table 1A-11 and Table 1C-11, has been updated accordingly to show this corrected environment.
- The pressure boundary weld of the 52B DSC inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from being exposed to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1A-11, has been updated accordingly to show the correct environment.

Renewal Application Impact:

Tables 1A-11 and 1C-11 have been revised as described in the response.

DSC-RAI-9: Provide additional information on the Aging Management Review Results for the 24PHB DSC:

- Clarify, and/or correct, the aging management review for the inner grapple ring support listed in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR, Rev. 3, sheet 3 of 6, indicates the inner grapple ring support is welded stainless steel in a sheltered environment. For other welded stainless steel DSC components in a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify, and/or correct, the aging management review for the bottom shield plug, forging types 1 and 2 in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR, Rev. 3, sheet 3 of 6, indicates the bottom shield plug, forging types 1 and 2 are welded stainless steel in a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify the operating environment for the top side of the top shield plug, forging types 1 and 2 in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR, Rev. 3, sheet 5 of 6, indicated the top side of the top shield plug, forging types 1 2 are not in an inert gas environment.
- Clarify the operating environment for the top shield plug plate in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR, Rev. 3, sheet 5 of 6, indicates the top side of the top shield plug plate is not in an inert gas environment.
- Clarify and/or correct the aging management review for the grapple ring of the 24PHB DSC. This grapple ring is not in the aging management review shown in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR Rev. 3, sheet 1 of 6 incorporates by reference drawings NH-03-1021-SAR and NUH-03-1051-SAR which show that the grapple ring is welded stainless steel in a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify, and/or correct, the aging management review for the cylindrical shell of the 24PHB DSC. The cylindrical shell component is not in the aging management review shown in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR, Rev. 3, sheet 1 of 6, incorporates by reference drawings NUH-03-1021-SAR and NUH-03-1051-SAR which show that the cylindrical shell is welded stainless steel in a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.

- Clarify, and/or correct, the aging management review for the outer top cover plate of the 24PHB DSC. The outer top cover plate is not in the aging management review shown in CoC renewal application Table 1E-11. Drawing NUH-HBU-1000-SAR, Rev. 3, sheet 1 of 6, incorporates by reference drawings NUH-03-1023-SAR and NUH-03-1053-SAR which show that the outer top cover plate is welded stainless steel in a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-9

- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel dry shielded canister (DSC) surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 24PHB DSC inner grapple ring support listed in Table 1E-11 is subject to loss of material and stress corrosion cracking aging effects, which require management. Accordingly, the aging effects and the aging management activity for the 24PHB DSC inner grapple ring support listed in Table 1E-11, have been updated.
- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 24PHB DSC bottom shield plug forging, Types 1 and 2 listed in Table 1E-11 is subject to loss of material and stress corrosion cracking as aging effects requiring management. Accordingly, the aging effects and the aging management activity for the 24PHB DSC bottom shield plug forging, Types 1 and 2 listed in Table 1E-11 have been updated.
- The 24PHB DSC top side of the top shield plug forging, Types 1 and 2, is embedded below the lead shielding by the pressure boundary weld. The operating environment for the 24PHB DSC top side of the top shield plug forging, Types 1 and 2 listed in Table 1E-11 has been updated accordingly to show this corrected environment.
- The 24PHB DSC top side of the top shield plug plate is embedded below the outer top cover plate by the pressure boundary weld. The operating environment for the 24PHB DSC top shield plug plate listed in Table 1E-11 has been updated accordingly to show this corrected environment.
- A new line item has been added to Table 1E-11 to show the aging management review results for the 24PHB DSC grapple ring.
- A new line item has been added to Table 1E-11 to show the aging management review results for the 24PHB DSC cylindrical shell.
- A new line item has been added to Table 1E-11 to show the aging management review for the 24PHB DSC outer top cover plate.

Renewal Application Impact:

Table 1E-11 has been revised as described in the response.

DSC-RAI-10: Provide additional information on the Aging Management Review Results for the 61BT DSC:

- Clarify the operating environment for the inner top cover plate in CoC renewal application Table 1C-13. Drawing NUH-61B-1060-SAR, Rev. 6, Sheet 2 of 2 suggests that the top side of the inner top cover plate is not in an inert gas environment.
- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1C-13. Drawing NUH-61B-1060-SAR, Rev. 6, Sheet 2 of 2, suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify, and/or correct, the aging management review for the 61BT DSC test port plug in CoC renewal application Table 1C-13. Drawing NUH-61B-1060-SAR Rev. 6, Sheet 2 of 2 indicates that the test port plug is welded stainless steel in a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-10

- The pressure boundary weld of the 61BT dry shielded canister (DSC) inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from exposure to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1C-13, has been updated accordingly to show this corrected environment.
- The pressure boundary welds of the 61BT DSC siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent port cover plates, shown in Table 1C-13, has been corrected accordingly to show this corrected environment.
- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 61BT DSC test port plug listed in Table 1C-13 is subject to loss of material and stress corrosion cracking aging effects, which require management. Accordingly, the aging effects and the aging management activity for the 61BT DSC test port plug listed in Table 1C-13 have been updated.

Renewal Application Impact:

Table 1C-13 has been revised as described in the response.

DSC-RAI-11: Provide additional information on the Aging Management Review Results for the 32PT DSC:

- Clarify, and/or correct, the material for the 32PT DSC top shield plug in the aging management review shown in CoC renewal Application Table 1E-10. Drawing NUH-32PT-1001-SAR, Rev. 7, sheet 1 of 3, indicates 32PT DSC top shield plug may be A36 steel with an electroless-Ni coating, or Type 304 stainless steel. CoC renewal application Table 1E-10 implies that the Type 304 stainless steel version of the top shield plug has an electroless-Ni coating.
- Clarify, and/or correct, the aging management review for the 32PT DSC bottom shield plug outer casing in CoC renewal application Table 1E-10. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects. Drawing 32PT-1002-SAR, Rev. 5, sheet 2 of 2, indicates this part does not form part of the pressure boundary, but it is exposed to a sheltered environment. Because it is not part of the pressure boundary an AMP may not be required but it may be included as an indicator of localized corrosion of stress corrosion cracking initiation, as it could be more accessible than other external DSC welds.
- Clarify, and/or correct, the aging management review for the 32PT DSC alternative inner bottom cover plate in CoC renewal application Table 1E-10. Drawing 32PT-1002-SAR, Rev. 5, sheet 2 of 2, indicates the alternative inner bottom cover plate is part of the containment pressure boundary constructed of stainless steel and has a through thickness weld exposed to a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify, and/or correct, the aging management review for the 32PT DSC shear key in CoC renewal application Tables 1E-10 and 1H-24. Drawing 32PT-1002-SAR, Rev. 5, sheet 1 of 2, indicates the shear key is part welded stainless steel exposed to a sheltered environment. The shear key is not part of the pressure boundary but is needed to facilitate DSC removal and placement. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify, and/or correct, the aging management review for the 32PT DSC shell bottom in CoC renewal application Table 1E-10. Drawing 32PT-1002-SAR, Rev. 5, sheet 2 of 2, indicates the shell bottom is part of the containment pressure boundary constructed of stainless steel and has a through thickness weld exposed to a sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-11

- The material for the 32PT dry shielded canister (DSC) top shield plug in Table 1E-10 has been corrected to show that only the A36 material has electroless nickel coating.
- The aging effects and the aging management activity of the 32PT DSC bottom shield plug outer casing listed in Table 1E-10 have been updated to indicate that it is subject to loss of material and stress corrosion cracking again effects, which require management.
- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 32PT DSC alternative inner bottom cover plate listed in Table 1E-10 is subject to loss of material and stress corrosion cracking aging effects, which require management. Accordingly, the aging effects and the aging management activity for the 32PT DSC alternative inner bottom cover plate listed in Table 1E-10 have been updated.
- The aging effects and the aging management activity for the 32PT DSC shear key listed in Table 1E-10 and Table 1H-24 have been updated as suggested.
- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 32PT DSC bottom shell assembly listed in Table 1E-10 is subject to loss of material and stress corrosion cracking as aging effects requiring management. Accordingly, the aging management activity for the 32PT DSC shell bottom listed in Table 1E-10 has been updated.

Renewal Application Impact:

Tables 1E-10 and 1H-24 have been revised as described in the response.

DSC-RAI-12: Provide additional information on the Aging Management Review Results for the 24PTH DSC:

- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1F-13. Drawing NUH24PTH-1001-SAR, Rev. 5, sheet 3 of 4, suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1F-13. Drawing NUH24PTH-1001-SAR, Rev. 5, sheet 3 of 4, suggests that the top side of the inner top cover plate is not in an inert gas environment.
- Clarify, and/or correct, the aging management review for the 24PTH shell assembly bottom forging in CoC renewal application Table 1F-13. Drawing NUH24PTH-1002-SAR lists 4 types of forgings (Items 7, 8, 14, and 15) all with a through thickness weld to the cylindrical shell that is exposed to the sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify, and/or correct, the aging management review for the 24PTHF basket assembly aluminum insert in CoC renewal application Table 1J-13. This item is listed as safety classification A, but the environment and the safety functions are listed as N/A in table 1J-13.
- Clarify, and/or correct, the aging management review for the 24PTH inner grapple ring support in CoC renewal application Table 1F-13. Based on Drawing NUH24PTH-1002-SAR, Rev. 2, sheet 2 of 3, the inner grapple ring support appears to be in sheltered environment and is welded 304 SS, however this items is missing from Table 1F-13. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-12

- The pressure boundary welds of the 24PTH dry shielded canister (DSC) siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent cover plates, shown in Table 1F-13, has been updated accordingly to show this corrected environment.
- The pressure boundary weld of the 24PTH DSC inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from exposure to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1F-13, has been corrected accordingly.

- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 24PTH DSC shell assembly bottom forging listed in Table 1F-13 is subject to loss of material and stress corrosion cracking aging effects which require management. Accordingly, the aging effects and the aging management activity for the 24PTH DSC shell assembly bottom forging listed in Table 1F-13 have been updated.
- Table 1J-13 has been updated for the 24PTHF basket assembly aluminum insert to include the environment (inert gas) and to replace the "N/A" for the aging effects and aging management activity.
- A new line item has been added to Table 1F-13 to show the aging management review results for the 24PTH DSC inner grapple ring support.

Renewal Application Impact:

Tables 1F-13 and 1J-13 have been revised as described in the response.

DSC-RAI-13: Provide additional information on the Aging Management Review Results for the 61BTH DSC:

- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1H-20. Drawing NUH61BTH-2000-SAR, Rev. 2, Sheet 4 of 4, suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1H-20. Drawing NUH61BTH-2000-SAR, Rev. 2, Sheet 4 of 4, suggests that the inner top cover plate is not in an inert gas environment.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-13

- The pressure boundary welds of the 61BTH dry shielded canister (DSC) siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from being exposed to the inert gas environment. The operating environment for the siphon and vent port cover plates, shown in Table 1H-20, has been corrected accordingly.
- The pressure boundary weld of the 61BTH DSC inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from being exposed to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1H-20, has been updated accordingly.

Renewal Application Impact:

Table 1H-20 has been revised as described in the response.

DSC-RAI-14: Provide additional information on the Aging Management Review Results for the 32PTH1 DSC:

- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1H-21. Drawing NUH32PTH1-1001-SAR, Rev. 2, Sheet 2 of 3, suggests that the top side of the inner top cover plate is not in an inert gas environment.
- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1H-21. Drawing NUH32PTH1-1001-SAR Rev. 2, Sheet 2 of 3 suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify, and/or correct, the aging management review for the shell bottom, inner, in CoC renewal application Table 1H-21. Drawing NUH-32PTH1-1002-SAR, Rev. 1, sheet 2 of 2, item No. 4, shows the shell bottom, inner, has a through thickness weld to the cylindrical shell that is exposed to the sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Clarify, and/or correct, the aging management review for the shell bottom, recessed, in CoC renewal application Table 1H-21. Drawing NUH-32PTH1-1002-SAR, Rev. 1, sheet 2 of 2, item No. 8, shows that the shell bottom, recessed, has a through thickness weld to the cylindrical shell that is exposed to the sheltered environment. For other welded stainless steel DSC components exposed to a sheltered environment inside the HSM, the 1004 CoC renewal application aging management review identifies loss of material from localized corrosion and stress corrosion cracking as potential aging effects.
- Correct typographical error in the CoC renewal application Table 1H-21 for the transition rail nut material. Drawing NUH32PTH1-1003-SAR, Rev. 2, sheet 1 of 5, indicates that the transition rail nut should be ASME SA-194 Grade 8.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-14

- The pressure boundary weld of the 32PTH1 dry shielded canister (DSC) inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from exposure to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the inner top cover plate, shown in Table 1H-21, has been updated accordingly.
- The pressure boundary welds of the 32PTH1 DSC siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent port cover plates, shown in Table 1H-21, has been updated accordingly.

- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 32PTH1 DSC shell bottom, inner, listed in Table 1H-21 is subject to loss of material and stress corrosion cracking aging effects, which require management. Accordingly, the aging effects and the aging management activity for the 32PTH1 DSC shell bottom, inner, listed in Table 1H-21 have been updated.
- Section 3.5.4.2 provides a discussion of the aging mechanisms for the stainless steel DSC surfaces when exposed to a sheltered environment. Consistent with Section 3.5.4.2, the 32PTH1 DSC shell bottom, recessed, listed in Table 1H-21 is subject to loss of material and stress corrosion cracking aging effects, which require management. Accordingly, the aging effects and the aging management activity for the 32PTH1 DSC shell bottom, recessed, listed in Table 1H-21 have been updated.
- The typographical error for the transition rail material, listed in Table 1H-21, has been corrected.

Renewal Application Impact:

Table 1H-21 has been revised as described in the response.

DSC-RAI-15: Provide additional information on the Aging Management Review Results for the 69BTH DSC:

- Clarify the operating environment for the top side of the inner top cover plate in CoC renewal application Table 1J-15. Drawing NUH69BTH-72-1002, Rev. 0 suggests that the top side of the inner top cover plate is not in an inert gas environment.
- Clarify, and/or correct, the operating environment for the outer top cover plate in CoC renewal application Table 1J-15. Drawing NUH69BTH-72-1002, Rev. 0 suggests that outer top cover plate is in a sheltered environment, however, the environment listed in Table 1J-15 is “Inert Gas”. CoC renewal application Table 1J-15 identifies that the 69BTH outer top cover plate is covered by an AMP.
- Clarify the operating environment for the siphon and vent port cover plates in CoC renewal application Table 1J-15. Drawing NUH69BTH-72-1002, Rev. 0 suggests that the siphon and vent port cover plates are not in an inert gas environment.
- Clarify the operating environment for the top side of the inner top cover plate for the alternate top closure in CoC renewal application Table 1J-15. Drawing NUH69BTH-72-1004, Rev. 0 suggests that the top side of the inner top cover plate on the alternate top closure is not in an inert gas environment.
- Clarify the operating environment for the siphon and vent port cover plates for the alternate top closure in CoC renewal application Table 1J-15. Drawing NUH69BTH-72-1004, Rev. 0 suggests that the siphon and vent port cover plates on the alternate top closure are not in an inert gas environment.
- Clarify the operating environment for the top shield plug outer plate on the alternate top closure in CoC renewal application Table 1J-15. Drawing NUH69BTH-72-1004, Rev. 0 suggests that the top shield plug outer plate on the alternate top closure is not in inert gas environment.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-15

- The pressure boundary weld of the 69BTH dry shielded canister (DSC) inner top cover plate with the DSC shell prevents the top side of the inner top cover plate from exposure to the inert gas environment. Hence, the top side of the inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. The operating environment for the top side of the inner top cover plate, shown in Table 1J-15, has been updated accordingly.
- The 69BTH DSC outer top cover plate operating environment in Table 1J-15 has been corrected to show a sheltered environment.
- The pressure boundary welds of the 69BTH DSC siphon and vent port cover plates to the siphon and vent block prevent the top side of these cover plates from exposure to the inert gas environment. The operating environment for the siphon and vent port cover plate, shown in Table 1J-15, has been updated accordingly.

- As discussed in the first bullet of the response, the top side of the 69BTH DSC inner top cover plate is considered as embedded between the outer top cover plate and the top shield plug. This also applies to the alternate top closure. The operating environment for the top side of the inner top cover plate for the alternate closure, shown in Table 1J-15, has been updated accordingly to show this corrected environment.
- As discussed in the third bullet of the response, the top side of the 69BTH DSC siphon and vent port cover plates are prevented from exposure to the inert gas environment. This also applies to the alternate top closure. The operating environment for the siphon and vent cover plates for the alternate top closure shown in Table 1J-15 has been updated accordingly.
- The 69BTH DSC top shield plug outer cover plate for the alternate top closure is embedded below the outer top cover plate. The operating environment for the top shield plug outer cover plate for the alternate top closure shown in Table 1J-15 has been updated accordingly.

Renewal Application Impact:

Table 1J-15 has been revised as described in the response.

