Holtec Response to Request for Supplemental Information

Docket No. 72-1032
Holtec International
HI-STORM FW
Multipurpose Canister Storage System
Certificate of Compliance No. 1032
Amendment No. 7

Thermal RSI

4-1 Provide dimensions (e.g., thickness) for the unventilated overpack components (as indicated below) depicted on the Licensing Drawing No. 11897 of the proposed Final Safety Analysis Report (FSAR).

Staff reviewed the Licensing Drawing No. 11897 (Sheets #1 and #2) of the proposed FSAR and found that the dimensions (e.g., thicknesses) of HI-STORM FW lifting rib plate (item 3), full depth rib plate (item 9), RIB-I plate (item 12), and RIB-II plate (item 13) are missing on the drawing. The applicant should provide the dimensions of these unventilated overpack components depicted on the licensing drawings for verification that the dimensions relied on by the thermal analyses are consistent with the design drawings.

The staff needs this information to determine compliance with 10 CFR 72.236(b) and (f).

Holtec RSI Response:

The dimensions of the aforementioned items are documented in the Critical Dimension Report HI-2200095 and, therefore, are not provided in Drawing 11897. This document was submitted as Attachment 10 to Enclosures in Holtec Letter 5018083.

Confinement RSI

9-1 Demonstrate that Proposed Change #2 will reasonably maintain confinement of radioactive material under normal, off-normal, and credible accident conditions.

In its Statement of Proposed Changes, the applicant proposed to modify vent and drain penetrations to include the option of second port cover plate. The applicant also stated that the addition of a second cover plate for these penetrations removes the need to do field helium leak testing of these cover plates.

The weld on the port cover plate cannot have been executed under conditions where the root pass might have been subjected to pressurization from the helium fill in the canister itself. When executing vent and drain connection cover plate welds, one should not assume that the fill and drain closure valves quick-disconnects, or similar, are leak tight without performing helium leak testing. It is assumed that mechanical closure devices (e.g., a valve or quick-disconnect) permit helium leaks. Field experience has shown that such leaks occur and have been responsible for causing leak paths through the weld. Consequently, welds potentially subjected to helium pressure (by way of leakage through a mechanical closure device) during the welding process must be subsequently helium leakage tested in accordance with the method in ANSI N14.5. In addition, ANSI N14.5 does not allow for the elimination of leakage rate testing based on the use of multiple barriers.

This information is required to satisfy 10 CFR 72.236(d), (j), and (l).

Holtec RSI Response:

Holtec concurs with the Staff that mechanical closures such as valves and quick connect fittings may not provide definitive closure against the leakage of helium required to make a leak-tight closure weld. To guard against this vulnerability and to prevent leakage of helium, Holtec employs an engineered device known as the Remote Valve Operating Assembly (RVOA) that uses a metallic (impermeable) seal ring to establish a high integrity "mechanical seal" whose sole purpose is to prevent loss of helium from the MPC while the welding operations are carried out.

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We submit that this two cover-plate confinement system (without crediting the high integrity "mechanical seal on the MPC port connections) fulfills NRC's position in the matter of leak-tightness of confinement welds set forth in ISG-18. Actually, the two welded port cover closures proposed herein emulate the process used in the closure of the Lid to Shell weld system which has historically relied on the same guidance from ISG-18 to eliminate helium leak testing of the MPC loaded with used nuclear fuel.

Therefore, it is logical to conclude that the closure system will provide the required reasonable assurance of confinement of radioactive material under normal, off-normal, and credible accident conditions. Finally, note that both the vent and drain port openings are enclosed by the annular Closure Ring (a mandatory design feature in Holtec's MPCs) which, as a fully qualified "NB" pressure boundary, provides yet another confinement protection.

The main driver for this proposed change is to minimize crew dose during the lid closure work effort where the minor (limited to the port covers) helium test requires deployment of a whole new crew, setting up of the apparatus in a high radiation environment and thus incurring significant additional radiation dose. While deleting the helium test, we have strengthened the existing weld on the first port cover plate and added another port cover plate with multiple weld passes meeting the provisions of ASME Section III Subsection NB.

