May 28, 2010

Ms. Tammy Morin,
Licensing Manager
Holtec International
Holtec Center
555 Lincoln Drive West
Marlton, NJ 08053

SUBJECT: FIRST REQUEST FOR ADDITIONAL INFORMATION TO LICENSE AMENDMENT REQUEST NO. 8 TO HOLTEC INTERNATIONAL HI-STORM 100 CERTIFICATE OF COMPLIANCE NO. 1014 (TAC NO. L24398)

Dear Ms. Morin:

By letter dated November 28, 2009, Holtec International submitted license amendment request No. 8 to the U. S. Nuclear Regulatory Commission for the HI-STORM 100 Certificate of Compliance No. 1014. The NRC staff has reviewed your application and has determined that additional information is required to complete its detailed technical review. The additional information is identified in the enclosure to this letter. We request that you provide the information by June 30, 2010. Please inform us in writing at your earliest convenience, but no later than June 15, 2010, if you are not able to provide the information by the requested date. You should also include a new proposed submittal date and the reasons for the delay to assist us in re-scheduling your review.

Please reference Docket No. 72-1014 and TAC No. L24398 in future correspondence related to this licensing action. If you have any questions, please contact me at (301) 492-3325.

Sincerely,

/RA/

John Goshen, P.E., Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No.: 72-1014

TAC No.: L24398

Enclosure: Request for Additional Information

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OFC:	SFST	SFST	SFST	SFST	SFST	SFST
NAME:	JGoshen	JVera	GHornseth	VWilson	JChang	WWheatley
DATE:	5/25/2010	5/27/2010	5/25/2010	5/25/2010	5/25/2010	5/24/2010
OFC:	SFST	SFST	SFST	SFST	SFST	SFST
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DATE:	5/27/2010	5/27/2010	5/27/2010	5/ 27/2010	5/27 /2010	5/28/2010

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HOLTEC INTERNATIONAL

DOCKET NO. 72-1014

LICENSE AMEMDMENT REQUEST NO. 8

TO THE HI-STORM 100 CASK STORAGE SYSTEM

FIRST REQUEST FOR ADDITIONAL INFORMATION

By letter dated November 28, 2009, Holtec International (Holtec) submitted license amendment request (LAR) No. 8 to the U. S. Nuclear Regulatory Commission (NRC) for the HI-STORM 100 Certificate of Compliance No. 1014. The NRC staff (staff) has reviewed your application and has determined that additional information is required to complete its detailed technical review.

3.0 Structural Evaluation

3-1 Clarify the use of Metamic Classic and Metamic-HT for Multi Purpose Canister (MPC). Section 3.0 "Design Features" lists 10B loadings for several baskets; several of them include "METAMIC". The definition of METAMIC encompasses both Metamic Classic and Metamic-HT. Does Holtec intend to use Metamic-HT solely as a neutron absorber in previously approved MPC's?

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

3-2 Provide the following analyses and clarifications.

a) Provide analyses for different basket orientations for side drop analysis.

Holtec Report HI-2012787, page 1, states:
"For the side drop event, only the 0° fuel basket circumferential orientation is analyzed and the 45° fuel basket circumferential orientation is disregarded. The 0° orientation is considered to be bounding because the basket panels are more vulnerable when each fuel assembly is directly supported only by one basket panel instead of being equally supported by two adjacent basket panels in the 45° orientation."

The applicant is applying what should be a conclusion of the analysis as an assumption. The loading in the 45° orientation is potentially a worse load condition than the one analyzed.

b) Clarify the provenance of bounding deceleration. Holtec Report HI-2012787, page 1, states: "A 70 g's bounding deceleration in the lateral direction is specified in the HI-STORM FSAR…." The staff cannot find that number in the reference.

c) Justify use of elastic model for basket shims. Holtec Report HI-2012787, page 2, states: "Elastic model is defined for the basket shims since no plastic deformation is expected." There is no mentioned basis for the "expected" behavior, and the elastic model does not allow for plastic strain to develop.

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

3-3 Evaluate the potential for crack propagation and growth for the MPC baskets under tipover conditions. Attachment D of the Metamic HT Sourcebook is based on results for conditions applicable only to the HI-STAR 180 and not the HI-STORM MPC-68M multiple-purpose canister system.