DSC-RAI-16: Provide additional information on the Aging Management Review Results for the 37PTH DSC:

- Clarify if the shell bottom inner cover in CoC renewal application Table 1J-16 includes the shell bottom, recessed, shown as Item #8 Option 3 in Drawing NUH-37PTH-72-1003.
- Clarify, and/or correct, the operating environment for the 37PTH DSC test port plug listed in CoC renewal application Table 1J-16. Drawing NUH37PTH-72-1004, Rev. 0 indicates that the test port plug is in a sheltered environment, however, the environment listed in Table 1J16 is "Inert Gas". CoC renewal application Table 1J-16 indicates the 37PTH test port plug plate is covered by an AMP.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-16

- The 37PTH DSC shell bottom, inner, (item 4 on drawing NUH37PTH-72-1003) listed in Table 1J-16 addresses both the shell bottom, inner (item 4) and shell bottom, recessed (item 8) types. Also, both of the shell bottom types have an identical material specification and safety function, and are exposed to the same sheltered/inert gas environment. Table 1J-16 has been updated to provide this clarification.
- The operating environment for the 37PTH DSC test port plug, alternate top closure, listed in Table 1J-16 has been corrected to show a sheltered environment.

Renewal Application Impact:

Table 1J-16 has been revised as described in the response.

DSC-RAI-17: Provide additional information on the assessment of the DSC Materials and Environments and specifically indicate if gamma radiation will be sufficient to alter the environment if deliquescence of deposited salts occurs. Specifically address whether the formation of oxidizing species such as H_2O_2 or HNO_3 are possible. If oxidizing species are expected, provide an evaluation of the effects of these species on pitting and stress corrosion cracking (SCC) susceptibility and propagation rates. See Section 3.4.1 of the application.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-17

In the presence of gamma radiation, radiolysis of water on the canister surface can generate radiolytic oxidizing products (e.g., hydrogen peroxide, nitric acid), which could raise the corrosion potential of the stainless steel canister when exposed to a humid atmosphere. Any increase of corrosion potential could accelerate the corrosion process. Of more importance with stainless steel is the possibility of radiation-induced localized corrosion (pitting corrosion and crevice corrosion) and stress corrosion cracking (SCC). While most studies related to gamma radiation and its effect on metal corrosion were conducted for the fuel cladding material under reactor conditions at high temperature and high dose rate, as introduced below, there are limited data available that can be applicable to the dry storage environment at low temperature and low dose rate. In Figure 3E-5, for the initial heat load of 40.8 kW that can represent the maximum dose rate for NUHOMS® 32PTH1-S DSC, the dose rate at the outer surfaces of the canister shell is estimated to be high as 1.1×10^4 rad/hr at storage time zero, gradually decreasing with time to ~1×10^4, 6.4×10^3, 4.4×10^3, and 2×10^3 rad/hr after 1, 10, 20 and 60 years, respectively.

<u>Gamma Radiation Effect on Localized Corrosion of Stainless Steel</u>

Glass et al. [1] reported a shift of corrosion potential of stainless steel 304L and 316L in the positive direction by about 0.2 V when exposed to gamma radiation of 3.3×10^6 rad/h in 0.1 M NaCl solution at 30 °C. As noted in [1], however, pitting was not expected to occur under irradiation due to the relatively large difference of about 0.2 V between the corrosion potential and pitting potential. A similar increase of the corrosion potential was also observed by Marsh et al. in [2] when stainless steel 304L was irradiated with a gamma dose rate of 2×10^5 rad/hr in chloride solution at 40 °C. Based on the potential measurement results for pitting and repassivation, which showed higher pitting potential with gamma radiation than without radiation and almost the same repassivation potential both with and without gamma radiation, Marsh et al. [2] claimed that gamma radiation can inhibit localized corrosion due to cathodic depolarization, formation of a more oxidized, less defective passive layer, or both. On the other hand, contrary to the observed inhibition effect of gamma radiation for pitting corrosion by Marsh et al. [1], crevice corrosion test results indicated that the presence of radiation could increase the probability of crevice corrosion initiation and enhance its propagation in stainless steel 304L when tested in chloride solution (3% NaCl) at 30 °C (Worthington et al., [3]). At the dose rate of 10^5 rad/h, propagation was sustained once a crevice was initiated. At a relatively low dose rate of 10^3 rad/h, however, propagation was limited; crevice current decreased with time, and repassivation eventually occurred. Since no data in the 10^4 rad/h range are reported in [3], it is difficult to determine how gamma radiation of 10^4

rad/h would affect crevice corrosion of stainless steel. Considering the relatively dry conditions of the canister surface at the beginning of storage time due to high canister temperature, though the dose rate could be on the order of 10^4 rad/h over less than a year (based on dose rate estimation in Figure 3E-5), it is unlikely that radiolysis due to gamma radiation of 10^4 rad/h would accelerate the canister pitting and crevice corrosion. At a low dose rate on the order of 10^3 rad/h, no significant effect of gamma radiation on localized corrosion of the canister is expected based on the observation of limited propagation.

Gamma Radiation Effect on Stress Corrosion Cracking of Stainless Steel

Similar to the limited data applicable for localized corrosion of the canister under gamma radiation, only the study by Furuya et al. [4] is available for the dry storage condition, although the temperature of 100 °C used for testing was relatively high. Furuya et al. [4] conducted SCC testing for sensitized stainless steel 304 using double U-bend coupons in chloride solution at 100 °C. When irradiated at the dose rate 8.6×10^5 rad/h or 10^5 rad/h, cracking occurred on the outer surface of the inner pieces, indicating that crevice conditions existing between the two pieces are important. The crack growth rate (CGR) was higher at 8.6×10^5 rad/h than the CGR at 10^5 rad/h. In the absence of gamma irradiation, however, no SCC occurred. Unfortunately, in Furuya et al. [4], no lower dose rates, such as 10^3 or 10^4 rad/h, were investigated. Due to current lack of the data for lower dose rates, it is inconclusive to determine potential effects of gamma radiation on canister chloride-induced stress corrosion cracking (CISCC) during storage. As a result, the gamma irradiation effect on canister CISCC is included as a potential aging effect requiring management in the revised aging management review (AMR) in Section 3.5.4.2 (Discussion of Aging Mechanisms). Based on SCC occurrence on the outer surface of inner pieces under gamma irradiation as reported in Furuya et al. [4], the crevice area of the DSC shell contact rail support could be the area most susceptible to CISCC.

Section 3.5.4.2 has been revised by adding a paragraph regarding gamma radiation effects on canister corrosion, with additional references also added to Section 3.11. Enhancement of crevice corrosion and SCC by gamma ray radiolysis of the dry shielded canister (DSC) surface water has been added to Sections 6A.3.3 and 6A.4.3 of the aging management program. In Appendix 3E, Sections 3E.1, 3E.2, 3E.3, and 3E.4 have been revised to estimate a level of gamma radiation when the water is present on the DSC outer surface.

References

[1] R.S. Glass, G.E. Overturf, R.A. van Konynenburg, and R.D. McCright, “Gamma radiation effects on corrosion-I. Electrochemical mechanisms for the aqueous corrosion processes of austenitic stainless steels relevant to nuclear waste disposal in tuff,” Corrosion Science, Volume 26, Issue 8, Pages 577-590, Lawrence Livermore National Laboratory, Livermore, California, January 1986.

[2] G.P. Marsh, K.J. Taylor, G. Bryan, and S.E. Worthington, “The influence of radiation on the corrosion of stainless steel,” Corrosion Science, Volume 26, Issue 11, Pages 971-982, Corrosion Technology Group, AERE Harwell, Oxfordshire X11 ORA, United Kingdom, 1986.

[3] S.E. Worthington, G.P. Marsh and K.J. Taylor, “Improvements in Materials Reliability in the Back End of the Nuclear Fuel Cycle,” IAEA Vienna, Austria, IAEA-TECDOC-686, Pages 55-64, IAEA Technical Committee Meeting, Vienna, November 28-December 1, 1989.

[4] T. Furuya, H. Tomari, K. Fujiwara, S. Muraoka and K. Araki, “Influence of Gamma Irradiation on Stress Corrosion Cracking of Austenitic Stainless Steels,” Fuel Reprocessing and Waste Management, Pages 493-502, American Nuclear Society, LaGrange Park, Illinois; ANS International topical meeting on fuel reprocessing and waste management; Jackson Hole, Wyoming; August 26-29, 1984.

Renewal Application Impact:

Sections 3.5.4.2, 3.11, 3E.1, 3E.2, 3E.3, 3E.4, 6A.3.3, and 6A.4.3, have been revised as described in the response.

DSC-RAI-18: Provide additional information on the assessment of galvanic corrosion in the Aging Effects/Mechanisms for the Dry Shielded Canisters during the Period of Extended Storage.

- Provide a definitive assessment of the potential for galvanic corrosion as a potential aging mechanism for the stainless steel DSC. CoC renewal application Section 3.5.4.2 does not provide a definitive conclusion regarding galvanic corrosion as a potential aging mechanism requiring management.
- Provide additional information on the information cited to support the lack of galvanic corrosion between stainless steels and graphite lubricants. The information provided in the CoC renewal application does not clearly identify examples of where graphite lubricants are used in contact with stainless steels in operating reactors, or if these operating experiences are under similar environmental conditions to the operating environment for the DSC. Note that valve packing material using graphite typically includes either zinc (low temperatures only, to avoid molten zinc and liquid metal embrittlement), or phosphorous, as corrosion inhibitors. Although austenitic stainless steels are noted to be less susceptible than martensitic stainless steels often used in valve components, austenitic stainless will still be preferentially anodic when coupled to graphite.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-18

Galvanic corrosion may occur on the dry shielded canister (DSC) shell resulting from contact between dissimilar materials along the length of the DSC support structure at the contact area where graphite lubricant is used to facilitate DSC loading into the horizontal storage module (HSM). The graphite is cathodic relative to the stainless steel 304 used in the DSC shell and Nitronic® 60 DSC support rail plate. The lubricant used does not include zinc, phosphorous, or other corrosion inhibitors. Therefore, galvanic corrosion between graphite lubricant and stainless steel DSC shell, and between the graphite lubricant and the Nitronic® DSC support rail could occur and could accelerate crevice corrosion of the DSC shell and the Nitronic® stainless steel support rail. Significant loss of material in the DSC shell and Nitronic® DSC support rail due to galvanic corrosion is not expected as a result of the relatively small ratio of cathodic to anodic surface area (1:1 or less) contacting between the graphite lubricant and the DSC shell as well as between the graphite lubricant and the Nitronic® support rail. Additionally, there is a limited amount of electrolyte present on the canister surface. Even though there is no reported operating experience of stainless steel degradation where a graphite lubricant film has caused galvanic corrosion, loss of material due to galvanic corrosion of both the DSC shell and the Nitronic® support rail is an aging effect requiring management for the stainless steel DSC shell in a sheltered environment.

Sections 3.5.4.2, 3.6.4.4, 6A.3.3, 6A.3.5.3, 6A.3.5.4, 6A.3.5.6, 6A.4.3, 6A.4.5.3, 6A.4.5.6, 6A.5.3, 6A.5.5.3, and 6A.5.5.6 and Attachment A, Tables A-2, A-3 and A-4 have been revised to address galvanic corrosion at the canister-graphite-Nitronic interface.

Renewal Application Impact:

Sections 3.5.4.2, 3.6.4.4, 6A.3.3, 6A.3.5.3, 6A.3.5.4, 6A.3.5.6, 6A.4.3, 6A.4.5.3, 6A.4.5.6, 6A.5.3, 6A.5.5.3, and 6A.5.5.6 and Attachment A, Tables A-2, A-3 and A-4 have been revised as described in the response.

Proprietary Information on Pages 28 through 52
Withheld Pursuant to 10 CFR 2.390

DSC-RAI-22: Provide additional information to support the assessment that temporary attachments will not result in areas of sensitization and residual stresses that may lead to increased susceptibility to intergranular corrosion, and stress corrosion cracking. CoC renewal application Section 3.5.4.7 states that welding and grinding can result in temperatures above those needed for sensitization; however, the substrate would cool rapidly and deny the opportunity for sensitization to occur. In addition, CoC renewal application Section 3.5.4.7 also states that the residual tensile stresses from welding and grinding to remove temporary attachments would be confined to a very narrow near surface region of the DSC shell thickness and any cracking that initiated would be arrested at a shallow depth. No data is provided to support these assessments. According to time temperature sensitization diagrams for stainless steels, the time at temperature needed to induce sensitization is a function of the carbon content of the stainless steel, with standard grade 304 with up to 0.08 percent carbon a cooling rate of 300°C/min (5°C/second) would be necessary from 900 to 600°C to avoid any sensitization of stainless steel.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-22

Section 3.5.4.7 has been revised to provide increased detail and discussion in response to this RAI.

Renewal Application Impact:

Section 3.5.4.7 has been revised as described in the response.

DSC-RAI-23: Provide additional information to support the assessment in Sections 3.5.3 and 3.5.4.1 of the CoC renewal application that indicates elevated temperature exposure will not result in a change in mechanical properties requiring management in the period of extended operation for the welded stainless steel components including the DSC basket. The CoC renewal application indicates that the average helium temperature inside the DSC reaches 573°F [300°C] at the beginning of storage for the bounding heat load DSC, the 32PTH1 with an initial heat load of 40.8 kW. Bounding temperatures for the aluminum components in the basket are stated in the renewal application Section 3.5.4.3 to reach up to 680°F [360°C]. Elevated temperature exposures of austenitic stainless steel welds can result in a significant change in material properties. For example, NUREG/CR–6428 (Gavenda et a., 1996) shows that fracture toughness of austenitic stainless steel welds can be decreased by spinodal decomposition of the delta ferrite phase, and depending on temperature, G-phase can also be formed. Chandra et al. (2012) showed that the spinodal decomposition of 304L welds can occur at temperatures as low as 635°F [335°C] and significant hardening occurs at 752°F [400°C] in 500 hours.

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-23

The “Elevated Temperature” discussion in Section 3.5.4.2 has been expanded to discuss change of mechanical properties due to elevated temperature.

Renewal Application Impact:

Section 3.5.4.2 has been revised as described in the response.

DSC-RAI-24: Provide additional information to support the assessment in Section 3.5.3 of the CoC renewal application that states that elevated temperature exposure will not result in a change in mechanical properties requiring management in the period of extended operation for the Al 6061 used in the DSC basket transition rails. The CoC holder provided an evaluation of creep for Al 6061 and Al 1100 in Section 3.5.4.3 of the CoC renewal application. However, it is known that both elevated temperature and neutron irradiation can affect the properties of Al 6061. Neutron effects are not observed until $>10^{20}$ n/cm^2. Temperature affects the allowable stress for all tempers including T4, T451, T6, and T651, but especially for the T6 and the T651 tempers (ASME, 2013). In addition, ASME Section II, Part D, Table 1B requires that time dependent properties must be used for exposures above 350°F [177°C]. According to the CoC renewal application Section 3.5.4.3, the representative temperatures for the transition rails are between 470°F [243°C] to 390°F [199°C] for the time ranging from 0 to 10 years after loading. These temperatures will result in a significant decrease in mechanical properties according to the information provided in ORNL/TM-13049 (Farrell, 1995).

This information is required to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO DSC-RAI-24

Aluminum 6061 is used for the perimeter “rails” to provide the transition between the basket fuel support compartments and the circular shell. The 6061 aluminum transition rails are aluminum sections (e.g., machined plates) confined between the shell and the basket. They are loaded under compression during storage and have a structural function.

As described in UFSAR, Sections M.2.2.5.1.2 (32PT DSC), P.2.2.5.1.2 (24PTH DSC), T.2.2.5.1.3 (61BTH DSC), U.2.2.5.1.3 (32PTH1 DSC), Y.2.2.5.1.3 (69BTH DSC), and Z.2.2.5.1.3 (37PTHH DSC), the aluminum transition rails perform their function (support of the fuel compartment grid assembly) by remaining in place. The loads on the rails are primarily bearing from the fuel compartment grid. “Failure” of the transition rail would require that the rail no longer provide support to the fuel compartment grid. Since the aluminum rails are constrained between the DSC shell and the fuel compartment grid, this cannot occur. For normal conditions of storage (deadweight and handling loads), stresses in the aluminum rails are limited to the allowable bearing stress, equal to Sy, from ASME Subsection NG-3227.1(a). The stress evaluation is based on mechanical properties corresponding to annealed 6061 (6061-O) regardless of the particular temper. The use of properties based on annealed condition (no credit taken for enhanced properties obtained by heat treatment) in the stress qualification of the transition rails eliminates any changes in strength that may occur under exposure to elevated temperatures and ensures no adverse impact on the properties used in the design.

The “Elevated Temperature” discussion in Section 3.5.4.2 has been modified to discuss change of mechanical properties due to elevated temperature.

Renewal Application Impact:

Section 3.5.4.2 has been revised as described in the response.

Proprietary Information on Pages 56 through 67
Withheld Pursuant to 10 CFR 2.390

B. Horizontal Storage Modules (HSMs)

HSM-RAI-1: Revise Tables 1A-12, 1B-10, 1C-14 and 1H-28 to provide a one-to-one correlation with the subcomponents listed in Table 2B-1. Revise Tables 1F-14, 1G-18, 1H-30 and 1J-17 to provide a one-to-one correlation with the subcomponents listed in Table 2B-2. Revise Tables 1H-22, 1I-12 and 1J-17 to provide a one-to-one correlation with the subcomponents listed in Table 2B-3. Revise Tables 1F-15 and 1H-29 to provide a one-to-one correlation with the subcomponents listed in Table 2B-4.

Tables 2B-1 thru 2B-4 comprehensively identified subcomponents per HSM design bases drawings. However, the applicant aggregated subcomponents in the AMR result tables where the subcomponents are not identified per the scoping evaluation. The applicant is asked to revise the AMR result tables to provide a one-to-one correlation with the scoping evaluation tables. The correlation helps ensure that all subcomponents are accounted in the AMR process.

This information is required to ensure compliance with 72.240.

