UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 06, 2020

Ms. Joyce Tomlinson
Adjunct Licensing Manager
Holtec International
One Holtec Boulevard
Camden, NJ 08104

SUBJECT: AMENDMENT NO. 15 TO CERTIFICATE OF COMPLIANCE NO. 1014 FOR THE HI-STORM 100 MULTIPURPOSE CANISTER STORAGE SYSTEM – REQUEST FOR ADDITIONAL INFORMATION

Dear Ms. Tomlinson:

By letter dated March 20, 2019 [Agencywide Document Access and Management System (ADAMS) Accession No. ML19092A189] and supplemented by a letter dated September 16, 2019 (ADAMS Accession No. ML19277H035), Holtec International submitted an amendment request to the U.S. Nuclear Regulatory Commission for the HI-STORM 100 Multipurpose Canister Storage System Certificate of Compliance (CoC) No. 1014.

The NRC staff reviewed your application and determined the need for additional information as identified in the RAI in the enclosure to this letter. We request that you provide the responses to these RAIs within 30 days from the date of this letter. If you are unable to meet this deadline, please notify us in writing, within two weeks of receipt of this letter, of your new submittal date and the reasons for the delay.

Please reference Docket No. 72-1014, CAC No. 001028 and EPID No. L-2019-LLA-0059 in future correspondence related to this licensing action. If you have any questions, please contact me at 301-415-1018.

Sincerely,

/RA/

Yen-Ju Chen, Sr. Project Manager
Storage and Transportation
Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No.: 72-1014
CAC No.: 001028
EPID No.: L-2019-LLA-0059

Enclosure:
Request for Additional Information

SUBJECT: AMENDMENT NO. 15 TO CERTIFICATE OF COMPLIANCE NO. 1014 FOR THE HI-STORM 100 MULTIPURPOSE CANISTER STORAGE SYSTEM – REQUEST FOR ADDITIONAL INFORMATION

DOCUMENT DATE: March 6, 2020

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Request for Additional Information
Docket No. 72-1014
Holtec International
HI-STORM 100
Multipurpose Canister Storage System
Certificate of Compliance No. 1014
Amendment No. 15

The staff identified additional information needed in connection with its review of the subject application as provided in the request for additional information discussed below. Each question describes information needed by the staff to complete its review of the application and to determine whether the applicant has demonstrated compliance with regulatory requirements in 10 CFR Part 72.

Structural Evaluation

3-1 Justify the structural qualifications of MPC-32M.

The applicant proposes the inclusion of MPC-32M (Proposed Change #2). Supplement II contains structural analyses for the MPC-32M, including the non-mechanistic tipover analysis of the HI-STORM Version E overpack with MPC-32M. It is not clear to the staff if the non-mechanistic tipover analysis presented in Supplement II and associated calculation package (Report HI-2188448R0) have adequately addressed different azimuthal orientations of the MPC-32M fuel basket during the drop. Regarding the non-mechanistic tipover analysis:

a. Clarify the orientation used in the analysis.
b. Clarify why the current analysis represents the bounding scenario for the MPC-32M.

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

3-2 Confirm the information in Table 3.II.4.12 of Final Safety Analysis Report (FSAR) Supplement II.

Table 3.II.4.12 of FSAR Supplement II lists the maximum local plastic strains for different components during the non-mechanistic tipover analysis. It is similar to Table 9.1 in Report HI-2188448R0. Both tables have the same information but refer to different MPCs. Table 3.II.4.12 refers to MPC-32 whereas Table 9.1 refers to MPC-32M. Since there are multiple versions of MPC-32, confirm that the information in Table 3.II.4.12 is accurately reported.

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

3-3 Confirm baseplate thickness of MPC-32M, MPC-32 Version 1, and MPC-68 Version1.

In Proposed Changes #2 and #3, the applicant proposes the inclusion of the structural qualification for MPC-32M, MPC-32 Version 1, and MPC-68 Version 1. The applicant describes the new MPCs as modified versions of its classical counterparts with larger

cell openings and “slightly thickened” vessel baseplate. Similar qualitative statements are found throughout FSAR Supplement II that provide no quantification of the additional thickness of these MPCs when compared to their previous counterparts. Since the enclosure vessel baseplate has load bearing function and is part of the confinement boundary, provide clear and quantitative descriptions of its characteristics and dimensions in appropriate sections of FSAR Supplement II.