Observations

OBS 4-1 Provide a description of HI-STORM FW UVH fire in HI-STORM FW FSAR.

For the Proposed Change #5, the use of a computational fluid dynamics (CFD) analysis for the site-specific fire scenario, the applicant provided a description of the HI-TRAC VW fire in the proposed HI-STORM FW FSAR Section 4.6.2.1 and Table 4.6.11, but did not include a description of the UVH fire (fire accident on the unventilated overpack containing MPC) in the HI-STORM FW FSAR.

The staff notes that Section A.6.5 of Report HI-2200191, "Thermal Analysis of HISTORM FW

UVH System," provides a description on the evaluation of the HISTORM FW UVH fire, which could inform a description in the FSAR.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

The description of modeling of UVH fire is discussed in Section 4.I.6.2 of Supplement 4.I. A callback to HI-2200191 has been added to the section. Table 4.I.6.4 has been added to Supplement 4.I to detail the steps to model site-specific fire events, similar to the description of methodology for site-specific HI-TRAC VW fire evaluation in Chapter 4 of the FSAR.

OBS 4-2 Clarify how the thermal conditions of the transfer cask are determined for the cases of the HI-DRIP ancillary cooling system failure during short-term operations.

The applicant stated, in the proposed SAR Section 4.5.7, that the HI-DRIP system has been approved for use with HI-STORM 100 system. However, for HI-STORM FW system, the applicant needs to clarify in the application how the thermal conditions (initial conditions) of the transfer cask are determined and used in the time-to-boil calculation if the plant's water supply system were to fail.

The staff needs this information to verify that adequate time-to-boil values (based on realistic thermal conditions) are determined and properly applied to prevent fuel cladding from exceeding temperature limits.

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

Holtec RSI Response:

In an event the plant's water supply system were to fail, the time-to-boil (TTB) limits shall be calculated by measuring the water temperature inside the MPC similar to that described in FSAR Section 4.5.3.1. The measured MPC water temperature shall be used as the initial temperature to re-evaluate the maximum allowable time duration for fuel to be submerged in water to prevent bulk boiling of water inside the MPC. The re-calculated maximum allowable time may be used as an updated time-to-boil clock. Alternately, a forced water circulation can be initiated and maintained to remove the decay heat from the MPC cavity as described in FSAR Section 4.5.3.3. At the conclusion of forced water circulation, the measured temperature of water in the MPC shall be used to re-calculate the maximum allowable time duration for fuel to be submerged in water and update the time-to-boil clock.

This clarification has been added to Section 4.5.7 of the FSAR.

OBS 4-3 Provide the details of how the cooling water flow rate from HI-DRIP ancillary cooling system is sized, monitored, and/or controlled.

The applicant stated, in the proposed FSAR Section 4.5.7, "HI-DRIP", that the HIDRIP system has been approved for use with HI-STORM 100 system and provided a calculation of heat rejection from the external surface of the cask to the ambient when the MPC water boils. However, given that the transfer cask HI-TRAC VW, used for HI-STORM FW system, is different from the transfer cask models used for HI-STORM 100 system, the applicant needs to clarify the following issues:

a) The cooling water flow rate depends on the rate of heat extraction required and the duration of the short-term operation. The applicant should customize the cooling water flow rate for each storage system.

b) Instead of a fixed heat rejection value from the cask external surface to the ambient, the water temperature variations inside the MPC can be transient (dynamic) and, therefore, may make the heat rejection from the cask external surface be transient as well. Under this circumstance, the applicant should describe how to monitor and/or control the cooling water flow rate from HI-DRIP ancillary cooling system.

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

Holtec RSI Response:

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OBS 4-4 Provide rationales for (a) the use of a heat transfer coefficient of <u>15 BTU/ft2 -hr-°F</u> from the vaporization-aided cask surface in calculation of the heat rejection rate, and (b) initiation of the cooling water drip, <u>no later than 50% of the time into Interval 2</u>, in operation of the HI-DRIP system.

