Response to NRC Request for Supplemental Information
Holtec International
Docket No. 71-9325
HI-STAR 180 Transportation Package

1- GENERAL INFORMATION

NRC RAI 1-1

1-1 Provide the American National Standard Institute (ANSI) N14.5-2014 definition of leaktight on Page G-4 of the application.

On Page G-4 of G-9 of the application, the definition of leaktight does not match the definition of leaktight in ANSI N14.5-2014.

This information is needed to determine compliance with Title 10 of the Code of Federal Regulations 10 CFR 71.51(a)(1) and (2).

Holtec Response to RAI 1-1:

The definition of “Leaktight”, in the Glossary and Notation section of the HI-STAR 180 Transport SAR, has been revised to reflect the definition of Leaktight in ANSI N14.5-2014. Furthermore, for the purposes of completeness, a note has been appended to the definition of Leaktight to reflect the ANSI N14.5-2014 definitions of “Reference Cubic Centimeter per Second” and “Reference Air Leakage Rate”. All proposed changes are reflected in Revision 7.B of the HI-STAR 180 Transport SAR provided with this response.

2- STRUCTURAL AND MATERIALS EVALUATION

NRC RAI 2-1

2-1 Explain and justify (i) the technical basis for taking an exception to ASME Code Section II for an option not to meet the required Charpy absorbed energy for the dose blocker steels in Table 2.1.10A of the application, (ii) the use of a full-penetration quality factor for the partial-penetration fuel basket friction stir welds, and (iii) why these welds were reclassified from non-important to safety (NITS) to important to safety (ITS).

The applicant made changes regarding the Fracture Toughness Test Criteria (Dose Blocker Steel Parts, Table 2.1.10A) and removed the requirement for the measurement of the Charpy absorbed energy. Such changes are not consistent with the requirements of ASME B&PV Code Section II. Furthermore, the applicant did not provide any justification for such a change to allow for an option to measure the Charpy lateral

expansion in Table 2.1.14, “ASME Code Requirements and Alternatives for the HI-STAR 180 Package.”

In addition, while the staff has approved full penetration for Friction Stir Welds (FSW), the applicant is now using welds that provide less than a full penetration. The reasons for the change from full-penetration to partial penetration, as well as the possible identification of functions to cause the safety designation to change from NITS to ITS are unclear for the staff.

The applicant needs to explain the reasons for such changes, as well as provide the proper rationales and detailed justifications of those changes.

This information is needed to determine compliance with 10 CFR 71.31(c).

Holtec Response to RAI 2-1:

The dose blocker parts identified in Table 2.1.10A of the HI-STAR 180 Transport SAR are used to reduce gamma radiation levels around the cask to comply with regulatory limits and ALARA. They do not form any part of the pressure boundary used for containment of the spent fuel assemblies. The two materials in the table that have impact testing requirements under Section II of the code, SA-352-LCC and SA-350-LF2, are defined in Section II as “Specification for Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low Temperature Service” and “Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components” respectively. Both of these materials are normally used as pressure retaining material, but in this application they are selected to provide a shielding function due to their low temperature fracture toughness properties. Because the parts perform a shielding function, Holtec has applied the requirements of ASME Section III, Subsection NF for the brittle fracture testing and is not relying on the Section II testing requirements applicable to pressure retaining parts. In addition, Subsection 7.2.1 of the SA-350 material specification allows an exception to the test requirement for testing at a different temperature provided that the test temperature is at least as low as the intended service temperature, which is true in this application. The Specification for SA-352 material notes in Section 1.2 that the -50F temperature shown is the usual minimum testing temperature at which the material is expected to pass the impact requirements and is the basis for the test temperature. The specification notes that it does not guarantee that the material is suitable for a particular application. Thus, the brittle fracture testing required by Section III, Subsection NF of the Code is a more appropriate criteria for dose blocker parts. As a result, per the requirements of paragraph NF-2331 the fracture toughness of the material may be demonstrated on the basis of Charpy absorbed energy or Charpy lateral expansion values. Table 2.1.14 has been revised to include an exception for the requirement to test SA-352-LCC and SA-350-LF2 material to the Section II requirements for Impact Testing.

