June 6, 2006

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

SUBJECT: HI-STORM 100, AMENDMENT 3, REQUEST FOR ADDITIONAL INFORMATION NO. 2 (TAC NO. L23850)

Dear Mr. Rosenbaum:

By letter dated December 30, 2004, Holtec International (Holtec), submitted 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. As a result of issues identified during the staff's acceptance review, 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. The staff issued a Request for Additional Information (RAI) -1 on November 30, 2005. Holtec responded to the staff's RAI-1 on February 18, 2006.

In connection with the staff's review of the application and the response to the staff's RAI-1, further information identified in the enclosure to this letter is needed. This information should be provided by July 5, 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 results 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: RAI

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Docket No. 72-1014
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Enclosure: RAI
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Request For Additional Information No. 2
Holtec International HI-STORM 100 Cask System
License Amendment Request 1014-3, Revision 1, Docket 72-1014

By application dated December 30, 2004, and revised May 16, 2005, and February 18, 2006, 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 second Request for Additional Information (RAI-2) 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 Final Safety Analysis Report (FSAR). If a new RAI is related to the staff's RAI-1 dated November 30, 2005, the original RAI number is denoted in [ ]. 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. Justify inclusion of the 16x16 CE System 80+ assembly as approved contents for the Multi-Purpose Canisters (MPCs).

The 16x16 CE System 80+ assembly is 178.3 inches tall, excluding manufacturing tolerances and any swelling and deformations experienced during irradiation in the reactor. The current MPC (see Drawing 3923, Revision 13) has a cavity dimension of 178.3125 inches. Thus the clearance would be 0.0125 inches. The fuel assembly manufacturing tolerances alone appear sufficient to make this assembly unable to fit in the current MPC design. Furthermore, the applicant has recognized that the assembly does not physically fit into the MPC. The SAR should be revised to remove the changes that were made in order to include the fuel assembly in the approved contents list or additional justification should be provided to demonstrate that the fuel assembly will fit in the MPC and thus be included in the approved contents list.

This information is needed to confirm compliance with 10 CFR 72.11(a) and 72.236(a).

Chapter 1 - General Description

1.1 Provide ASME specifications, or more detailed requirements and criteria, for the alternative materials mentioned for the items listed as important to safety items in SAR Chapter 1, drawing 4762, sheet 2, rev. 0, and SAR table 2.I.7.

The bill of materials states "or equivalent" for numerous important to safety items. The staff appreciates that flexibility of material choice is possible and desired for these components. However, the phrase "or equivalent" does not convey sufficiently what the substitute material may be or what the desired material properties must be. The staff

notes that the applicant has previously employed the “alloy x” method for handling certain material substitutions.

This information is required for compliance with 10 CFR 72.25(c)(3).

1-2. Include the Bill of Materials (BOM) for the HI-STORM 100U submitted as Attachment 6 to the February 18, 2006, transmittal letter in the FSAR or propose equivalent information from the BOM to be added to the FSAR. [November 30, 2005, RAI 1-3]

The BOM provides a needed compendium linking the item number and nomenclature of the various components with the identification of the material reference specification to be used in fabrication, nominal dimensions, and its safety classification that can be used for evaluation of the cask system. It should be noted that a similar Bill of Materials, BM-1575, for the HI-STORM 100 Overpack is currently included in the FSAR, Section 1.5,

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

Chapter 2 - Principle Design Criteria

2-1 Provide adequate details of the joint (minimum depth of 24") configuration including the joint width and joint material used between the portion of the top pad surrounding the Cavity Enclosure Container (CEC) and that portion of the top pad that serves as the transporter riding surface. [November 30, 2005, RAI 2-1]

The details should be sufficient to determine if the joint will be a true isolation joint to preclude loading of the CEC outer shell caused by a defined maximum differential settlement across the transporter riding surface. The details of a typical expansion joint added to Drawing 4501, Sheet 3, as an illustrative detail, appears only as a straight line at the toe of the slope for the transition between top pad portions, without any other detail.

