Request for Additional Information
Holtec International
Docket No. 71-9374
Model No. HI-STAR 80 Package

By letter dated August 23, 2016, Holtec International (or the applicant) submitted an application for Certificate of Compliance No. 9374, Revision No. 0, for the Model No. HI-STAR 80 package. Staff issued a request for supplemental information dated October 6, 2016, to which the applicant responded by letter dated October 20, 2016. Staff accepted the application for review by letter dated November 9, 2016.

This request for additional information (RAI) letter identifies information needed by the U.S. Nuclear Regulatory Commission staff (the staff) in connection with its review of the Model No. HI-STAR 80 package application to confirm whether the applicant has demonstrated compliance with regulatory requirements.

The requested information is listed by chapter number and title in the package application. NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," was used for this review.

Chapter 1 – Licensing Drawings

1-1 Clarify the tolerances specified in the licensing drawings of the Model No. HI-STAR 80 package.

The staff found that there were not any dimensional tolerances on any components within the HI-STAR 80 cask drawings, with the exception of the basket wall thicknesses in Drawings 9796 and 9797. The staff requests that the applicant provide tolerances for the cask and its components within the other drawings, such as Drawings 9800, 9795, 9798 and 9801, as well as the other basket dimensions in Drawings 9796 and 9797(such as the steel shims). Tolerances in material thickness and size can appreciably alter the performance of the package with respect to the drop tests cited in 10 CFR 71.71 and 71.73, as well as shielding. ISG-20 states that *"The reviewer should ensure that reasonable tolerances for dimensions and weights are specified, because packaging features may be subject to some variability in fabrication."* NUREG/CR-5502, "Engineering Drawings for 10 CFR Part 71 Package Approvals," provides guidance for preparing drawings of transportation packages submitted in an application for approval under 10 CFR Part 71. It states that engineering drawings should have tolerances that are consistent with the package evaluation.

While it is clear that tolerances allow for variability in fabrication, it is currently unclear what those tolerances are for this package. NUREG CR-5502, page 2, states: *"All dimensions indicated on drawings should include tolerances that are consistent with the package evaluation. Tolerances may be addressed by a drawing note that defines a general tolerance applicable to many features. If a design feature needs a more (or less)*

restrictive tolerance than indicated by the note, the appropriate tolerance should be specified explicitly in the dimensioning of that feature."
The staff also notes that this is a recurring topic which has been repeatedly addressed in the HI-STAR 180 and 180 D applications, as well as in both the request for supplemental information and two rounds of RAIs for the Model No. HI-STAR 190 package.

Therefore, the applicant is requested to specify nominal tolerances on the engineering drawings. Calculations related to package performance shall incorporate tolerances indicated on the engineering drawings as necessary to show compliance with 10 CFR Part 71.

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

Chapter 2 – Structural and Materials Evaluation

2-1 Clarify, in Chapter 7, how the top and bottom lifting trunnions will be rendered inoperable as tie-down devices for transportation or provide an analysis to verify that they meet the requirements of 10 CFR 71.45(b)(1).

Section 2.5.2 of the application states that there are no tie-down devices that are a structural part of the package for transport in the U.S., but that the bottom lifting trunnions may be utilized for transport outside the U.S. Figures 7.A.1 and 7.A.2 of the application depict the general arrangement of the HI-STAR 80 package on a transport vehicle with impact limiter and tie-downs attached, but do not distinguish between transport configurations. Figure 7.A.1 indicates that the transport frame features saddles and bottom trunnion tie-downs. Figures 1.3.1 and 1.3.2 of the application are the same illustrations as Figures 7.A.1 and 7.A.2, but include notes that are not included in the figures in Chapter 7.

Note 1 of Figure 1.3.1 states that, in that illustration, the trunnions have been rendered inoperable by a custom tie-down device. Section 7.1.3 of the application makes no mention of rendering either set of trunnions (top or bottom) inoperable for tie-down, whether as part of a custom tie-down system or not. Because Chapter 7 is part of the Certificate of Compliance, the staff requires clarification, in Chapter 7, as to how the top and bottom trunnions will be rendered inoperable as tie-down devices for transport within the U.S., or an analysis, in Chapter 2, that shows that they meet the tie-down requirements of 10 CFR 71.45(b)(1)

This information is required to determine compliance with 10 CFR 71.45(b)(2).

2-2 Justify the calculated radial lead slump value of 1.6 inches in diameter in the lower forging gamma shield due to the side drop (slap down) analysis.

