November 30, 2005

Mr. Evan Rosenbaum
Project Manager
Holtec International
555 Lincoln Drive West
Marlton, NJ 08053

SUBJECT: HI-STORM 100, AMENDMENT 3, REQUEST FOR ADDITIONAL INFORMATION (TAC NO. L23850)

Dear Mr. Rosenbaum:

By letter dated December 30, 2004, Holtec International (Holtec) submitted (resubmitted February 22, 2005, to satisfy proprietary withholding requirements) an application to the United States Nuclear Regulatory Commission (NRC) to amend Certificate of Compliance (CoC) No. 1014 for the HI-STORM 100 Cask System (License Amendment Request 1014-3, Revision 0) in accordance with 10 CFR Part 72. This amendment proposed to: (a) add a new underground variation of the HI-STORM 100 Cask System, designated as the HI-STORM 100U, and (b) increase the maximum licensed thermal capacity of the HI-STORM 100 Cask System.

The complexity of the material submitted, the uniqueness of the underground system, and the knowledge of prior unresolved technical issues associated with the request for an increase in the licensed thermal capacity obligated the NRC staff, hereafter referred to as the staff, to perform a technical “acceptance review.” As a result of issues identified during the staff’s acceptance review Holtec requested that staff suspend technical review in order to make improvements to the HI-STORM 100U Cask System Design. Holtec submitted revised Amendment 3 on May 16, 2005. By letter dated June 14, 2005, the staff informed you that your revised Amendment 3 application contained sufficient information for the staff to begin a technical review.

In connection with the staff’s review, information identified in the enclosure to this letter is needed. This information should be provided by February 28, 2006. If you are unable to meet this deadline, you must notify us in writing, at least 2 weeks in advance of your new submittal date, and the reasons for the delay. The staff will then assess the impact of the new submittal date and notify you of a revised schedule. If additional information requested by this letter result in you making changes to the Final Safety Analysis Report (FSAR), revised FSAR pages should be submitted. Justification for any FSAR changes should also be included in your response.

Reference Docket No. 72-1014 and TAC No. L23850 in future correspondence related to this licensing action. If you have any questions regarding this matter, you may contact me at (301) 415-8500.

Sincerely,

/RA/

Christopher M. Regan, Senior Project Manager
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket No. 72-1014
TAC No. L23850

Enclosure: Request for Additional Information

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Enclosure

Request For Additional Information
Holtec International HI-STORM 100 Cask System
License Amendment Request 1014-3, Revision 1, Docket 72-1014

By application dated December 30, 2004, resubmitted February 22, 2005, and revised May 16, 2005, Holtec International (Holtec) requested Amendment 3 to Certificate of Compliance (CoC) No. 1014 for the HI-STORM 100 Cask System in accordance with 10 CFR Part 72. This Request for Additional Information (RAI) identifies additional information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the application. The requested information is listed by chapter number and title and, where possible, section number, in the applicant's safety analysis report. NUREG-1536, "Standard Review Plan For Dry Cask Storage Systems," was used by the staff in its review of the application.

Each individual RAI describes information needed by the staff in order to complete the review of the application and to determine whether the applicant has demonstrated compliance with regulatory requirements.

General:

G-1. Add change bars in the right margin to the new information added in the Supplement I to each Chapter. Additionally clarify and indicate which portions of Chapter 4 and 11 are new or revised material. If the entire chapter is considered revised, change bars should be added to indicate a wholesale rewrite of the chapter.

This information is needed to determine compliance with 10 CFR 72.244.

Chapter 1 - General Description

1-1. Revise the characterization that NUREG-1536 contains regulatory requirements

Table 1.0.3 lists NUREG-1536 "requirements." NUREG-1536, "Standard Review Plan (SRP) for Dry Cask Storage Systems," provides guidance to the NRC staff in Spent Fuel Project Office (SFPO) for performing safety reviews of dry cask storage systems. The SRP is intended to ensure the quality and uniformity of the staff reviews, present a basis for the review scope, and clarification of the regulatory requirements. As such the SRP does not contain or impose regulatory requirements.

This information is needed to determine compliance with 10 CFR 72.244.

1-2. Provide a drawing of the details of the actual hardware that constitute the basket supports inside the Multi-Purpose Canister (MPC).

Proposed Final Safety Analysis Report (FSAR) change 1-13 states that, "Figures 1.2.2 through 1.2.4 - Modified to remove basket supports, which were not representative of the actual hardware." No substitute figure or drawing was identified in the remainder of proposed Amendment 3 to identify the basket support system.