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

3-4 Confirm the weight and center of gravity for fuel types 10X10I, 10X10J, and 11X11A.

Proposed Change #5 adds three (3) additional BWR fuel types, 10X10I, 10X10J, and 11X11A, to the approved contents of CoC No. 1014, Appendix B, for MPC-68M only. In order to qualify the added fuel types:

a. Confirm that the additional fuel types are bounded by the maximum allowable weight of the storage system components.
b. Confirm that the center of gravity of the storage system is not changed by the addition of the new fuel types.

This information is needed to determine compliance with the requirements of 10 CFR 72.236(a) and (l).

3-5 Clarify design basis limit deceleration for the non-mechanistic tipover analysis “Loading Case M-3; Non-Mechanistic Tip-Over” from FSAR Section 3.II.4.4.2 summarizes the analysis for the aforementioned event. It refers to FSAR Section 2.2.3.2 for description of the loading case applicable to the HI-STORM Version E module. Section 2.2.3.2 provides a design limit of 45 g’s. Given the reported maximum rigid body deceleration of 81.6 g at the top of the fuel assembly, as shown in Figure 15 of the non-mechanistic tipover calculation package, it is not clear to the staff if the design limits in FSAR Section 2.2.3.2 are applicable to the HI-STORM Version E. Clarify the following information:

a. Address this apparent discrepancy and specify if there are deceleration design basis limits for the HI-STORM Version E.
b. Describe how the rigid body deceleration at the top of fuel assembly is used for evaluation.
c. Does the stress analysis method of evaluation (MOE) presented for this tipover analysis deviates from the subsection NG “stress category” approach as specified in ASME Code Section III, Appendix F?

This information is necessary to determine compliance with the requirements of 10 CFR 72.236(b) and (l).

3-6 Justify the changes resulting from Proposed Change #9.

In Proposed Change #9 the applicant proposes to remove the dose rate evaluation from the accident analyses for the non-mechanistic tipover event. The applicant claims that the basis for this removal is that the event is not credible. The staff notes that performing the tipover accident analysis, as documented in applicable sections of Chapters 11.II and 3.II, provides additional assurance that the design will maintain

confinement, criticality, and shielding during storage. In addition, potential tipover could be caused by misloading or mishandling as evidenced in the past operating experiences. The regulatory requirements in 10 CFR 72.106(b) states any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of the Part 20 dose limits. NUREG-1536 Section 2.5.2.2 (3) "Accident conditions," states that the cask tipover is considered a design basis event that should be evaluated. Based on the aforementioned statements, the staff requests that the applicant:

a. Provide a definition for "non-credible" event and justify that the tipover event is a "non-credible" event. The staff currently does not have guidance on the definition of "non-credible" for dry storage systems; however, the staff would consider guidance in other areas for consistency, such as NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." For example, 10 CFR 70.65(b)(9) requires that applicants for a license for special nuclear material provide a definition for likely, highly unlikely (non-credible), and credible, and NUREG-1520 provides staff review guidance and acceptance criteria for the definitions.

Or

b. Provide the following information:
   i. Provide the dose rate evaluation associated with the non-mechanistic tipover event.
   ii. Take credit for the analysis that demonstrates the MPC is designed to withstand credible drops and non-mechanistic tipovers by referencing it in applicable portions of Table 7.II.1.4 of the application, and provide justification that the HI-STORM 100 will maintain confinement considering the cask tipover design basis event.

This information is needed so that the staff can make a determination on whether this system meets 10 CFR 72.236(d) and (l).

Thermal Evaluation

4-1 Provide calculations and analysis results that show the dry ice jacket (DIJ) cooling capabilities can provide cooling function up to the time specified in the application.

