NRC Observation 1-1

Revise the application to clearly state that plutonium, except in the form of depleted $UO_2$ fuel, is not authorized for transport in the Model No, HI-STAR 100MB package.

Section 1.2.3 of the application, "Special Requirements for Plutonium," states:"The contents of the package provided in Section 1.2.2 and to be transported in the HI-STAR 100MB Package plutonium in solid form and in varying quantities." This statement is incorrect as plutonium in any other form than in the spent $UO_2$ fuel is not authorized for transport since the application does not include safety analyses for plutonium contents in solid form for any quantity.

This information is required to determine compliance with 10 CFR 71.33(b)(2), 71.55, and 71.63.

Holtec's Response to 1-1

Revised Section 1.2.3 to state the following: "Plutonium in any form other than in the spent $UO_2$ fuel is not authorized for transport."

NRC Observation 2-1

Clarify apparently conflicting information on the nature of the surface preservatives of the HI-STAR 100MB package.

Note 12 on the HI-STAR 100MB drawing states that all non-stainless steel interior containment boundary surfaces and external surfaces of the package are to be coated with a surface preservative such as stainless steel clad or weld overlay. Section 2.2.1.3 of the application also states that the use of stainless clad or overlay removes the concern of surface degradation.

However, Section 2.2.1.2.4 states that outer shells made of carbon steel will employ Carboguard or equivalent surface preservative. Also, Section 2.2.1.2.5 states that the package interior steel surfaces may be coated with Thermaline or equivalent surface preservative.

The applicant should provide a consistent description of the materials used in the HI-STAR 100MB package.

This information is required to determine compliance with 10 CFR 71.33(a)(5) and 71.43(d).

Holtec's Response to Observation 2-1

For consistency, note 12 on the HI-STAR 100MB licensing drawing (Holtec Drawing No. 11070) has been revised to include the option for other approved types of surface preservatives (e.g., Carboguard and Thermaline).

NRC Observation 2-2

Revise Section 2.2.1.3 to provide an evaluation of the chemical, galvanic, or other reactions that could occur due to the welding of the MPC.

Section 2.2.1.3 states that no operations were identified that could produce adverse reactions because no closure welding is performed. However, Section 7.1.6 of the application describes a "load and go" option that includes MPC loading and closure welding.

This information is required to determine compliance with 10 CFR 71.43(d).

Holtec's Response to Observation 2-2:

Section 2.2.1.3 has been revised to address the above observation.

NRC RSI 3-1

Provide the axial decay heat profile of the fuel assembly.

The applicant states, in Section 3.1.2, that the heat generation in each fuel assembly is non-uniformly distributed over the active fuel length to account for design basis fuel burnup distribution.

The axial decay heat profile of the fuel assembly (Table or Figure) is needed to verify the correct simulation of the heat generation distribution in the thermal evaluation model.

This information is required to determine compliance with 10 CFR 71.71 and 71.73.

Holtec Response's to RSI 3-1

The requested information is addressed in 100MB SAR Table 5.4.4 located in Chapter 5. Section 3.1.2 of the SAR is revised to cite this SAR table.

NRC RSI 3-2

Provide figures of the regionalized storage arrangements (per cell allowable heat loads) of the MPC-32M, and the bare basket configurations F-24M and F-32M, to verify the heat load profiles selected in the thermal analysis.

The applicant states, in Section 3.1.4, that "the uniform heat load case bounds all regionalized storage arrangements that meet the requirements of (i), (ii) and (iii) as shown in pages 3.1-2 and 3.1-3."

Figures of the regionalized storage arrangements (per cell allowable heat loads) for the MPC-32M, and the bare basket configurations F-24M and F-32M, are needed to verify the per cell heat load distribution and the bounding correlation between regionalized and uniform loadings.

This information is required to determine compliance with 10 CFR 71.71 and 71.73.

Holtec's Response to RSI 3-2

Response to RSI 3-2 is proprietary and provided in Enclosure 2 to Holtec Letter 5014847.