This information is needed to determine compliance with 10 CFR 72.230 and 10 CFR 72.24 (c)(3).

1-3. Provide the proposed Bill-of-Materials for the HI-STORM 100U comparable to drawing BM-1575, Sheets 1 and 2, as provided in Section 1.5 of the FSAR.

Proposed Drawing 4501 of 6 sheets apparently does not have an associated Bill-of-Materials provided in the proposed Amendment 3.

This information is needed to determine compliance with 10 CFR 72.236 (b) and 10 CFR 72.24 (c)(3).

1-4. Revise the FSAR and Technical Specifications (TS) definition of damaged fuel to coincide with the HI-STAR 100, Amendment 2, CoC 9261.

The definition of damaged fuel should consider both storage and transportation. Although different definitions of damaged fuel could be employed between storage and transport, that could result in the re-examination and re-classification of the spent fuel already in storage against a different damaged fuel definition necessary to meet the requirements for transportation. It should be recognized that the conditions for storage are relatively mild compared to the conditions and loads the spent fuel would experience under design accident conditions of transportation.

Re-classification and potentially repackaging of spent fuel should be avoided. Therefore, the staff considers it desirable to adopt a single definition of damaged fuel that satisfies the demands of both storage and transportation. The staff notes that the current definition of damaged spent fuel from the HI-STAR 100 CoC is considered acceptable.

This information is necessary to ensure consistency between Holtec designs, consistency with present staff guidance, and completeness of the application, in accordance with 10 CFR 72.24, 72.26, and 72.236(m).

1-5. Clarify what would be a limiting bounding case for the screen opening size of the inlet and outlet passages of the Vertical Ventilated Module (VVM) discussed in Section 1.I.2.1.. The FSAR states the screen opening size and total perforation area are selected on a site specific basis to minimize the resistance to the air flow ventilation. However, no analysis is provided that would bound the thermal analysis results for any site.

This information is needed to determine compliance with 10 CFR 72.11 and 72.236.

Chapter 2 - Principle Design Criteria

2-1. Indicate what consideration has been made in addition to assuring the top reinforced concrete pad will always settle more than the support foundation for purely vertical movement to address possible rotation or differential settlement across the top

reinforced concrete pad and the resulting non-uniform lateral loading on the Cavity Enclosure Container (CEC).

Proposed Table 2.I.2 in Item 1, defining the minimum vertical stiffness of the support foundation (lb/in), indicates that this minimum stiffness prevents excessive support foundation settlement under load. It is also noted in Footnote 1 that the computed settlement of the top reinforced concrete pad should always be more than that of the support foundation and the supported HI-STORM 100U VVM so that any remediation due to subgrade settlement can be restricted to the top reinforced concrete pad. No mention is made for the condition of other than uniform vertical settlement.

This information is needed to determine compliance with 10 CFR 72.236(b) and 10 CFR 72.24(c)(2).

2-2. Indicate how the top reinforced concrete pad provides a water seepage barrier (leak tight) against rainwater and melting snow as it girdles the container shell and underlies the container flange.

Proposed Section 2.I.2, in characterizing the principal design criteria, describes the pathway between these subcomponents of the CEC and the top reinforced concrete pad as leak tight, yet it is expected that there will be relative vertical movement between the outside of the container (cavity) shell and the top reinforced concrete pad. No provisions for such a leak tight seal are apparent in the proposed Amendment 3.

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

2-3. Clarify that the minimum reinforcing steel, identified in proposed Table 2.I.6 for the support foundation and the top reinforced concrete pad, is a single layer in two orthagonal directions with its location in the slabs undefined.

Table 2.I.6 identifies #11 bars at 12 inch centers for the support foundation and #9 bars at 12 inch centers for the top reinforced concrete pad, each placed in two directions. However, concrete cover minimums are given for top and bottom surfaces in the 24 inch minimum thickness slabs that would indicate there is more than a single layer of reinforcing in two directions.

This information is needed to determine compliance with 10 CFR 72.24(c)(3).

2-4. Explain why Table 2.1.13, which has been deleted from the FSAR, is referenced on Page 2.0-4.

This information is needed to assure compliance with 10 CFR 72.11 and 72.236.

2-5. Clarify why the design basis fuel assembly types for each design criterion have been deleted from Table 2.1.5.