Section 2.2.1.7 of the FSAR states that calculations show that the DIJ can be sized for transfer casks to maintain their cooling function for a period specified in the FSAR. However, the application does not provide calculations that show how long cooling function could be maintained by the DIJ. The staff needs this information to verify that an adequate configuration of the transfer cask has been analyzed to demonstrate that predicted temperatures remain below applicable limits.

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

4-2 Clarify how the thermal conditions of the transfer cask are determined for cases where the HI-DRIP auxiliary cooling system were to fail during short-term operations.

Section 2.2.1.8 of the FSAR states that if the plant's water supply system were to fail, the time-to-boil of the transfer cask is monitored. However, it is not clear from the application how the thermal conditions (initial conditions) of the transfer cask are determined and used in the calculation for the time-to-boil. 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 MPC over-pressurization.

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

4-3 Provide calculations and analysis results for the case that HI-STORM 100S Version E overpack is used in a sheltered configuration.

Section 1.II.2.1 of the FSAR states, "Like all other versions, Version E can be deployed in an unsheltered or sheltered storage mode. However, if the sheltered configuration is used then site-specific evaluations should be performed to ensure that the temperature profile (time averaged, as applicable) of the ventilation air entering the cask complies with the normal storage temperature limit set forth in Supplement 2.II (Principal Design Criteria) herein." However, the applicant did not provide any thermal models, calculations, and analysis results that demonstrate the predicted temperatures would be below any applicable temperature limits for a sheltered configuration. The staff needs this information to make sure the HI-STORM 100S Version E overpack in a sheltered configuration will not results in temperatures exceeding the criteria specified in the FSAR.

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

4-4 Add a note to FSAR Figures 2.II.1-2 and 2.II.1-3 to clarify that the maximum quadrant decay heat specified in Table 2.II.1.5 applies to these figures. Correct these figures to make them consistent with Appendix D of the Technical Specifications.

FSAR Figures 2.II.1-2 and 2.II.1-3 show discrete heat load patterns A and B. However, the total heat load shown in these figures exceed the limits specified in Table 2.II.1.5. Also, reported values in FSAR Figures 2.II.1-2 and 2.II.1-3 are not consistent to Figures 2.4-1 and 2.4-2 of Technical Specifications Appendix D. The staff needs assurance that any applicable limits have been adequately analyzed to demonstrate that predicted temperatures remain below applicable limits.

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

4-5 Clarify how heat rejection by natural convection is implemented in the HI-STORM 100S Version E thermal model.

Section 4.II.4.1 of the FSAR states that natural convection is modeled in the same manner as defined in the HI-STORM FW FSAR using the Jakob & Hawkins correlations references in the FSAR. However, staff's review of the HI-STORM 100S Version E thermal model does not indicate these correlations were used to perform the thermal analysis. The staff needs this information to have assurance predicted temperatures remain below allowable limits.

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

4-6 Provide a technical justification demonstrating how the cases provided in Section 4.II.4.3 of the FSAR would result in maximum predicted temperatures.

Section 4.II.4.3 of the FSAR states that two extreme cases are considered that reasonably bound discrete loading under cask aggregate and cell specific limits. The cases are described in FSAR. However, the applicant did not provide technical justification that explains why from all the different combinations for loading patterns, these two cases would result in maximum predicted temperatures. The applicant needs to consider other patterns (for example, intermediate cases) that show that the extreme loading cases are in fact bounding. This could be demonstrated by performing additional sensitivity calculations or analysis. The staff needs this information to have reasonable assurance that the predicted temperatures remain below allowable limits.

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

4-7 Provide a technical justification demonstrating how the multiple drying cycles will not result in temperatures exceeding the acceptance criteria for the important to safety components.

Section 4.II.5.3 of the FSAR provides a summary of a methodology and assumptions for cyclic vacuum drying for high burnup fuel but no predicted peak cladding temperatures were provided. The application does not include any calculations or analysis results to show how the calculations are performed for multiple cycles and results from each cycle. The staff needs this information to verify cyclic vacuum drying will not result in temperatures exceeding the criteria specified in ISG-11, Revision 3 for multiple drying cycles.

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

4-8 Provide calculation and analysis results for cask cooldown and reflood during fuel unloading operations.