NRC RSI 3-3

Provide thermal models and input files for the short-term operations.

Such models for package operations such as vacuum drying are missing from the application.

This information is required to determine compliance with 10 CFR 71.35, 71.71 and 71.73(a)(4).

Holtec's Response to RSI 3-3

FLUENT thermal input files supporting vacuum drying operations provided as Enclosure 7 to Letter No. 5014847. SAR Chapter 3, Para 3.3.6.2 revised to address thermal modeling and incorporate vacuum drying results under threshold heat load limits and for an example case under cyclic drying. The models and methods articulated in this application is consistent with vacuum drying methodology deployed in licensing other HI-STAR transport casks such as HI-STAR 190 and 180D casks under Docket numbers 71-9373 and 71-9367.

NRC Observation 3-4

Clarify the maximum normal operating pressures (MNOPs) for the MPC-32M and the bare basket F-32.

The applicant states in Note 2 of Table 3.1.2 that the MNOP of the MPC cavity is calculated based on an initial MPC cavity with helium backfill pressure limits as specified in Tables 7.1.2, 7.1.4, and 7.1.8 of the application. Table 3.1.2 shows higher MNOPs in the MPC-32M than in the F-32M, with a 0% rod rupture under normal conditions of transport (NCT) and a 3% rod rupture, even though the design heat load for the bare basket F-32M is greater than the design heat load for the MPC-32M (32 kW compared to 29 kW).

It is not clear to the staff how the MNOPs for the MPC-32M can be greater than those for the bare basket F-32M. The applicant should provide calculations for those MNOPs under NCT and 0% rod rupture, as well as a 3% rod rupture.

This information is required to determine compliance with 10 CFR 71.71.

Holtec's Response to Observation 3-4

Higher MNOP is consistent with limiting initial helium pressure under MPC-32M backfill specifications tabulated below:

| **Basket** | **Initial Helium Backfill Limits (psig)** | **Reference** | **Comments** |
|---|---|---|---|
| F-32M | 2.9 to 21.8 | SAR Table 7.1.8 | None |
| MPC-32M | 2.9 to **31.8** | SAR Table 7.1.4 | Limiting backfill pressure highlighted |

SAR Table 3.1.2 provides NCT MNOP under 0% and 3% rod rupture requested in the observation.

NRC Observation 3-5

Perform the NCT thermal analysis with the personnel barrier included in the thermal model

The applicant states, in Section 3.1.7, that (i) under 38°C (100°F) and in the shade, the maximum computed package surface temperature (Table 3.1.5) is above the allowable surface temperature limit of 85°C (185°F) and (ii) a personnel barrier will be required to meet the accessible surface temperature limit.

Given the fact that the personnel barrier may block the air from cooling down the package during NCT, the applicant should provide a thermal analysis with the personal barrier included in the model to demonstrate that its use does not impact the rate of heat rejection from the package to the ambient by convection and radiation.

This information is required to determine compliance with 10 CFR 71.71.

Holtec's Response to Observation 3-5

Thermal calculation with personnel barrier is not required as justified next. The HI-STAR 100MB application adopts same personnel barrier design as evaluated and adopted in HI-STAR 180, 180D and 190 casks (Docket numbers 71-9367 and 71-9373 respectively). These designs are defined by critical characteristics that ensure cask heat dissipation is unaffected[1]. The same characteristics are mandated in the 100MB SAR (See personnel barrier specifications Table 3.3.4).

[1] SARs yield ~5°C delta due to personnel barrier. The margins in 100MB are sufficient to accommodate such deltas.

NRC Observation 3-6

Demonstrate that the mesh/grid size used in the thermal model is appropriate for both the NCT and HAC thermal evaluations.

The applicant states, in Section 3.3.2, that (i) the mesh defined for the thermal analysis is guided by grid sensitivity studies carried out in for the Model No. HI-STAR 190 package, and (ii) therefore, the grid independent calculation of the peak cladding temperature is reasonably assured.