Each fuel assembly type was selected to bound a specific criteria to simplify the thermal calculations. Otherwise, individual thermal evaluations for each fuel assembly type intended to be stored in a given MPC should be provided.

This information is needed to assure compliance with 10 CFR 72.11 and 72.236.

2-6. Revise Table 2.1.27 to include the MPC maximum decay heat as specified in the FSAR. Maximum decay heat is missing in this Table.

This information is needed to assure compliance with 10 CFR 72.11 and 72.236.

Chapter 3 - Structural Design

3-1. Clarify which American Society of Mechanical Engineers (ASME) Code edition and Addenda are to be used with Table 3-2 of Appendix B of the CoC.

Proposed Section 3.3 of Appendix B of the CoC and Table 3-2 do not identify the ASME Code edition and Addenda that are to be used for the underground overpack (VVM).

Section 3.3 states that, "The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), 1995 Edition with Addenda through 1997, is the governing Code for the HI-STORM 100 System MPCs, above ground overpacks and transfer casks, as clarified in Specification 3.3.1 below, except for Code Sections V and IX. The Code paragraphs applicable to the underground overpacks are listed in Table 3-2."

These statements indicate other Code edition and Addenda apply to the underground overpacks (VVMs) because Table 3-2 does not identify which Code edition and Addenda apply. The proposed FSAR, in Section 2.I.7, indicates the VVM will be designed and constructed to the Code requirements for Subsection NF Class 3, 1995 Edition, with Addenda through 1997.

This information is needed to determine compliance with 10 CFR 72.236(b) and 10 CFR 72.24(c)(4).

3-2. Describe how the volume of shielding concrete within the closure lid will be placed, the number of separate volumes that will be placed, and the sequence of the placements during fabrication.

Additional information beyond that provided in Drawing 4501 and Section 3.I is needed to ascertain the manner of fabrication and the method of assuring adequate concrete placement into the volumes of the closure lid.

This information is needed to determine compliance with 10 CFR 72.236(b) and 10 CFR 72.24 (c)(3).

3-3. Identify the load path used in the "conservative representative seismic analysis" through which an assumed 50% of the MPC inertia force is transferred to the top of the CEC container shell. Also provide the calculation package identified in Section 3.I.6.4.

It is not clear from the description provided in Section 3.I.4.7 whether the load transfer path is via the upper MPC guides or is through direct contact of the MPC shell on the CEC.

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

3-4. Specify the chloride level restriction and its basis for the insulation material used in the VVM. Provide an assessment of the affects of corrosion on the VVM and the consequent ability of the VVM to perform its design basis function. Also, discuss the potential impact that leached chlorides or other corrosive species would have on the spent fuel cask.

Although the VVM is not normally expected to contain water, postulated flooding events could wet the insulation and cause corrosion under the insulation. Additionally, leached chlorides (or other corrosive species) contained in the wetted insulation, could cause unanalyzed or potentially deleterious effects upon the structure or heat removal ability of the VVM, or introduce corrosive species into the VVM and storage cask environment.

This information is needed to determine compliance with 10 CFR 72.24.

3-5. Provide a complete, engineered design for corrosion protection of the exterior of the CEC, incorporating a coating with an impressed current cathodic protection (CP) system. Include detailed design drawings. Discuss operation, testing, and maintenance requirements for the CP system. Propose and discuss appropriate CP system Limiting Conditions of Operation (LCO) for the Technical Specifications. Provide discussion supporting the use of an active system in a storage facility. Specify the coating system to be used, including design coating thickness. Discuss the coatings qualifications program to be used to select or qualify the specified coating and any alternative supplier coating.

The applicant has proposed four different conceptual designs for protecting the exterior of the CEC from corrosion. The staff has reviewed these designs along with other industry corrosion protection standards and methods for buried structures. Based upon this review, the staff offers the following general comments.

With respect to the two designs that specify an organic coating without a CP system, the staff believes that, for a 40-year design life, a success path with this approach is unlikely. Consequently, the staff recommends the applicant discontinue this approach.

Under the Department of Transportation (DOT) rules for buried pipelines contained in 49 CFR 195.551 through 195.569 (10-1-04 edition), the only acceptable method for protecting a buried steel structure (pipeline) is by means of an organic coating with a CP system. These regulations also outline other requirements. A similar corrosion protection requirement exists for the tank bottoms of above-ground storage tanks. Under Environmental Protection Agency rules, a CP system is required. The NRC staff considers the DOT requirements provide a sound basis for the design of underground structures and suggests the applicant consider these requirements when developing the design of the HI-STORM 100U cask system. The staff views an organic coating system combined with an impressed current CP system as a design potentially acceptable to the staff, although a thorough evaluation of the expected useful lifetime of organic coatings is warranted.