Section 4.II.5.3 of the FSAR states that during fuel unloading operations could lead to MPC over-pressurization if the rate of water addition is not controlled. However, the applicant did not provide any calculations to show how the rate of water addition is determined to control the MPC pressure. Surveillance Requirement 3.1.3.1 states that the MPC cavity pressure is ensured to be within limits via analysis or direct measurement. However, as stated above, the application does not include analysis to support SR 3.1.3.1. Other chapters may need to be revised to reflect the analysis results, when these become available (for example, Operating procedures, Technical Specifications Bases, etc.). The staff needs this information to verify MPC over-pressurization is avoided with adequate control of the rate of water addition to the MPC cavity.

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

4-9 Provide a technical justification demonstrating how low-wind speeds impact the PCT or other components important to safety.

Section 4.II.0 of the FSAR states that Version E overpack features a large axi-symmetric outlet opening with substantially larger outlet flow area than the prior model overpacks currently in use to ensure that it will reject more heat than the prior models regardless of the MPC model stored inside it. Normal low-speed wind could affect the cask thermal performance, specifically in the HI-STORM 100 systems, because of the larger axi-symmetric outlet opening resulting in higher predicted temperatures compared to quiescent conditions, by blocking the air vents, which could have an impact on the cooling effect by reducing the mass flow rate through the annular gap. This can be demonstrated by performing sensitivity calculations based on a range of wind speeds which is typically considered normal (in the range of 0 to 15 miles per hour) in order to obtain bounding speed. A three-dimensional model that includes an extended domain to represent the surrounding environment is generally used for wind studies to obtain accurate results (see NUREG-2174 “Impact of Variation in Environmental Conditions on the Thermal Performance of Dry Storage Casks” for additional information). The staff needs this information to have assurance predicted temperatures remain below allowable limits during long term storage.

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

Confinement Evaluation

5-1 Clarify the following for the MPC enclosure vessels:

a. the thickness of the MPC-32M, MPC-32 Version 1, and MPC-68 Version 1 fuel baskets MPC enclosure vessel baseplate and,
b. the MPC enclosure vessel (MPC enclosure vessel or MPC enclosure vessel version 1) that can be used for the MPC-32M, MPC-32 Version 1, and MPC-68 Version 1 fuel baskets.

Proposed changes #2 and #3 describe that the MPC-32M, MPC-32 Version 1, and MPC-68 Version 1 enclosure vessel baseplate is slightly thickened to increase its pressure and load bearing capacity.

Supplement 7.II, “Confinement,” of the SAR, in the first paragraph, describes that the main body of Chapter 7, “Confinement,” of the FSAR remains fully applicable for the HI-STORM 100 System using an MPC-32M, MPC-32 Version 1 or MPC-68 Version 1, except as indicated below since the MPC-32M, MPC-32 Version 1 and MPC-68 Version 1 fuel baskets are used with the MPC enclosure vessel which is the confinement boundary of the system. The staff notes that the revised licensing drawing for the MPC enclosure vessel (Drawing No. 3923, sheet 3) showing the increased thickness of the enclosure vessel baseplate was not provided; however, it is not clear if the phrase MPC enclosure vessel Version 1 could have been intended in the SAR, rather than use the phrase MPC enclosure vessel. Using an MPC enclosure vessel with a confinement boundary baseplate that is not sufficient for the pressure and load bearing capacity necessary for the associated fuel baskets is an unanalyzed condition.

Supplement 7.II of the SAR, in the last sentence of the first paragraph, refers to the drawing of the MPC enclosure vessel in Section 1.II.5 of the SAR. However, Section 1.II.5 describes an MPC enclosure vessel Version 1. If the MPC enclosure vessel Version 1 is the containment boundary for the MPC-32M, MPC-32 Version 1, and MPC-

68 Version 1 fuel baskets, that should be clearly described in the application, rather than use the phrase MPC enclosure vessel.

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

5-2 Provide clarification on the licensing drawings that the MPC enclosure vessel Version 1 confinement boundary components are ITS category A.

