Response to Request for Additional Information
Supplemented July 2020

Docket No. 72-1014
Certificate of Compliance No. 1014
Amendment No. 15 to the HI-STORM 100 Multipurpose Canister Storage System

Chapter 6 - Shielding Evaluation

Introduction: Basket Loading Evaluation Approaches

Over time, various approaches have been introduced to evaluate the dose rates around the casks based on the approved content. In some cases, more than one set of approved content is applicable to an individual MPC, hence more than one evaluation approach may be presented for that MPC. Since it may be helpful for understanding the radiological analyses performed for this Amendment, the different approaches are characterized below before the responses to the individual RAIs are presented.

There are three important aspects present in each approach:

- The thermal analyses qualify certain thermal distributions, i.e. heat load limits for each cell in an MPC. This is the initial driver for the radiological limits and evaluations.
- Radiological limits (i.e. burnup, enrichment and cooling times) now need to be defined that, just from a practical perspective, allow loading of the fuel that is qualified from a thermal perspective. These radiological limits are therefore linked to or informed by the thermal limits. However, they are still completely independent requirements, in that compliance has to be demonstrated independently with both sets of limits, and compliance with the thermal limits is no substitute for compliance with the radiological limits, and vice vera. Since there is no one-to-one correspondence between assembly heat load and assembly burnup, enrichment and cooling time, the radiological limits are typically more complicated in their formulation than the thermal limits. Additionally, explicit dose rate limits may be defined, in addition to the burnup, enrichment and cooling time limits.

The purpose of the shielding analyses documented in Chapter 5 and Chapter 10 is to qualify the fuel that meets the defined radiological limits. For this FSAR, a bounding approach is used, i.e. an attempt is made to bound the dose effects of all permitted burnup, enrichment and cooling time combinations, although also taking into consideration dose rate limits as applicable. But it is often not feasible to evaluate all possible combinations, [Proprietary information withheld in accordance with 10 CFR 2.390]
The following approaches have been used over time:

[Proprietary information withheld in accordance with 10 CFR 2.390]

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.

Holtec Response:

The revised Supplement uses the MPC-32M as the bounding MPC for both the HI-TRAC MS and the HI-STORM Version E, so this MPC is used throughout the supplement. Evaluations in Section 5.II.4 demonstrate that the MPC-32M in fact bounds all other MPCs. This is mainly due to the more extensive content qualified for the MPC-32M.

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.

Holtec Response:

The evaluation of the accident conditions for HI-TRAC Version MS is performed using MPC-32M with the bounding content specifically evaluated for the accident conditions, and lower bound shielding thicknesses, so the results in Subsection 5.II.1.2 of the FSAR now present an overall

bounding condition.

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.

Holtec Response:

Please see the response to RAI 6-1.

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.

Holtec Response:

The discussion in Paragraph 5.II.2.2.1 has been expanded to provide additional clarification.

Note that this methodology is similar to that utilized for qualification of MPC-37 and MPC-89 with loading curves in the HI-STORM FW FSAR for Amendment 5.

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).

Holtec Response:

a) The calculations presented in Table 10.3.1b are based on the dose rates at operator locations around the HI-STORM and HI-TRAC overpacks with MPC-24 loaded with fuel at a burnup of 60,000 MWd/MTU and a cooling time of 3 years, which were determined for LAR 1014-3 and summarized in Appendix Y of HI-2012702 Rev.15 (see Page Y-results-29).

b) The occupational exposures in Table 10.3.1b are based on MPC-24, as discussed above. Supplement 10.II was revised, and the results were presented for HI-TRAC Version MS with MPC-32M (with the bounding content), and shielding thicknesses that result in side dose rates consistent with the applicable dose rate limit for that area.

c) According to Figure 10.3.1 of the FSAR and Appendix Y of HI-2012702 Rev.15 (see Page Y-results-30), most of the points are located at a distance from the cask surface (from 1 foot to several meters). The only cask surface location selected as the operator location is 16D (see Tables E.2.1 and E.2.2 of HI-2188253 Revision 3). This is acceptable for HI-TRAC Version MS since as shown in Table C.2.5, the dose rate ratios to the reference 100-ton HI-TRAC are essentially the same between the surface dose location and at 1 m distance.