Table 2.7.4 of the application reports a maximum radial lead slump of 1.6 inches in diameter for the lower forging lead shield as a result of the side drop (top down), slap down test. This value is echoed in Table 5.3.7 in which a radial lead slump of 0.8 inches in radius is reported for the lower forging.

The staff reviewed the LS-DYNA model output file (HS80ST2\d3plot) and measured a change in diameter for the lower forging lead shield of 3.55 inches as a result of the side

drop (top down), slap-down case. As a second check, the staff measured a distance of 3.53 inches between the edge of the bottom forging lead shield and the bottom forging outer edge in the LS-DYNA model following the slap down scenario. This is much larger than the reported value of 1.6 inches.

This information is required to determine compliance with 10 CFR 71.51(a)(2)

2-3 Provide a discussion of the thermolysis and radiolysis data of Holtite-B as neutron shielding material.

Under normal conditions, the applicant claims that the depletion of the B-10 in the Metamic and Holtite neutron shield is negligible, less than 10^{-6} over 50 years. However, the applicant did not show testing data, calculation results, or relevant references to arrive at these conclusions for Holtite-B. Additionally, the applicant did not assess the micro-structural integrity of Holtite-B, as a result of thermolysis or radiolysis.

Given that the Model No. HI-STAR 80 is a new package, the applicant needs to confirm the applicability of previously NRC approved similar cases for the detailed information described above.

This information is required to determine compliance with 10 CFR 71.43(d) and 71.55(d).

Chapter 3 - Thermal Evaluation

3-1 Provide specific and detailed information on the thermal properties of materials, e.g., cladding materials, basket materials and gasket materials, at higher temperatures, e.g., up to 800 ˚C.

Temperature data under HAC conditions are provided in Table 3.1.3 and includes maximum temperatures under fire, i.e., cladding materials, 502 ˚C, and fuel basket materials, 473 ˚C. The cladding temperature remains below the HAC limit of cladding temperature, 570 ˚C. The applicant also states that the containment gasket can be relaxed (softened) from fire, see (Section 2.1.2.1). Given that the Model No. HI-STAR 80 is a new package, detailed information on the thermal properties used in the analyses under HAC at higher temperatures, e.g., up to 800 ˚C, needs to be provided. The applicant also needs to update Tables 1.2.4, 3.2.2, 3.2.3, 3.2.8, and 3.2.9 with thermal properties up to 800 ˚C.

This information is required to determine compliance with 10 CFR 71.43(d) and 71.55(d).

3-2 Provide the values of the package heat load, thermal inertia of the loaded package, and rate of temperature rise (dT/dt) for both the F-12P and F-32 B baskets in Table 3.3.6 of the application to verify the maximum permissible time for completion of wet transfer operations.

The applicant stated in Section 3.3.4 that water inside the Model No. HI-STAR 80 package cavity is not permitted to boil during fuel loading operations, in accordance with NUREG-1536. The applicant used equations provided in Section 3.3.4 and performed an adiabatic heat up calculation to determine a bounding heat-up rate based on the package heat load and thermal inertia of the loaded package, and then obtained the

maximum permissible time for completion of wet transfer operations, as shown in Table 3.3.6 of the application.

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

3-3 Provide the heat load limit of non-fuel waste (NFW) loaded in the HI-STAR 80 package and specify a heat load limit required as a criterion to backfill the package cavity with helium or just air.

The applicant stated in Section 3.1.1 that it is not necessary to backfill the package cavity with helium to improve its thermal performance because of the significantly lower decay heat for a package loaded with non-fuel waste (NFW).

Given that the NFW loaded in HI-STAR 80 package can be low to high level waste, the applicant needs to provide the heat load limit of NFW allowable in the application or explain whether a heat load limit is required as a criterion to backfill an NFW-loaded package with helium or just air.

This information is required to determine compliance with 10 CFR 71.33 and 71.71.

3-4 Clarify if the information provided in references for the fluorocarbon compound V1289-75 is applicable or appropriate to verify the performance of fluorocarbon compound V1285-75 used in the HI-STAR 80 package.

In its RSI response, the applicant stated that: (1) Note-5 of Table 3.2.12 is applied to denote seals that must withstand a temperature of 250°C (482°F) for at least 70 hours in the short term operational and accident conditions; and (2) Parker fluorocarbon compound V1285-75 has been identified as a suitable material for these seals. These two documents from the manufacturer are provided in the RSI response to serve as references for compliance of the Parker fluorocarbon compound V1289-75.