Section 2.II.0.5 of the SAR describes that the ITS category of each part for each component (Version E overpack, MPC-32M, Version 1 of MPC-32 and MPC-68, and HI-TRAC MS transfer cask) is provided in the respective component's Licensing Drawing in Section 1.II.5. Licensing drawing No. 11572 Revision 0, Sheet 1 of 2, for the MPC enclosure vessel Version 1 describes the safety category for each of the confinement boundary components as ITS but does not include the specific ITS category (category A). NUREG-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety," describes in Table 6, "Classification categories for dry spent fuel storage systems," that components that have a containment function are ITS category A, the highest ITS category classification for the important to safety confinement function. In addition, licensing drawing No. 3923 Revision 35, Sheet 1 of 9, Note 11 also describes that the safety category for the MPC enclosure vessel is ITS category A, and this is also shown in Table 2.2.6, "Materials and Components of the HI-STORM 100 System," of the SAR. Providing the ITS category for each of the MPC enclosure vessel Version 1 confinement boundary components on the licensing drawing No. 11572 Rev. 0 sheet 1 of 2 would be consistent with the previously approved licensing drawings and the licensing drawings that are part of this amendment request, and also clearly emphasize the highest ITS category classification for the important to safety confinement function. Providing the ITS category on the licensing drawing may also aide NRC staff in performing risk-informed inspection activities.

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

5-3 Provide Table 1.A.6 of the SAR.

Table 1.A.6 is referenced for example in, Table 2.2.3, "Design Temperatures," and Table 7.II.1.1, "Summary of Confinement Boundary Design Specifications," of the SAR. However, the staff could not find Table 1.A.6 in the SAR (Attachments 7 and 8 of the amendment request).

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

5-4 Provide clarifications to the following from the proposed Certificate of Compliance (CoC) No. 1014, Appendix C of the Technical Specifications:

LCO 3.1.1 of the proposed CoC No. 1014, Appendix C of the Technical Specifications should describe, with underlining shown for emphasis, that, "Table 3-1 provides decay heat and burnup limits for forced helium dehydration (FHD) and vacuum drying." FHD and vacuum drying are described in Table 3-1 of the proposed CoC No. 1014, Appendix C of the Technical Specifications; therefore, vacuum drying should also be consistently described in LCO 3.1.1 of the proposed CoC No. 1014, Appendix C of the Technical Specifications.

Table 3-3, “Completion Time for Actions to Restore HI-STORM 100S Version E SFSC Heat Removal System to Operable,” of the proposed CoC No. 1014, Appendix C of the Technical Specifications should describe, with underlining shown for emphasis, that the MPC Type is the, “MPC-32 Version 1 / MPC-68 Version 1,” to explicitly avoid confusion with the MPC-32. The use of MPC-32/68 Version 1 also occurs in SR 3.1.2 on page 3.1.2-2 and LCO 3.1.4, applicability c3 on page 3.1.4-2.

3.1.3 Supplemental Cooling System on page 3.1.4-2, should be renamed to, 3.1.4 Supplemental Cooling System because 3.1.3 is already named MPC Cavity Reflooding on page 3.1.3-1.

This information is needed to determine compliance with 10 CFR 72.234(a).

5-5 Provide clarification to the following from the proposed CoC No. 1014, Appendix D of the Technical Specifications.

Page 3-4 of the proposed CoC No. 1014, Appendix D of the Technical Specifications, the row for NB-3100 and NF-3100, describes, “100 system FSAR, serving as the Design Specification, which establishes the service conditions and load combinations for the storage system. FSAR, serving as the Design Specification, which establishes the service conditions and load combinations for the storage system.” The intended meaning of the previous sentence is not clear. In comparison, a clearer sentence is on Page 3-6 of the proposed CoC No. 1014, Appendix B of the Technical Specifications the first row describes, “These requirements are not applicable. The HI-STORM FSAR, serving as the Design Specification, establishes the service conditions and load combinations for the storage system.”

This information is needed to determine compliance with 10 CFR 72.234(a).

Shielding Evaluation

6-1 Provide justification for using the MPC-68M as the bounding MPC for the HI-TRAC MS.