Given the fact that the configurations of the Model Nos. HI-STAR 100MB and HI-STAR 190 packages are not completely identical, the applicant should either demonstrate that the grid independent calculation from the HI-STAR 190 is applicable to the HI-STAR 100MB, or perform stand-alone grid sensitivity studies for the HI-STAR 100MB.

This information is required to determine compliance with 10 CFR 71.71 and 71.73.

Holtec's Response to Observation 3-6

Response to Observation 3-6 is proprietary and provided in Enclosure 2 to Holtec Letter 5014847.

NRC Observation 3-7

Explain how the backfill pressures for the MPC-32M, F-32M, and F-24M are determined.

The applicant provided helium backfill requirements of 6~15 psig for the MPC-32M annulus, 2.9~31.8 psig for the MPC-32M cavity (as shown in Tables 7.1.2 and 7.1.4, respectively) and of 2.9~21.8 psig for the F-32M/F-24M cavity and 0~2.5 psig for the F-32M/F-24M inter-lid space (as shown in Table 7.1.8), but did not explain or provide any calculation on how these backfill pressures for either the MPC-32M, F-32M, and the F-24M are determined.

This information is required to determine compliance with 10 CFR 71.35 and 71.71.

Holtec's Response to Observation 3-7

The principal requirement guiding helium backfill pressures is compliance with 10CFR Part 71 MNOP limits (100 psig, B(U) licensed 100MB package). As guided by scoping evaluations suitable upper limits are specified to remain within transport regulations. A lowerbound limit is also specified to facilitate helium backfill operations with liberal margins for instrument uncertainties.

NRC Observation 3-8

Provide the references for the thermal properties of Holtite-A and Holtite-B used for the neutron shield.

The applicant provided the thermal properties of Holtite-A and Holtite-B, such as thermal conductivity, density, and specific heat, in Tables 3.2.1, 3.2.2 and 3.2.7, but did not provide the corresponding references (e.g., pages in Sourcebook) for staff's review.

This information is required to determine compliance with 10 CFR 71.71 and 71.73.

Holtec's Response to Observation 3-8

Sourcebook pages supporting relevant properties for SAR (density, heat capacity and thermal conductivity) are provided as Enclosure 8 to Letter No. 5014847.

NRC RSI 4-1

Provide the layout of a single closure lid – MPC containment boundary and containment system components in SAR Chapter 4.

The HI-STAR 100MB design includes options for a single closure lid when used with an MPC and a dual closure lid when used with a bare basket. The applicant provided the layout of a dual closure lid cask containment boundary and containment system components in Figure 4.1.1 but did not provide the corresponding layout for a single closure lid – MPC containment boundary and containment system.

This information is required to determine compliance with 10 CFR 71.33(a)(4).

Holtec's Response to RSI 4-1

Figure 4.1.2 depicting the layout for a single closure lid cask containment boundary and containment system has been added to Chapter 4 and Section 4.1 updated accordingly.

NRC Observation 4-2

Clarify whether there are seals in the inner closure lid for the bare basket configuration.

The applicant provided Table 4.9.1 for a concise evaluation of the ability of the two containment boundaries in the HI-STAR 100MB system to individually maintain leak-tightness under the various loading conditions. The "Inner Containment" Column of Table 4.9.1 states, "There are no seals or gaskets in the inner containment," and "the inner containment boundary has no seals or gasket." However, Section 4.1.5.1 states that, "In the inner closure lid, the inner seal is the containment seal."

Given that the inner seal is located in the inner closure lid and therefore is a part of the inner containment boundary for the bare basket configuration, it would appear then that there are seals in the inner containment.

The applicant should clarify such inconsistencies between Table 4.9.1 and Section 4.1.5.1.

This information is needed to determine compliance with 10 CFR 71.33(a)(4) and 71.7.

Holtec's Response to Observation 4-2:

Corrections have been made to Table 4.9.1.

NRC Observation 6-1

Provide the sources of the material composition data used in the criticality safety analyses.