As part of the initial submittal of the license amendment request (LAR 9325-3), the friction stir welds used for the basket were changed from essentially full penetration welds (with full penetration weld symbol) to a partial penetration weld at approximately 85% of the panel thickness (specified as a 12.7 mm min. weld) to prevent the flow of Metamic HT material into the cell opening while welding the cell panels. When performing a FSW, a portion of the material being mixed at the weld joint tends to project out past the tool depth and when using a tool sized to fully penetrate the panel, a portion of the mixed material tends to flow out past the opposite side of the panel and into the cell openings, creating the potential for the fuel assembly to get

caught if the weld is not ground back flush. Using a tool with a depth equal to 85% of the panel thickness assures that the weld depth is between 85% and 100% of the panel thickness and the resulting weld strength is proportional to the weld depth. When making a weld using a traditional arc welding process, the weld depth is not always equal to the depth of the weld preparation as the tight opening at the bottom sometimes causes the arc to not penetrate the full depth of the weld preparation and leaving a small, unwelded connection at the bottom of the groove which is not detectable with surface NDE processes such as visual and liquid penetrant/magnetic particle testing. Thus, a lower weld quality factor is given for partial penetration welds in Table NG-3352-1 of the ASME Code when performing analysis. In contrast, the FSW process results in a fully formed weld which slightly exceeds the tool depth, and thus we utilize the weld quality factor for a Type III full penetration weld per Table NG-3352-1 together with an effective weld size equal to the minimum FSW tool depth (i.e., 12.7 mm) as indicated on the drawings. SAR Subsection 2.3.1 and SAR Subsection 8.1.2 have been revised to update the fuel basket weld category from C to E to reflect the weld location more accurately. The basket corner weld configuration is more akin to a Category E joint, which according to NG-3351.5 are for joints at the ends of webs of beams, whereas Category C joints, according to NG-3351.3, are primarily for joining flanges to cylinders. Nevertheless, the weld quality factors as specified in Table NG-3352-1 and applied in the structural evaluation of the HI-STAR 180, are unaffected by the proposed change. Other enhancements have also been made to Subsection 2.3.1.

With respect to the reviewer's question on the change of weld classification from NITS to ITS, Holtec is not aware of such a change on the basket drawings. The corner welds remain as ITS in this application. The welds that retain the end panels during assembly of the basket remain as NITS welds. Nonetheless, to avoid any potential confusion Note 17 on Licensing Drawing 4847 has been revised to eliminate the following statement (which appeared in Rev. 8): "WELDS ARE SECONDARY STRUCTURAL FEATURES AS THEY ARE NOT CRITICAL TO THE SAFETY FUNCTION DURING STORAGE AND TRANSPORT OPERATIONS." The processes used to fabricate and examine the basket corner FSWs are the same across all Metamic-HT fuel baskets licensed by Holtec under 10CFR71.

All proposed SAR changes are reflected in Revision 7.B of the HI-STAR 180 Transport SAR and associated licensing drawing package provided with this response.

NRC RAI 2-2

2-2 Clarify the set pressure of the neutron shielding pressure relief devices in the licensing drawings.

Holtec Licensing Drawing 4845, "HI-STAR 180 Cask," contains a revision to Note 17 which states that (i) the maximum set pressure of the neutron shielding pressure relief devices is 35 psig and (ii) the set pressures of the devices will be lower if needed to avoid overstressing neutron shielding cover plates. Drawing Note 17 provides no indication of how a lower set pressures would be determined.