The applicant stated, in Section 4.5.7 of the proposed FSAR, that a heat rejection rate of 291,431 BTU/hour or 85 kW is calculated assuming a heat transfer coefficient of 15 BTU/ft2 -hr-°F from the vaporization-aided cask surface and the cooling water drip should be initiated no later than that 50% of time into Interval 2 (a time period when the MPC, full of water, is out of the pool in an ambient environment). The applicant should explain how these underlined numbers are determined in the analysis and operation of the HI-DRIP system.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

PROPRIETARY INFORMATION WITHHELD IN ACCORDANCE WITH 10CFR2.390

OBS 4-5 Clarify the heat load limits presented in Technical Specifications (TS) Appendix B Table 2.3-7A, Figures 2.3-14 (Loading Pattern 1), and 2.3-15 (Loading Pattern 2) for the MPC-37P stored in a ventilated overpack.

The applicant indicated a maximum heat load of <u>45 kW</u> in TS Appendix B Table 2.3- 7A for MPC-37P stored within a ventilated overpack. Table 2.3-7A refers to TS Appendix B Figure 2.3-14 for heat load limit per cell in Loading Pattern 1 and Figure 2.3-15 for heat load limit per cell in Loading Pattern 2.

The total heat loads for Loading Patterns 1 and 2, by adding the heat load limit per cell, are both <u>49.5 kW</u>, which exceeds the maximum heat load of 45 kW listed in Table 2.3-7A for MPC-37P stored in a ventilated overpack. The applicant should clarify this discrepancy in heat load limits between Table 2.3-7A and Figures 2.3-14 and 2.3-15.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

Staff's observation is correct that the aggregate heat load i.e., summation of decay heat per cell in Figures 2.3-14 and 2.3-15, exceeds the total heat load limit specified in Appendix B Table 2.3-7A. However, there is no discrepancy in the heat load limits between Table 2.3-7A and Figures 2.3-14 and 2.3-15 as explained next.

The certificate holder is required to adhere to all the requirements specified in Table 2.3-7A and Figures 2.3-14 and 2.3-15, as summarized below:

1. per cell decay heat limits shall be equal to or below that specified in Appendix B Figures 2.3-14 and 2.3-15
2. total MPC heat load shall not exceed 45 kW
3. total heat load in every quadrant defined in Appendix B Figure 2.1-4 shall not exceed 11.25 kW

The above is also further explained in Section 5.0 of Holtec report HI-2210379 Revision 0.

OBS 4-6 Clarify the applicability of the heat load data presented in TS Appendix B Tables 2.3-1A, B, and C to the MPC-37P.

The applicant provided MPC cavity drying limits in Table 3-1 of TS Appendix A and referred the heat loads of the MPC-37P to Tables 2.3-1A, B, and C of TS Appendix B, i.e., Patterns A and B for fuel assemblies with burnups less than or equal to 45,000 MWD/MTU in Table 2.3-1A, and Patterns A and B for fuel assemblies with burnups greater than 45,000 MWD/MTU in Tables 2.3-1A, B, and C.

With the conditions described above, the applicant should consider including the MPC-37P in the titles of Tables 2.3-1A, B, and C or add a note to these tables that indicates that the MPC-37 heat load data is also applicable to the MPC-37P for clarification.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

Heat loads of MPC-37P during drying specified in Appendix A Table 3-1 refers to only Patterns A and B specified in Table 2.3-1A of Appendix B. There is no reference to Tables 2.3-1B and 2.3-1C of Appendix B in Table 3-1 of Appendix A under MPC-37P. But as the reviewer has recommended, Table 2.3-1A of Appendix B has been revised to include MPC-37P in the title. No changes are required to the title of Tables 2.3-1B and 2.3-1C of Appendix B.