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

2-2. Revise the FSAR to indicate that the integrity of the caulking system used in conjunction with the concrete top pad and the corrosion protection coating of the CEC will undergo routine visual surveillance at an appropriate frequency based on service conditions and material manufacturer’s recommendations as part of the Independent Spent Fuel Storage Installation’s (ISFSI’s) preventive maintenance program. [November 30, 2005, RAI 2-2]

The NRC staff considers the caulk seals to be secondary barriers in the corrosion protection system that are to preclude surface moisture access to the below grade portions of the Vertically Ventilated Module (VVM).

This information is needed to determine compliance with 10 CFR 72.236 (g) of the CEC.

Chapter 3 - Structural Design

3-1. Provide for the inclusion of corrosion protected steel reinforcement within the protective concrete coating of the Concrete Enclosure Container (CEC).

The staff observes that the 5 inch thick concrete coating specified for protection of the CEC against corrosion is unreinforced. It is recognized that the use of reinforcement within concrete used for shielding purposes may introduce the potential for creating unintended voids within the concrete shield should the concrete mix bridge across the reinforcement during emplacement. However, in the case of the HI-STORM 100-U design, the specified concrete around the CEC is for corrosion control only. To better aid this concrete's purpose of forming a water-retarding, corrosion inhibiting layer, the staff suggests that some reinforcement be included. Reinforcement would aid in controlling the size of any shrinkage cracks that are bound to eventually form in this protective concrete layer.

This information is required for compliance with 10 CFR 72.25(c)(3).

3-2. Re-include on Drawing 4501, Sheet 5, the bottom view of the closure lid assembly showing the vertical lid buttress and the location of the section cut, previously identified as Section F-F, and re-include the revised Drawing 4501, Sheet 6, reflecting the increased size of the inlet openings. [November 30, 2005, RAI 3-2]

The details to be provided on the referenced drawings are necessary for the NRC staff review and evaluation.

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

3-3. Clarify what design characteristics and configurations of the HI-STORM 100U are in fact addressed by the Calculation Package for the HI-STORM 100U, Holtec Report No. HI-2053389, Rev. 1, dated February 17, 2006. [November 30, 2005, RAI 3-3].

The scope of Holtec Report No. HI-2053389 is referred to as “including all of its versions” yet only a single design concept appears to be addressed based on the figures included in the calculation and the proposed FSAR supplements.

This information is needed to determine compliance with 10 CFR 72.238.

3-4. Provide justification for the assumption that a rigid foundation pad results in a conservative response for the HI-STORM 100U system under seismic loading conditions. [November 30, 2005, RAI 3-3]

Previous Soil Structure Interaction (SSI) analyses of 2 foot thick ISFSI pads show that the bending flexibility of the pad results in amplification at the cask center of gravity (c.g.) of as much as 1.6 above the cask base acceleration. (Reference: Bjorkman, et al., “Influence of ISFSI Design Parameters on the Seismic Response of Dry Storage Casks,” SMiRT-16, 2001, Washington, D.C.) While the amount of bending amplification from a sub-surface foundation may not be as great, amplification is still expected. The

assumption of a rigid foundation implies no amplification and biases the behavior of the system.

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

3-5. Provide justification for the assumption that the lower portion of the CEC outer shell and the baseplate in the region of the exterior gussets at the Foundation Anchor Housings are rigid, and that this assumption results in a conservative response to seismic loading conditions. [November 30, 2005, RAI 3-3]

Lateral inertia forces acting on the loaded MPC are resisted by the external gusset plates welded to the CEC shell and baseplate. The circumferential distribution of radial forces acting on the gussets will be highly asymmetric and deform the gusset into the CEC shell, and apply shear and vertical tension to the weld joining the gusset to the baseplate. This will induce stresses in the shell and welds that have not been accounted for or evaluated in the design based on the calculations in Holtec Report No. HI-2053389.

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

3-6. Provide justification that the analysis of a single VVM on a support foundation with lateral dimensions at least three times those of the top pad bounds the results for multiple VVMs on the support foundation for seismic loads. [November 30, 2005, RAI 3-3]

The SSI analysis considers only a single VVM on the support foundation, when in practice it would appear that multiple VVMs will be anchored to the pad at relatively close spacing. Based on the extensive length and width of the foundation pad in the seismic analysis model, it is much too large for a single VVM. Note that while Section 1.I.1 states that each VVM functions completely independent from any other VVM, the figures included in the documentation seem to indicate by section cuts into the figures that the support foundation extends beyond the VVM representation.