RESPONSE TO HSM-RAI-1

As noted in Section 2.3, the subcomponents within the scope of renewal are identified in Chapter 1, Appendix 1A through Appendix 1K on an amendment-by-amendment basis. The detailed scoping evaluation results, along with the results of the aging management review (AMR), for each component of the NUHOMS® System, broken down to the subcomponent and subcomponent parts level, are provided in various Tables 1X-Y (where X = A through K, and Y = specific table numbers for DSC models, HSM models, etc.) of Appendix 1.

Appendices 2A through 2D present the detailed scoping evaluation results on a component-by-component basis based on the current Revision 14 of the updated final safety analysis report (UFSAR), which incorporates Amendment 13, plus changes based on the proposed changes to the UFSAR associated with Amendment 14, which is currently under NRC review. Thus, Table 2B-1 presents the scoping evaluation results for HSM Model 80 and Model 102 based on the configuration described in UFSAR Revision 14 and proposed Amendment 14 changes.

For example, Table 1A-12 identifies the subcomponents of horizontal storage module (HSM) Model 80 based on the HSM design basis drawings listed in Table 1A-4 and contained in UFSAR Revision 4A. It uses Table 2B-1 as a template, but only lists the subcomponents contained in HSM drawings listed in Table 1A-4. In addition to performing a scoping evaluation for HSM Model 80 subcomponents, Table 1A-12 also presents the AMR results of the HSM in-scope subcomponents.

Some of the subcomponents, such as various embedment assemblies, have an identical material specification, safety classification and are exposed to the same environment. The scoping evaluation and AMR results for such subcomponents remain unaffected whether they are presented as separate line items or grouped together. Hence, various subcomponent embedment assemblies were presented as a single line item in Table 1A-12. A similar approach was adopted for subcomponent attachment hardware such as bolts, studs, nuts and washers.

As suggested, these aggregated line items have been separated in the revised Table 1A-12. The updated Table 1A-12 also corrects additional discrepancies resulting from a one-to-one review against HSM Model 80 design basis drawings listed in Table 1A-4. This review also resulted in an update to Table 1C-14. No changes are needed to Tables 1B-10 and 1H-28.

A one-to-one review of the HSM-H subcomponents listed in Tables 1F-14, 1G-18, 1H-30 and 1J-17 has been performed against the corresponding HSM-H design basis drawings listed in Tables 1F-2, 1G-3, 1H-7, and 1J-8, respectively. As discussed above, the aggregated line items for HSM-H have been separated into individual line items along with implementing corrections to some minor discrepancies. Accordingly, Tables 1F-14, 1H-30 and 1J-17 have been revised as suggested. No changes are needed to Table 1G-18. In addition, an editorial change was made to the Note at the bottom of Table 1J-17 to correct the cross-reference of the previous AMR results for the HSM-HS from "Table 1H-16" to "1H-22."

A similar review of the HSM-HS subcomponents listed in Tables 1H-22, 1I-12 and 1J-17 has been performed against the corresponding HSM-HS design basis drawings listed in Tables 1H-8, 1I-8 and 1J-9, respectively. The aggregated line items for HSM-HS have been similarly separated into individual line items. Tables 1H-22 and 1J-17 have been revised as suggested. No changes are needed to Table 1I-12.

Finally, a one-to-one review of the HSM Model 152 subcomponents listed in Tables 1F-15 and 1H-29 has been performed against the corresponding HSM Model 152 design basis drawings listed in Tables 1F-6 and 1H-10, respectively. The aggregated line items for HSM Model 152 have been separated into individual line items and Table 1F-15 has been updated. No changes are needed to Table 1H-29.

Renewal Application Impact:

Tables 1A-12, 1C-14, 1F-14, 1F-15, 1H-22, 1H-30, and 1J-17 have been revised as described in the response.

HSM-RAI-2: Provide drawing NUH-03-6017-03, Rev. 5B.

Table 2B-1 lists two subcomponents for the cask alignment target embedment, which reference drawing NUH-03-6017-03. The drawing is not in Appendix E.2 of the UFSAR, Rev. 14, nor referenced in Table 2E.2 of the renewal application. The applicant is asked to provide the relevant drawing for these subcomponents so the staff can complete the review.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-2

Drawing NUH-03-6017-03, Revision 5B was incorrectly called out in Table 2B-1. The correct drawing number is NUH-03-6017-01-SAR, Revision 7. This has been corrected in Table 2B-1.

Renewal Application Impact:

Table 2B-1 has been revised as described in the response.

HSM-RAI-3: Provide drawing NUH-07-2109-SAR.

Drawing NUH-03-6008-SAR, "Standardized NUHOMS® ISFSI Horizontal Storage Module ISFSI General Arrangement," references drawing NUH-07-2109-SAR, "CASK/HSM RESTRAINT SYSTEM". The referenced drawing is not in Appendix E.2 of the UFSAR, Rev. 14, nor referenced in Table 2E.2 of the renewal application. The applicant is asked to provide the referenced drawing so the staff can complete the review.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-3

Updated final safety analysis (UFSAR) drawing NUH-03-6008, "Standardized NUHOMS ISFSI Horizontal Storage Module ISFSI General Arrangement," listed the procurement drawing NUH-07-2109, "Cask/HSM Restraint System," as a reference drawing since the initial approval of the Standardized NUHOMS® System CoC No. 1004 (Amendment 0).

Historically, AREVA has created NUH-07 series drawings to serve as procurement drawings, versus NUH-03 series drawings, which are UFSAR drawings for inclusion in the UFSAR. Hence, this specific drawing, NUH-07-2109, being a procurement drawing, was never intended to be included in the UFSAR and was listed in the initial UFSAR Revision 3A submittal, in drawing NUH-03-6008, as a reference only. At that time, UFSAR drawings did not include a suffix "–SAR" at the end of a SAR drawing callout.

In UFSAR Revision 13, AREVA corrected some labelling discrepancies present in the callout of reference SAR drawings listed on drawing NUH-03-6008-SAR. This change added a suffix "-SAR" behind each of the SAR drawings listed as a reference on drawing NUH-03-6008-SAR. However, this change was also inadvertently applied to the callout of the procurement drawing NUH-07-2109, thus leading to an incorrect implication of the existence of a SAR drawing, "NUH-03-2109-SAR."

AREVA has updated UFSAR drawing NUH-03-6008-SAR to correct this discrepancy. This corrected drawing will be included in UFSAR Revision 15.

Finally, as discussed above, since reference drawing NUH-07-2109 "Cask/HSM Restraint System" is not a SAR drawing, Note 2 in Table 2-1 has been modified accordingly to exclude this subsystem as part of the HSM.

Renewal Application Impact:

Table 2-1 has been revised as described in the response.

HSM-RAI-4: Clarify the intended function of subcomponents 1, 4 and 5 of Drawing NUH-03-6018-SAR. Reconcile the scoping evaluation for subcomponents 1-6 of Drawing NUH-03-6018-SAR with the more recent revision of the drawing incorporated in UFSAR, Rev. 14.

Subcomponents 1, 4 and 5, "Pipe Sleeve", "Angle" and "Studs" in Table 2B-1 are identified to mitigate cosmetic damage during handling and installation and therefore not within the scope of renewal. The drawing references specification NUH-03-114 for requirements of construction. The staff has not reviewed this specification and is unclear about the intended function of these items. The applicant is asked to provide additional clarification to justify the exclusion of these subcomponents.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-4

The pipe sleeve, Subcomponent 1 of Drawing NUH-03-6018-SAR, provides access for the shield wall support assembly installation. It functions only during HSM fabrication, and provides no structural functionality after the installation has taken place. Additionally, this subcomponent is not credited with confinement, shielding, criticality, or heat transfer functionality.

Nelson stud, Subcomponent 5 from Drawing NUH-03-6018-SAR, fastens the angle, Subcomponent 4, in place. The angle provides protection for the corners of the end shield wall to mitigate cosmetic damage that could potentially occur during transportation from the fabrication site, as well as during handling at installation. These subcomponents do not provide structural, confinement, shielding, criticality, or heat transfer functionality.

Specification NUH-03-114 provides general construction parameters for precast concrete components of the Standardized NUHOMS® System. Design basis information such as concrete density and codes and standards are included in the Certificate of Compliance (CoC) 1004 Updated Final Safety Analysis Report (UFSAR). NUH-03-114 does not specifically reference these items and, therefore, does not provide additional clarification on the intended function of these subcomponents.

Items 1-6 of Drawing NUH-03-6018-SAR have been updated in Table 2B-1 to reflect Revision 7 of Drawing NUH-03-6018-SAR as shown in the CoC 1004 UFSAR Revision 14. In addition, editorial corrections have been made in Table 2B-1 to change the drawing numbers from "NIH-..." to "NUH-...."

Renewal Application Impact:

Table 2B-1 has been revised as described in the response.

HSM-RAI-5: Revise Table 2B-1 to include the material of construction for subcomponent 6 of drawing NUH-03-6018-SAR.

Table 2B-1 does not identify the material of construction of subcomponent 6, “Std Washer Ø1 1/8” of drawing NUH-03-6018-SAR. The subcomponent is identified to be within the scope of renewal. The staff requires the information to complete the review.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-5

Table 2B-1 has been revised to include the material of construction for Subcomponent 6 of Drawing NUH-03-6018-SAR, Revision 7.

Renewal Application Impact:

Table 2B-1 has been revised as described in the response.

HSM-RAI-6: Clarify the intended function of subcomponents 10, 11 and 17 of drawing NUH-03-6024-SAR.

Subcomponents 10, 11 and 17, "Plate", "Pipe" and "Tube" are identified to not affect a safety function in the case of failure. The drawing references specification NUH-03-115 for requirements of construction. The staff has not reviewed this specification and is unclear about the intended function of these items. The applicant is asked to provide additional information to justify the exclusion of these subcomponents.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-6

Subcomponents 10, 11 and 17 of drawing NUH-03-6024-SAR comprise the shield wall support assembly. See Figure HSM-RAI-6-1. This assembly provides access for installation of the shield wall support bolts for the alternate shield wall configuration (NUH-03-6024-SAR Subcomponents 12 and 13) during the horizontal storage module (HSM) assembly process when attaching the shield wall to the HSM base. The annulus between Subcomponents 17 and 11 is filled with grout once installed and, therefore, provides no structural function once the shield wall support bolts are in place. Additionally, these subcomponents are not credited with confinement, shielding, criticality, or heat transfer functionality.

Figure HSM-RAI-6-1
HSM 80/102 Shield Wall Support Assembly

Security-Related Information
Figure Withheld Under CFR 2.390

Specification NUH-03-115 provides general construction parameters for steel components of the Standardized NUHOMS® System. The NUH-03-115 does not specifically reference these items and, therefore, does not provide additional clarification on the intended function of these subcomponents.

Renewal Application Impact:

No changes as a result of this question.

HSM-RAI-7: Revise Table 2B-1, "Scoping Evaluation for HSM 80 and HSM 102," to account for the following:

- Subcomponents 9 and 12 of Drawing NUH-03-6017-01-SAR
- Subcomponents 13, 14, 18, in Drawing NUH-03-6008-SAR

The listed subcomponents are not identified in Table 2B-1. Their exclusion from the scope of renewal has not been justified.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-7

Table 2B-1 has been revised to include Subcomponents 9 and 12 in Drawing NUH-03-6017-01-SAR, and Subcomponents 13, 14, and 18 in Drawing NUH-03-6008-SAR.

Renewal Application Impact:

Table 2B-1 has been revised as described in the response.

HSM-RAI-8: Justify the determination that the support structure steel of the HSM Model 80 will not be subject to aging effects.

The support structure steel in Table 1A-12 (page 1A-42) is identified to be constructed of ASTM A36 carbon steel and to provide structural support to the DSC. These subcomponents are subject to material loss due to general corrosion in a sheltered environment, as revealed by the lead inspection results from the Calvert Cliffs ISFSI. The inspections of two HSM modules revealed general corrosion of interior carbon steel surfaces and bolting hardware (Figure 8, ML12212A216). The applicant is asked to justify any determination to the contrary.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-8

Table 1A-12 has been revised to include loss of material in the dry shielded canister (DSC) support structure assembly (ASTM A36 carbon steel subcomponents) in the horizontal storage module (HSM) Model 80 as an aging effect requiring management in the NUHOMS® Aging Management Program (AMP).

Renewal Application Impact:

Table 1A-12 has been revised as described in the response.

HSM-RAI-9: Clarify the intended function of the canister axial retainer sleeve (ASTM A36 or ASTM A500 Grade B) identified in Tables 1A-12, 1B-10, 1C-14.

The subcomponent is identified in Tables 1A-12, 1B-10, 1C-14 as not important to safety, but it does not appear to be listed in Table 2B-1. The applicant is asked to reconcile the scoping evaluation with the aging management review for the HSM model 80 and model 102. The staff requires the information to complete the review.

This information is required to ensure compliance with 10 CFR 72.236(b) and 72.240.

RESPONSE TO HSM-RAI-9

The original configuration of the dry shielded container (DSC) axial retainer assembly consisted of two parts: an axial retainer sleeve, as shown in drawing NUH-03-6017-01-SAR, Revision 5, item 4 and an axial retaining rod attached to a mounting plate, as shown in drawing NUH-03-6024, Revision 2, items 7 and 8. These two parts are shown in Table 1A-12. Table 1B-10 shows a minor change in the material specification callout of the axial retainer sleeve.

The DSC axial retainer assembly configuration was modified per Condition 9 of CoC 1004 (similar to 10 CFR 72.48 which was promulgated later), as documented in safety evaluation SRS 72-1434 as described in Section 1C.1.4.3. The axial retainer sleeve was replaced with a drop-in steel tube and plate, as shown in drawing NUH-03-6017-01-SAR, Revision 6, items 6 and 7. This revised configuration of the axial retainer sleeve is reflected in Table 1C-14. Based on this, Section 3.6.1 is also revised in the "Seismic Restraints" description.

Appendix 2B, Table 2B-1 reflects the final configuration of the DSC axial retainer sleeve, as shown in updated safety analysis report (UFSAR) Revision 14, drawing NUH-03-6017-01-SAR, Revision 7, items 6 and 7. This callout in Table 2B-1 is consistent with the callout in Table 1C-14, discussed above. Hence, there is no change required to Table 1A-12, Table 1B-10, or Table 1C-14. For consistency, Table 2B-1 has been revised to change the callout for item 7 of drawing NUH-03-6024, to say “DSC Axial Retainer” instead of “Tube Steel Retainer.”

The axial retainer assembly sleeve is a not important-to-safety item. This item is used as a blockout during concrete casting, as discussed in Table 2B-1.

Renewal Application Impact:

Table 2B-1 has been revised as described in the response.

Section 3.6.1 has been revised as described in the response.

HSM-RAI-10: Revise the following tables to address the aging effect of loss of material due to general and crevice corrosion for Category B steel embedments, or justify the determination that the aging effect is not applicable.

Table 1A-12 (HSM model 80):

- Cask docking ring assembly (rings, plates, studs, door clamps, door bolts, nuts, washers)
- Heat shield embedment assemblies (bolts, sleeve nuts)
- Cask restraint embedment assembly (rods, sleeve nuts, hexagonal nuts)
- Miscellaneous embedment assemblies (sleeve nuts)

Table 1F-14 (HSM model H):

- Main assembly embedments (for rail extension, door, attachment, cask restraint, shield wall, etc.)
- Main assembly (rear connection plate)

Table 1F-15 (HSM model 152):

- Threaded insert Dayton superior
- Tube steel
- Expanded coil insert Dayton superior
- Plate

Table 1I-12 (HSM model HS):

- Main assembly (roof attachment, #7 bar with threaded head)
- Main assembly (roof attachment, coupling nut)

The application does not justify why loss of material due to general and crevice corrosion is not an applicable aging effect for embedments in the concrete structure. The lead inspection results from the Calvert Cliffs ISFSI revealed general corrosion of interior carbon steel surfaces and bolting hardware (Figure 8, ML12212A216). Section 3.6.4.2, of the renewal application, states that corrosion of embedded steel can be an aging degradation mechanism for concrete structures. Section 3.6.4.2 further states that if the concrete is degraded by other mechanisms, which may reduce the protective cover of the steel, corrosion may occur at a significantly higher rate. The applicant is asked to clarify if the aging management program will rely on visual inspection of internal surfaces of the HSM to determine if the intended functions of embedments are compromised.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-10

Consistent with the discussion provided in Chapter 3, Section 3.6.4.2, the category B steel embedments listed in Table 1A-12 (HSM Model 80), Table 1F-14 (HSM-H), Table 1F-15 (HSM Model 152) and Table 1I-12 (HSM-HS) are subject to loss of material in a sheltered environment. Accordingly, the aging effects requiring management and aging management activity for the horizontal storage module (HSM) steel embedments listed in Tables 1A-12, 1F-14, 1F-15 and 1I-12 have been updated. In addition, Table 1H-22 has also been updated.

The HSM Aging Management Program (AMP) relies on the visual inspection of the HSM internal surfaces to determine whether the intended functions of embedments are compromised. As stated in paragraph 3 of Section A6.5.4, Appendix 6, "The HSM AMP for external and internal surfaces includes the inspection of internal surfaces of concrete modules for evidence of aging degradation. The inspection may be performed using a video camera, or fiber-optic scope or borescope technology." No additional changes are needed.

Renewal Application Impact:

Tables 1A-12, 1F-14, 1F-15, 1-H-22, and 1I-12 been revised as described in the response.

HSM-RAI-11: Revise Table 1C-12 to address the design change incorporating the reinforced concrete shielded door.