OBS 4-7 Clarify the statements regarding thermal conductivity of carbon steel found in items #3 and #4 of Appendix N.5.20 of Report HI-2094400, "Thermal Evaluation of HI-STORM FW."

The applicant stated, in Appendix N.5.14 (the labeling should be corrected to N.5.20), "Onsite Transfer using HI-TRAC at Low Ambient Temperatures" of Report HI-2094400, that the thermal conductivity of all materials except carbon steel increases with a decrease in temperature (item #3 on page N-22) and that the thermal conductivity of carbon steel increases with a decrease in temperature (item #4 on page N-22). It seems that the statement in item #3 indicates that the thermal conductivity of carbon steel will NOT increase with a decrease in temperature which is inconsistent with the statement in item #4.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

The labeling of Section N.5.14 has been corrected to N.5.20.

Holtec agrees with the staff's observation of the inconsistency.
As can be seen from Table N.20 of HI-2094400, the thermal conductivity of carbon steel increases with decrease in temperature, while that of all other materials decreases with decrease in temperature. Item #3 has therefore been corrected to indicate that the thermal conductivity of all the materials except carbon steel decreases with decrease in temperature. Item #4 is stated accurately and therefore does not need any correction.

OBS 4-8 Clarify the values for the MPC-44CBS pressure found in Table 4.4.5 of the proposed FSAR and Table Z.5.2 of Report HI-2094400 for the accident with 100% fuel rod rupture under long-term storage.

The applicant presents MPC-44CBS pressures of 183.6 psig in Table 4.4.5 of the proposed FSAR and 193.4 psig in Table Z.5.2 of Report HI-2094400 for the accident with 100% fuel rod rupture under long-term storage. The applicant should clarify any discrepancy between the tables mentioned.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

Holtec regrets the inconsistency between the FSAR and Report HI-2094400. Table 4.4.5 of the proposed FSAR has been corrected to reflect the pressure of 193.4 psig for MPC-44CBS, in line with Table Z.5.2 of HI-2094400.

OBS 4-9 Describe or locate notes as indicated in the documents below.

Describe notes in Report HI-2200191, Thermal Analysis of HI-STORM FW UVH System

- Note 2 in Table A.6.2 of Appendix A
- Note 4 in Table A.6.4 of Appendix A
- Note 2 in Table B.6.1 of Appendix B

Locate notes in the proposed FSAR

- Notes 2 and 3 in Table 4.4.2
- Notes 1 and 2 in Table 4.5.1
- Note 2 in Table 4.5.19

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

The following changes have been made to HI-2200191:

Table A.6.2:

1. Footnote 2 has been added to indicate that the "maximum cross-sectional average is reported" for the appropriate components.
2. The footnote to MPC Baseplate component temperature has been corrected from #2 to #3

since section average temperature (and not cross-sectional average temperature) is reported for MPC Baseplate.

Table A.6.4:

3. Footnote to MPC Lid has been corrected to #4 (section average temperature). Similarly, footnotes to Overpack Body Concrete and Overpack Lid Concrete temperatures have been corrected to #5 (cross-sectional average temperature).
4. Numbering discrepancies have been corrected.

Table B.6.1:

5. Footnote to MPC Baseplate has been corrected to #1.
6. Footnote 2 has been added to indicate that the cross-sectional average temperatures of these components are reported.

The following changes have been made to the HI-STORM FW FSAR Chapter 4:

Table 4.4.2:

1. Reference to Note 2 has been added to the Table. Note 3 is a relic from the previous revision of the FSAR that is no longer used.

Table 4.5.1:

2. References to Notes 1 and 2 have been added to the Table.

Table 4.5.19:

3. References to Note 2 have been added wherever vacuum drying is allowed with time limits.

Any other discrepancies in the Tables have been addressed.

OBS 4-10 Add a note for “threshold heat load limit” for the MPC-37P (with MPC heat load ≤ 33.3), in Table 3-1 of TS Appendix A and Table 2.3-7B of TS Appendix B.