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

3-7. Provide justification for not explicitly modeling the divider shell restraints, the VVM divider shell, the upper and lower MPC guides, the loaded MPC, and closure lid for the seismic analysis. Also, provide justification for how the mass of these components was distributed to the top flange ring and baseplate for the proposed seismic model. [November 30, 2005, RAI 3-3]

Based on the information provided, it is not clear what basis was used to conservatively characterize the 50% load distribution to the top flange ring and bottom baseplate for the participation in the soil structure interaction. Also, distributing mass uniformly to the top flange prevents asymmetric loading of the top flange by the lid, divider shell and MPC and leads to non-conservative results.

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

3-8. Demonstrate that the SSI model is adequate in depth and lateral extent to produce reasonably accurate results for the response under seismic loads. [November 30, 2005, RAI 3-3]

The buried support foundation and multiple VVMs anchored to the pad together with the entrapped soil between the VVMs could be considered the structure in the SSI analysis. The soil beneath the support foundation and the soil surrounding the exterior of the multiple VVMs are absent from the model. It should be demonstrated that the omission of the soil beneath the pad and around the exterior of the multiple VVMs leads to conservative results.

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

3-9. Provide information that demonstrates the ability of LS-DYNA to accurately perform SSI analysis for buried structures under seismic loads. The information can be in the form of published benchmarks that have used accepted SSI computer codes such as SASSI (System for Analysis of Soil Structure Interaction). Provide a copy of Reference 1 by Stojko in CALC07. [November 30, 2005, RAI 3-3]

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

3-10. Provide a copy of the LS-DYNA SSI input and output files for the seismic analyses performed. [November 30, 2005, RAI 3-3]

CALC07 states that "the entire model is developed with brick elements." From the figure of the model provided in the calculation, the NRC staff cannot determine how many elements there are through the thickness of the shell and whether reduced integration was used.

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

3-11. Provide a seismic analysis for the 100U VVM system reflecting the above RAIs in which concrete around part of the CEC is used as the corrosion mitigation measure. [November 30, 2005, RAI 3-3]

The NRC staff considers that based on the table of options for corrosion mitigation in Section 3.I.4.1 of the proposed FSAR supplement, it is likely that many areas of use will be in a mild soil environment. As such, some users will not elect to use an impressed current cathodic protection system, therefore, concrete will possibly be the most prevalent mitigation measure.

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

3-12. Clarify the intent of the heading description "METHOD" used on the cover sheet of each of the nine separate calculations included in Holtec Report No: HI-2053389. Explain what constitutes a change in evaluation method performed with ANSYS software or where the method is described as "Strength of Materials." [November 30, 2005, RAI 3-3]

The language of 10 CFR 72.48(a)(2) addresses a "departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses." The NRC staff must assure that the items important to safety have been evaluated by means acceptable to the NRC to demonstrate that the storage system will reasonably maintain confinement of radioactive material under the required design conditions. The NRC staff must have an understanding of what would constitute a departure in method of evaluation for these calculations. For example, it is not clear in CALC 009, which states the method as "ANSYS," or in CALC 008, which states the method as "Strength of Materials," what would constitute a "departure from method of evaluation." Such "method" heading and descriptions are too vague and do not adequately bound the methodology and could potentially lead to misapplication of 10 CFR 72.48.

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

3-13. Provide a detailed description of the appropriate methodology and its application that is used in the seismic calculations. [November 30, 2005, RAI 3-3]

The NRC staff must understand what would be considered a departure from method of evaluation in the context of 10 CFR 72.48. See also RAI 3-12.

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

3-14. Provide a drawing(s) to demonstrate the extent of the CEC concrete encasement with 5 inches of cover. Also, identify the "appropriate guidelines for commercial concrete" that would be used to design and construct this concrete component. Provide a seismic analysis of the VVM system incorporating the "concrete encasement." [Revised FSAR Section 3.I.4.1 submitted in response to the November 20, 2005, staff RAI]

This proposed "concrete encasement" concept is now a possible configuration for the corrosion mitigation measure for the VVM, but there is a lack of adequate information to evaluate this concept.