Employment of a CP system will require the inclusion of appropriate Limiting Conditions for Operation (LCO) and Technical Specifications (TS) to cover anticipated power outages, CP system failures, and/or maintenance outages for the CP system. Since

corrosion in the ground generally proceeds slowly, LCO times should not prove burdensome. A discussion and justification of proposed LCO times is necessary.

For the concrete encased design, two design variations may be potentially acceptable to the staff, one with an impressed current CP system for more (typical) aggressive environments, and one without, for atypical mild or dry environments. It is expected that the majority of users would require use of the CP protected system. The criteria that would differentiate between the two would include primarily (but not necessarily be limited to) the soil pH, conductivity, and chloride content. Defining the boundary between the two cases is important and should be made clear in the application and FSAR. If this option is exercised, the choice of design must be a major consideration by any potential purchaser of the HI-STORM 100U cask system when performing the 10 CFR 72.212 evaluation.

Potential acceptance of a concrete encased design (without CP) versus a polymeric coating (without CP) is due to the pH buffering effect of concrete when soil conditions are relatively mild. Polymer systems do not provide this chemical buffering effect.

Given the information provided by the applicant the staff was unable to determine the consequences of corrosion upon the CEC structure. It was not clear if, for example, perforation of the CEC structure by corrosion pitting constituted a "failure" of the system. Such an analysis is especially necessary for any design that employs only a barrier coating and is not supplemented by a cathodic protection (CP) system. The staff believes only a CP system, properly operated, ensures continued corrosion-free integrity of a buried structure exposed to typical soil conditions.

For the detailed design(s) submitted for review, the applicant must ensure that details and drawings of the CP system design are included. Include in the design a means for periodically testing the efficacy of the CP system with reference electrodes. Discuss the acceptance testing for the coating and the Quality Assurance/Quality Control (QA/QC) program for avoiding damage to the coating system and CP system electrodes and cables when backfill is emplaced.

With respect to organic coatings, the staff recognizes the desire to change coating vendors and to use "equivalent" coatings. This may be accomplished by specifying one or two specific types or brands and then specifying the coatings qualification program with performance or selection criteria that would be used for selecting or testing the alternatives. The criteria and evaluation/test methods should be controlled by the TS, i.e., the staff would consider incorporation by reference into the TS of the FSAR criteria and evaluation/test methods, if appropriate, with specific notation in the FSAR indicating the information is not changeable under 10 CFR 72.48.

Coating application should be controlled by the coating manufacturer's recommendations. Governing procedures and QA/QC programs should be incorporated by reference into the TS.

With respect to CP system design, ensure that the bottom plate is adequately protected by CP. Also ensure that any necessary test connections are incorporated into the design so that the bottom plate and the rest of the CEC structure can be periodically

tested for adequate CP system performance by use of reference electrodes. Establish the acceptance criteria for these periodic surveys.

This information is required for completeness of the application under the provisions of 10 CFR 72.24 and 72.26.

Chapter 4 - Thermal Evaluation

4-1. Provide a reference for the emissivity value of the insulation material used in the HI-STORM 100U thermal analysis. Update Table 4.2.1 and Table 4.2.2 of the FSAR accordingly.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-2. Provide references for the thermal properties of soil used in the HI-STORM 100U thermal analysis. Update Tables 4.2.1, 4.2.2, and 4.2.5 of the FSAR accordingly.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-3. Clarify if all the carbon steel surfaces are painted in order to justify an emissivity value of 0.85 which, according to Table 4.2.4 of the FSAR, corresponds to painted surfaces.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-4. Provide a thermal calculation package for the pressurized water reactor (PWR) and boiling water reactor (BWR) fuel configurations provided in the FSAR for both HI-STORM 100 and HI-STORM 100U storage casks. This calculation package should include input and output files (e.g., gambit data base, FLUENT case and data files for the two-dimensional (2-D) and three-dimensional (3-D) models described in the FSAR).