Calculation 27 of Structural Calculation Package HI-2063552, Rev. 15, shows that the pressure limit for the Holtite enclosure space in the inner closure lid assembly would be overstressed if pressures where allowed to reach 35 psig. The drawing note should more specifically identify the set pressures for the neutron shielding pressure relief devices.

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

Holtec Response to RAI 2-2:

Pressure limits for cask cavities containing neutron shielding have been added to the licensing drawing, and these pressure limits are bounded by the allowable pressures determined in Calculation 27 of Structural Calculation Package HI-2063552. Flag Note 17 on Holtec Licensing Drawing 4845, "HI-STAR 180 Cask" has been updated to state clearly each neutron shielding location and the maximum allowable pressure relief setpoint. All proposed changes are reflected in Revision 7.B of the HI-STAR 180 Transport SAR and associated drawing package provided with this response.

NRC RAI 2-3

2-3 Provide, in Licensing Drawing 4845, the material options for the following components: Fuel Impact Attenuator, Outer Closure Lid Access Port Plug Seal, Outer Closure Lid Access Port Cover Seal, Outer Closure Lid Inter-Seal Test Port Plug Seal, Outer Closure Lid Outer Seal, Outer Closure Lid Inner Seal, Inner Closure Lid Inter-Seal Test Port Plug Seal, Inner Closure Lid Outer Seal, and Inner Closure Lid Outer Seal.

These components reference either Drawing Note 41 or Drawing Note 43 in place of listed material options. However, in the latest revision to Licensing Drawing 4845, Drawing Note 43 has been deleted. Also, Drawing Note 41 has been revised to remove the material options and refers solely to an appendix and table in the application.

These material options need to be explicitly listed in the drawing package. The drawings tie down the design of the packaging and, as such, notes to the drawings are to be explicit and detailed in full.

This information is needed to determine compliance with 10 CFR 71.33.

Holtec Response to RAI 2-3:

Per proposed change PC-26 in the Summary of Proposed Changes that was included with the initial submittal of LAR 9325-3, Fuel Impact Attenuators are now interchangeable with fuel spacers. Drawing note 43 was deleted as a result of this change. Holtec has identified the materials of construction for the fuel impact attenuators in the drawing bill of materials on sheet 7. The materials of construction for this item shall be stainless steel. Drawing 4845 has been revised to reflect this change as well as remove the remaining reference to note 43.

The materials of construction for the seals listed in this RAI may vary amongst several options, depending on the seal used. In the previous revision of drawing 4845, all materials were listed in note 41, which duplicated information from Appendix 4.A. These materials were removed from note 41 to avoid the unnecessary duplicate reference. As materials are considered critical characteristics, they are included in tables 4.A-1 thru 4.A-4, per revised note 41 of the Drawing 4845.

NRC RAI 2-4

2-4 Clarify the difference between the maximum loaded quiver weight of 375 kg, specified in Table 2.2.14 of the application, and the maximum allowable loaded quiver weight of 500 kg, specified in Table 1.2.3a of the application.

Section 2.7.1, "9-meter Free Drop," states that drop simulations are not needed for inclusion of the Quiver, because the analyzed fuel assemblies have similar weights to the loaded Quiver. It is necessary to clarify the weight of the Quiver that would experience this free drop.

This information is needed to determine compliance with 10 CFR 71.33 and 71.73.

Holtec Response to RAI 2-4:

Table 1.2.3a specifies the weight limit of a loaded quiver to be same as the bounding weight of loaded fuel assemblies (i.e., 500 kgs) for the purposes of the qualification of the cask and basket. The actual loaded quiver weight design specification, as noted in Figure 1.2.5, is defined in Table 2.2.14 to be 375 kgs, which satisfies the weight limit requirement in Table 1.2.3a. Since only one or two of the 32 or 37 basket cells could be loaded with quivers, the 9-meter free drop analysis results obtained for the HI-STAR 180 package would not be affected by the very small package weight change resulting from replacing two fuel assemblies with two quivers. The quiver is expected to experience the same deceleration as the fuel assembly in HI-STAR 180 cask in a free drop accident and is independently qualified to the g-load limits specified in Table 2.2.14 per the design described in reference [1.2.34].