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

4.0 Thermal Evaluation

4.1 Provide a hypothetical fire accident analysis of the MPC-68M under the credible fire-transient duration.

The applicant stated that as the MPC-68M temperatures during storage or under on-site transfer are bounded by the MPC-68 temperatures, the MPC-68M temperatures are likely bounded by the MPC-68 temperatures in the fire test. The applicant neither performed the thermal analysis nor provided the resulting temperatures of the pool fire test to support this statement.

The staff finds that with better heat transfer capability due to using the Metamic-HT as the fuel basket material in the MPC-68M, it is likely that more heat will be transferred from the fire to the stored fuels within the MPC-68M, and the MPC-68M should not be bounded by the MPC-68. The applicant is required to perform a fire analysis and provide the base to justify the credible fire duration (4~5 minutes, 10~15 minutes or even longer) by

- using the bounding regionalized storage scenario (the maximum decay heat of 36.9 kW and the fuel storage configuration of X=0.5),
- removing the uniform gap of 0.4 mm on each side (from bottom to top) of the intersection basket panel in the fire-transient analysis,
- including the combined forced convection and thermal radiation (with a conservative radiation emissivity of at least 0.9 and an ambient temperature of 1475^{o}F in the model) in the fire-transient analytical model,
- replacing the specific heat of 914 J/kg-^{o}K with 879.2 J/kg-^{o}K (= 0.21 Btu/lb-^{o}F in Supplement III Table 4.III.1) for Metamic-HT fuel basket to make the model analysis consistent with the SAR.

The applicant should list all the test conditions, parameters and data, as well as the resulting maximum component temperatures and MPC pressure during the fire transient and the subsequent post-fire cool-down in the FSAR.

This information is required by the staff to determine compliance with 72.24(d), 72.122(c), 72.122(h)(1), 72.128(a)(4), and 72.236(f).

4.2 Perform the transient analysis for vacuum drying (VD) process for the proposed change of “Vacuum drying of the MPC-68M is not subject to time limit.”

The applicant proposed to modify Appendix A, LCO 3.1.1 in LAR 1014-8 with “Vacuum drying of the MPC-68M is not subject to time limit,” and supported the proposed change with two steady-state analyses: (1) Scenario A with the moderate burnup fuel assemblies and the decay heat of 36.9 kW, and (2) Scenario B with one or more high burnup fuel assemblies and the decay heat of 29 kW. The applicant modeled the analyses with the moisture in the MPC and conservatively assumed that the water in the HI-TRAC annulus is boiling under the hydrostatic head of water at the annulus bottom (232^{o}F) and the bottom surface of the MPC is insulated.

However, it’s likely that the fuel cladding temperature will continuously rise up during the VD process until a balance of heat transfer is reached and a maximum, stable temperature exists. Therefore, the applicant is required to perform the transient analysis, display the fuel cladding temperature history, and verify a maximum, stable fuel cladding temperature is available and is below the allowable temperature limit during the VD process.

This information is required by the staff to determine compliance with 72.24(d), 72.122(c), 72.122(h)(1), 72.128(a)(4), and 72.236(f).

4.3 Provide more information of the fuel debris and justify its impacts on the adjacent intact fuel assemblies or the cask.

The MPC-68M is designed to accommodate to sixty eight intact BWR fuel assemblies. However, up to sixteen damaged fuel containers (DFCs) containing BWR damaged fuel assemblies and/or up to eight DFCs containing fuel debris may be stored in the MPC-68M, with the remaining fuel storage locations filled with intact BWR fuel assemblies. Since the fuel debris can be in a type of rubble fuel assembly which may be concentrated in a smaller area and create hot spots in the cask and increase the cladding temperatures of the adjacent intact assemblies. The applicant is required to provide more information of the fuel debris, and perform the thermal analysis, if the fuel debris exists as a type of rubble fuel assembly, to ensure the pressure and the fuel cladding temperature will be below the limits.

This information is required by the staff to determine compliance with 72.24(d), 72.122(c), 72.122(h)(1), 72.128(a)(4), and 72.236(f).

5.0 Shielding Evaluation

5-1 Provide additional details on the differences between the design-basis Babcock & Wilcox 15x15 and the 15x15I fuel assemblies.

Using the upper limits given in section 2 and the initial bounding analysis from the FSAR, identify how the proposed fuel assembly differs in any significant way from the design-basis assembly.

This information is necessary to determine compliance with 10 CFR 72.236

5-2 EDITORIAL: The example given in the zone 1 contribution analysis of the MPC-68M uses the MPC-32 analysis from the FSAR as an example. However, the conclusion drawn for the neutron dose contribution is more in line with that of the MPC-68 (21% versus 27%). Correct or clarify the example.