Section 1C.1.4.3 of the renewal application identifies the changes incorporated in HSM model 102 relative to the earlier HSM model 80. One of the changes involved replacing the composite door with steel liners on all faces by a reinforced concrete shield door (with a steel liner on the inside only). This is confirmed by the scoping evaluation in Table 2B-1. However, the AMR in Table 1C-12 does not reflect the change. The applicant is asked to address the new subcomponent and potential aging effects in Table 1C-12. The staff requires the information to complete the review.

This information is required to ensure compliance with 10 CFR 72.236(d, e) and 72.240.

RESPONSE TO HSM-RAI-11

Table 1C-14 is the application table which accounts for the HSM subcomponents. Table 1C-14 has been updated to add the items associated with the addition of a reinforced concrete door for HSM Model 102, as described in Section 1C.1.4.3.

Renewal Application Impact:

Table 1C-14 has been revised as described in the response.

HSM-RAI-12: Justify the determination that the liner plates for the inlet and outlet vents of the HSM model 102 are not subject to the aging effect of loss of material due to general corrosion, or revise Table 1C-14 to address the aging effect and identify an aging management activity.

The liner plates of the inlet and outlet vents in Table 1C-14 are identified to be constructed of ASTM A36 carbon steel and to provide shielding. These subcomponents are subject to material loss due to general corrosion in an external environment. The applicant is asked to justify a determination to the contrary, or revise Table 1C-14 to address the aging effect and identify an aging management activity.

This information is required to ensure compliance with 10 CFR 72.236(d) and 72.240.

RESPONSE TO HSM-RAI-12

Since the liner plates are constructed of ASTM A36 carbon steel and provide shielding, these subcomponents are subject to material loss due to general corrosion in an external environment, and are therefore subject to the NUHOMS® AMP. Accordingly, Table 1C-14 has been updated to reflect this information.

Renewal Application Impact:

Table 1C-14 has been revised as described in the response.

HSM-RAI-13: Revise Tables 1F-14 (HSM model H), 1F-15 (HSM model 152) and IH-29 (HSM Model 152) to address the aging effect of loss of material due to localized corrosion for the support rail plate of the HSM-H and HSM-152 models, or justify the determination that these models are not subject to the aging effect.

The support rail plate in Tables 1F-14 (HSM model H), 1F-15 (HSM model 152) and IH-29 (HSM Model 152) is identified to be constructed of NITRONIC 60®/ UNS S21800 austenitic steel. The applicant further identified the plate as not important to safety, although failure would prevent fulfillment of an important to safety function (i.e., to provide structural support to the DSC). The plates are further identified to provide corrosion protection due to potential galvanic corrosion between the support structure and the DSC, and reduce friction during loading/unloading operations. The subcomponent is subject to loss of material due to localized corrosion in a sheltered environment, as was stated in Tables 1A-12 and 1H-22 for the HSM model 80 and HSM model HS, respectively. The application should justify any determination to the contrary for models HSM-H and HSM-152, or revise Tables 1F-14 (HSM model H), 1F-15 (HSM model 152) and IH-29 (HSM Model 152) to address aging effect and identify an aging management activity.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-13

Since the support rail plates are constructed of NITRONIC 60® stainless steel, these subcomponents are subject to material loss due to localized corrosion in a sheltered environment and are, therefore, subject to the NUHOMS® Aging Management Program. Accordingly, Tables 1F-14 (HSM-H), 1H-30 (HSM-H), 1F-15 (HSM Model 152), and IH-29 (HSM Model 152) have been updated to reflect this information.

Renewal Application Impact:

Tables 1F-14, 1F-15, 1H-29, and 1H-30 have been revised as described in the response.

HSM-RAI-14: Justify the determination that the alternate 2 side and top heat shield main assembly for the HSM-H model is not subject to aging effects, or revise Table 1G-18 and identify an aging management activity.

The alternate 2 side and top heat shield main assembly in Table 1G-18 is identified to be constructed of stainless steel and to provide shielding and heat transfer from the DSC. The subcomponent is subject to loss of material due to localized corrosion in a sheltered environment. The applicant is asked to justify a determination to the contrary, or revise the table and identify an aging management activity.

This information is required to ensure compliance with 10 CFR 72.236(f) and 72.240.

RESPONSE TO HSM-RAI-14

Consistent with the discussion provided in Chapter 3, Section 3.6.4.4, the alternate two sides and top heat shield of the HSM-H Model listed in Table 1G-18 are subject to loss of material due to localized corrosion in a sheltered environment. Accordingly, the aging effects requiring management and aging management activity for the horizontal storage module structural steel listed in Table 1G-18 have been updated.

Renewal Application Impact:

Table 1G-18 has been revised as described in the response.

HSM-RAI-15: Provide a technical basis for the conclusion that tensile stresses in the HSM structural bolting are not sufficiently high to initiate stress corrosion cracking. Clarify if lubricants are used for the installation of structural bolting.

The applicant stated that bolting fabricated from high-strength (actual measured yield strength, Sy, ≥ 150 ksi) low-alloy steel (ASTM A193 Gr. B7) is susceptible to stress corrosion cracking. NUREG-1801 includes low-alloy structural bolting in the Structures Monitoring AMP (XI S.6), which also relies on preventive actions delineated in EPRI NP-5769, NP-5067 and TR-104213, to ensure proper installation torque and prevent cracking of high strength bolting. Design-bases drawings for the HSM models reference different revisions of the AISC steel construction manual. The 2010 revision of that manual, states that there is no minimum of maximum tension requirements for snug-tight bolts. It further states that the magnitude of the clamping force that exists in a snug-tightened joint is not a consideration and need not be verified. The applicant is asked provide a technical basis (valid analyses, references, fabrication specifications) that ensure that tensile stresses of low-alloy structural bolting are not sufficient to initiate stress corrosion cracking.

NUREG-1801 also states that operating experience and laboratory examinations show that the use of molybdenum disulfide (MoS_2) as a lubricant is a potential contributor to stress corrosion cracking (SCC), especially when applied to high strength bolting. The applicant is also asked to clarify if lubricants are used for the installation of structural bolting.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-15

The AREVA horizontal storage module (HSM) installation specification requires that all bolted connections (including high strength bolting ASTM A193 Grade B7) are installed snug-tight. The term snug-tight describes the moderate tightness achieved with sufficient effort to prevent the fastener from loosening during service. Section J.3 of [1] defines the snug-tight condition as: “The snug-tightened condition is the tightness that is attained by either a few impacts of an impact wrench or the full effort of a worker with an ordinary spud wrench that brings the connected plies into firm contact.” No specific level of installed tension is required to achieve the snug-tightened condition. A snug-tightened condition is achieved at relatively low levels of pretension (see Reference [2], Section 8.1 Commentary). Because pretension is not required for the proper performance of snug-tightened joint, pretension does not need to be verified.

Low-alloy ASTM A193 Grade B7 (specified yield strength = 105 ksi and ultimate tensile strength = 125 ksi) bolts are used primarily to tie HSMs units or HSM components together. These are long (2-foot to 6-foot), large diameter (1-inch to 2-inch) bolts or studs. As stated above, tensile stresses associated with snug-tight condition are relatively low. The tensile stress can be determined by the standard relationship between torque and tension on the bolt as follows [3]:

$$T = KDF$$

Where:

T = torque applied.

D = nominal diameter of bolt.

F = induced force (clamp load).

K = empirical constant accounting for friction and variable diameter of the bolt at the threads.

The applied torque can be estimated by assuming that a 34-inch-long wrench and a force of 100 lb are used to snug tighten the bolt using the full effort of one person. Thus, the applied torque is 100 x 34 = 3400 in-lb. A bolt nominal diameter, D = 1.5 in., is used as a representative case. The empirical constant, K, can vary between 0.06 and 0.35 depending on fastener surface conditions [3]. A conservative value of 0.12 corresponding to a well-lubricated bolt is used here. Thus, the bolt tension is:

$$F = \frac{T}{KD} = \frac{3400}{0.12*1.5} = 18{,}889\ lb$$

The stress area of a 1.5 inch nominal diameter bolt having six threads per inch is calculated as:

$$Stress\ \ Area = 0.7854\left[D - \frac{0.9743}{6}\right]^2 = 1.405\ in^2$$

Bolt Stress = 18,889/1.405 = 13,444 psi, or about 11 percent of the bolt ultimate strength. If the applied wrench force is increased to 150 lb, the resulting increased torque would be 5,100 in-lb. The bolt tension would increase to 28,333 lb. The resulting bolt stress would then be 20,166 psi, which is about 16 percent of bolt ultimate strength. The bolt stress for a snug-tightened joint is, therefore, still relatively low in comparison with the specified minimum bolt pretension value, which is equal to 70 percent of the bolt ultimate strength (See Table 8.1 of [2]) for a pretensioned joint.

Therefore, it can be concluded that the level of tensile stresses in the low-alloy structural bolting is insufficient to initiate stress corrosion cracking.

It should be noted that the calculated tension loads due to snug tightening are consistent with experimentally obtained values, as shown in Table 3 of [4].

Per the AREVA HSM fabrication drawings, use of nickel-based grease, such as Bostik's Never-Seez®, is allowed to lubricate the fastener threads. This product does not contain molybdenum disulfide, as shown in the attached Pure Nickel Special, Nuclear Grade Technical Data Sheet.

References

[1] ANSI/AISC 360-05, "Specification for Structural Steel Buildings," March 9, 2005, American Institute of Steel Construction, Inc.

[2] 6410.AISC, “Specification for Structural Joints Using ASTM A325 or A490 Bolts,” June 30, 2004, Research Council of Structural Connections (RCSC), American Institute of Steel Construction, Inc.

[3] Fastener Standards, Sixth Edition, Industrial Fasteners Institute, 1988.

[4] R. D. Till, N.A. Lefke, “The Relationship between Torque, Tension, and Nut Rotation of Large Diameter Anchor Bolts,” Research Report No. R-1330, Research and Technology Section, Michigan Transportation Commission, Lansing, Michigan, October 1994.

Renewal Application Impact:

No changes as a result of this question.

NEVER·SEEZ®
Anti-Seize & Lubricating Compound

TECHNICAL DATA SHEET

Pure Nickel Special, Nuclear Grade

Product Description

Never-Seez® Pure Nickel Special, Nuclear Grade is specially tested and certified pure for use in nuclear power plants. Each production lot of Nuclear Grade Never-Seez is tested for contaminants of sulfur, halogens and low-melt metals and each container is labeled with the lot number that certifies purity.

Pure Nickel Special, Nuclear Grade is a superior, high temperature anti-seize and extreme pressure lubricant containing flake particles of pure nickel, graphite and other additives in a special grease carrier found to enhance anti-seize performance.

Recommended for use when applications prohibit the presence of copper, especially when resistance to corrosive acidic and caustic solutions is required.

Product Benefits

- Excellent heat dispersing qualities
- Minimizes corrosion
- Prevents seizure at high temperatures
- Resists galvanic action between dissimilar metals
- Enables fast disassembly-even after high temperature exposure
- Prevents galling on steel to stainless steel, titanium, magnesium and other hard metals
- Resists alkaline solutions, most chemical and acid vapors, road salt, steam, salt water, ionized water

Product Applications

- Fittings, fasteners exposed to high temperatures in steel mills, power plants, nuclear plants
- Stainless steel pipe fittings, flanges, pump fittings
- Fasteners in exhaust manifolds and boilers
- Steam generators
- Assembly of dissimilar metals

Limitations

- Never-Seez® Pure Nickel Special, Nuclear Grade is not recommended for high speed bearing applications. Never-Seez Red Bearing Lubricant is suggested for these applications.
- In applications where indirect food contact is possible, use USDA approved Never-Seez® White Food Grade.

Technical Specifications

Color		Silver Gray	
Temperature Range, °F (°C)		-297°F to 2400°F (-183°C to 1316°C)	
Thickener Type		Lithium Soap	
Particle Size, mil (microns)		2 maximum (50 m)	
Density, (g/cm3)		1.22 to 1.28	
		ASTM Test Method	
Flash Point, °F (°C)		>300°F (>149°C)	D-92
Copper Corrosion Test@ 212°F (100°C), 24 hrs.		No corrosion	D-130
Worked Penetration, 60 strokes @25°F (25°C)		260-310	D-217
NLGI Grade		1/2	D-217
Dropping Point, °F (°C)		360°F (182°C)	D-566
Water Washout, % loss @ 100°F		<2	D-1264
@ 175°F		<5	
Coefficient of Friction @ 167°F (75°C), Four Ball		0.092	D-2266
Torque Coefficient, k factor		0.158	
Four Ball EP	Load Wear Index	68	D-2596
	Last Non-seizure Load (scar)	79 kgf (0.59 mm)	
	Last Seizure Load (scar)	250 kgf (1.46 mm)	
	Weld Load	315 kgf	

Specifications: G.E. Atomic Equipment Division, #D50YP12; G.E. D6Y6; MIL-A-907; Ford ESE-M12A4-A; Ford WSD-M13P8-A1; Boeing BAC 5008 Type 7-3; U.T. Pratt & Whitney PWA 36053-1; G.E. Engine A50-TF198 Class A; Garrett Engine PCS5721.

Ingredients: A special, high-quality grease with graphite, pure nickel, and other additives. Contains no molybdenum disulfide, lead, or mercury except as trace elements.

Shelf Life: Never-Seez® Pure Nickel Special, Nuclear Grade compound does not deteriorate with age when stored unopened at temperatures below 120°F (49°C). Quality and performance are guaranteed for five years from the date of manufacture on unopened containers.

How Never-Seez Pure Nickel Special, Nuclear Grade Affects Torque:

Compared to unlubricated fasteners, the use of Never-Seez Pure Nickel Special, Nuclear Grade can be viewed 2 ways:

(1) It provides up to 15% MORE clamping force when applying the SAME amount of torque!

(2) It provides the SAME clamping force when applying up to 15% LESS torque!

IMPORTANT!

- In order to best represent typical torque reduction values, Bostik references a "K-Factor" for unlubricated carbon steel fasteners of 0.185.
- Proper torque is critical and, if not clearly understood, users may over-torque their fasteners which may lead to costly damage. BOSTIK is not liable for any damages incurred. Refer to the Bostik standard warranty for details.

Use in accordance with Material Safety Data Sheet.

Ordering Information:

NEVER-SEEZ® PURE NICKEL SPECIAL, NUCLEAR GRADE

STOCK NUMBER	DESCRIPTION	SIZE
NG-165	Flat Top	1 lb.
NG-8	Flat Top	8 lb.
NGBT-8	Brush Top	8 oz.
NGBT-16	Brush Top	1 lb.

Maximum Specification Limits:

Arsenic, As	<50 ppm
Antimony, Sb	<50 ppm
Bismuth, Bi	<50 ppm
Cadmium, Cd	<50 ppm
Gallium, Ga	<50 ppm
Indium, In	<50 ppm
Lead, Pb	<10 ppm
Mercury, Hg	<1 ppm
Silver, Ag	<50 ppm
Tin, Sn	<50 ppm
Zinc, Zn	<50ppm
Total Chlorine	<200 ppm
Total Nitrate	<200 ppm
Total Sulfur	<200 ppm
Total Phosphorous	<200 ppm

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N24-062008

HSM-RAI-16: Provide an evaluation for the disposition of the aging effect of change in materials properties due to elevated temperatures for aluminum, carbon steel and stainless steel subcomponents.

Section 3.6.4.3 identified the aging effect of change in materials properties due to elevated temperatures for aluminum, carbon steel and stainless steel subcomponents. However, Section 3.6.4.4 of the application did not provide a technical basis for disposition of the identified effect/mechanism.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-16

The discussion on elevated temperature aging mechanism has been added to Section 3.6.4.4. Section 3.11 has been revised to add associated new supporting references.

Renewal Application Impact:

Sections 3.6.4.4 and 3.11 have been revised as described in the response.

Proprietary Information on this page
Withheld Pursuant to 10 CFR 2.390

HSM-RAI-18: Clarify how degradation of silicone sealants used during previous repairs will be addressed by the HSM Aging Management Program for External and Internal Surfaces.

Table 3.2-1, "Operating Experience Documentation of Potential Age-Related Degradation," identifies operating experience (OE ID#3) of an advanced horizontal storage module (ASHM) where concrete was chipped to about 36" wide by 48" high from an event-driven crack. Although the event was not age-related, degradation of polymeric sealants may lead to ingress of water with further potential degradation due to freeze-thaw, leaching of $CaOH_2$, corrosion of the reinforcement and alkali-silica reaction. The disposition section states that potential degradation of the silicone sealant is an inspection attribute in the aging management review and monitoring inspections. However, the HSM Aging Management Program for External and Internal Surfaces does not include degradation of repair sealants.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-18

The applicable horizontal storage module (HSM), where a similar event as that described in Table 3.2-1 operating experience (OE) ID # 3 occurred in Certificate of Compliance (CoC) 1004, is HSM Model 152. As described in OE ID # 2, the HSM 152 was repaired and the through-holes were filled with non-shrink grout to eliminate potential water intrusion. Silicone sealant is not relied on to prevent water intrusion into the grouted bolt hole and does not need to be an inspection attribute. A design change was implemented and installation procedures were changed to implement this change in subsequent HSM Model 152 installations. The OE disposition of OE ID # 3 in Table 3.2-1 has been revised to be consistent with the actual disposition of the repair actions for the subject HSM Model 152.

There are no changes needed to the HSM Aging Management Program for External and Internal Surfaces described in Section 6A.5.

Renewal Application Impact:

Table 3.2-1 has been revised as described in the response.

HSM-RAI-19: Revise the Aging Management Program to address aging effects of the below-grade section of the concrete pad, which was identified in Section 2.3.1 to be within the scope of renewal.