V1289-75 Parker Compound Data Sheet recommends a temperature range of (-50°F to 400°F) for the use of V1289-75, which is below 482°F as indicated in Note 5. The applicant should explain whether the use of the Parker fluorocarbon compound is appropriate for the HI-STAR 80 package.

It is also not evident that information for fluorocarbon compound V1289-75 is appropriate to serve as a reference for fluorocarbon compound V1285-75, particularly with respect to dry heat resistance. The applicant should clarify that information provided in the fluorocarbon compound V1289-75 references is applicable or appropriate for the fluorocarbon compound V1285-75.

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

3-5 Clarify if the information provided in document “Parker Seal Test Report – FF400 Compression Set” is applicable to verify the performance of FF400 O-ring seal used in the Model No. HI-STAR 80.

Note-6 in Table 3.1.2 is applied to denote seals that must withstand a temperature of 320°C (608°F) for at least one hour followed by another temperature of 200°C (392°F) for at least 70 hours, and Parker perfluoro-elastomer compound FF400-80

has been identified as a suitable material for these seals.

However, the document “Parker Seal Test Report – FF400 Compression Set” provided by the applicant in response to staff’s RSI indicates that: (1) a control specimen FF400 O-ring seal was tested under the common condition of 70 hours at 200°C (392°F), and (2) two specimens of FF400 O-ring seals were tested in separate ovens at 300°C and 320°C (608°F) for the first hour of the test duration in order to replicate the fire emergency conditions.

It appears the test described in the document “Parker Seal Test Report – FF400 Compression Set” is not identical to the test required by Note-6 in Table 3.1.2 (a FF400 O-ring seal is tested under two consecutive temperature conditions of 320°C for at least one hour first, and then followed by 200°C for at least 70 hours. The applicant should clarify that the test conditions in the document “Parker Seal Test Report – FF400 Compression Set” is appropriate to verify the performance of FF-400 O-ring seal in the Model No. HI-STAR 80 package.

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

3-6 Justify whether a backfill pressure selected from a broad range of pressures (2.9 ~ 29 psia) is appropriate for shipment of non-fuel waste.

Compared to the pressure range of 25 ~ 29 psia required for the package cavity (Table 7.1.4) for backfill pressure requirements in shipment of spent nuclear fuel, there is a broad range of backfill pressure (2.9 ~ 29 psia) specified for the package cavity in shipment of non-fuel waste (Table 7.1.5). The applicant should provide the criteria which justifies whether a backfill pressure selected from a broad range of pressures (2.9~29 psia) is appropriate for shipment of NWF.

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

3-7 Clarify whether the package accessible surface temperature measurement is required for the package loaded with moderate burnup fuel (MBF) and non-fuel waste (NFW) in preparation for transport.

The applicant stated, in Section 7.1.3 “Preparation for Transport”, that the surface temperatures of the accessible areas of the package are measured if required. For packages containing HBF, the surface temperature measurements shall include the surface temperature measurements required by the post-shipment fuel integrity acceptance test specified in Chapter 8. The applicant should clarify whether the surface temperature survey is required for the package loaded with moderate burnup fuel (MBF) and non-fuel waste (NFW).

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

3-8 Perform the transient thermal analyses and provide the temperature history (as a function time) for the package loaded with HBF and MBF, respectively, to ensure the acceptability of the PCT acceptance criteria.

In response to staff’s RSI, the applicant lowered the PCT acceptance criteria from 390°C (734°F) to 380°C (716°F) during drying to ensure adequate time is available for

operations. Based on operational experience, the applicant stated that the acceptance criterion for the temperature limit of HBF is lowered to 380ºC (716ºF), which leaves sufficient time to perform operations like backfilling the cask cavity with helium. Additionally, a similar requirement for the MBF temperature limited to 550ºC (1022ºF) is added to the same section in the application.

The NRC staff still does not have reasonable assurance that adequate time will be available at temperatures of 380°C (716°F) for HBF and 550°C (1022°F) for MBF to perform operations such as helium backfill. The applicant should perform transient thermal analyses and provide the temperature history (as a function time) for a package loaded with HBF and MBF, respectively. The temperature history will establish the appropriate time frames for PCTs rising from 380°C (716°F) to 400°C (752°F) for HBF and from 550°C (1022°F) to 570°C (1058°F) for MBF.