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

3-15 Justify the use of Table 5.3 of the L. M. Poukhonto reference to conclude that a minimum 5 inches of concrete cover ("concrete encasement") of the CEC, with cylindrical dimensions of 18' high with a diameter exceeding 7', will provide for a 100-year service life, so as to guarantee a service life of 40 years for the VVM. [Revised FSAR Section 3.I.4.1 submitted in response to the November 20, 2005, staff RAI]

The NRC staff notes that the referenced table is contained in Section 5.2.3.1, entitled "Concrete as Protective Material for Reinforcement." The introductory paragraph is as follows: "One of the aspects of combined working of concrete and reinforcement is that concrete provides chemicophysical protection to the reinforcement from corrosion. The chemical effect of the concrete lies in its alkalinity, which makes for the formation of an oxide layer on the reinforcement surface (passivation) and protects it from corrosion." This mechanism applies to conditions where there is bonding between the concrete and

steel whereas the proposed concept has an epoxy coating on the formed steel plate surface.

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

3-16. Justify the classification of the lower MPC guides as not-important-to-safety (NITS) because these are in the lateral load path between the MPC and the support foundation. The upper MPC guides should also be addressed for the same reason. [November 30, 2005, RAI 1-3]

The current proprietary information in the BOM and in Table 2.I-7 indicates these guides are NITS yet it appears from the design that an integrated analysis for seismic loading would show the guides as being important in transferring lateral loads.

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

3-17. Revise the proposed Drawing 4501, Sheet 4, Rev. 1, to reflect a version similar to Rev. 0.

The current proposed version has eliminated the details of the Foundation Anchor Housing (Detail K), the shell guide and the associated welds, and all ITS-C (Important-to-Safety-Class C) items. The same is true for the divider shell and the container shell. Based on RAI 3-16, the upper and lower MPC guides may also need to be re-added to the drawing. Proposed Sheet 4, Rev. 1, of Drawing 4501, does not provide adequate information for the Important-to Safety items.

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

Chapter 4 - Thermal Evaluation

4-1 Provide a copy of a drawing or any other design information for both Boiling Water Reactor (BWR) and Pressurized Water Reactor (PWR) bounding fuel assembly types, where the grid spacer height and thickness are explicitly given.

Based on the staff's review, the grid spacer height and thickness dimensions used by the applicant to calculate the flow resistance of the bounding fuel assembly types do not appear to be conservative.

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

4-2 Modify the Computational Fluid Dynamics (CFD) fuel assembly flow resistance calculations based on the shear stress method by allowing a larger number of thermal-hydraulic iterations and decreasing the residuals convergence criteria to values that are at least 1.0E-06 or lower. The above CFD calculation is described in Holtec Report No. HI-2043285.

The staff determined, based on the applicant's CFD developed models, that wall shear stresses are approximately 10% higher than the applicant's calculated results. The use of accurate resistance parameters may result in smaller thermal margins as compared to the margins claimed by the applicant.

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

4-3 Provide updated thermal calculation packages (HI-2043317 and HI-2043168) for the PWR and BWR fuel configurations provided in the FSAR. These calculation packages 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). In order to provide an acceptable response, the staff suggests that the applicant to review Interim Staff Guidance (ISG) 21, dated April 5, 2006.

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

Chapter 5 - Shielding Evaluation

The staff has no RAIs specific to Chapter 5. However, note that responses to other RAIs may require revisions to this section.

Chapter 6.0 - Criticality Evaluation

6-1 Revise the FSAR to accurately reflect the proposed change regarding "F" and non-"F" series MPCs.

The application proposes to combine the specifications of the "F" series and non-"F" series MPCs. As a result, various changes have been made to the FSAR (text, figures, etc.). Several items do not appear to be consistent with the intent of the proposed change. The FSAR (text, figures, etc.) should be modified in a manner that is consistent with the proposed change. Examples are listed below. This list may not be all-inclusive.

a. Drawing 3923, Revision 13, Sheet 3 (the drawing for the MPCs), Note 4 makes reference to the secondary containment requirement for transportation. While the "F" series MPCs were designed to provide for secondary containment, secondary containment is no longer required for transportation. Thus, this note should be updated to reflect the change in the requirements. Other items on this and the other drawings that address this previous requirement should be updated accordingly as well.

b. Some information seems to be missing in the first bullet of the Table 2.1.22 "Other Limitations" section. The information appears to deal with the Thoria rod canister approved for loading into the MPC-68.