The applicant stated that the concrete pad is classified as not important to safety, as verified in Section 3.4.3 of the UFSAR, Rev. 14. The applicant determined that the pad is within the scope of renewal since its failure may impact the structural stability of the HSM, which is important to safety (Section 2.3.1 of the renewal application). However, the applicant excluded the below-grade section of the concrete pad from the aging management review (Sections 3.3.2 and 3.4.1 of the renewal application). The applicant further states in Section 6A.5.4 that aging management of the below grade portion (underground environment) of the ISFSI storage pad (e.g., groundwater chemistry sampling) is the general licensee's responsibility and is not within the scope of the HSM AMP for External and Internal Surfaces. The applicant is asked to revise the aging management review and provide an aging management program to address potential degradation of the below-grade section of the pad structure. The staff notes that the responsibility of developing aging management activities (TLAAs or AMPs) resides in the CoC holder, as the applicant for the CoC renewal, and the owner of the storage cask design. General licensees are responsible for implementing AMPs. If there is an AMP that specifies that it is not applicable to certain users (e.g., if it is not applicable in certain climates or environments), the general licensee can include the technical justification in its 10 CFR 72.212(b)(5) report for not implementing such an AMP.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-19

Sections 2.3.1 and 3.4.1 have been modified to include the below-grade portion of the storage pad within the scope of renewal. Also, Section 3.3.2 has been expanded to discuss design considerations of the storage pad.

Section 3.6.6 has been added to discuss the aging management review (AMR) of the storage pad. Section 6A.5: "HSM Aging Management Program for External and Internal Surfaces" has been expanded to include the storage pad. Groundwater chemistry sampling is used to monitor the condition of the below-grade inaccessible portions of the storage pad. Attachment A, Table A-4 has also been revised to reflect the changes to the HSM Aging Management Program in Section 6A.5.

Renewal Application Impact:

Sections 2.3.1, 3.3.2, 3.4.1, 6A.5, and Attachment A, Table A-4 have been revised as described in the response.

Section 3.6.6 has been added as described in the response.

HSM-RAI-20: Clarify in the HSM aging management review if aging effects from carbonation of concrete will be managed.

Carbon dioxide, present in the atmosphere, has been found to react with calcium hydroxide or other lime-bearing compounds in hardened concrete to produce a reduction in volume (i.e., shrinkage) and an increase in weight. Carbonation of concrete decreases the alkalinity of the hydrated cement paste in which the reinforcement bars are embedded (see NUREG/CR-7116). The increased pH, in conjunction with oxygen diffusion and the availability of pore water promotes rebar corrosion. The HSM AMP has identified corrosion of embedded steel for reinforced concrete as an aging mechanism, with carbonation as a causing factor. However, the HSM aging management review does not discuss carbonation leading to corrosion of the rebar. The applicant is asked to clarify the discussion in the HSM AMR.

This information is required to ensure compliance with 10 CFR 72.240.

RESPONSE TO HSM-RAI-20

The HSM aging management review in Section 3.6.4.2 has been revised to discuss carbonation of concrete leading to corrosion of the rebar in the “Corrosion of Embedded Steel” subsection. In addition, Section 3.11 has been revised to add a new reference, NUREG/CR-7116 [3.11.66], to support this discussion.

Renewal Application Impact:

Sections 3.6.4.2 and 3.11 have been revised as described in the response.

C. Transfer Casks

TC-RAI-1: Justify the description of the transfer cask external environment as being "sheltered" in the AMR results tables, given that (1) there are no requirements for the transfer casks to be stored in a building or otherwise sheltered from precipitation and (2) casks leased by AREVA to several sites may spend a significant amount of time in use.

Section 6A.7.5.2, of the renewal application, states that the transfer casks should be stored in conditions that prevent exposure to precipitation or condensation. However, there is no requirement to do so in either the UFSAR or CoC.

Additional information, including operational data, is needed to support the position that transfer casks have not, and will not, spend a significant amount of time exposed to outdoor conditions. Absent such assurance, the AMR results tables should be revised to reflect the potential for prolonged exposure to outdoor conditions.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-1

The aging management review (AMR) results tables (Tables 1A-13, 1H-23, 1I-10, 1I-11, and 1J-18) for the transfer casks have been revised to show the environment(s) to which transfer cask subcomponents are exposed during a lifecycle. These environments are (using the AREVA-owned transfer cask for purposes of discussion):

1. While not in use, the AREVA-owned transfer cask is normally stored in a specialized container box or inside a facility building (sheltered).

2. While in transport from site to site, the transfer cask is transported in the same container box, so it is also in a sheltered environment.

3. While in operations at a site, since the transfer cask is central to operations, during active loading it is exposed to the external ambient conditions only during onsite transportation to the independent spent fuel storage installation (ISFSI), transfer to the horizontal storage module (HSM) insertion operations, and return to the reactor/spent fuel pool building. These three steps would be typically less than one 12-hour shift per dry shielded canister (DSC) loading. During actual fuel loading, the transfer cask is submerged in the spent fuel pool. The duration varies with the number of loaded fuel assemblies, operational issues, etc., but on average, it would be approximately 12 hours per DSC loading.

The duration of the front end of an active loading campaign could be a few days to about one week. After the loading campaign, there is typically a one or two day duration before it is returned to its shipping container. The transfer cask may be exposed to external ambient conditions during these mobilization and demobilization activities.

In summary, the transfer cask is in a sheltered environment for a significant period of its lifetime. However, the aging management activities conservatively consider bounding exposure environments and this is reflected in the revised AMR tables. The preventive actions described in Section 6A.7.5.2 for transfer cask storage are good practice measures, and are not credited in the AMP.

Renewal Application Impact:

Tables 1A-13, 1H-23, 1I-10, 1I-11, and 1J-18 have been revised as described in the response.

TC-RAI-2: Revise the AMR results tables for the transfer cask subcomponents that are either continuously or intermittently exposed to the liquid (water) neutron shield to include an AMR line item for that environment.

The AMR results tables for transfer casks with liquid neutron shielding (including the light neutron shield assembly for the OS197L TC) do not include AMR line items that evaluate aging for the shield-side environment. Some examples include:

- The structural shell of transfer casks, which is embedded against lead on one side and exposed to water shielding on the other. The AMR results in Table 1A-13 only include the "Embedded/Encased" environment.
- The neutron shield panel plates, which are exposed to water shielding on one side and the external environment on the other. The AMR results in Table 1A-13 only include the "Sheltered" (external) environment.
- The neutron shield panel support angles, which are exposed to water shielding. The AMR results in Table 1A-13 only include the "Embedded/Encased" environment.

This information is needed to demonstrate compliance with 10 CFR 72.236(d) and 72.240.

RESPONSE TO TC-RAI-2

The aging management review (AMR) results tables for the transfer cask subcomponents that could be continuously or are intermittently exposed to liquid neutron shield water have been revised to include an AMR line item for components exposed to water. Section 6A.7.5.2 and Attachment A, Table A-6 have been changed to require draining of the neutron shield prior to storage of the transfer cask.

Renewal Application Impact:

Section 6A.7.5.2 and Tables 1A-13, 1H-23, 1I-10, 1J-18, and Attachment A, Table A-6 have been revised as described in the response.

TC-RAI-3: Provide additional justification in Section 3.7.4.2 of the renewal application for why galvanic corrosion is not an aging effect requiring management for instances in which a carbon steel trunnion sleeve is in contact with a stainless steel structural shell and neutron shield panel, given that a liquid (water) neutron shield may be present to act as an electrolyte.

The Transfer Cask Aging Management Program recommends, but does not require, the use of demineralized water as the neutron shield. The AMP refers to the potential for chlorine and hard water deposits in municipal water to cause deterioration in the shield.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-3

Section 3.7.4.2 has been revised to provide the additional justification requested.

The carbon steel trunnion sleeves are protected with a stainless steel weld overlay, and all of the transfer cask models that use a liquid neutron shield have a stainless steel structural shell. Therefore, there is no galvanic coupling between the trunnion sleeve and the structural shell inside the neutron shield.

The use of demineralized or municipal water for the neutron shield does not affect this conclusion. The response to TC-RAI-6 addresses measures to mitigate and inspect for pitting and crevice corrosion in the neutron shield shell.

Renewal Application Impact:

Section 3.7.4.2 has been revised as described in the response.

TC-RAI-4: Provide additional justification in Section 3.7.4.2 of the renewal application for why stress corrosion cracking is not an aging effect requiring management for the external stainless steel surfaces and fasteners of the transfer casks. Alternatively, revise the transfer cask AMR results and aging management program to include stress corrosion cracking as an aging effect.

Section 3.7.4.2 of the renewal application states that stainless steel transfer cask subcomponents are not susceptible to stress corrosion cracking because they are not exposed to temperatures above 30°C (86°F) for prolonged periods.

The staff noted that operating experience does not support the proposed 30°C stress corrosion cracking threshold. In 2001, Koeberg Nuclear Power Station experienced externally-initiated through-wall stress corrosion cracking of stainless steel tanks that were maintaining water between 7 and 40°C (NRC Information Notice 2012-20).

In addition, if a lower temperature threshold for SCC were to be justified, additional information is nevertheless required to support the position that the transfer casks are not exposed to conditions that may be conducive to stress corrosion cracking. The staff noted that the site-specific parameters permitted by the CoC include average daily ambient temperatures up to 100°F (Section 1.1.1 of the TS, Amendments 0 through 10; Amendment 10 adds up to 106°F for the 32PTH1 DSC, and Section 4.3.3.3 of the TS for Amendments 11-13).

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-4

Section 3.7.4.2 of the renewal application has been revised to address stress corrosion cracking for the external stainless steel surfaces. Transfer cask (TC) fasteners are maintenance items routinely inspected and replaced. Therefore, TC fasteners are not subject to the TC Aging Management Program. Please see the response to TC-RAI-12 for additional details.

Renewal Application Impact:

Section 3.7.4.2 has been revised as described in the response.

TC-RAI-5: Regarding the evaluation for the need to manage the aging of coatings on carbon steel transfer cask subcomponents:

a. Provide additional information to support Section 3.7.4.4 of the renewal application, in which coatings are described as not being credited for the prevention of aging effects (and thus not required to be managed). Alternatively, revise the transfer cask AMR and AMP to manage coating degradation.

   Section 1.2.2 of the UFSAR, "Principal Design Criteria," (NUH-003, Rev. 14), states "Given the corrosion resistant properties of materials and coatings used for construction…no limits on the range of acceptable external atmospheric conditions are required." Section 1.2.2 continues: "All components are either stainless steel, are coated with inorganic coatings, or are galvanized. Hence, all metallic materials are protected against corrosion."

   Section 4.6 of the UFSAR, "Cathodic Protection," (NUH-003, Rev. 6) justifies the lack of cathodic protection by stating "[a]ny carbon steel used in the transfer cask is protected from corrosion by suitable coatings".

   The NRC staff noted that coating degradation not only exposes metal surfaces to potentially corrosive external environments, but also may create particularly aggressive local conditions by trapping moisture between the coating and bare metal.

b. After the evaluation of part (a), if coatings remain as not being credited for the prevention of aging effects, revise the Transfer Cask Aging Management Program and its UFSAR Supplement to remove any references to coating inspection activities.

   If coatings are not credited for managing loss of material, the references to coatings inspections in the Transfer Cask AMP may create uncertainty for the general licensee and regulator when the AMP is enacted.

This information is needed to demonstrate compliance with 10 CFR 72.240.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-5

Section 3.7.4.4 of the renewal application has been expanded to discuss each of the transfer cask (TC) coated subcomponents described in Table 3.7-3 and to provide clarity regarding the coated TC subcomponents requiring aging management inspection.

Renewal Application Impact:

Section 3.7.4.4 has been revised as described in the response.

TC-RAI-6: Justify why the Transfer Cask Aging Management Program does not include aging management activities for surfaces that are intermittently wetted with the neutron shield water.

Section 6A.7.5.1 of the renewal application states that "[i]f water is drained from the neutron shield at the end of each loading campaign…no inspection of the neutron shield is required." Conversely, Section 3.7.4.2, of the application, states that carbon steel and stainless steel are susceptible to corrosion in periodically immersed environments. Also, the transfer cask AMR results tables cite loss of material as an aging effect for other cask surfaces that are intermittently wetted, such as the inner liner plate that is exposed to the demineralized water in the annulus between the TC and DSC during fuel loading.

Section 6A.7.5.2 recommends, but does not require, the use of demineralized water as the neutron shield. This section refers to the potential for chlorine and hard water deposits in municipal water to cause deterioration in the shield.

This information is needed to demonstrate compliance with 10 CFR 72.236(d) and 72.240.

RESPONSE TO TC-RAI-6

Section 6A.7.5.1 has been revised to remove the condition that no inspection of the neutron shield is required if water is drained from the neutron shield at the end of each loading campaign. Section 6A.7.5.2 and Attachment A, Table A-6 have been revised to require draining of the neutron shield water at the end of each loading campaign. This is consistent with the Updated Final Safety Analysis Report Section 4.7.3.2, which requires precautionary measures to be taken to ensure that the neutron shield water does not freeze during cold weather operations. Draining of the neutron shield water jacket fluid after each fuel loading campaign will mitigate the conditions for crevice and pitting corrosion to occur.

The surfaces of the neutron shield cavity that are intermittently wetted with neutron shield water are managed for loss of material due to corrosion. Aging management activities include a Section XI VT-1 visual examination to examine the neutron shield for any signs of possible leakage. This has been added in 6A.7.5.1, 6A.7.5.4, and Attachment A, Table A-6. Of the neutron shield internal stainless steel surfaces subjected to degradation, the 3/16-inch thick external shell will be breached first while maintaining adequate structural margins on all other components (e.g., the 1 ½- to 2-inch thick structural shell). Also, as discussed in Section 3.7.4.2 in response to TC-RAI-4, the discovery of a crevice or pit sufficient to cause a leak in the neutron shield shell does not result in a loss of intended function of the transfer cask (TC).

Renewal Application Impact:

Sections 6A.7.5.1, 6A.7.5.2, 6A.7.5.4, and Attachment A, Table A-6 have been revised as described in the response.

TC-RAI-7: Revise the Transfer Cask Aging Management Program to include the specific acceptance criteria for the neutron shield water testing and provide the technical justification for how the parameters monitored and acceptance criteria for the water testing will be capable of detecting corrosion and providing for timely corrective actions.

The Transfer Cask AMP states that analyzing the neutron shield water for radioactivity, specific gravity, and fluid purity will provide evidence of corrosion of steel and stainless steel component in contact with the water. However, no details are provided regarding the specific acceptance criteria for those parameters. Also, no technical justification is provided to show that water chemistry monitoring has sufficient sensitivity to detect corrosion in the neutron shield – in particular localized corrosion, such as pitting, that may have a very limited effect on the water chemistry. This information is needed to demonstrate the feasibility of this corrosion detection technique.

This information is needed to demonstrate compliance with 10 CFR 72.172, 72.236(d) and 72.240.

RESPONSE TO TC-RAI-7

The water chemistry testing of the neutron shield liquid described in Section 6A.7.5 and Attachment A, Table A-6 of the renewal application has been deleted. It is no longer necessary since the water in the neutron shield is required to be drained at the end of each loading campaign. See the response to TC-RAI-6 for additional aging management activities for the neutron shield cavity.

Renewal Application Impact:

Section 6A.7.5 and Attachment A, Table A-6 have been revised as described in the response.

TC-RAI-8: Provide the technical basis for the use of annual VT-2 inspections to identify degradation of the transfer cask liquid neutron shield components prior to the loss of their structural and shielding intended functions.

The Transfer Cask Aging Management program includes the optional use of VT-2 leakage inspections to identify degradation of the liquid neutron shield jacket. Additional information is needed to support the position that leaks are a sufficient early indicator of degradation prior to challenging the jacket component intended functions (e.g., that potential degradation prior to a leak won't challenge the ability of the shield to maintain its structural function and that the timing of the inspections (once per year) is sufficient to identify leakage that could drain the jacket and prevent it from maintaining its shielding function).

The NRC staff noted that Section 4.5.1 of the UFSAR, "Routine Inspection," (NUH-003, Rev. 6) includes an activity to visually inspect the neutron shield jacket prior to each use of the transfer cask; however, the parameters monitored for this activity are not defined in the UFSAR and this activity is not credited in the aging management program.

This information is needed to demonstrate compliance with 10 CFR 72.236(d) and 72.240.

RESPONSE TO TC-RAI-8

The design-basis function of the neutron shield is to provide neutron shielding for the plant workers during fuel loading and transfer operations. The neutron shield is classified as "not-important-to-safety" and the loss of the neutron shield is an analyzed condition in the updated final safety analysis report (UFSAR). To minimize the potential for an over-pressure accident that could injure plant workers, the transfer cask (TC) neutron shield shell is fabricated and tested as a pressure vessel. Also, it is desirable to have the cavity remain leaktight to prevent the intrusion of contaminated spent fuel pool water into a closed space that is difficult to decontaminate.

As discussed in the responses to TC-RAI-4 and TC-RAI-6, leakage of the neutron shield does not necessarily result in a loss of intended function. A leak not identified by the annual leak test described below would be too small to allow appreciable draining of the neutron shield water. A significant leak would be detectible by site Radiation Protection As Low As Reasonably Achievable (ALARA) programs. A leak of pool water into the neutron shield would be detected during normal TC decontamination.