Table 6.3.5 of the application provides the material composition data of the major components of the HI-STAR 100MB packaging but does not provide the sources of such data. Because the material composition data is critical to the accuracy of the criticality safety analyses, the applicant needs to provide the sources of the data and demonstrate that the data is reliable and accurate.

This information is required to demonstrate compliance with 10 CFR 71.55(b), 71.55(d), and 71.55(e).

Holtec's Response to Observation 6-1

Response to Observation 6-1 is proprietary and provided in Enclosure 2 to Holtec Letter 5014847.

NRC Observation 6-2

Provide justification for the material compositions assumed for the BWR control rods in Table 6.B.6 and demonstrate that it is conservative to use this data to determine the material compositions of the fuel for burnup credit analyses.

Page 6.B-33 of the application shows material compositions assumed for the BWR control rods. However, such material composition data appears more likely to be used in PWR control rods: as an example, $B_4C$ is more commonly used in the BWR control rods. The applicant needs to provide justification for this assumption and demonstrate that this assumption is conservative for burnup credit analyses because $B_4C$ has a fairly large difference in absorption cross sections in comparison with the control rod material composition.

This information is required to determine compliance with 10 CFR 71.55(b), 71.55(d), and 71.55(e).

Holtec's Response to Observation 6-2

Only baskets that load PWR spent fuel are qualified in the HI-STAR 100MB criticality safety analysis. Table 6.B.6 lists properties of the cruciform blades control element operated with Combustion Engineering (CE) 15x15 fuel assembly which is a PWR fuel assembly. The material composition of the poison for the CE 15x15 cruciform blades control element can be found in Appendix 2E of [6-2.1].

Therefore, the assumed material compositions for the CE 15x15 fuel assembly control blades are justified.

Reference

[6-2.1] "Characteristics of Spent Fuel, High-Level Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation", DOE/RW-0184, Vol. 5, U.S. Department of Energy.

NRC RSI 8-1

Revise section 8.1.6 to demonstrate that the proposed approach for defining the allowable MPC flaw depth adequately considers flaw propagation.

Section 8.1.6 states that the integrity of MPCs containing high burnup fuel will be demonstrated by inspecting for flaws that exceed an allowable depth. The allowable flaw depth is established by considering the flaw's effect of reducing the net wall thickness, which increases the local membrane stress.

It is not clear to the staff whether flaws approaching the net wall thickness limit could propagate in a hypothetical accident. The applicant should demonstrate that defining the allowable flaw depth, based on net wall thickness, is conservative, and that a flaw propagation failure mode could not occur.

This information is required to demonstrate compliance with 10 CFR 71.73 and 71.85(a)

Holtec's Response to RSI 8-1:

Section 8.1.6 has been revised to correct the allowable flaw size (i.e., 2mm as opposed to 0.25"). It is demonstrated in Holtec Position Paper DS-438 (Revision 1) that any flaw identified on the MPC cylindrical surface with a depth of 2 mm or less cannot propagate in a hypothetical accident or under normal conditions of transport. The above justification is also stated in Subsection 2.7.1.4 of the SAR. A copy of Holtec Position Paper DS-438 is provided along with this RSI response.

NRC RSI 8-2

Revise Section 8.1.6 to clarify the extent of surface coverage of the eddy current testing for MPCs containing high burnup fuel.

Section 8.1.6 states that the eddy current testing will be used to identify defects in the MPC shell; however, the applicant is not clear regarding the extent of the inspection on a given MPC (i.e., entire MPC shell vs a fraction of the shell surface). The staff requires this understanding of the proposed inspection in order to evaluate the efficacy of the approach to demonstrate the integrity of MPCs that contain high burnup fuel.

This information is required to demonstrate compliance with 10 CFR 71.85(a).

Holtec's Response to RSI 8-2:

Section 8.1.6 has been revised to clarify that the entire vertical surface of the MPC shell shall be subjected to Eddy current testing.