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-5. Explain why the 3-D porous media model developed to benchmark porous media model for peak cladding temperature calculations is not sensitive to changes in the flow resistance parameters even when the numerical values used in the FLUENT model are increased by 3 or 4 orders of magnitude.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-6. Provide the flow resistance calculation for PWR and BWR fuel assembly configurations.

One possible approach to obtain the porous media flow resistance parameters would be to perform a Computational Fluid Dynamics (CFD) analysis for each type of fuel

assembly for the expected operating conditions (pressure and average gas temperature) when it is inside the dry storage cask. This approach is described as follows:

The FLUENT porous media flow resistance model is defined as:

$$\frac{\Delta P}{L} = D\mu V + C\left(\frac{1}{2}\rho V^2\right) \qquad (1)$$

where

ΔP is porous media pressure drop
V is superficial fluid velocity
L is length of porous media
μ is fluid viscosity
ρ is fluid density
D is viscous resistance parameter
C is inertial resistance parameter

The pressure drop for a laminar flow pipe has been experimentally determined to correspond to the following expression:

$$\frac{\Delta P}{L} = \frac{32\mu}{D^2} V \qquad (2)$$

where a friction factor

$$f = \frac{F}{\mathrm{Re}} \qquad (3)$$

with **F** = 64

has been experimentally determined.

For an array of solid rods, as is the case of a PWR or BWR nuclear spent fuel assembly, the value of the factor "F" can be determined from available literature (see for example E.M. Sparrow and A.L. Loeffler, in "Longitudinal Laminar Flow Regime Between Cylinders Arranged in Regular Array," American Institute of Chemical Engineering Journal, Volume 5 Number 3, Pages 325-330, September 1959). Based on this reference, "F" has been found to have a value around 100, depending on the p/d ratio and the porosity of the array where d is the fuel rod diameter and p is the fuel rods pitch.

Using Equation (1) and neglecting the inertial term (since for the type of flow internal to the canister, the dominant contributor to pressure drop is mostly due to viscous effect), the pressure drop for an square array of solid rods can be simplified to:

$$\frac{\Delta P}{L} = D\mu V \qquad (4)$$

where D is defined as follows (based on Equation (2)):

$$D = \frac{F}{2d_h^{\,2}} \qquad (5)$$

From the CFD calculations, the wall shear stresses should be obtained separately for bare fuel rods and for fuel rods plus grid straps. These results combined with the flow Reynolds number (based on the applicable hydraulic diameter (d_h)) can then be used to calculate **F** using Equation (3) as follows:

$$f = \frac{4\tau_w}{\left(\frac{1}{2}\rho V^2\right)} \qquad (6)$$

$$F = f\,\mathrm{Re} \qquad (7)$$

And finally D, the viscous resistance parameter, is calculated using Equation (5)

This information is needed to determine compliance with 10 CFR 72.230(f).

4-7. Provide additional detail of the calculations used to obtain a Nusselt number of 79 for the water in the water jacket of the transfer cask. Additionally, provide either experimental data or a CFD analysis to justify a Nusselt number of 79 for the water in the water jacket of the transfer cask.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-8. Provide a bounding thermal calculation that includes the effect of site elevation on the atmospheric pressure. The location of the site where the HI-STORM 100 or HI-STORM 100U storage system is deployed may have an impact on the operating pressure. This in turn will have a direct impact on the calculated peak cladding temperature.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-9. Discuss the methods used to experimentally determine the mass flow rates of the HI-STORM 100U storage system inlet and outlet vents and which verify the CFD predictions described in the FSAR.

Due to the new and unique design concept, additional assurance of the validity of the predicted mass flow rates is necessary. The peak cladding temperature is highly

sensitive to the predicted value of this variable. Based on sensitivity studies, the staff determined that it would require approximately a 5 to 15% reduction in the CFD predicted mass flow rates to violate the peak cladding temperature allowable limit.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-10. Clarify the original intent of the thermal testing specified in the CoC and justify why it has been deleted from the CoC.

The changes to the operating conditions, modeling assumptions, and thermal design, resulting from addition of the HI-STORM 100U overpack, suggest that some additional testing may be required to justify the proposed design and analysis methods provided in the FSAR.

This information is needed to assure compliance with 10 CFR 72.11, 72.24(d), and 72.236.

4-11. Verify that the new time limits for completion times provided in the proposed TS are consistent with the thermal analysis results given in the FSAR. Some of the time limits have changed as a result of increased heat load.

This information is needed to assure compliance with 10 CFR 72.11, 72.24(d), and 72.236.