The staff observed that there is a significant difference in the maximum heat load limit between Table 2.3-7A (45.0 kW) and Table 2.3-7B (33.3 kW) in TS Appendix B for the MPC-37P containing high burnup fuel assemblies placed within the ventilated overpack. This difference is also observed for the MPC-37P in Table 3-1 (page 3.4- 2) of TS Appendix A.

To avoid any confusion over the significant difference in the heat load limits, add a note to specify that the “threshold heat load limit” is listed for MPC-37P (with MPC heat load ≤ 33.3) in Table 3-1 of TS Appendix A (page 3.4-2) and Table 2.3-7B of TS Appendix B.

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

<u>Holtec RSI Response:</u>

Two unique heat load patterns for MPC-37P are presented in Appendix B Tables 2.3-7A and 2.3-7B. For these heat load patterns, the drying methods are defined in Appendix A Table 3-1. These two patterns are independent of each other and should be treated as such. Holtec would like to avoid use of any new terminology such as “threshold heat load” in the TS. The significant difference in heat load patterns proposed for MPC-37P is similar to what has been previously approved for

MPC-37 (Table 2.3-1A vs Table 2.3-3, Appendix B) and MPC-89 (Table 2.3-2A vs Table 2.3-4, Appendix B). Therefore, no additional changes are made to the TS.

OBS 4-11 Correct typo “Table 1.2.3c” to “Table 1.2.3e” on page 2-3 of the proposed FSAR.

The applicant stated on page 2-3 of the proposed FSAR in the proposed language that “MPC-37P follows a storage pattern shown in Figure 1.2.9, while MPC-44CBS is uniformly loaded as specified in Table 1.2.3c.”

Staff finds Table 1.2.3c is for alternative MPC-37P heat load data and Table 1.2.3e is for MPC-44CBS heat load data. The applicant should correct the typo “Table 1.2.3c” (underlined above) to “Table 1.2.3e” in the “quoted” statement above for clarification.

The staff needs this information to determine compliance with 10 CFR 72.236(f).

Holtec RSI Response:

The typo has been corrected in the FSAR.

OBS 7-1 Clarify the loading requirements for BPRAs and other non-fuel hardware in the MPC-44.

Table 2.1-1.V of TS Appendix B states in Section C: “Up to twenty-two (22) BPRAs are authorized for loading in the MPC-44.” Note 1 to this section states: “Fuel assemblies containing BPRAs, TPDs, WABAs, water displacement guide tube plugs, orifice rod assemblies, or vibration suppressor inserts, with or without ITTRs, may be stored in any fuel storage location.”

a) These two statements appear to be in conflict with each other. It is not clear why BPRAs may be allowed in any location when the number of BPRAs must be limited.

b) Also, if BPRAs are limited to no more than 22, the applicant should clarify if this restriction applies to other non-fuel hardware components, such as TPDs, WABAs, etc. It would appear that a similar limit is needed for other non-fuel hardware components for which BPRAs are used to bound their effects in the shielding analyses.

This information is needed in accordance with the requirements in 10 CFR 72.236(a), (c) and (d).

Holtec RSI Response:

a) Holtec does not see a conflict between these two statements. The first statement limits the total number of BPRAs allowed in a single MPC-44 basket to 22. The second explains that these 22 BPRAs can be loaded into any basket cell and are not restricted to certain cells or regions in the basket. In other words, up to 22 fuel assemblies containing BPRAs can be loaded clustered in the center of the MPC-44 basket, clustered in a quadrant of the basket, or randomly distributed in the basket.
   As discussed in response part b below, the restriction of the number of BPRAs per basket is based on limiting the possible release of helium into the MPC cavity due to the hypothetical rupture of large gas inventory non-fuel hardware. The location of the BPRAs (and WABAs as discussed below) in the basket is unimportant.
b) The restriction on the number of non-fuel hardware components derives its origin from pressure analyses rather than shielding analyses. NFHs that release helium into the MPC cavity do so on neutron capture by the B-10 isotope present in the borosilicate glass or B4C in

refractory solid matrix, as described in Section 4.4.5.2 of the FSAR. Among the NFHs allowed in HI-STORM FW system, only BPRAs and WABAs are capable of doing so.