The annual VT-2 inspection has been replaced by the VT-1 inspection at a frequency of once every five years, which is consistent with the other TC inspections under the TC AMP. This change is also a result of the fact that the TC is subjected to the routine and annual inspections delineated in UFSAR Sections 4.5.1 and 4.5.2. These include visual inspection of the neutron shield jacket. The UFSAR does not specify how these inspections and tests are performed. Operations and maintenance manuals are provided to the licensee as guidance on preparing site-specific procedures to be included in the licensee's TC maintenance program. For AREVA-owned TCs, the neutron shield jacket inspection procedure includes leak testing of the neutron shield welded seams and joints, and pressure relief valve and quick disconnect fittings performed annually to verify integrity. The leak testing is performed by bubble testing or

a pressure decay test. Degraded parts are repaired or replaced as appropriate. These maintenance inspections provide additional confidence that any degradation of the TC will be identified prior to loss of intended function.

The VT-1 visual examination has been added to the TC Aging Management Program (AMP) in Section 6A.7.5 to replace the VT-2 and supplement the VT-3 visual examinations. The added VT-1 inspection provides additional confidence that degradation of the neutron shield components will be identified prior to the loss of their intended function. The VT-1 examination is focused on the external surfaces of the neutron shield components where the VT-3 examination shows signs of corrosion. The VT-1 examination is conducted to detect discontinuities and imperfections on the surfaces of the neutron shield components, including such conditions as cracks, wear, or corrosion to provide reasonable assurance that the TC liquid neutron shield components remain able to perform their intended function.

Renewal Application Impact:

Section 6A.7.5 has been revised as described in the response.

TC-RAI-9: Revise the Transfer Cask Aging Management Program and UFSAR Supplement to fully describe the extent of examination for the visual inspections of the surfaces of the casks (all), and the supplemental shielding (OS197L TC).

The Transfer Cask AMP and UFSAR do not fully describe the extent (coverage) of the visual inspections of some cask component surfaces. It is unclear to the staff (1) whether the visual inspections are to be conducted on 100 percent of the exterior surfaces and (2) whether the scope of these inspections is also extended to surfaces that are normally obstructed by the top cover assembly (e.g., cask cavity / inner liner plates). Also, although the inspection of the OS197L supplemental shielding is described in the AMP program description, it is not described in the AMP elements or UFSAR Supplement.

The AMR results for transfer cask inner liner plates state that these subcomponents are susceptible to loss of material and this aging effect is addressed with an aging management program. However, the Transfer Cask AMP does not provide specific direction for these components to be visually inspected for loss of material.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-9

All (100%) of the accessible surfaces of the transfer cask (TC), including the cavity surfaces obstructed by the top cover assembly and the supplemental shielding for the OS197L, are included in the visual inspections. Sections 6A.7.5.1, 6A.7.5.3, 6A.7.5.4, and 6A.7.5.5 and Attachment A, Table A-6 have been revised to add this clarification.

Renewal Application Impact:

Section 6A.7.5 and Attachment A, Table A-6 have been revised as described in the response.

TC-RAI-10: Regarding the Transfer Cask Aging Management Program, justify the use of ASME Section XI VT-3 examinations, rather than VT-1, to detect wear on the transfer cask rails and pitting and crevice corrosion of the transfer cask external surfaces. In addition, reconcile the ASME reference for these inspections in Section 6A.7.5.4, which currently references the ASME paragraph for VT-1 (ASME Section XI IWA-2211).

ASME Section XI, Paragraphs IWA-2211 and 2213 describe the use of VT-1 examinations to evaluate the condition of a component ("discontinuities and imperfections on the surface of components, including such conditions as cracks, wear, and corrosion") and VT-3 examinations to evaluate the general mechanical and structural condition of a component. The staff noted that the DSC External Surfaces Aging Management Program requires VT-1 examinations to detect pitting and crevice corrosion on weld seams, crevice locations, and locations that exhibit water staining and discoloration during VT-3 inspections.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-10

As discussed in Section 3.7.4.2, the transfer cask (TC) rails are fabricated from Nitronic 60 material to minimize wear and coated with a dry film lubricant to minimize friction during insertion and retrieval of the DSC. The TC rails are cleaned, lubricated, and visually inspected for any indications of excessive wear prior to each use. Operating experience of the AREVA Inc.-owned OS197 TC has shown no significant wear of the rails throughout almost 20 years of constant use. The VT-3 method of examination used to detect degradation due to wear of the TC rails is in accordance with ASME Section XI IWA-2213.

The exterior surfaces of the TC that are exposed to the environment are fabricated from heavy structural forgings at each end, while the majority of the external surface is covered by the neutron shield shell. Inspection requirements for the neutron shield shell are discussed in the responses to TC-RAI-6, TC-RAI-8 and TC-RAI-9. A VT-3 level of inspection for the heavy forgings is considered adequate to detect any significant pitting or crevice corrosion long before it could become a safety issue. As discussed in the response to TC-RAI-4, the operational requirements to decontaminate and clean the entire TC exterior surface prior to each insertion into the spent fuel pool for a DSC loading or unloading keeps contaminant concentrations low, resulting in the restart of the pitting and crevice corrosion process after each use.

The reference to IWA-2211 has been corrected to IWA-2213 and a requirement to include a VT-1 inspection if areas of water staining or discoloration are found on the external surfaces of the neutron shield shell during the VT-3 inspection has been added to the TC AMP in Section 6A.7.5 and Attachment A, Table A-6.

Renewal Application Impact:

Section 6A.7.5 and Attachment A, Table A-6 have been revised as described in the response.

Proprietary Information on this page
Withheld Pursuant to 10 CFR 2.390

TC-RAI-12: Revise the Transfer Cask Aging Management Program to describe the activities that are performed to manage the aging of fasteners.

The AMR results for several transfer cask fasteners state that the fasteners are susceptible to loss of material, which will be managed with an aging management program; however, the Transfer Cask Aging Management Program does not describe how the aging of fasteners will be managed.

The staff noted that Section 4.5.1 of the UFSAR describes routine transfer cask inspections that include visual inspection of all threaded parts and bolts. If these inspections are being credited for managing the effects of aging, these fastener inspections should be captured in all appropriate elements of the AMP.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-12

Updated Final Safety Analysis Report (UFSAR) Section 4.5.1 indicates that routine inspection of the transfer casks (TCs) covers inspection and replacement of fasteners on a routine use basis. Lid bolts, threaded inserts, and quick-connect fittings are routinely replaced when damaged threads and/or coatings are discovered. Since these are routinely inspected and replaced, they are maintenance items and not part of the TC Aging Management Program (AMP).

Tables 1A-13, 1H-23, 1I-10, and 1I-11 have been revised to remove fastener hardware from the TC AMP. The replacement of these parts is a function of normal maintenance.

Renewal Application Impact:

Tables 1A-13, 1H-23, 1I-10, and 1I-11 have been revised as described in the response.

TC-RAI-13: Reconcile the AMR results for the transfer cask "NSP Top and Bottom Support Ring" in Table 1A-13 and the Transfer Cask Aging Management Program, which differ with respect to whether cracking is an aging effect requiring management.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-13

Section 3.7.4.2, as updated in the response to TC-RAI-4, provides additional justification for the reason that stress corrosion cracking is not an aging effect requiring management for the external stainless steel surfaces of the transfer casks (TCs). Accordingly, the "Aging Effects Requiring Management" column for the TC "NSP Top and Bottom Support Ring" in Table 1A-13 has been revised to delete cracking as an applicable aging effect for the NSP Top and Bottom Support Ring to be consistent with Section 3.7.4.2.

Renewal Application Impact:

Table 1A-13 has been revised as described in the response.

TC-RAI-14: Regarding the annual visual and dye penetrant testing on transfer cask trunnion bearing surfaces and welds:

a) Describe how the Transfer Cask Aging Management Program will perform these examinations on surfaces that are obstructed by the transfer trailer supports.

b) Reconcile the frequency of these examinations, which are described as “at least once every five years or prior to the next fuel loading campaign” in Section 6A.7.5.3 and “at a frequency of once per year” in Section 6A.7.5.4 (and Table A-6) of the renewal application.

This information is needed to demonstrate compliance with 10 CFR 72.240.

RESPONSE TO TC-RAI-14

a) To perform the visual and liquid penetrant examinations of the upper and lower trunnion bearing surfaces and the accessible trunnion welds that are obstructed by the transfer trailer supports, the transfer cask (TC) is removed from the transfer trailer skid and placed in a position to provide access to all areas of the trunnions, either standing upright on a suitable surface, or placed on saddles or other supports that provide access to all areas of the trunnions. Section 6A.7.5.4 of the TC Aging Management Program (AMP has) been revised to add this information.

b) The Transfer Cask Aging Management Program, described in Sections 6A.7.5.3 and 6A.7.5.4, and Table A-6 of Attachment A of the renewal application are intended to specify five year interval inspections. The AMP inspections supplement the routine and annual inspections described in the Updated Final Safety Analysis Report, Sections 4.5.1 and 4.5.2. Section 6A.7.5.4 and Attachment A, Table A-6 of the TC AMP have been revised to clarify the frequency of the inspections as being once every five years.

Renewal Application Impact:

Section 6A.7.5.4 and Attachment A, Table A-6 have been revised as described in the response.

D. Spent Fuel Assemblies (SFAs)

SFA-RAI-1: Revise Table 2D-1 to identify the materials of all assembly subcomponents within the scope of renewal. Revise Tables 2-2, 3-8 and 2D-1 to identify the cladding for all allowable high burnup fuel (HBF) contents, for all amendments, including the specific type(s) of zirconium-based alloys (e.g., zircaloy-4, low-Sn zircaloy-4, M5®, and Zirlo™).

The scoping evaluation for the spent fuel assemblies as discussed in Section 2.3 and tabulated in Table 2D-1 does not identify the materials of construction of the subcomponents of the spent fuel assemblies. Tables 2-2, 3-8 and 2D-1 do not identify the specific type(s) of zirconium-based alloys for the various amendments. The applicant stated in Table 2D-1 that the AMR for the SFAs focuses primarily on the fuel rod cladding as it is considered the limiting component of the fuel assembly hardware. Section 6A.8.2.1 identifies cladding types loaded as zircaloy-2, zircaloy-4, and M-5, which cannot be verified in the scoping evaluation nor in the aging management review. The staff needs to corroborate that the applicant has properly identified the materials of construction of the spent fuel assemblies, and ensure that all cladding type(s) are covered by the proposed HBF aging management program. The information provided in the design bases is not specific (UFSAR, Rev. 14, Tables K.5-5, M.5-6, N.5-5, P.5-6, T.5-6, U.5-4, Y.5-5, and Z.5-4).

This information is needed to determine compliance with 10 CFR 72.236(d) and 72.240.

RESPONSE TO SFA-RAI-1

Tables 2-2, 3.8-1 and 2D-1 have been revised to identify specific cladding types. *Table 2D-1 footnote (1) has been expanded to clarify that only the cladding is considered within scope of renewal because it is the limiting fuel assembly component. The cladding material and environment are also stated.* Additionally, Table 2D-1 is changed to indicate that the cladding of failed fuel assemblies is not able to provide any intended function and is therefore not considered in scope for renewal. Based on this, changes were also made to Tables 1J-13 and 1J-14 to remove failed fuel cladding table rows.

Renewal Application Impact:

Tables 2-2, 3.8-1, 1J-13, 1J-14, and 2D-1 have been revised as described in the response.

SFA-RAI-2: Revise the renewal application, Section 3.8.4, subsections "Cladding Considerations for the Transportation and Storage of Spent Fuel," and "Conclusions," to clarify that cladding creep is an active cladding degradation mechanism during the period of extended operation.

As currently written this section is not consistent with the primary conclusion of ISG-11, Rev. 3 that creep is the most likely breach degradation mechanism of cladding during storage. It also appears to draw the conclusion that the only cladding concerns during storage for high burnup fuel are hydride embrittlement and hydride reorientation.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO SFA-RAI-2

Section 3.8.4, subsection "Cladding Considerations for the Transportation and Storage of Spent Fuel," has been revised to include a discussion of cladding creep as an active degradation mechanism during the period of extended operation.

Renewal Application Impact:

Section 3.8.4 has been revised as described in the response.

E. Other Technical Disciplines

E.1 Shielding

SHIELD-RAI-1: Demonstrate that the 24PTH DSC with the B&W 15x15 Mark B design basis fuel is a bounding cask configuration for B-10 depletion calculation for all DSCs in the Standardized NUHOMS® system, , although the 24PTH DSC does not have the lowest boron content among the DSCs.

Section 3.5.4.5 and Appendix 3D of the application, summarize the results of the CoC holder's TLAA for Dry Shielded Canister Poison Plates Boron Depletion. The CoC holder indicated that for this evaluation, an MCNP5 model of a bounding fuel assembly and basket compartment was used. From the UFSAR, the B&W 15x15 Mark B is identified as the bounding fuel that produces the maximum neutron source per assembly and the basked used in the analyses was that for the 24PTH DSC. The CoC holder noted that although the boron content in the 24PTH is not the lowest boron content basket among the DSCs in the Standardized NUHOMS® System, using the 24PTH DSC as the bounding configuration is justified based on the combined consideration of neutron strength and boron content because the DSCs with lower boron contents also have fuel assemblies with about 10 times lower neutron source strengths. The CoC holder stated that the results presented demonstrate that minimal depletion occurs with the irradiation of poison plates. However, it is not clear how the B-10 loss with high boron loading/high source cask will bound a low boron load/high source cask, though the staff does understand that a cask containing low source will consume less B-10.

The applicant should demonstrate that the calculation is bounding for all cases, including the one with lowest boron content, and provide supporting documents as appropriate.

This is required to evaluate compliance with 10 CFR 72.240.

This is required to evaluate compliance with 10 CFR 72.236(b) and 72.236(d).

RESPONSE TO SHIELD-RAI-1

Sections 3D.2 and 3D.3 have been revised to include a statement that an additional sensitivity calculation was performed using the maximum neutron source and a poison plate with half as much Boron-10 as in the 24PTH DSC. In addition, Table 3D-2 has been revised to replace values for the depleted B-10 amount, and to add a row with the results of the additional sensitivity using half as much B-10. This is slightly less than the boron content in the 52B DSC, which has the lowest boron content. Similar results were obtained, indicating that more than 99.999% of B-10 remains in the poison plates. Therefore, a bounding model, with maximum source strength and slightly below minimum Boron-10 content, confirms that a negligible amount (not more than 0.001%) of B-10 is depleted.

Renewal Application Impact:

Table 3D-2 has been revised as described in the response.

Sections 3D.2 and 3D.3 have been revised as described in the response.

Proprietary Information on Pages 113 through 114
Withheld Pursuant to 10 CFR 2.390

E.2 Structural

STRUCT-RAI-1: Provide the ANSYS input and output files for the structural evaluations of the DSC in Appendix 3N.

Appendix 3N is a bounding evaluation of the DSC with reduced shell thickness due to Chloride-Induced Stress Corrosion Cracking under normal and off normal conditions of storage during the renewal period. Modifications were made to the original input file to change the shell thickness as a means of simulating the CISCC conditions.

This information is required to show compliance with 10 CFR 72.240.

RESPONSE TO STRUCT-RAI-1

ANSYS input and output files associated with the evaluation of the DSC in Appendix 3N were provided in response to item B.d, in Enclosure 7 of the March 16, 2015 AREVA submittal E-41361, referenced below.

References

[1] AREVA E-41361, "Response to Request for Information - AREVA Inc. Renewal Application for the Standardized NUHOMS® System- CoC 1004 (Docket 72-1004, TAC No. L24760)," March 16, 2015.

Renewal Application Impact:

No changes as a result of this question.

STRUCT-RAI-2: Provide a copy of the applicable portions ACI 209R-82 and any calculations required to justify the creep and shrinkage values presented for the concrete that comprises the HSM in Chapter 3 of the renewal application.

In Chapter 3 of the renewal application, values for creep and shrinkage are stated based on ACI 209R-82. The staff does not possess ACI 209R-82. Based on ACI 209R-92, the staff believes these values are the result of calculations involving concrete composition (fine aggregate percentage, cement content, air content, etc.), initial curing, the environment, the geometry of the HSM, the loading history and stress conditions that makes the predicted values non-trivial. The staff requires the reference and the calculations to verify the values presented by the applicant.

This information is required to show compliance with 10 CFR 72.240.

This information is required to show compliance with 10 CFR 72.240(c)(2).

RESPONSE TO STRUCT-RAI-2

The creep and shrinkage values presented for the concrete that comprises the horizontal storage module (HSM) in Chapter 3 are obtained using the recommended creep and shrinkage equations of [1] for the standard conditions. These equations are simplified expressions that may be used if specific material response parameters are not available for local materials and environmental conditions. Since testing the actual materials under environmental and loading conditions similar to those expected in the field yields the most accurate prediction, use of these equations is an estimate.

Table 2.4.1 of ACI 209R-92 [1] provides the time-ratio values for creep as 0.78, 0.93, 0.95 and 0.96 at one year, 10 years, 20 years, and 30 years, respectively. Similarly, the time-ratio values for shrinkage are provided as 0.91, 0.98 and 1.00 at one year, five years, and 20 years, respectively. These values are derived based on Equation (2-8) and Equation (2-9) of ACI 209R-92 [1].

Equation (2-8) and Equation (2-9) of ACI 209R-92 are recommended for predicting creep and shrinkage of concrete member at any time under the standard conditions, as summarized in Table 2.2.2 [1]. The creep and shrinkage time-ratio values listed above are considered to be applicable for all the HSMs, assuming the concrete mixtures used in the HSM construction satisfy the standard conditions. The HSM components are sufficiently thick compared to standard conditions size and shape of six inches. The correction factors for average thickness provided in Table 2.5.5.1 [1] shows that the creep and shrinkage factors will be reduced by 10% and 18%, respectively, for a 12-inch thick member as compared to the standard thickness of six inches. The minimum thickness of HSM components is typically 12 inches.