NRC RAI 2-5

2-5 Provide the structural design information for the proposed Quiver damaged fuel container.

Quivers are classified as ITS. Section 2.1.2.2, "Acceptance Criteria," of the application states that the structural design data of the Quiver is summarized in Table 2.2.14, "Structural Capacity Data on the Quiver." Section 2.1.2.2 also states that the loading limits, maximum axial deceleration, and maximum lateral deceleration sustained by the Quiver must remain below the design limits in Table 2.2.14. However, Table 2.2.14 simply lists the heights of the free drop conditions required by 10 CFR 71.71(c)(7) and 71.73(c)(1).

Details of the structural design, including the structural capacity of Quivers, are needed to ensure that the use of Quivers in the HI-STAR 180 Cask System meets the regulatory requirements.

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

Holtec Response to RAI 2-5:

The structural capacity of the Westinghouse 14x14 LTS PWR Quiver is calculated in Section 4.9 of the Westinghouse design document titled "Structural Verification of 14x14 LTS PWR Quiver Design", which is provided along with this response and is also listed as a newly added reference (i.e., reference [2.2.10]) in Chapter 2 of the revised SAR. Specifically, the quiver structural capacity calculation demonstrates significant safety margins against the maximum axial and horizontal deceleration limits (100 g's) listed in Table 2.2.14 of the HI-STAR 180 SAR. All proposed SAR changes are reflected in Revision 7.B of the HI-STAR 180 Transport SAR. More information on the design and loading sequence for the Quiver is provided in Holtec's response to RAI 2-8.

NRC RAI 2-6

2-6 Justify the classification of FSW, along the length of the exterior corners of HI-STAR 180 fuel baskets, as full penetration corner welds.

Calculation 17, the basket weld calculation, of Holtec Report No. HI-2063552, "Calculation Package for the HI-STAR 180 Transportation Cask System," uses a weld quality factor taken from Table NG-3352-1 of the ASME Boiler & Pressure Vessel Code, Section III, Subsection NG. As stated in the calculation, this weld quality factor is associated with Type III full penetration welded joints.

However, these FSWs are not full penetration welds. As noted by the applicant in the report, "Summary of Proposed Changes HI-STAR 180 Transport LAR 9325-3, Revision 0," and Licensing Drawings 4847 and 4848, these FSWs have a weld size less than the basket panel fitness[LH1].

Section 2.3.1 states that these welds are "incorporated in the basket's design, included in the structural finite element evaluations, and specified as structural welds in the drawing package." Further justification is needed for classifying the welds as full penetration welds and the use of the associated weld quality factor.

This information is needed to determine compliance with 10 CFR 71.31.

Holtec Response to RAI 2-6:

See the response to RAI 2-1 for justification as to why the FSWs located at the basket corners are treated as Type III full penetration welds with respect to the weld quality factors given in Table NG-3352-1 of the ASME Code. Calculation 17 in Holtec Report HI-2063552 has been revised to include similar justification. The calculation has also been amended to show that, even if the FSWs were conservatively treated as single groove welds for the purpose of Table NG-3352-1, the calculated safety factor would remain above 1.0.

NRC RAI 2-7

2-7 Justify the removal of the weld between the Bottom Ring Forging and the Monolithic Shield Cylinder in Licensing Drawing 4845.

The applicant states in the report, "Summary of Proposed Changes HI-STAR 180 Transport LAR 9325-3, Revision 0," that "sufficient structural support" is provided by a separate weld between the Monolithic Shield Cylinder and the Containment Baseplate.

However, there is no further information to support this statement in any section of the application, any structural calculation report, or in the licensing drawings. Further justification is needed to remove this basket weld from licensing drawing 4845.