The staff was unable to find a basis for using the MPC-68M for all of the dose and dose rate evaluations for the HI-TRAC MS. The staff requests that the applicant provide justification that this MPC and its allowable contents would produce the highest surface and site boundary dose rates under both normal and accident conditions than all other MPCs allowed within the HI-TRAC MS.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104 and 106.

6-2 Justify the burnup and cooling times assumed for the accident condition of the HI-TRAC Version MS.

Table 5.II.1.5 of the FSAR shows the accident condition dose rates for the HI-TRAC Version MS. This table states that the MPC-68M was used as the design basis MPC and that the source term includes fuel at 70,000 MWd/MTU and 6 years cooling for the dose rates at 1 meter, and 50,000 MWd/MTU and 3 years cooling for the dose rates at

100 meters. The staff requests that the applicant justify the use of these burnups and cooling times and the use of the MPC-68M as the design basis MPC for this table. It seems other MPCs and allowable assemblies would have more limiting design source terms for accident conditions. For example, Table 5.1.10 of the FSAR is based on the MPC-24 at 75,000 MWd/MTU and 5 years cooling; Table 2.1-4 of the Appendix D to the CoC allows for a 3.26 kW assembly at a burnup of 70,000 GWd/MTU and a minimum cooling time of 2.25 years; and for a 1.66kW assembly (allowed in loading patterns QSHL-2, QSHL-3, and QSHL-4 for the MPC-68M), Appendix B TS 2.4.3 allows a burnup of 67,000 MWd/MTU, enrichment of 4.2%, and cooling time of 2.25 years.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.106.

6-3 Provide the enrichment used for all calculations that involve the MPC-68M (or any MPC used in the design basis calculations for this amendment that is not the MPC-32M).

The staff has the minimum enrichment for a given burnup range for the MPC-32M; however, minimum enrichment is considered an input into the equation that provides burnup in Section 2.4.3 of the TS (Appendix B to the CoC) for all of the other MPCs. The staff requests that the applicant provide the enrichment so that it can verify the source term used and if the burnup and cooling time are appropriate.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104 and 106.

6-4 Clarify the burnup assumptions used for the MPC-32M for calculating the source term for non-fuel hardware.

Section 5.II.2.4 states that in order to qualify non-fuel hardware with the lower cooling time for the MPC-32M, the “BPRA and TPD with the minimum cooling time of 1 year, independent of the burnup” was considered. The staff requests that the applicant provide additional information on how this evaluation was performed “independent of the burnup.”

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104 and 106.

6-5 Provide tolerances for components that are used for shielding of the MPC-32M and the MPC Enclosure Vessel, MPC-32M Version 1, MPC-68M and Version 1, and MPC Enclosure Vessel Version 1 and HI-STORM 100S Version E.

The applicant states in Section 5.II.3.1 of the SAR that nominal dimensions are used in the models. The applicant states that this is “*consistent with the main part of Chapter 5, unless stated otherwise. This is considered sufficient for the purpose of this supplement to demonstrate reasonable assurance of an adequate level of safety.*” Although the staff agrees with the concept that nominal dimensions are considered sufficient to demonstrate *“reasonable assurance of an adequate level of safety,”* this statement is

dependent upon whether the tolerances are small enough that a minimum dimension (rather than nominal one) would not drastically reduce shielding. The staff requests that the applicant provide tolerances for all components credited for shielding in drawings: 3923 Revision 40, 11371 Revision 0, 11381 Revision 0, 11425 Revision 0, and 11572 Revision 0. The staff requests that the applicant update the FSAR with this information and does not necessarily require updating the drawings as long as the applicant states where in the FSAR this information is located. The staff needs this information to determine if using nominal dimensions continues to demonstrate reasonable assurance of an adequate level of safety.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104 and 106.

6-6 Provide additional information regarding the minimum concrete density specification for the HI-STORM 100S Version E.

The applicant states in Section 5.II.4.1 of the FSAR that *"… an increase of shielding performance for HI-STORM 100S Version E, … is mainly rendered by a concrete material with increased density."* Although the staff verified that the applicant used a higher concrete density for modeling this component, the minimum density requirement for this component is not clear. The staff requests that the applicant discuss how this requirement is specified. Table 3.II.2.4 of the FSAR shows the concrete density but this is not listed as a minimum, it is "Ref. concrete density," which the staff assumes means "reference." The staff was unable to locate the minimum concrete density for this component within the TS or the drawings.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104.