Thus, standard condition concrete mixture can still be considered applicable to HSM concrete for creep and shrinkage.

Reference [3.11.24] in Section 3.11 and Section 3.6.4.2 has been revised from the 1982 edition to the 1992 edition (ACI 209R-92).

References

[1] ACI 209R-92, “Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures.”

Renewal Application Impact:

Section 3.6.4.2 and 3.11 have been revised as described in the response.

STRUCT-RAI-3: Justify the conservatism of the number of uses per year for the transfer casks as it applies to the fatigue analysis in Appendix 3B.

The applicant states that 24 uses per year is a conservative average for the transfer cask and uses this number to justify that the conditions of ASME B&PV Code Section III, Division 1 subsection NC-3219.2 are satisfied and that no fatigue evaluation is required. The staff believes the conservatism of this estimate could be verified using operational data for the various transfer casks over the last 20 years.

This information is required to show compliance with 10 CFR 72.240.

RESPONSE TO STRUCT-RAI-3

The average number of 24 uses per year is consistent with the original fatigue evaluations of the transfer cask (TC) as documented in the updated final safety analysis report (UFSAR), Section C.4.2. The service life of the TC used in those evaluations was 50 years (UFSAR Table 1.2-2), resulting in 24 x 50 = 1200 uses of the TC. Accordingly, for the renewal application, the use cycles were increased to [ ] period of extended operation.

Table STRUCT-RAI-3 provides historical operational data of all the TCs certified under CoC 1004, including the user-owned casks designed by AREVA Inc. To supplement the usage data under CoC 1004, Table STRUCT-RAI-3 also shows usage data for other NUHOMS® TCs certified under other general license CoCs or site-specific licenses. Based on historical use data, the average yearly use does not exceed 13 cycles/year use. Therefore, the initial assumption of 24 cycles per year is still considered to be a conservative estimate.

Renewal Application Impact:

No changes as a result of this question.

Table STRUCT-RAI-3
Historical Operation Date on the Transfer Casks certified under CoC 1004 License

Cask Nameplate Designation	Total Uses	Years Actual Use (Note 1)	Avg. Use per Use-Year (Note 1)	Cask Transfers by Year																									
				90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
NUHOMS Casks Licensed Under 72-1004																													
OS197-1	181	14	13					0	3	0	0	0	5	18	23	4	14	23	14	0	0	17	7	7	20	13	13	0	0
OS197-2	74	12	7												0	8	0	7	4	5	5	8	6	9	5	5	6	6	0
OS197H-3	82	10	9													0	4	11	3	0	5	8	11	12	7	4	0	17	0
OS197H-4	34	7	5																	0	3	0	5	5	4	4	0	6	7
OS197H-6	33	8	5																			2	5	5	4	3	5	4	5
OS197H-7	30	6	5																					4	2	6	10	4	4
OS197H-8	0	0	0																										0
OS197L-5	4	1	4																	4	0	0	0	0	0	0	0	0	0
OSTC-1	62	7	9																		0	12	0	5	21	8	4	8	4
OSTC-2	0	0	0																								0	0	0
OSTC-3	0	0	0																								0	0	0
OTC24P-001	139	24	6	4	9	7	4	5	5	0	6	0	6	11	5	10	5	5	2	3	7	7	8	7	6	2	7	3	5
Other NUHOMS Casks (Other Site-Specific or General Licenses)																													
BGE001	76	18	5	0	0	0	2	6	2	5	0	9	0	12	0	4	6	1	2	3	4	4	3	3	3	3	0	4	0
IF-300	8	1	8	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MP187-1	22	3	8												10	11	0	0	0	1	0	0	0	0	0	0	0	0	0
MP187-2	0	0	0																										
OS187H-1	26	8	4																0	0	2	4	3	0	3	3	7	2	2
OS187H-2	25	7	4																	0	0	4	3	3	3	0	5	4	3

Note 1: This column conservatively does NOT include years when a cask was idle. Example: For OS197-1 the average of 13 is based on 14 years (does not include seven years when the cask was idle). When including all 21 years since the cask was first used in 1995, the average number of uses per year = 8.62 (181 uses / 21 yrs).

STRUCT-RAI-4: Justify why aging management for the seismic ties for the HSM-HS was not addressed.

An analysis of the seismic ties that connect adjacent HSM-HS systems together was performed in Appendix U of the UFSAR. Both tensile and shear loads were determined using ANSYS Finite Element software. A shear-tension interaction ratio of 0.96 resulted, which the applicant used as the qualification basis of the ties. Because these ties connect adjacent HSMs, they are somewhat exposed to the weather (i.e. not completely embedded) and are subject to loss of material as a result of corrosion. The applicant is asked to justify that this loss of material will not be significant enough to affect the tensile and shear stress capacities of the ties with a corresponding increase of the tensile-shear interaction ratio.

This information is required to show compliance with 10 CFR 72.240.

RESPONSE TO STRUCT-RAI-4

Aging management for the seismic ties for the HSM-HS is addressed in Table 1H-22 of the application under the entries: “HSM-HS Roof Attachment Assembly,” “Side to Side Module Connection Assembly,” and “Back to Back Module Connection Assembly.”

It should be noted that the shear-tension interaction ratio of 0.96 is based on a 10 percent reduction in the tensile stress area of 2.5 in^2 for a 2-inch diameter bolt, i.e., the stress calculation uses area of 0.9*2.5 = 2.25 in^2 to account for material loss due to corrosion. Based on these areas, the respective bolt diameters are calculated as d = 1.784 inch for 2.5 in^2 bolt and d = 1.693 inch for 2.25 in^2 bolt. Thus, the corrosion allowance corresponding to a 10 percent reduction in bolt area is (1.784-1.693)/2 = 0.046 inch.

Per ASTM G101, Reference [1], Figure X1.3, the thickness loss due to corrosion in a U.S. marine environment over a period of 60 years is estimated to be 550 µm (0.022 inches) for low- alloy weathering steels such as ASTM A588. Based on Reference [1], Table X2.1, ASTM A588 shows a lower range of 6.1-7.0 atmospheric corrosion resistance indices as compared to ASTM A242. The lower corrosion index is indicative of the lower corrosion resistance. Thus, projected material loss for A588 material is considered for calculating the corrosion penetration depth. ASTM G101, Section 6.3.2 presents a method for calculating the predicted corrosion loss (corrosion index) based on the material chemical composition. The corrosion index for ASTM A588 is calculated to be 6.17. Using the mid-range chemical composition values for ASTM A193 B7, also a low-alloy steel, the calculated corrosion index is 5.69, which signifies that the ASTM A193 B7 material has lower corrosion resistance than ASTM A588. Therefore, conservatively, a factor of 2 is applied to the estimated corrosion penetration for ASTM A588. This results in an estimated corrosion penetration of 0.022*2 = 0.044 inch. This corrosion penetration is below the calculated corrosion allowance of 0.046 inch.

In addition, these bolts are also zinc coated by electroplating. Thus, the tensile and shear stress capacities of the seismic ties have sufficient margin, and loss of material due to corrosion is not a concern.

Reference:

[1] ASTM G101-04(2010), “Standard Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels,” ASTM International, West Conshohocken, PA, 2010.

Renewal Application Impact:

No changes as a result of this question.

STRUCT-RAI-5: Provide the calculations for the axial stress and hoop stress values reported in Tables 3J-2 and 3J-3.

The applicant reports the values of the hoop stress and axial stress within the various fuel assemblies based on internal pressure, but does not provide the calculations for these values. If these values are scaled from stresses reported in the UFSAR, as is done for the bending stress in these tables, provide the tables in which the original stresses can be found along with the pressure associated with these stresses.

This information is required to show compliance with 10 CFR 72.240.

RESPONSE TO STRUCT-RAI-5

The formulae used for calculating the axial and hoop stress values due to internal pressure reported in Tables 3J-2 and 3J-3 have been added to these tables as notes.

Renewal Application Impact:

Table 3J-2 and Table 3J-3 have been revised as described in the response.

Section 3J.2 has been revised as described in the response.

E.3 Thermal/Confinement

THERM/CONFINE-RAI-1: 1 Clarify the assumptions used in Appendix 3F.

a) Section 3F.2 mentions that a sensitivity analysis was performed to verify "suitability of each source term", but there was no mention whether this analysis resulted in bounding source terms when determining doses.

b) Clarify whether the 29 DSCs loaded in a single ISFSI is a bounding quantity for a dose analysis.

c) Explain the relevance of the assumed 100 m and 500 m distances from the DSC, considering that 10 CFR 72.104 and 10 CFR 72.106 refer to distances associated with the ISFSI controlled area boundary.

d) Specify the units of activity in Table 3F-1 and Table 3F-2.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO THERM/CONFINE-RAI-1

a) Appendix 3F, Section 3F.2 has been revised so that high burnup fuel is also bounded.

b) Appendix 3F, Section 3F.4 has been revised to address the ISFSI bounding doses without mentioning the 29 DSCs. The 29 DSCs was related to off-normal conditions, not normal conditions. Over 400 DSCs could leak under normal conditions before the dose limits are approached.

c) Appendix 3F, Section 3F.1 has been revised to relate the distance of 100 meters to 10 CFR 72.106(b). The 500 m information has been deleted.

d) The units of activity in Appendix 3F, Table 3F-1 and Table 3F-2 are curies. The two tables were changed to specify the activity unit.

Renewal Application Impact:

Appendix 3F has been revised as described in the response.

THERM/CONFINE-RAI-2: Provide details and clarify the changes, if any, of the thermal models/analyses mentioned in Appendices 3G and 3C from those performed for the original/amended CoCs.

a) Appendices 3G and 3C provided results, but did not include inputs/details on the thermal models/analyses used and whether those models/analyses were the same as in previous amendment submittals. Currently, there is insufficient information to perform a review.

b) Provide explanations that show the assumptions, boundary conditions, and models would result in accurate, or bounding, values for determining minimum temperatures of components; recognizing that most thermal analyses in the UFSAR make assumptions that result in maximum component temperatures.

This information is needed to determine compliance with 10 CFR 72.240.

This information is needed to determine compliance with 10 CFR 72.240(c)2.

RESPONSE TO THERM/CONFINE-RAI-2

a) The thermal model described in Section 3G.2 is a fully coupled, three-dimensional computational fluid dynamics (CFD) model utilizing ANSYS FLUENT CFD code (referred to as FLUENT model in the following discussion). This FLUENT model was not used in any previous amendment submittals. Detailed comparisons between the FLUENT model and the model used in previous amendment submittals are discussed in Response Item b).

   Section 3G.2 in Appendix 3G has been revised to include the details of the FLUENT model.

b) In previous amendment submittals, the thermal evaluation of the horizontal storage modules (HSMs) is performed using a two-step process. In the first step, the energy balance and hydraulic equations are combined to calculate the bulk air temperatures in the HSM cavity. In the second step, the thermal model of the HSM was developed in ANSYS (referred to as ANSYS model in the following discussion). It includes the dry shielded canister (DSC) shell and end plates, the concrete structure, and the heat shields. Heat load is assumed as a uniform heat flux boundary condition specified on the inner surface of the DSC shell.

   The ANSYS model does not explicitly model the heat transfer due to convection, which is the primary mode of heat transfer within the HSM. Rather, this approach approximates the heat transfer due to convection within the HSM using classical heat transfer correlations and justifies the methodology by comparison to the measured values. The maximum temperatures determined from the two-step evaluation are significantly conservative when compared to the measured values as shown in [1]. This conservatism has further been validated based on the confirmatory evaluation in NRC safety evaluation report for Amendment 10 to Certificate of Compliance (CoC) No. 1004 [2] using STAR-CD CFD code.

The FLUENT model presented in Appendices 3G and 3C eliminates the need for a two-step approach and includes the conduction, convection and radiation heat transfer modes within the HSM cavity. It uses the transitional k-ω SST turbulence model, which was validated in Section 7.0 in NUREG-2152 [3] for a VSC-17 spent fuel dry storage cask. As shown in Figures 7-11a and 7-11b in [3], the transitional k-ω SST turbulence model predicts the temperature distribution fairly well in the fuel region inside the canister, as well as on the multi-assembly sealed basket (MSB) wall. It conservatively overpredicts the maximum fuel cladding temperature. For the minimum temperatures on the ends of the MSB walls, the FLUENT model overestimates the experimental data within 5 K (5 °C).

To evaluate the sensitivity of the minimum canister temperature prediction, the time to initiate the chloride-induced stress corrosion cracking (CISCC) is estimated when the minimum canister temperature is 5 °C lower than the base case in Table 5A-1 in Appendix 5A. Table THERM/CONFINE-RAI-2-1 below summarizes the results of the approximate time for CISCC initiation at the airborne chloride salt concentration of 8.5 $\mu g/m^3$ for a 32PTH1-S DSC with 32 kW and 6 kW heat loads using Eq. 5A-1 in Appendix 5A. When compared to the CISCC initiation time of 35 years for the base case in Appendix 5A, the 5 °C lower case can result in CISCC initiation one year earlier and is not considered to be significant for canister CISCC.

Table THERM/CONFINE-RAI-2-1
Approximate Time for CISCC Initiation When the Minimum Temperature is 5 °C Lower than the Base Case

32PTH1-S DSC	Approximate Time for CISCC Initiation at the Airborne Chloride Salt Concentration of 8.5 $\mu g/m^3$	
	Base case (Table 5A-1 in Appendix 5A)	5 °C lower
32 kW	35 years	34 years
6 kW	35 years	34 years

Furthermore, to evaluate the minimum confinement weld temperatures, an average annual temperature of 70 °F (21 °C) is conservatively considered in the FLUENT model. This ambient temperature is much lower than the 106 °F (41 °C) of normal hot storage conditions considered in the ANSYS model in previous amendment submittals.

Therefore, the FLUENT model presented in Appendices 3G and 3C is able to predict the minimum temperatures of the components in the HSM for the period of extended operation.

References

[1] TN Document, "Thermal Testing of the NUHOMS® Horizontal Storage Module, Model HSM-H," Document No. E-21625, Revision 1.

[2] U.S. NRC, “Final Safety Evaluation Report Transnuclear, Inc. Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel,” Docket No. 72-1004 Amendment No. 10 (ADAMS Accession No. ML092290329).

[3] NUREG-2152, “Computational Fluid Dynamics Best Practice Guidelines for Dry Cask Applications,” U.S. Nuclear Regulatory Commission, March 2013.

Renewal Application Impact:

Section 3G.2 has been revised as described in the response.

THERM/CONFINE-RAI-3: Clarify inputs found in Appendix K and confirm that the NUHOMS® 37PTH and 69BTH DSCs are the bounding DSC/fuel combination to be used when evaluating the impact of a breach of confinement during the period of extended operation.

a) In order to review the analysis in Appendix K, it is necessary to know if it represents a bounding evaluation when using input for NUHOMS® 37PTH and 69BTH.

b) Provide the details associated with the "releasable source", including release fractions, etc.

c) Explain the relevance, in the dose analysis, of the distances from the DSC considering that 10 CFR 72.104 and 10 CFR 72.106 refer to distances associated with the ISFSI controlled area boundary.

d) Explain the basis for the two hour exposure duration in the dose analysis.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO THERM/CONFINE-RAI-3

a) Section 3K.2 has been revised to provide the justification that the source terms are bounding.

b) Section 3K.1 has been revised to describe the release fractions of the radionuclides considered in the defense-in-depth analysis. The term, releasable source, is removed.

c) Section 3K.1 has been revised to relate the distance of 100 meters to 10 CFR 72.106(b).

d) Section 3K.2 has been revised to provide the justification for the two-hour exposure duration.

Renewal Application Impact:

Sections 3K.1 and 3K.2 have been revised as described in the response.

THERM/CONFINE-RAI-4: Justify the choice of the inner top cover plate as the DSC component most affected by the stresses developed by the DSC internal pressure.

It is stated that Appendix L, Appendix M, and Appendix N are written to demonstrate the structural integrity of the confinement boundary, which consists of shell, top plate, bottom plate, welds, etc. However, there was no evaluation to show that the inner top cover plate is the critical component.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO THERM/CONFINE-RAI-4

For higher internal pressure load, the inner and outer top cover plates of the dry shielded canister (DSC) would act together to resist the bending. Section 3L.2 has been revised to clarify the selection criteria for the bounding DSC. The combined thickness of the DSC top assembly is used as the discriminator for the selection of bounding DSCs. The stresses are calculated accordingly using equations from 3M5.2 and are shown in Table 3M-1.

Section 3M.1 has been modified to clarify the choice of combined thickness of the top cover plate assembly.

Renewal Application Impact:

Sections 3L.2 and 3M.1 have been revised as described in the response.

THERM/CONFINE-RAI-5: Provide, or specify the location of, the evaluation of the dose rate effects from 1% of ruptured fuel rods mentioned on page 3L-3.

Appendix 3L refers to a dose rate evaluation, but no evaluation is found in the appendix and therefore, a review cannot be performed.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO THERM/CONFINE-RAI-5

The defense-in-depth dose assessment presented in Appendix 3K assumes a more conservative internal pressure and cavity gas temperature after 20 years of storage (at off-normal conditions) taken from Table 3L-3. The corresponding statement on page 3L-3 has been revised and clarified.

Renewal Application Impact:

Section 3L.2 has been revised as described in the response.