Chapter 5 - Shielding Evaluation

5-1. Revise the discussion of the source term methodology to include the effects of axially zoned enrichments.

Page 5.4-1 states that the axial source strength is adjusted (power of 4.2 relationship) to account for the effect of axial exposure variations. The methodology should also include discussion of the effect of enrichment variations. NUREG/CR-6802 states that the neutron source is proportional to the relative enrichment raised to the power of -1.98. This indicates that if an assembly design has a central zone enrichment of 4.5 weight percent U-235 and utilized natural uranium blankets the neutron source term in the nodes corresponding to the natural blankets should be increased by a factor of nearly 40. The effect of this correction will depend on the shielding design at the ends of the cask as well as the lower relative exposure of the blanket regions. The methodology should include an allowance for this potentially significant correction.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-2. Revise the determination of site boundary doses for the HI-TRAC accident case to utilize an appropriate methodology.

Page 5.1-10 (Section 5.1.2) states that the site boundary dose for the accident configuration of the HI-TRAC transfer cask is determined by multiplying the 1 meter HI-TRAC transfer cask dose by the ratio of the site boundary and 1 meter doses for the HI-STORM storage cask. Because the quality of radiation is very different for these cases (97-98% gamma verses 26% gamma) it is not appropriate to use this ratio.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-3. Provide a consistent comparison between the various overpack designs.

There are a number of overpack and MPC designs presented in Chapter 5, with the stated claim that the HI-STORM 100 Version B overpack is bounding from a shielding perspective. A comparison of the various designs using a consistent source term is needed to validate the bounding nature of the Version B overpack. This information is also needed to separate the dose rate increase into the component that is due to an increase in source term and the component that is due to changes in overpack design.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-4. Provide additional information to validate the statement on Page 5.4-14 that the uniform source term bounds the regionalized loading scheme where it is possible to preferentially load higher decay heat assemblies on the periphery of the basket.

The discussion deleted from this section had provided detailed justification for the use of a uniform loading pattern to bound the range of allowed regionalized loading patterns. In order to confirm that the use of uniform loading patterns is still bounding for the increased source term and altered lid designs of the HI-STORM 100U and HI-STORM 100S Version B it is necessary that similar information be provided in this amendment.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-5. Provide additional information concerning the geometry of the model used to determine the values of C in Table 5.4.7 on Page 5.4-23.

From the discussion provided it is unclear as to the fraction of a “shielded cask” that is within a direct line of sight of the dose recipient. This information could be sketches, input files, or additional description.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-6. Provide additional justification for the claim on Page 5.3-4 that the difference between the current MPC-24 design and the previous design is not significant to the shielding analysis.

Although the general location of the fuel assemblies remains the same, there are additional streaming paths between assemblies that decrease the shielding provided by the outer assemblies. The assemblies also appear to be located slightly closer to the edge of the MPC. These differences may have an effect on the dose rates outside the cask and need further justification.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-7. Provide additional information justifying the use of the MPC-24 basket as the most limiting MPC for normal and accident conditions in the HI-TRAC transfer cask (125 and 100 ton versions).

Sections 5.1.2 provides a description for the shielding analysis for the accident conditions when the HI-TRAC transfer cask neutron shield is drained but does not provide justification concerning the use of the MPC-24 as the most limiting contents of the HI-TRAC transfer cask under either normal or accident conditions.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-8. Provide dose rate verses radius information for the top of the HI-STORM 100U underground storage module.

The shielding design for the 100U lid represents a significant change from previously approved designs yet there is no assessment of the dose verses radius. Because this is the area that site personnel will have access to during operation it is of importance to demonstrate that As Low As Reasonably Achievable (ALARA) requirements are met.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-9. Provide additional information, to include a sketch, regarding the location of the 1 meter dose for the HI-STORM 100U underground storage module.

The provided analysis is unclear as to the exact location of the 1 meter dose listed in Table 5.I.1 (Page 5.I.4). It is possible for the location to be 1 meter above the cask centerline or 1 meter from the edge of the cask along the surface grade and a sketch is not provided. The 1 meter dose rate should be established for the most limiting location that is accessible to site personnel. The HI-STORM 100U design allows access to a number of different locations and further information is needed to demonstrate that the most limiting 1 meter dose rate has been determined.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-10. Provide the documentation supporting the 10 CFR 72.48 evaluation of the HI-STORM 100S Version B Overpack and revise the FSAR to include this evaluation and design.