c. The titles for Tables 6.2.41 through 6.2.45 previously described the tables' information as applicable to the MPC-68F and the MPC-68FF. The MPC-68FF

has been removed; however, based upon the text of Section 6.2.4.1, it appears that the MPC-68 should be added to the title of these tables.

d. The "F" series MPCs are still noted in some places in the FSAR text: the middle paragraph of page 6.4-9 (68FF), the paragraph at the bottom of page 6.4-16 (32F), and the MPC labels in Table 6.C.1 on pages Appendix 6.C-12,13 (24EF).

e. The contents specifications have been combined for the MPC-68 and 68FF (Table 2.1-1 of Technical Specifications, Appendix B). Previously, the MPC-68 was approved for storage of one Thoria rod canister (rods from Dresden Unit 1). However, in combining the specifications, the Thoria rod canister is no longer permissible for loading in the MPC-68.

This information is needed to confirm compliance with 10 CFR 72.11(a) and 72.236(a) and (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

The staff has no RAIs specific to Chapter 8. However, note that responses to other RAIs may require revisions to this section.

Chapter 9 - Acceptance Criteria and Maintenance Program

9-1 Propose, in the Technical Specifications (TS), at least one inspection of the CEC for exterior corrosion at installations that do not have an Impressed Current Cathodic Protection System (ICCPS).

The proposed TS specify inspections for cathodically protected CECs in cases where ICCPS operation has been outside the acceptable TS criteria. However, for systems lacking an ICCPS, there is no specific requirement to verify that the performance of the coating system is adequate. NRC regulations are generally formulated upon the premise that a system be designed according to best engineering practice and the continued performance of important-to-safety components be confirmed through periodic inspections or surveillance. The FSAR, as submitted, appears to lack a specific requirement for verifying the absence of significant soil induced corrosion of the CEC, where no ICCPS is employed. The staff considers at least one mandatory inspection, not to exceed a 20-year interval, to be appropriate.

This information is required for compliance with 10 CFR 72.25(c)(3).

Chapter 10 - Radiation Protection

The staff has no RAIs specific to Chapter 10. However, note that responses to other RAIs may require revisions to this section.

Chapter 11 - Accident Analysis

The staff has no RAIs specific to Chapter 11. However, note that responses to other RAIs may require revisions to this section.

Chapter 12 - Operating Controls and Limits (Technical Specifications)

12-1. Propose a revision to Technical Specifications (TS), Appendix B, Table 2.1-1 paragraph V.A.d.ii. to reference the correct section of the TS.

The current proposed paragraph references Section 2.3 of TS, Appendix B, which does not exist. Similar paragraphs for the other MPCs in Table 2.1-1 reference Section 2.4. Thus, it would seem that the correct reference for paragraph V.A.d.ii. is Section 2.4.

This information is needed to confirm compliance with 10 CFR 72.236(a).

12-2. Explain the lack of a Section 2.3 in TS, Appendix B.

The proposed TS do not contain an Appendix B, Section 2.3. This section was apparently not part of any of the previous versions of the TS. The numbering of the TS sections should be sequential and any references to the sections appropriately modified to account for any renumbering of TS sections done to make the section numbering sequential.

This information is needed to confirm compliance with 10 CFR 72.11(a) and 72.236(a).

12-3. Propose a revision to the TS, Appendix B, Table 2.1-1, that limit certain contents to specific basket cell locations so that the entries in Table 2.1-1 reference Figures 2.1-1 through 2.1-4 (also in TS, Appendix B).

Figures 2.1-1 through 2.1-4 are referenced in TS, Appendix B, paragraph 2.1.3, to illustrate the cells that comprise different regions for regionalized fuel loading. The cell location layouts/numbering schemes in these figures also identify the basket cell locations in each MPC to which loading of damaged fuel, fuel debris, and other contents specified in Table 2.1-1 is restricted.

This information is needed to confirm compliance with 10 CFR 72.236(a).

12-4. Modify the proposed Supplement 12.I to delete the term “long-term” (and in any other such location in the FSAR or its supplements).

The NRC staff does not characterize a review, evaluation, and issuance of a Certificate of Compliance for a spent fuel storage cask to safely store spent fuel for a minimum of 20 years to be considered as “long term.”

This action is needed to determine compliance with 10 CFR 72.236 (g).

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.