6-7 Provide additional information demonstrating that the MPC-32M is the bounding canister for the HI-STORM 100S Version E overpack.

The applicant performed annual dose and dose rate calculations for the HI-STORM 100S Version E overpack using the MPC-32M; however, the staff did not find the basis for using this canister as the bounding canister when all other HI-STORM 100 canisters are to be used within this overpack.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104.

6-8 Provide additional information on how all of the allowable loading patterns are bounded for the MPC-32M in the dose rate evaluation.

In Section 5.II.1 of the FSAR, the applicant explains how it bounds the allowable uniform and regionalized/discrete loading patterns when representing the system for performing shielding evaluations. The staff requests additional clarifying information so that it can better understand this process and make a determination that all allowable loading

patterns are reasonably bounded. The staff requests that the applicant state what loading pattern was determined to be the bounding one for the various analyzed configurations and what burnup/enrichment/cooling time was used in these patterns. The staff also requests additional clarifying information to supplement the discussion on page 5.II-4 of the SAR. Although the staff understands in principle that the 1.8 kW assemblies would be shielded by the peripheral assemblies, this may not be the case when evaluating the dose rate at the top of the transfer cask or overpack. The staff requests that the applicant provide additional information on how the applicant has determined the bounding loading pattern.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104 and 106.

6-9 Provide additional information on the Version E top lid outer ring.

Section A.2.2.3 of HI-2188253 Revision 1 states that "*(s)ince the Version E top lid outer ring OD is not specified, a value of 131.75" is assumed*." The staff requests that the applicant provide additional information on the purpose of this component and if it is used in some way within the safety analyses for it to explain why it the outer diameter is not specified.

This information is needed for the staff to determine that the cask system is capable of meeting regulatory requirements of 10 CFR 72.236(d) which requires a dry storage system to meet the dose limits in 10 CFR 72.104 and 106.

Criticality Evaluation

7-1 Revise the application to provide the lengths of the partial length rods for the 10x10I, 10x10J, and 11x11A fuel assembly classes.

Section 6.III.4.2 of the SAR discusses analyses performed by the applicant to determine the bounding condition of partial length rods in the various boiling water reactor (BWR) fuel assembly classes. For the 10x10I and 11x11A BWR assembly classes, the applicant demonstrates that it is conservative to assume that partial length rods are removed from the assembly. The staff needs the actual partial length rod active fuel lengths to confirm this conclusion. For the 10x10J, the applicant's analyses determine that the most conservative configuration is with the actual active lengths of the partial length rods. However, the SAR does not contain the partial length rod active fuel lengths for the staff to confirm.

This information is needed to ensure that the HI-STORM 100 cask system will continue to meet the criticality safety requirements of 10 CFR 72.236(c).

7-2 Revise Holtec Report HI-2033039, "Critical Experiment Benchmark," or the SAR, to include descriptions of the benchmark experiments included for k_{eff} bias and bias uncertainty determination relevant to the partial gadolinium credit analysis of the MPC-68M, with references provided for detailed descriptions.

Table C.2 of Appendix C of HI-2033039 provides a listing of input files and resulting k_{eff} values for an "extended set" of critical benchmarks used for benchmarking MCNP5-1.51 analyses of BWR fuel in the MPC-68M with partial gadolinium credit. However, the applicant did not provide relevant details of the critical experiments that include gadolinium for the staff to make a determination that the critical experiments selected are applicable. The staff requests that the applicant provide descriptions of the critical experiments analyzed, including references for more detailed descriptions, and confirmation that these experiments adequately represent cask and fuel features and parameters that are important to reactivity.

This information is needed to ensure that the HI-STORM 100 cask system will continue to meet the criticality safety requirements of 10 CFR 72.236(c).

7-3 Provide Holtec Report HI-2104790, "Nuclear Group Computer Code Benchmark Calculations," referenced in HI-2033039.