The HI-STORM 100S Version B Overpack was originally incorporated into the FSAR via a 10 CFR 72.48 evaluation and by an approved amendment. Since the HI-STORM 100S Version B is now the most limiting overpack design (per FSAR Page 5.1-4) it is necessary to include this design in order to justify the TS dose limit changes requested for TS. (See also RAI 5-6 above.)

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-11. Revise Table 5.I.1 and Figure 5.I.1 to indicate the location of Dose Point Location 3.

Dose Point Location 3 is not shown on the figure.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

5-12. Provide additional justification for the use of Shielding Analysis Sequence No. 2 (SAS2) results for the generation of source terms to 70/75 GWd/MTU (BWR/PWR) when the validations referenced in Section 5.2 extend only to 57/47 GWd/MTU.

The burnup values applied in the Amendment 3 analyses are significantly higher than for prior amendments. This increase in exposure is not accompanied by any discussion as to the fidelity of the isotopic predictions or the adequacy of the 5% conservatism added. To justify the adequacy of the added margin a discussion of the behavior of the uncertainty verses exposure is needed.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

Chapter 6.0 - Criticality Evaluation

6-1 Clarify why “F” shells remain in the last full paragraph on Page 6.1-4 and in the titles for Sections 6.2.4.3.1 and 6.2.4.3.2 on Page 6.2-8.

LAR 1014-3, Revision 1, proposed change number 7 states: “The special feature that separated the MPC-24EF, MPC-32F and MPC-68FF from their ‘non-F’ counterparts were only required to meet secondary containment requirements for fuel debris in transportation governed by 10 CFR 71. Changes to 10 CFR 71 have eliminated the need for those features.”

This information is needed to determine compliance with 10 CFR 72.124.

6-2 Clarify the type of 16x16 assembly data presented in Table 6.C.1, Page 6.C-14.

The specific numerical designation for the 16x16 array has been deleted with no replacement indicated.

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

6-3 In Table 6.C.1 on Page 6.C-14, provide new values for k_{eff} in the 16x16 case.

There are no replacement values for maximum and calculated k_{eff} on Page 6.C-14 for the 16x16 assembly.

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

Chapter 7 - Confinement Evaluation

The staff has no RAIs specific to Chapter 7. However, note that responses to other RAIs may require revisions to this section.

Chapter 8 - Operating Procedures

8-1. Confirm that during loading, when the water level in the loaded cask is lowered in preparation for lid welding, either of these conditions occur: 1) the water level reduction is restricted so as to avoid uncovering the fuel cladding, or, 2) an inert gas is used to displace the water. Also verify that similar controls exist during cask unloading.

In addition, provide proposed wording for incorporating this restriction into the Technical Specifications.

The intent of this provision is to ensure that no fuel cladding is in contact with air when it is at an elevated temperature (above the boiling point of water). This is to ensure that no deleterious oxidation of the fuel pellets can occur. Note that the fuel need not be damaged for this situation to occur. The definition of undamaged fuel still permits pinhole leaks and hairline cracks which may allow oxidation of the fuel pellets and consequent splitting of the cladding.

This information is needed to determine compliance with 10 CFR 72.24 and 72.26.

8-2. Revise FSAR Page 8.1-21, Table 8.1.7, FSAR Chapter 9, FSAR Section 12.2.2, and the TS to restore helium leak testing of the DSC vent and drain port cover plates.

Table 8.1.7 is inconsistent with current leak testing criteria and information contained elsewhere in the FSAR and TS.

This information is needed to determine compliance with 10 CFR 72.24 and 72.26.

8-3 Clarify that the tables of estimated handling weights (Tables 8.1.2 through 8.1.4) reflect the possible increased weight in BWR fuel assemblies from 700 lbs to 710 lbs and in PWR fuel assemblies from 1680 lbs to 1720 lbs.

This information is needed to determine compliance with 10 CFR 72.11, 72.24(c), and 72.236.

Chapter 9 - Acceptance Criteria and Maintenance Program

9-1. Provide additional discussion in the FSAR paragraph 9.I.2.1 to support Table 9.I.1, Item 9, In-Service Inspection of the VVM. In the discussion, list the specific inspections and justify the recommended intervals for the VVM inspection activities.

Note that the actual inspection guidance document(s) must include a reference to the plant corrective action program for disposition of inspection findings.

This information is needed to determine compliance with 10 CFR 72.24.