This information is needed to determine compliance with 10 CFR 71.31.

Holtec Response to RAI 2-7:

The weld which was removed from Licensing Drawing 4845 was between the bottom Monolithic Shield Cylinder and the Bottom Ring Forging. The structure is still supported by welds between the bottom Monolithic Shield Cylinder, Containment Baseplate, Bottom Ring Forging, and Monolithic Shield Cylinder Bottom Cap. The welds between these components are credited in structural analyses of the cask. The weld which was removed from the licensing drawing was not credited in any structural analysis, and was removed due to potential practical difficulties in making such a weld as described in the proposed change PC-17 in the Summary of Proposed Changes that was included with the initial submittal of LAR 9325-3.

NRC RAI 2-8

2-8 Provide the method and confirmation methodology used for sealing the quiver.

The Quiver is a type of damaged fuel container for individual fuel rods which have been removed from their assemblies. For example, fuel debris are loaded into Quivers. The Quiver maintains its contents (fuel rods) in an inert (helium filled) environment, thus precluding the risk of in-service corrosion of its contents, according to page 1.2-20 of the application.

However, the applicant did not explain or justify how an inert environment is maintained in a Quiver in order to avoid corrosion. The staff needs to review both the methods and confirmation methodologies for sealing a Quiver.

This information is needed to determine compliance with 10 CFR 71.31(b) and 71.31(c).

Holtec Response to RAI 2-8:

The quivers consist of a rectangular body cavity and bolted on lid. Fuel rods and fuel debris are loaded into the quiver with the lid removed. After the contents are loaded, the lid and lid seals are installed and the lid is bolted tight. The lid includes two valve connections for attaching process fittings to drain, dry, and backfill the interior of the quiver. After the process fittings are attached to the lid, an inert gas is used to force water out of the drain connection. When the bulk water is removed, a vacuum pump is introduced to evacuate any remaining liquid water.

The acceptance criteria for drying the quiver are the same as that for drying the cask cavity (see Table 7.1.2 of the HI-STAR 180 Transport SAR). Following confirmation of quiver dryness, helium is introduced into the quiver and the pressure is adjusted per the requirements for the Cask Cavity Space (see Table 7.1.4). All quiver operational requirements are presented in Table 7.1.5. Additionally, the backfill pressure range listed in Table 7.1.5 has been revised to show the pressure range in absolute pressure to match Table 7.1.4. Following backfill, the process connections are removed and the port connections on the quiver are closed such that the quiver cavity remains isolated until the quiver is loaded into the cask and the cask is drained, dried and backfilled.

8- ACCEPTANCE TESTS AND MAINTENANCE

NRC RAI 8-1

8-1 Clarify Sections 8.1.4 and 8.2.2 of the application to specify an American Society for Nondestructive Testing (ASNT) nondestructive testing (NDT) Level III in leak testing.

An ASNT NDT Level III specifically in leak testing, should write and approve the detailed leakage rate testing procedures for each package. Personnel trained to ASNT NDT Level III in leak testing have gained knowledge and experience of complex issues, and are able to review a leak test procedure to verify the procedure adequately detects leaks to the level intended by the requirements of NRC regulations.

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

Holtec Response to RAI 8-1:

Subsection 8.1.4 and Subsection 8.2.2 of the HI-STAR 180 Transport SAR have been revised to clearly state that “Leakage rate testing procedures shall be approved by an American Society for Nondestructive Testing (ASNT) Level III specialist in leak testing for the nondestructive method(s) of leak testing for which the procedures are written”. In addition, the edition of SNT-TC-1A in reference [8.1.2] has been revised from “2006” to “2006 (or subsequent revisions)”. The proposed changes are reflected in Revision 7.B of the HI-STAR 180 Transport SAR provided with this response.

NRC RAI 8-2

8-2 Provide justification for, or alternatively revise the factor of 1.86 in Note 1 of Table 8.1.1 of the application.