THERM/CONFINE-RAI-6: Clarify the decay heat load and maximum cladding temperature values listed in Table 3L-2.

a) In order to review Table 3L-2, provide the decay heat curves for the referenced 61BTH, 32PT-S125 and 32PTH1-S DSCs. This information will help to confirm the very large drop in decay heat over the 20 year storage period for the 32PTH1-S DSC fuel.

b) Confirm that the 32PTH1-S DSC, which has the highest 20 year decay heat value, has the lowest maximum fuel cladding temperature.

c) Confirm that the unit of temperature is “deg F” for the profiles found in Figures 3L-1, 3L-2, and 3L-3.

d) Indicate the location in the UFSAR that describes the DSC model and material properties referred to on page 3L-3 and specify the changes in the model input.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO THERM/CONFINE-RAI-6

a) Based on the equations provided in Table A.1.4.2-8 and Table A.1.4.8-8 of [1] for pressurized water reactor (PWR) and boiling water reactor (BWR) fuel assemblies (FAs), the decay heat load per FA is a function of the FA initial burnup, initial enrichment, and cooling time. The total decay heat load per dry shielded canister (DSC) is calculated based on the limiting heat load zone configuration (HLZC) for each bounding DSC. To be conservative, the maximum allowable decay heat load for each zone in the limiting HLZC is assumed to calculate the corresponding minimum cooling time at the start of storage.

   The total decay heat loads for the referenced 32PTH1-S, 32PT-S125 and 61BTH Type 1 DSCs over the 20-year storage period are calculated and shown in Figure THERM/CONFINE-RAI-6-1. As shown in the figure, the decay heat loads after a 20-year storage period are 9 kW for 61BTH Type 1 DSC, 10.2 kW for 32PT-S125 DSC, and 12.3 kW for 32PTH1-S DSC, respectively.

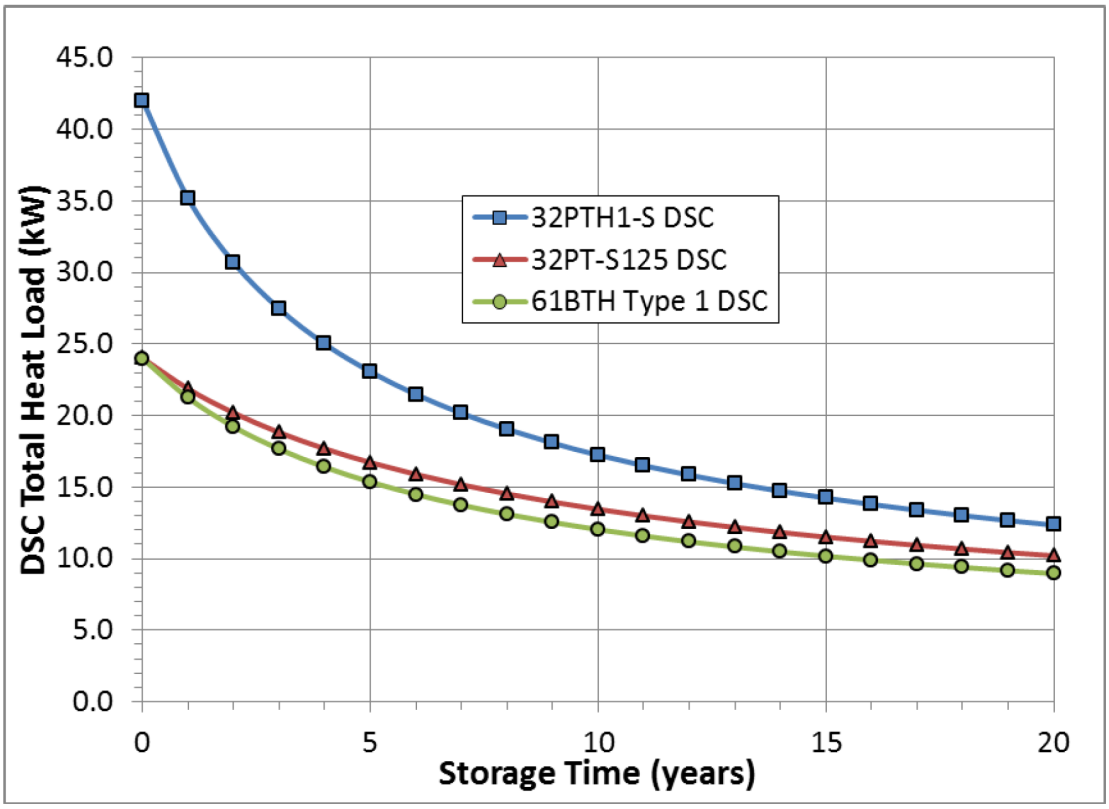

Figure THERM/CONFINE-RAI-6-1
Decay Heat Load per DSC over the 20-year Storage Period

b) The ANSYS models and results have been reviewed and verified to have the correct results.

   Among the three DSCs, the 32PTH1-S DSC has the most efficient thermal design, which increases the maximum heat load capacity up to 40.8 kW, compared to 22 kW for the 61BTH Type 1 DSC and 24 kW for the 32PT-S125 DSC. After 20 years of storage, the total heat loads for all three types of DSCs decline to about 10 kW without significant difference. Therefore, the 32PTH1-S DSC with the best thermal design performance results in the lowest maximum fuel cladding temperature.

c) The “deg F” is the correct unit of temperature as shown in revised titles for Figures 3L-1, 3L-2, and 3L-3.

d) The 61BTH Type 1 DSC model and material properties are the same as those described in Chapter T.4 of Certificate of Compliance (CoC) No. 1004 Updated Final Safety Analysis Report (UFSAR) [2] (Sections T.4.2 and T.4.3 for material properties and Section T.4.6.2 for DSC model).

   The 32PT-S125 DSC model and material properties are the same as those described in Chapter M.4 of CoC 1004 UFSAR [2] (Sections M.4.2 and M.4.3 for material properties and Section M.4.4.1 for DSC model).

The 32PTH1-S DSC model and material properties are the same as those described in Chapter U.4 of CoC 1004 UFSAR [2] (Sections U.4.2 and U.4.3 for material properties and Section U.4.6.1 for DSC model).

There are no changes in the above DSC models and material properties inputs except that the decay heat load per FA for the limiting HLZC decreases from the initial value to the 20-year storage value for each DSC model.

References

[1] AREVA TN Document, "NUHOMS® -MP197 Transportation Package Safety Analysis Report," NUH09.101, Revision 17.

[2] AREVA TN Document, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NUH-003, Revision 14, September 2014.

Renewal Application Impact:

Figure titles for Figures 3L-1, 3L-2, and 3L-3 have been revised as described in the response.

THERM/CONFINE-RAI-7: Provide an analysis to show that helium is retained during the period of extended operation to ensure an inert environment within the canister.

The fuel assembly AMP refers to an inert atmosphere within the DSC. An inert atmosphere is necessary to prevent material degradation, however, an analysis to confirm the presence of an inert atmosphere was not provided.

This information is needed to determine compliance with 10 CFR 72.240.

RESPONSE TO THERM/CONFINE-RAI-7

As shown in the updated Appendix 3F, Section 3F.2, the fraction of helium loss to the initial helium inventory within the DSC for the total 60 year operational period is negligible. This has also been added to the discussion in Attachment A, Table A-1.

Renewal Application Impact:

Section 3F.2 and Attachment A, Table A-1 have been revised as described in the response.

F. General

GEN-RAI-1: Explain the rationale for including the 24PT2 DSC in the renewal application.

This DSC was added using the 72.48 process, and so does not appear in the TS, the CoC, or 10 CFR 72.214. This DSC cannot therefore be used by a general licensee under the provisions of Part 72; if used for a site specific license, it would need to be renewed under that license. (See Application, Table 1-1, Table 2-2, Section 3.3.1, etc.) Note that including it in the renewal application does not mean that it will be added to any of the above listed documents.

This information is needed to complete the review in accordance with 10 CFR 72.240.

RESPONSE TO GEN-RAI-1

The NUHOMS®-24PT2 dry shielded canister (DSC) is a modified version of the NUHOMS®-24P DSC. The 24PT2S and 24PT2L versions of the 24P DSC were added using the provisions of Condition 9[1] of the NUHOMS® Certificate of Compliance (CoC) No. 1004, Amendment 2. Certificate of Compliance No. 1004 Amendment 2 listed only the 24P and the 52B as the Standardized NUHOMS® cask models. These were the initial pressurized water reactor (PWR) and boiling water reactor DSC models. The 24PT2S and 24PT2L were based on the 24P PWR model design, as detailed in the application. The addition of these DSCs did not involve a change to the conditions of use as described in Amendment 2 to the CoC. The 24PT2 DSCs were evaluated against the same fuel types and environmental conditions as the 24P DSC. Similarly, subsequent amendments have caused the list of cask models in the technical specifications (TS), the CoC, and in 10 CFR 72.214, to change to include newly designed DSCs, but those lists do not contain all versions of the newly listed DSC models.

Because they are modified versions of the 24P DSC, which is listed in the TS, the CoC, and 10 CFR 72.214, AREVA considers that the 24PT2S and the 24PT2L DSCs can be used by a general licensee under the provisions of Part 72, and it is not AREVA's intention that these modified versions be added to those documents.

Renewal Application Impact:

No changes as a result of this question.

[1] The Condition 9 provision was very similar to the provisions of 10 CFR 72.48, which did not become effective for dry cask storage certificate holders until April 5, 2001. In Amendment 3 (which was effective on Sept. 12, 2001), the NRC, on its own initiative, removed CoC Condition Nos. 9, 10, and 11. Condition No. 9 was superseded by a change to 10 CFR 72.48 (see 64 FR 53582; October 4, 1999) which permitted certificate holders to make certain changes to a cask design without prior NRC approval.

GEN-RAI-2: Explain the rationale for including the HSM Model 152 in the renewal application.

This HSM was added using the 72.48 process, and so does not appear in the TS or the CoC. This HSM cannot therefore be used by a general licensee under the provisions of Part 72; if used for a site specific license, it would need to be renewed under that license. (See Application, Section 1.2.2.2, Table 1-1, Table 3.2-1, Section 3.3.2, etc.) Note that including it in the renewal application does not mean that it will be added to either of the above listed documents.

This information is needed to complete the review in accordance with 10 CFR 72.240.

RESPONSE TO GEN-RAI-2

A history of the inclusion of the various horizontal storage module (HSM) models is provided below to explain the rationale for the inclusion of the HSM Models 152 and 202 in the renewal application.

Certificate of Compliance (CoC) No. 1004 Amendment 0 discusses the HSM, with no mention of any specific HSM model, as do the Amendment 0 technical specifications (TS), and as does Final Safety Analysis Report (FSAR) Revision 3A, which incorporates Amendment 0. Final Safety Analysis Report Revision 4A makes no changes regarding HSM models, and does not incorporate any amendment. Amendments 1 and 2, and associated FSAR Revision 5 also make no changes regarding HSM models.

Amendment 3, which is incorporated into FSAR Revision 6, makes no changes regarding HSM models. However, FSAR Revision 6 also includes changes approved by Safety Evaluation 72-1616 (see ML022620156) which establish HSM Models 80 and 102, declaring the Model 80 as the original HSM and the Model 102 as an alternate version of the standardized HSM design. Amendment 4, incorporated into FSAR Revision 7, and Amendments 5 through 7, all incorporated into FSAR Revision 8, make no changes regarding HSM models.

Amendment 8, incorporated into FSAR Revision 9, introduces a distinctively new HSM design, the HSM-H, which is explicitly cited in the CoC and has multiple TS solely associated with this new design. Final Safety Analysis Report Revision 9 also includes changes approved by Safety Evaluation 721004-045 (see ML062140043), which establish HSM Model 152 as an alternative version of the standardized HSM design to the HSM Model 80 and Model 102.

Amendment 9, incorporated into FSAR Revision 10, makes no changes regarding HSM models. However, FSAR Revision 10 also includes changes approved by Safety Evaluation 721004-338 Revision 1 (see ML082110243), which establish HSM Model 202 as an alternative version of the standardized HSM design to the HSM Model 80, the Model 102, and the Model 152.

Amendment 10, incorporated into FSAR Revision 11, introduces an upgraded version of the HSM-H for locations where higher seismic levels exist, denoted as the HSM-HS, which is distinctly cited in the CoC and the TS. The introduction section of the TS for Amendment 10 states that the term “HSM” is applicable to both the Standardized HSM and the HSM-H modules unless the applicability of one of the TS contained in this document is limited to a specific HSM model. Similarly, the term HSM-H is applicable to both the HSM-H and the “high seismic” option of the HSM-H unless the applicability of one of the TS contained in this document is limited to a specific HSM-H model. Final Safety Analysis Report Revision 11 makes no other changes regarding HSM models.

In keeping with the new standardized format of the TS per NUREG-1745, Amendment 11 included a new Definitions section of the TS that clarified the term HSM to explain the different HSM models as follows:

> The HSM (Standardized HSM, HSM-H, high seismic option for HSM-H or other models enveloped by these designs) is a reinforced concrete structure for storage of a loaded DSC at a spent fuel storage installation. e.g., Standardized HSM includes HSM Model 80, Model 102, Model 152 or Model 202 as described in the Updated Final Safety Analysis Report (UFSAR). The generic term “HSM-H” refers to HSM-H or high seismic option for HSM-H except where a specific HSM-H configuration is called out.

Until Amendment 11, neither the CoC nor the TS explicitly cited the Model 80, Model 102, Model 152, or Model 202. In addition, the approved list of storage casks provided in the regulation 10 CFR 72.214 lists only the dry shielded canister (DSC) model numbers and not the HSM models. The addition of the different models of the HSM via either the amendment process or via 10 CFR 72.48 was done appropriately, and in accordance with the established regulatory processes. These HSM models are all in use at multiple independent spent fuel storage installations in the nuclear industry. Therefore, AREVA TN considers it to be appropriate that all these HSM models be included in the scope of the renewal application.

Renewal Application Impact:

No changes as a result of this question.

GEN-RAI-3: Explain the rationale for including the HSM Model 202 in the renewal application.

This HSM was added using the 72.48 process, and so does not appear in the TS or the CoC. This HSM cannot therefore be used by a general licensee under the provisions of Part 72; if used for a site specific license, it would need to be renewed under that license. (See Application, Section 1.2.2.2, Table 1-1, Section 3.3.2, etc.) Note that including it in the renewal application does not mean that it will be added to either of the above listed documents.

This information is needed to complete the review in accordance with 10 CFR 72.240.

RESPONSE TO GEN-RAI-3

See the response to GEN-RAI-2, which provides a history of the inclusion of the various horizontal storage module (HSM) models and provides a rationale for the inclusion of HSM Model 202 in the renewal application.

Renewal Application Impact:

No changes as a result of this question.

GEN-RAI-4: On April 7, 2000, the staff issued a letter to you (then Transnuclear West Inc.) enclosing the CoC for Amendment No. 1 to the Standardized NUHOMS® System (ML003704754). The letter stated that the "certificate [for Amendment No. 1] supersedes, in its entirety, Certificate of Compliance No. 1004, Amendment No. 0, dated January 23, 1995." In addition, the enclosed CoC states as condition 11, "General licensees will continue to use spent fuel storage casks manufactured under CoC No. 1004, Amendment No. 0, if the cask being used was fabricated before issuance of this amendment. All other casks must be manufactured in accordance with Amendment No. 1.

a. Are there any casks that were loaded under the original certificate that meet that certificate, and do not meet the requirements of the certificate for Amendment No. 1?

b. Given that the April 2000 letter stated that CoC for Amendment No. 1 supersedes the CoC for Amendment No. 0 (the original), please clarify whether your request includes renewing the original certificate, and if so, please explain why the original certificate should be renewed.

This information is needed to complete the review in accordance with 10 CFR 72.240.

RESPONSE TO GEN-RAI-4

The letter transmitting the approved Amendment 1 to Certificate of Compliance (CoC) No. 1004, and the letters for Amendments 2, 3, and 4 all have sentences indicating that the certificate supersedes, in its entirety, the prior amendments to the CoC. However, this statement was not included in the CoC. The CoC for each of these amendments states that general licensees will continue to use spent fuel storage casks manufactured under prior amendments IF the casks were fabricated prior to issuance of the new approved amendment. Therefore, in regards to being superseded, Amendments 1, 2, 3, and 4 are no different than Amendment 0, and the CoC condition regarding fabrication timing allows casks to have been loaded and operated under any of these amendments.

a. Regarding Item a. above, there are casks that were loaded under the original Amendment 0 certificate that were fabricated prior to the effective date of Amendment 1 (i.e., between January 23, 1995 and April 26, 2000). These are listed in Tables 1A-6, 1A-7 and 1A-8 of the renewal application. Based on the April 7, 2000 letter, which describes the scope of Amendment 1 to be to: (1) correct the expiration date to reflect 20 years after the final rule effective date (January 23, 2015); (2) change the title of the NUHOMS® Safety Analysis Report to be consistent with the new Section 72.248; (3) reflect the transfer of the certificate from VECTRA Technologies, Inc. to Transnuclear West, Inc.; (4) specify the applicability of Amendment Nos. 0 and 1; and (5) issue the certificate on the NRC's new form, it is reasonable to conclude that all casks loaded under Amendment 0 meet the requirements of Amendment 1.

b. Regarding Item b. above, based on the discussion regarding the sameness of Amendments 1, 2, 3 and 4, in regards to supersession and fabrication timing, and since casks have been loaded and are operating under Amendment 0, then renewal is also appropriate for these casks and for Amendment 0.

Renewal Application Impact:

No changes as a result of this question.