This information is necessary to determine compliance with 10 CFR 72.236

6.0 Criticality Evaluation

6-1 Justify the fuel specification of the 9x9E and 9x9F fuel assemblies.

For the 9x9E and 9x9F Note 13 in Table 2.1.4 of the FSAR says: *For the SPC 9x9-5 fuel assembly, each fuel rod must meet either the 9x9E or the 9x9F set of limits or clad O.D., clad I.D., and pellet diameter.* Provide additional information justifying that the criticality analysis for the MPC-68M was performed considering the most conservative set of fuel specifications.

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

6-2 Justify the fuel specification of the 8x8B and 8x8D fuel assemblies.

a. In Table 2.1.4, the 8x8B and 8x8D are specified with two separate values for "No. of fuel rod locations." Justify that the most reactive value was used in the criticality analysis in the MPC-68M for these fuel types.
b. In Table 2.1.4, the 8x8B can have either 1 or 0 water rods. Justify that the most reactive value was used in the criticality analysis for the MPC-68M for this fuel type.

This information is needed determine compliance with 10 CFR 72.236(a) and (c).

6-3 Demonstrate that the fuel dimensional variations (such as minimum fuel clad OD versus maximum and maximum channel thickness versus minimum, etc.) listed in Table 2.III.3 and 2.1.4 give the maximum reactivity for all fuel assembly types that are to be stored in the MPC-68M.

The staff finds that the FSAR does not provide enough information to show that the dimensional characteristics would be bounding for the assemblies proposed for storage in the MPC-68M considering the new assembly classifications and increased fuel enrichments. Section 6.2.1 of the FSAR (Rev. 7, 8-08) states that "For each assembly class, calculations have been performed for all of the dimensional variations for which data is available." The FSAR then states that these calculations were used to determine the fuel parameters that determine the maximum reactivity. Provide information demonstrating that the previous analyses are applicable to the new basket and contents including increased enrichments and new fuel classifications (10x10F and 10x10G). The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-4 Justify the use of planar averaged enrichments rather than maximum or discrete radial enrichments.

Appendix 6B of the FSAR (Rev. 7, 8/08) has some analyses showing that this is conservative for certain assemblies within certain MPC geometries. The results shown in Table 6.III.2.1 of the FSAR show that distributed enrichment case 2 has a higher reactivity than the reference case (planar averaged enrichment). Additionally, these results are only applicable for the 10x10A. Justify the use of the planar averaged enrichments despite this known possible non-conservatism and to quantify the maximum difference in k-eff (delta k) for the most reactive fuel type (10x10G) and justify that this would bound all other fuel types to be stored in the MPC-68M considering the higher enrichments and the specific basket materials and geometry. The subtraction of this value from the upper subcriticality limit should be incorporated into the next FSAR Revision upon amendment approval.

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

6-5 Justify the UO_2 fuel density used in the criticality calculations for the MPC-68M is realistic or conservative.

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-6 Provide additional information on the assumptions used about the part length rods (PLR) in the MPC-68M.

For assemblies that will contain PLRs were the PLRs modeled? If so, what length was used, and is this a minimum or maximum length? Provide PLR fuel rod specifications and add them to Table 2.1.3 of the Technical Specifications (TS) to reflect the modeling assumptions. They then need to be incorporated into the next FSAR Revision upon amendment approval.

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

6-7 Provide additional information about the modeling of damaged fuel and fuel debris for the MPC-68M and justify that they are conservative.

a. Explain the difference between the model for damaged fuel and the model for fuel debris.

b. Explain Table 6.III.4.1. Why was 11x11 the only array size calculated for the 10x10F array class?
c. What were the modeling assumptions for the DFC and/or fuel debris locations? Include information such as enrichment, array size, pellet size, etc.
d. What were the modeling assumptions of the intact fuel? Table 6.III.1.3 shows that several assembly classes were grouped together, what fuel was used to represent the intact fuel for each of these classes?
e. What were the moderation assumptions used in the DFC models?

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-8 Demonstrate that the manufacturing tolerances used within the criticality model are conservative for all fuel types that are allowed in the MPC-68M.

Table 6.III.3.1 of the FSAR presents the results of calculations performed to demonstrate that the tolerances chosen are more conservative than the nominal dimensions. The SAR states that this analysis uses 4.8% enriched 10x10A fuel for the MPC-89M. Per the results in Table 6.III.1.1, the 10x10G is the most reactive. Additionally Table 6.III.1.3 shows the damaged fuel evaluations are even more reactive. Section 6.III.3 of the FSAR (Page 6.III-6) states that the "reactivity effect (positive or negative) of the manufacturing tolerances is not assembly dependent." Provide justification for this position.