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

Chapter 4 – Containment Evaluation

4-1 Demonstrate the package containing the moderate burnup fuel (MBF) is leakage rate tested through a single barrier or redundant barriers, in accordance with ANSI N14.5.

The applicant noted in Table 8.1.2 that the pre-shipment and periodic leakage rate testing shall be performed on either the inner or the outer containment boundary closure seals (single barrier) for package containing MBF, but mentioned in Section 8.2.2 "Leakage Tests" that the maintenance leakage rate testing shall be performed on the redundant barriers along the leakage path through containment penetrations and lid closures for spent nuclear fuel (SNF).

Given that SNF also includes MBF, the applicant needs to explain why the package containing MBF is tested through a single barrier for the pre-shipment and periodic leakage rate testing, but may be tested through redundant barriers for the maintenance leakage rate testing.

This information is required to determine compliance with 10 CFR 71.51.

4-2 Demonstrate that the value of 4.41×10^6 cm^2 used for the calculation of the allowable leakage rates is greater than the surface area of the thirteen typical PWR fuel assemblies stored in the HI-STAR 80 package.

The applicant stated in Section 4.5.1 and Table 4.5.4 that a total surface area of 4.41×10^6 cm^2 of the contaminated solids stored in the HI-STAR 80 package is greater than the surface area of thirteen (13) typical PWR fuel assemblies, and therefore it is conservative to use the value of 4.41×10^6 cm^2 in calculation of the allowable leakage rates.

The applicant needs to show this derivation and demonstrate that the value of 4.41×10^6 cm^2 is greater than the surface area of the 13 typical PWR fuel assemblies.

This information is required to determine compliance with 10 CFR 71.35 and 71.51.

4-3 Clarify the features of the pressure testing, as described below, for the HI-STAR 80 package.

The applicant stated in Section 8.1.3.2 that pressure testing may be performed independently for the inner and outer closures using a single temporary test seal on each closure as applicable. The applicant's statement seems to indicate that the pressure testing can be also performed by treating the inner and outer closures together as a group and using a single temporary test seal on each closure.

The applicant needs to clarify whether the above statement is true as one alternative for the pressure testing. If true, the applicant needs to provide the criteria, conditions, and requirements to (a) perform the pressure testing on the inner and outer closures independently, and (b) perform the pressure testing on the inner and outer closures as a group.

This information is required to determine compliance with 10 CFR 71.35 and 71.51.

4-4 Explain why ANSI N14.5 test types A.5.1 and A.5.2 do apply to the NFW packages for the pre-shipment leakage rate test unless the alternative pre-shipment leakage rate acceptance criterion In Note 3 of Table 8.1.1 applies.

According to Table 8.1.2, ANSI N14.5 test types A.5.1 Gas pressure Drop ((pressure decay, nominal test sensitivity = 10^{-1} to 10^{-5} ref·cm^3/s) and A.5.2 Gas Pressure Rise (vacuum retention, nominal test sensitivity = 10^{-1} to 10^{-5} ref·cm^3/s) do not apply to the NFW packages for the pre-shipment leakage rate test unless the alternative pre-shipment leakage rate acceptance criterion In Note 3 of Table 8.1.1 applies.

The applicant needs to explain why ANSI N14.5 test types A.5.1 and A.5.2 do apply to the NFW packages for the pre-shipment leakage rate test unless the alternative pre-shipment leakage rate acceptance criterion In Note 3 of SAR Table 8.1.1 applies.

This information is required to determine compliance with 10 CFR 71.43(f) and 71.51.

Chapter 5 – Shielding Evaluation

5-1 Justify the approach for determining allowable fuel assemblies within the HI-STAR 80.

In discussing allowable fuel assemblies, Appendix 7.D states: *"… the fuel assembly may differ from any other dimension and specification, including specifications in the notes, listed in Table 7.D.2 for PWR fuel and Table 7.D.3 for BWR fuel."* It appears as though as long as the array size, e.g. 15x15, 10x10, etc., is the same that the allowable fuel assemblies can vary by any parameter.

The staff does not have enough information to determine that this approach is conservative with respect to meeting external dose rate limits for both NCT and HAC. For example, if the fuel mass is greater than assumed in the analysis, it will produce a higher source term. The applicant needs to provide additional information clarifying the approach and justify it ensures that all potential assemblies still meet regulatory dose rate limits.