The restriction on the number of NFHs is applicable to both BPRAs and WABAs. The amount of B-10 in BPRAs bound those in WABAs. However, as a layer of conservatism, the number of WABAs is also limited to 22. There is no restriction on other types of NFH.

This has been updated in the CoC.

OBS 7-2 Provide the correct figure or locations for DFCs to be stored in the MPC-44.

Table 2.1-1.V of Appendix B, Section B states: "DFCs may be stored in fuel storage locations 3-1 through 3-3, 3-6, 3-9 through 3-12, 3-15, and 3-18 through 3-20 (see Figure 2.1-5)." However, Figure 2.1-5 does not contain these locations and is not consistent with Figure 2.1.1d of the proposed FSAR which does have these locations.

This information is needed in accordance with the requirements in 10 CFR 72.236(a).

Holtec RSI Response:

Figure 2.1-5 has been updated to identify the allowable DFC locations and is brought into consistency with Figure 2.1.1d of the proposed FSAR. The cell numbering in the Figure has also been updated to be consistent with that in the proposed FSAR.

OBS 7-3 Provide information on how basket deflections associated with off-normal and accident conditions were accounted for in the criticality evaluation of the MPC-44.

Section 6.3.1 (page 6-35) of the HI-STORM FW FSAR Revision 9 (ADAMS Accession No. ML21169A038) has a discussion on how basket deflections for the MPC-37 and MPC-89 were accounted for within the criticality safety evaluation for the HI-STORM FW. This section does not include change bars to include the MPC44. It is not clear if the analysis of basket deflections performed for the MPC-37 and MPC-89 associated with off-normal and accident conditions was intended to also include (or bound) the MPC-44. The FSAR should address basket deflections for the MPC-44 criticality safety analyses.

This information is needed in accordance with the requirements in 10 CFR 72.236(c).

Holtec RSI Response:

The basket deflections associated with off-normal and accident conditions were also applied to the MPC-44. Calculations have been performed for MPC-44 with the cell ID reduced by 0.5% of the cell width to account for the potential deflections of basket walls. The Maximum k_{eff} results along with the selected dimensions are shown in Table 6.3.2, and the bounding basket dimensional assumption that includes the basket deflections is employed for all criticality analyses.

Editorial changes have been made in Section 6.3.1 of the proposed HI-STORM FW FSAR to provide information on the basket deflections for the MPC-44.

OBS 7-4 Provide the lengths and locations of the partial length rods for the 10X10J assembly class.

Page 6-24 of the proposed FSAR states the condition that was determined to be bounding for the 10X10J assembly class, considered short and long partial length rods. Providing the locations and the lengths of these partial length rods associated with the “real assembly” would help the staff to determine if the conditions selected by the applicant are bounding.

This information is needed in accordance with the requirements in 10 CFR 72.236(a) and (c).

Holtec RSI Response:

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OBS 7-5 Justify the modeling assumption for the variable diameter water rod for the 10X10J assembly class and provide the location of the water rod within this assembly class.

Page 6-25 of the proposed FSAR states: “For BWR assembly class 10x10J, a water rod may be with a variable diameter that displaces 4 or 12 fuel rods. But in all the calculations of this analysis, a water rod segment that displaces 4 fuel rods is assumed along the entire active fuel length. This is conservative since smaller water rod contains less material thus displaces less water, and the amount of fissile material may be potentially larger.” Spent fuel assemblies are generally under moderated, so the condition where there is more fuel and less water may not be the most reactive condition. The staff seeks additional information justifying the assumption that the water rod displaces 4 versus 12 fuel rods is bounding for criticality safety. In addition, providing the location of the water rod within the assembly would help the staff determine if the assumption is bounding.

This information is needed in accordance with the requirements in 10 CFR 72.236(a) and (c).

Holtec RSI Response:

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