Based on Section B.15.13, “Example 13,” of ANSI N14.5-2014, for 1.0×10^{-7} ref-cm^3/s, air, the equivalent helium leakage rate at the same reference conditions is 1.85×10^{-7} atm-cm^3/s, helium, rather than 1.86×10^{-7} atm-cm^3/s, helium.

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

Holtec Response to RAI 8-2:

Note 1 of Table 8.1.1 of the HI-STAR 180 Transport SAR has been revised to reflect a conversion factor of 1.85 consistent with ANSI N14.5-2014. The proposed change is reflected in Revision 7.B of the HI-STAR 180 Transport SAR provided with this response.

NRC RAI 8-3

8-3 Remove the following two paragraphs from Chapters 7 and 8, respectively, of the application.

"The text matter and data presented in this chapter in bold font (or as otherwise noted) are an integral part of the Certificate of Compliance (CoC) of the package and cannot be altered without NRC's approval through a license amendment. Moreover, essential elements and criteria in Section 7.0 through Section 7.3, essential elements and criteria in Appendix 7.A and the whole of Appendix 7.D have been identified as conditions of the CoC."

"The text matter and data presented in this chapter in bold font (or as otherwise noted) are an integral part of the Certificate of Compliance (CoC) of the package and cannot be altered without NRC's approval through a license amendment. Moreover, essential elements of the acceptance tests In Section 8.1 and of the maintenance program in Section 8.2 have been identified as conditions of the CoC."

The above two paragraphs are inconsistent with Condition 6 of the CoC that states: *"In addition to the requirements of Subpart G of 10 CFR Part 71:*

(a) The package shall be prepared for shipment and operated in accordance with Chapter 7 of the application.
(b) The package shall meet the acceptance tests and be maintained in accordance with Chapter 8 of the application."

Therefore, based on Condition No. 6 of the CoC, any change to Chapters 7 or 8 of the application necessitates NRC staff's approval.

This information is needed to determine compliance with 10 CFR 71 Subpart G and Condition No. 6 of the CoC.

Holtec Response to RAI 8-3:

The statements noted by NRC staff to be removed from Chapters 7 and 8 have been removed. In addition, bold text associated with these statements is no longer used and other markings associated with these statements have been removed. All proposed changes are reflected in Revision 7.B of the HI-STAR 180 Transport SAR provided with this response.

ADDITIONAL MINOR CLARIFICATIONS TO THE APPLICATION:

1) Table 4.A-1 “Inner Lid Seals” has been revised to correct the tolerance value for Seal Option 2 for the seal property Inner Seal Seal OD “ODs”. The value of +/- 0.025 mm has been corrected to +/- 0.25 mm. The value of +/- 0.010 inches has been confirmed to be correct.
2) SAR Table 8.1.4 “Tier System for Metamic-HT Production Coupon Testing” has been revised to enhance the explanation of the tier system and the use of the table. No technical changes have been made.
3) Note 1 in SAR Table 2.1.10 “Fracture Toughness Test Criteria: Containment System” has been revised in to allow the use of subsequent editions of ASTM E208-87a, since some vendors can no longer certify to the 87a edition and NRC periodic reviews of Reg Guides 7.11 and 7.12 as recent as 2016 concluded that the 2006 and 2012 editions of ASTM E208-87a do not affect the implementation of these Reg Guides. Due to the well-established nature of ASTM E208, it is foreseen that future revisions of ASTM E208 will not have material impact on these Reg Guides or ultimately a safety impact on the HI-STAR 180 package.
4) Editorial change to Subsection 8.1.2, item 3, where the reference to NITS welds in the last sentence of the paragraph is deleted in order to match the basket licensing drawing identification of these welds as Non-Structural welds.

The above additional minor clarifications are reflected in Revision 7.B of the HI-STAR 180 Transport SAR.