This information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-2 Discuss the effects on source spectra for assemblies irradiated with burnable poison rod assemblies present.

From the allowable loading tables in Appendix 7.D of the application, it does not appear that there are any restrictions or considerations for fuel burned with burnable poison rod assembly inserts. Based on NUREG/CR-6701, burnable poison rods insertion will affect the spectra and strength of source terms because of the production of extra actinides.

The applicant needs to discuss these effects on the source terms of spent fuel assemblies that have history of burnable poison rods for PWR fuel or control rods blade for BWR fuel during their depletion.

The information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-3 Refer to proprietary enclosure

5-4 Revise, as necessary, the tables within Chapter 5 of the application to clearly show the accumulated contributions to the external dose rates from all factors that increase dose rates within the application.

Within the application the applicant performs evaluations of the effects on external dose rates due to a different configuration, such as high burnup fuel, inclusion of stainless steel rods, and consideration of manufacturing tolerances. The applicant evaluated the effect of each of these factors individually and shows that, with each configuration, the HI-STAR 80 package still meets regulatory dose rate limits.

However it is not clear to the staff if the accumulated changes are being applied to all possible fuel configurations (burnup, enrichment cooling time, etc.), a limited subset, or the same fuel configurations that are being reported as the limiting configurations in Tables 5.1.1 through 5.1.8 of the application. It is not clear that these are the limiting configurations. It is also not clear if the applicant considered the increase in dose rates due to the combination of these effects (i.e. high burnup fuel, with steel rods at minimum tolerances).

The staff requests that the applicant discuss and justify that the configurations used to evaluate these studies are the limiting conditions. The applicant also needs to demonstrate that the combined combination of all effects still meet regulatory dose rate limits. For example, Table 5.1.7 of the application states that the maximum calculated hypothetical accident condition dose rate is 9.8 mSv/hr, and Tables 5.1.3 and 5.1.4 state that the maximum calculated normal conditions of transport dose rate at 2 meters from the vehicle is 0.092 mSv/hr. It is not clear that once the increase in dose rates discussed above is included that the HI-STAR 80 still meets regulatory dose rate limits.

The information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-5 Clarify if non-fuel hardware is allowed and provide associated shielding analyses as necessary.

Note 5 to Table 7.D.1 (F-12P) and Note 4 to Table 7.D.1 (F-32B) states: *"When complying with the maximum decay heat units in any basket cell location, decay heat from both the fuel assembly and any non-fuel hardware must be accounted, as applicable for the particular basket cell, to ensure the decay heat emitted by all contents in a basket cell does not exceed the limit."* However, the definition for allowable content in Appendix 7.D does not specify transport of non-fuel hardware within assemblies, nor is this considered within the external dose rate evaluations of the package.

The applicant needs to clarify what is included as "non-fuel hardware" and provide the necessary shielding analyses as well as allowable burnup and cooling times to demonstrate that inclusion of non-fuel hardware does not cause external dose rate under both NCT and HAC to exceed regulatory limits.

The information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-6 Revise Appendix 7.D to include decay heat from control rods or discuss how a user specifically includes this contribution to decay heat in determining the allowable contents.

The staff notes that the applicant calculated decay heat associated with activated control rod cladding and presented this information in Table 5.1.15 of the application (See RAI 5-5). However this table is not referenced in Appendix 7.D of the application. The applicant needs to discuss how the user calculates decay heat for non-fuel hardware and control rods in determining whether thermal limits are met.

The information is required to determine compliance with 10 CFR 71.43(g).

5-7 State if solid steel rods were included in the modeling of the fuel assembly 17x17 and update the analysis if necessary.

Table 7.D.2 of the application states for fuel assembly 17x17S1 that it can have 25 guide tubes but Note 2 says that it *"may include solid steel rods instead of guide tubes."* The applicant needs to discuss how it determined that regulatory dose rate limits for both NCT and HAC are met considering the additional Co-60 source from the steel rods.

The information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-8 Clarify the assumptions used in determining control rod activation.