This report is referenced in the benchmarking analysis in HI-2033039 but is not provided. This report is necessary for the staff to evaluate the applicant's benchmarking analysis for partial gadolinium credit of BWR fuel in the MPC-68M canister. Staff requests that the applicant provide this reference.

This information is needed to ensure that the HI-STORM 100 cask system will continue to meet the criticality safety requirements of 10 CFR 72.236(c).

7-4 Revise Figure 6.III.4.10 of the SAR to include the information for the 11x11A assembly class.

The title of Figure 6.III.4.10 indicates that the figure is supposed to be the reactivity differences from the design basis for two different gadolinium rod arrangements in the 11x11A fuel assembly class. However, the figure appears to be repeated from Figure 6.III.4.9 for the 10x10J fuel assembly class, axial segment 3. The staff requests that the applicant revise the figure to include the information for the 11x11A assembly class.

This information is needed to ensure that the HI-STORM 100 cask system will continue to meet the criticality safety requirements of 10 CFR 72.236(c).

Materials Evaluation

8-1 Clarify whether the HI-TRAC MS lift blocks and their attachment bolts are ITS SSCs and, if so, identify the materials specification and mechanical properties used in the structural analysis.

FSAR Section 8.1.2 discusses HI-TRAC and HI-STORM receiving and handling operations. Amendment No. 15 added an option to engage the lift yoke to the HI-TRAC MS via lift blocks that are attached to the transfer cask top forging with high strength bolts, as shown in FSAR Figure 8.II.0-1. The staff notes that neither the FSAR text nor licensing Drawing No. 11381, HI-TRAC Version MS, identifies the lift block and bolting material specification or ITS classification.

This information is needed to determine compliance with 10 CFR 72.140(a) and 72.236(b).

Radiation Protection

11-1 Provide additional clarifying information on how the dose rates in Table 10.II.3.1 of the FSAR were determined.

The applicant updated Chapter 10 of the FSAR to include information pertaining to radiation protection from the HI-TRAC MS. Table 10.II.3.1 of the FSAR shows the estimated occupational exposures. The title of this table states that fuel with 60,000 MWd/MTU with 3 years cooling time was used for these calculations. Table 10.II.4.2 shows the dose rates at 100, 200, and 300 meters for the HI-TRAC Version MS transfer cask. Sections 10.II.3 and 10.II.4 of the FSAR state that the values from Table 10.3.1b of the FSAR for the 100-ton HI-TRAC were scaled to be applicable to the HI-TRAC MS. Appendix E of HI-2188253 Revision 1 explains the basis for this scaling. The staff requests that the applicant provide additional information so that it can confirm that the dose rates in Table 10.II.3.1 of the FSAR are appropriate.

a. The staff specifically requests that the applicant provide the source of data for “dose rate at operator location mrem/hr” from Table 10.3.1b of the FSAR. These values do not seem to match that of Table 5.1.7 of the FSAR for the 100-ton HI-TRAC. Although the staff is not reviewing this table as it is not part of the current amendment, it needs to understand the basis of these numbers as it appears that they are used to determine the appropriate dose rates for the HI-TRAC MS.

b. Tables 10.3.1b and 10.II.3.1 of the FSAR state that the occupational exposures are based on a burnup of 60,000 MWd/MTU and 3-year cooled PWR fuel. The staff requests that the applicant state which MPC was used in these evaluations and state the basis for the selected MPC and source term parameters (burnup, enrichment, and cooling time).

c. The method to calculate scaling factors in Appendix E of HI-2188253 Revision 1 indicates that the scaling factors were only calculated for dose rates at 1 meter. The staff requests that the applicant clarify if the scaling factors for the 1-meter dose rates were also used for all surface dose rates in Table 10.II.3.1b of the FSAR or if there are different scaling factors used for dose rate estimates at loading operations near the surface of the HI-TRAC MS.

This information is needed for the staff to evaluate the capability of the cask system to control and limit occupational exposures within the limits in 10 CFR Part 20 and to meet the objective of maintaining exposures ALARA, and to evaluate the capability of the cask system to meet dose limits in 10 CFR 72.104 and 106 to evaluate compliance with 10 CFR 72.236(d).