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

6-9 Justify the separation in METAMIC in the basket panels used.

This was analyzed using 10x10A fuel for the MPC-68M. Per Tables 6.III.1.1 and 6.III.3 of the FSAR, this fuel type is not the most reactive fuel type for the MPC-68M, and damaged fuel appears to be more reactive. Justify that the calculation performed is bounding or representative of all fuel types to be stored in the MPC-68M. Provide the conditions used in the analysis and a justification used for the proposed separation.

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-10 Provide additional information on how the structural material for the fuel assemblies was modeled.

The staff was unable to locate any information describing how the structural material (spacers, top and bottom nozzle, etc.) was modeled in the criticality analysis for the MPC-68 M. Justify that the modeling assumptions are conservative.

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-11 Justify the positioning of the assemblies within each basket cell of the MPC-68M.

Section 6.III.3 of the SAR states that all evaluations were performed with eccentric fuel positioning where the fuel is placed closest to the center of the basket in each basket cell. The staff did not find any justification that this is the most conservative configuration for this MPC and fuel contents. Additionally Table 6.3.6 of the SAR (Rev. 7, 8/08) does not include results for the MPC-68. Provide additional information justifying the positioning of assemblies and DFCs are conservative.

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-12 Justify that the fully flooded condition is the most conservative for the MPC-68M and its allowable contents.

Section 6.III.4 of the FSAR states that the basket and DFCs are fully flooded and that this assumption is based on the various studies presented in the FSAR for previously approved baskets (the MPC-68) and that these studies are applicable to the MPC-68M due to the strong similarity in basket design. The staff reviewed the studies shown in the FSAR (Rev. 7, 8/08) and found that the studies done to show that the fully flooded condition was bounding was performed for the MPC-68 using 8x8 fuel at 4.2% enrichment. This is for the partial density water (internal and external), partial flooding, pellet-to-clad gap flooding and preferential flooding. Justify that these studies are applicable to the MPC-68M and its fuel types and allowed enrichment limits. Address partial flooding for assembly classes with part-length rods (PLRs) – 8x8 fuel has no PLRs.

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-13 Justify the use of the 10x10A fuel assembly class and the fuel condition used for the criticality evaluation of the storage cask (overpack).

Table 6.III.1.2 of the FSAR shows the results for a “representative value” of k-eff for the storage cask (overpack). This is for the 10x10A fuel. Justify that the use of this fuel assembly class is bounding for all others that are allowed in the MPC-68M. State if this calculation includes DFCs. The staff notes the most reactive condition is for damaged fuel (Table 6.III.1.3).

The staff needs this information to determine that k-eff has been calculated with the maximum reactivity and to ensure that the applicant has met the requirements in 10 CFR 72.124(a) and 72.236(c).

6-14 Clarify the criticality justification for the inclusion for the 15x15I in the MPC-32.

The criticality justification on page 6 in the letter to US NRC from T.S Morin, Holtec International, License Amendment Request No. 8 (LAR 1014-8) to HI-STORM 100 Certificate of Compliance, November 24, 2009, (ADAMS Accession No. ML09336046), states “Note that for the 15x15B array/class, the lower values for filled or voided guide tubes are listed below, while the 15x15I array/class has solid guide rods that cannot be filled or voided.” The staff asks the applicant to clarify what is meant by the term “lower values.”

10 CFR 72.11(a) requires that the information provided by the applicant be complete and accurate in all material respects.

6-15 Provide proposed revised FSAR pages as part of the supporting documentation for the criticality justification for the inclusion of the 15x15I.

10 CFR 72.11(a) requires that the information provided by the applicant be complete and accurate in all material respects.

7.0 Confinement Evaluation

7-1 Draft NUREG-1536, Revision 1C, “Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility,” and Draft Interim Staff Guidance – 25, “Pressure Test and Helium Leakage Test of the Confinement Boundary for Spent Fuel Storage Canister” have been issued for public comment and for which public comments have been resolved. These documents provide clarification to ANSI N14.5, and require helium leakage rate tests of the entire confinement boundary including welds and base material. The proposed Certificate of Compliance (CoC) states that helium leakage tests are performed on the MPC confinement boundary welds (excluding the lid-to-shell weld per ISG-18). Provide justification for the acceptability of weld helium leakage testing only (which is contrary to 10 CFR 72.236 (j) and (l) as well as the ANSI N14.5 consensus standard), or modify the FSAR to test the entire confinement boundary welds and base material. Also, FSAR Chapters 2, 7 and 9 do not appear to be consistent with the confinement boundary weld testing stated in the proposed CoC and should be clarified.