Pertaining to the analysis for control rod activation, provide the following information:

a) Clarify the assumption on control rod activation with respect to insertion. Page 5.2-3 in Section 5.2.3 of the application states that: *"At full power, the control rods are assumed to operate in a fully withdrawn position with respect to the active fuel region."* It is not clear to the staff if this is an analysis assumption. Because

assuming control rods fully withdrawn is not a conservative assumption, if this is the assumption used, the applicant needs to justify this assumption or include loading restrictions in Note 1 of Table 7.D.1 of the application to reflect that control rods inserted by any amount for any duration are not allowed for shipment.

b) The control rod source described in Table 5.2.15 of the application only shows the source and decay heat in terms of Co-60 from the stainless steel cladding. Note 1 of Table 7.D.1 of the application does not restrict control rod material; therefore, the applicant also needs to address non Ag-In-Cd control rods, such as the source from Hafnium rods, that could potentially be shipped, or restrict the allowable control rod materials in Note 1 of Table 7.D.1 of the application accordingly.

The information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-9 Refer to proprietary enclosure

5-10 Clarify the contents of the Non-Fuel Waste Basket (NFWB).

Table 7.D.7 of the application lists the allowable contents for the Core Component Cassette for the NFWB. The staff finds the description of allowable contents ambiguous and requests that the applicant add specific details of what, specifically, can be transported in this basket. Currently the description states: *"Core components such as fuel channels, transition pieces, spacer grids, control rods, neutron monitors, and burnable absorbers and meeting the following specifications."* Use of the language "such as" makes this description ambiguous and can lead to misinterpretation of what is allowed.

The staff requests that the applicant be specific on what components can be shipped and/or provide a loading procedure that informs package users of the allowable properties of contents including material, density, geometry, source and source distribution. For items such as "neutron monitors," the applicant should be specific and discuss what type of monitor/detector; for example: fission chamber, BF_3 tubes, or He-3 detector. The applicant should discuss whether these detectors are intact or damaged and whether there is any potential release of gaseous fission products or helium.

The information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-11 Discuss how activity that is not from Co-60 is accounted for in the non-fuel waste basket content (NFWB-1).

Section 5.2.4 of the application contains a list of nuclides from core components for the NFWB-1. However this list is not reflected in Appendix 7.D as allowable nuclides. Based on the list of core components, the applicant should also discuss the presence of crud and surface contamination.

The staff requests that the applicant states which nuclides are allowed for transport and how each one is limited. Table 7.D.7 of the application only contains limits for Co-60.

The applicant needs to discuss how activity from other nuclides are accounted for in a mixed source.

The staff also notes that Table 7.D.7 Section I.A.1.f of the application contains a limit for Type A quantity. The applicant needs to discuss the purpose of this limit as the staff does not know what this limit is for, but the staff notes if it is intended to cover other non-Co-60 nuclides that the staff does not accept multiples of A2 quantities as an appropriate means to limit allowable quantities as discussed in NRC RIS-2013-04.

This information is required to determine compliance with 10 CFR 71.47(b) and 71.51(a)(2).

5-12 Refer to proprietary enclosure

5-13 Demonstrate that the burned impact limiter steel shell can support the weight of the package without being crushed under hypothetical accident conditions (HAC) and recalculate the dose rates as necessary.

Section 5.1.2.2 of the application states: "*Conservatively, the shielding analysis of the hypothetical accident condition for the design basis fire assumes the neutron shield is completely lost and the impact limiters steel backbone is only present.*" The staff did not locate the appropriate structural analyses to support this conclusion. As assumed in the applicant's analyses, a thermal test, as prescribed in 10 CFR 71.73(b)(4), will burn all the wooden material inside the impact limiters, leaving only the stainless skin of the impact limiter. The applicant needs to demonstrate that the impact limiter steel shell (without the crush material) can support the weight of the package without being crushed under HAC or recalculate the dose rates from the location of the crushed surface.

The information is required to determine compliance with 10 CFR 71.51(a)(2).

5-14 Discuss the effects of the puncture HAC event on external dose rates.

The staff did not locate any discussion in Chapter 5 of the application on radiation attenuation effects due to the puncture event. The staff is aware that this produced local effects to the cask surface that are likely to be averaged out at the 1 meter dose rate location. The staff has accepted this explanation for the HI-STAR 190 package where there is a larger margin to HAC external dose rate limits; however, for the HI-STAR 80 package, the staff notes that there is very little margin to the limit for HAC. Table 5.1.7 of the application states that the calculated HAC dose rate is as high as 9.8 mSv/hr. This is only a 2% margin to the limit. The applicant needs to demonstrate that consideration of the puncture event at a 1 meter location directly across from the puncture does not cause external dose rates to increase beyond regulatory limits.

The information is required to determine compliance with 10 CFR 71.51(a)(2).