Chapter 10 - Radiation Protection

10-1. Provide an analysis of the occupational doses associated with the loading of an underground HI-STORM 100U overpack.

Chapter 10 provides projected occupational doses for the loading of an aboveground overpack and although many of the activities necessary to load an underground overpack would be similar, there may be some important differences (i.e., down loading the MPC and placement of the HI-STORM 100U overpack lid).

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

Chapter 11 - Accident Analysis

11-1. Revise Section 11.2.3.2 to address the reduced pedestal shielding of the HI-STORM 100S Version B overpack.

The HI-STORM 100S Version B overpack has significantly less shielding within the pedestal region (below the loaded MPC) as compared to the other above ground overpack designs. This reduction in shielding includes the total removal of hydrogenous materials and may have a dramatic effect on the neutron dose resulting from a tip over. Although the tip over accident is stipulated as non-mechanistic the consequences of the accident as described in the FSAR need to be updated for the HI-STORM 100S Version B design. Should the revised accident analysis result in non-negligible dose rates at the exposed bottom surface of the overpack, dose estimates to a person at the site boundary should also be provided.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

Chapter 12 - Operating Controls and Limits (Technical Specifications)

12-1. Restore the FSAR description and the TS to conform with the intent of ISG-18.

The NRC has recognized that the language of Interim Staff Guidance (ISG) -18, "The Design/Qualification of Final Closure Welds on Austinetic Stainless Steel Canisters as

Confinement Boundary for Spent Fuel Storage and Containment Boundary for Spent Fuel transportation," as written, is unclear and has consequently been mis-characterized in the FSAR. The intent of ISG-18 was to provide relief from the helium leak test requirement for the structural lid to shell weld only. However, the relief has been erroneously applied to other welds associated with the cask lids, specifically the vent and drain line cover plates.

This information is needed to determine compliance with 10 CFR 72.24.

12-2. Justify removal of the TS requirement to perform a dose rate measurement on the top of the HI-TRAC transfer cask.

Technical Specification Pages 5.0-5 and 5.0-6 indicate that the requirement to perform a dose rate measurement on the top of the HI-TRAC transfer cask is requested to be removed. Because the dose rates in this area contribute significantly to the doses delivered to personnel during cask operations verification of the expected dose rates is an important ALARA consideration.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

12-3. Revise Technical Specification 5.7 (Pages 5.0-5 through 5.0-7) to include measurements on the lid of both the aboveground and below ground overpacks.

The provided Technical Specifications do not include a requirement to establish dose rate limits for the top of the underground overpack. In order to insure that the requirements of 10 CFR 72.104(b) are met, it is necessary to include measurement requirements for the top of the underground overpack that are similar to those performed for the aboveground overpack (TS Sections 5.7.3(a) and 5.7.8(d)).

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

12-4. Justify how the dose rate limits proposed in Technical Specification Section 5.7.4 satisfy the requirements of 10 CFR 72.104(b).

The amendment requests a surface dose rate increase of nearly 300% without any compensating change in design or operational procedures to limit exposure.

This information regarding the source term and shielding is needed to determine compliance with 10 CFR 72.236(d).

12-5. Revise TS Limiting Condition for Operation (LCO) 3.1.1.B.2, and associated TS Bases to indicate how the results of the engineering evaluation used to return the MPC to an analyzed condition can be applied to exiting the LCO.

It is not clear from the existing TS language how a user can apply the results of the engineering evaluation to exiting the LCO. The TS, as written, implies that so long as an engineering evaluation is performed and the MPC is in "an analyzed condition" the

LCO action has been satisfied. It is not clear, however, whether the analyzed condition now satisfies the MPC helium backfill requirements. It is because of this the TS is confused and should be clarified.

This information is needed to determine compliance with 10 CFR 72.24.

12-6. Clarify the location of the temperature measurement, indicated as 180EF under steady state conditions, for the Supplemental Cooling System (SCS) design criteria (CoC Appendix B Section 3.7.2)

It is not clear where the 180EF temperature criteria should be applied as the temperature of the coolant will vary depending on its location within the SCS. Additionally this is not consistent with the description provided in Section 2.C.2, which states the coolant temperature will be limited to below 180EF under steady state conditions.

This information is needed to determine compliance with 10 CFR 72.24.

Chapter 13 - Quality Assurance

The staff has no RAIs specific to Chapter 13. However, note that responses to other RAIs may require revisions to this section.