NRC RSI 8-3

Clarify why the leakage testing of an MPC is required only when the package contains high burnup fuel (HBF).

The applicant stated in Note 4 of SAR Table 8.1.2 that for a single lid – MPC containment system, the leakage testing of an MPC is required if it contains HBF. However, being a part of containment boundary for a single lid – MPC containment system, MPC should be leakage rate tested for any types of spent fuel (e.g., MBF and LBF) loaded in HI-STAR 100 MB.

The information is needed to determine compliance with 10 CFR 71.51(a)(1) and (a)(2).

Holtec's Response to RSI 8-3

10 CFR 71.51(a)(1) and (a)(2) require that for normal conditions of transport and hypothetical accident conditions, respectively, that a Type B package meet the specified radioactive contents leakage rate and radiation levels. For a package containing an MPC with Moderate Burnup Fuel (MBF) or Low Burnup Fuel (LBF) and with a single cask lid, this is achieved via crediting the HI-STAR 100MB cask containment system (as defined in the licensing drawing – no. 11070R1) in the analyses to determine compliance with 10 CFR 71.51(a)(1) and (a)(2). However, when transporting High Burnup Fuel (HBF), the intent of the guidance provided in Interim Staff Guidance (ISG) -19 on the approach acceptable to NRC for approving HBF in a transport package is adopted for the HI-STAR 100MB. Specifically, the approach is to demonstrate that for the HI-STAR 100MB package loaded with HBF, water intrusion is not possible so that damage to HBF fuel, if any, would be inconsequential from a reactivity control perspective. "Added assurance" is accomplished via incorporating two independent containment enclosures (cask containment system and MPC), each providing a competent containment boundary capable of preventing intrusion of water subsequent to the HAC (30-feet drop). Thus, leakage testing is required for both the cask containment system and the MPC when transporting HBF, since both the cask containment system and MPC serve independently as containment boundary against leakage of radioactive material. Whereas, in the case of an MPC containing LBF or MBF, the cask containment system serves as the lone containment boundary, and is therefore the only barrier leakage tested.

The containment approach for transporting HBF is further described in Paragraph 1.2.1.2 and Chapter 4 of the SAR.

Note that this approach has been approved by NRC for Holtec's designed and licensed HI-STAR 190 package (Docket 71-9373).

NRC Observation 8-4

Add Note 2 to Fabrication Leakage Rate Test and Pre-shipment Leakage Rate Test under the column "Leakage Test" in SAR Table 8.1.2.

Instead of Note 4, the applicant should also add Note 2 to Fabrication Leakage Rate Test and Pre-shipment Leakage Rate Test under the column "leakage Test" in SAR Table 8.1.2. This add is based on the items (a) and (b) under note 2 in SAR Table 8.1.2.

This information is needed to determine compliance with 10 CFR 71.51(a)(1).

Holtec's Response to Observation 8-4

Added Note 2 to Fabrication Leakage Rate Test and Pre-shipment Leakage Rate Test under column "Leakage Test" on SAR Table 8.1.2. Note 2 items (a) and (b) describe the purpose of fabrication leakage rate tests and pre-shipment leakage rate tests and should be referenced.

NRC Observation 8-5

Correct a typographical error “HI-STAR 1100MB Cask” under the column of “System Tested” in SAR Table 8.1.2.

The applicant should correct “HI-STAR 1100MB Cask” to “HI-STAR 100MB Cask” under the column of “System Tested” in Table 8.1.2.

This information is needed to determine compliance with 10 CFR 71.7.

Holtec’s Response to Observation 8-5

Typographical error corrected on Table 8.1.2. “HI-STAR 1100MB Cask” replaced with “HI-STAR 100MB Cask” under the column of “System Tested” in Table 8.1.2.

NRC Observation 8-6

Section 8.1.6 paragraph on the proposed approach for defining the allowable MPC flaw depth contains an incomplete sentence.

Holtec's Response to Observation 8-6

Section 8.1.6 revised to clarify incomplete sentence.