5-15 Justify the assumptions with respect to lead slump within the HAC external dose rate evaluations.

The maximum axial and radial lead slump values in Table 2.7.4 of the application are not consistent with those reported in Table 5.3.7 of the application. The applicant needs to

discuss the lead slump assumptions within the evaluation of external dose rates under HAC and justify that the amount of slump assumed is appropriate or conservative.

The information is required to determine compliance with 10 CFR 71.51(a)(2).

5-16 Refer to proprietary enclosure.

5-17 Refer to proprietary enclosure.

5-18 Refer to proprietary enclosure.

5-19 Refer to proprietary enclosure.

5-20 Refer to proprietary enclosure.

5-21 Refer to proprietary enclosure.

5-22 Refer to proprietary enclosure.

5-23 Refer to proprietary enclosure.

5-24 Refer to proprietary enclosure.

5-25 Refer to proprietary enclosure.

Chapter 6 – Criticality Evaluation

6-1 Clarify the intended contents of the package, i.e., spent fuel or fresh fuel or both.

The applicant states on page 6.1-1: “The following fuel basket designs are available for use in the HI-STAR 80, as specified in Table 7.D.1:

- a 12-cell basket (F-12P), designed for fresh or spent undamaged PWR UO2 fuel assemblies with a specified maximum enrichment. Fresh or spent fuel assemblies are stored in all 12 cells of the basket, or 10 cells with locations 4 and 9 empty, or 10 cells with locations 5 and 8 empty;

- a 32-cell basket (F-32B), designed for fresh or spent undamaged BWR UO2 fuel assemblies with a specified maximum enrichment and fresh or spent undamaged BWR MOX fuel assemblies with a specified composition. Fresh or spent fuel assemblies are stored in all 32 cells of the basket, or 28 cells with locations 13, 14, 19, and 20 empty, or 24 cells with locations 12, 13, 14, 15, 18, 19, 20 and 21 empty, or 24 cells with locations 7, 8, 13, 14, 19, 20, 25 and 26 empty.”

However, the proposed CoC appears to indicate that only spent fuel and non-fuel waste are the intended contents; fresh fuel is not the intended content. The applicant needs to clarify the intended content for this packaging design.

This information is required to determine compliance with 10 CFR 71.55(b), 71.55(d), 71.55(e), and 71.59(a).

6-2 Clarify the significance of the fuel name extension in the allowable spent fuel types.

In Tables 6.1.2, 6.1.3, 7.D.2, and 7.D.3 of the SAR, the applicant identifies the allowable fuel assemblies with extension "S", e.g., 15x15S, 17x17S, 8x8S, etc. However, it is not clear whether the extension "S" has any special meaning because this is not a typical definition of fuel assembly types. The applicant needs to clarify the meaning of the fuel type extension "S".

This information is required to determine compliance with 10 CFR 71.55(b), 71.55(d), 71.55(e), and 71.59(a).

6-3 Provide criticality safety analyses for the fuel assembly designs as defined in Figure 6.B.7.

Figure 6.B.7 of the application shows that some BWR fuel assembly designs include a mixed load of MOX and UO_2 rods in the same fuel assembly. However, the application does not seem to include information on criticality safety analyses for a package with this type of content. The applicant needs to provide criticality safety analyses for the HI-STAR 80 package containing this type of fuel assemblies or provide a justification for how this type of mixed load assembly is bounded in an existing criticality safety analyses.

This information is required to determine compliance with 10 CFR 71.55(b), 71.55(d), 71.55(e), and 71.59(a).

6-4 Provide code benchmarking analyses to determine the bias and bias uncertainty of the MCNP code for performing criticality analyses for package containing fuel assembly designs as defined in Figure 6.B.7.

Figure 6.B.7 of the application shows that some BWR fuel assembly designs include a mixed load of MOX and UO_2 rods in a single fuel assembly. However, it is not clear if the code used for criticality safety analyses has been benchmarked for this type of fuel assembly designs.

The applicant needs to perform appropriate code benchmarking analyses to determine the bias and uncertainty of the MCNP code for performing criticality analyses for package with this type of payload. The applicant also needs to include information on the selected critical experiments for the code benchmark analyses and justify that the selected experiments are appropriate for this fuel configurations.

This information is required to determine compliance with 10 CFR 71.55(b), 71.55(d), 71.55(e), and 71.59(a).

6-5 Refer to proprietary enclosure.

6-6 Refer to proprietary enclosure.