For example, Section 9.III of the HI-STORM 100 FSAR Supplement states, “The main body of this chapter remains fully applicable for the HI-STORM 100 System using the MPC-68M model fuel basket (with existing MPC enclosure vessel) except as described below.” The main body of Chapter 9 in the HI-STORM 100 FSAR Rev. 7 does not appropriately address ANSI N14.5 fabrication leakage rate tests of the entire confinement boundary welds and base material (excluding the lid-to-shell weld per ISG-18).

Section 9.1.3 of the FSAR Rev. 7 states, “Leakage testing of the MPC shop welds (shell seams and shell-to-baseplate shop welds) and the field welded MPC lid-to-shell weld and closure ring welds are not required.” Also in Section 9.1.3 of the FSAR Rev. 7, the applicant does not address performing a fabrication leakage rate test on the MPC shell, baseplate, and lid.

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

7-2 Clarify step 8.1.5.9.f of the FSAR Rev. 7 to perform a helium leak test on the vent and drain port cover plates.

Section 8.III.0 of the FSAR Supplement states that the procedure steps outlined in Chapter 8 for loading, unloading, and recovery remain applicable. Step 8.1.5.8.f of the FSAR Rev. 7 states that a helium leak test will be performed on the vent and drain port cover plate welds. Step 8.1.5.9 of the FSAR Rev. 7 states, “Perform a leakage test of the MPC vent and drain port cover plates as follows:.” While step 8.1.5.9.f of the FSAR Rev. 7 also states that a helium leak test will be performed on the vent and drain port cover plate welds.

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

7-3 Modify Chapter 7 of the HI-STORM 100 FSAR to address the damaged fuel assemblies that have been requested to be loaded in the MPC-68M basket.
According to Table 2.1-1 Section VI of the proposed CoC provided by the applicant, damaged fuel will be loaded in the MPC-68M basket. Loading damaged fuel in the MPC-68M basket should additionally be addressed in Section 7.1.5 of the FSAR. The FSAR needs to be updated to reflect this upon approval of this amendment.

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

13.0 Materials Evaluation

13-1 FSAR Supplement Chapter 2. Clarify whether or not the fuel debris mentioned in FSAR supplement section 2.III.1 contains any materials not previously reviewed and accepted for storage applications. Previously reviewed and accepted fuel debris or non-fuel hardware materials include: boron carbide, borosilicate glass, silver-indium-cadmium alloy, and thorium oxide.

Should different materials from the above list be included in the fuel debris mentioned in FSAR supplement section 2.III.1, provide an assessment of potential chemical/galvanic reactions, as per FSAR Chapter 8.

This information is required to determine compliance with 10 CFR 72.120(d).

13-2 FSAR Supplement Chapter 4. Provide material property data and discussion which supports fuel basket operation above 350° C (662° F).The Metamic HT Sourcebook material property data is limited to a maximum temperature of 350° C (662° F). FSAR supplement tables 4.III.2, 4.III.5, and 4.III.7 all list normal operation or short-term/accident operating temperatures above 350° C (662° F).

This information is required to determine compliance with 10 CFR 72.124(b).

13-3 FSAR Supplement Chapter 3. Justify structural performance based on material properties under high temperatures.

Table 4.III.2 in the FSAR supplement sets temperature limits for Metamic HT at 752° F (normal storage) or 1000° F (off-normal/design accident temperature of FSAR supplement table 4.III.2). It is unclear, without supporting data or calculations, how

buckling or excessive plastic deformation of the basket, or other components such as anchor blocks, is precluded at such temperatures. These temperatures are higher than those previously considered in the HI-STORM FSAR, and contrary to information on the same supplement (e.g., FSAR supplement section 3.III.4.4.3.2 states that 325° C bounds the metal temperatures anywhere in the fuel basket under normal conditions. However, FSAR supplement table 4.III.2 states the normal storage temperature limit to be 752° F (400° C). Therefore, all cases for Normal, Off-Normal, Short-term Operations and Accident Conditions need to be reevaluated considering the effects on the materials of these temperatures.

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