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Mr. John Goshen
c/o Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

September 23, 2011

Subject: Comments on Draft Proposed Certificate of Compliance and Preliminary Safety Evaluation Report for Amendment 8 to Certificate of Compliance No. 1014 for the HI-STORM 100 Cask System; (TAC No. L24398)

Reference: [1] NRC Letter (Goshen) to Holtec (Morin), dated September 8, 2011

Dear Mr. Goshen:

Thank you for providing us the opportunity to review the Preliminary Safety Evaluation Report (SER), Certificate of Compliance (CoC), and associated Technical Specifications (TS) for Amendment 8 to the HI-STORM 100 CoC.

In Attachment 1 (total 12 pages) please find Holtec's comments on the subject documents. Holtec would appreciate another review of the documents before they become final.

Thank you for your continued effort toward timely approval of this amendment. Feel free to contact me if you have any questions.

Kindest regards,

Tammy Morin
Licensing Manager
Holtec International

cc (letter only): Mr. Michael D. Waters, USNRC
Mr. Doug Weaver, USNRC
Holtec Group 1

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The following listing and attached scanned pages provide Holtec's comments on the Draft Preliminary CoC/TS and SER documents sent on September 8, 2011 for comment.

CoC– No comments

Appendix A -
TOC – page number for 3.2.2 "TRANSFER CASK Surface Contamination" should be 3.2.2-1 and the actual page number on the page (no labeled 3.2.2-2) should be 3.2.2-1 to be consistent with the current numbering scheme of the Appendix - "LCO#-page#".

Revision bars where there are no text changes:
Page 1.1-3
Page 1.1-4
Page 1.1-5
Page 1.3-2
Page 5.0-5

Appendix B -
Table 2.1-3, Note 15 – "8x8E" should say" 8x8F" – See the 8x8F fuel assembly array/class column and Section 7 of the SER for confirmation.

Tables 2.1-4 through 2.1-7 are listed in the Appendix B TOC as deleted and have associated page number; however the placeholders for these tables on those pages are not included. The Appendix jumps from Table 2.1-3 to 2.1-8 (see pages 2-45 and 2-46) without any indication of the previously deleted tables.

Revision bars where there are no text changes:
Page 2-46
Page 3-3
Page 3-11
Page 3-20
Page 3-21

SER-
Please check 2nd paragraph of 4.1 for reference to FSAR Table 4.4.14 and 31.3 psig for backfill. It would appear that the reviewer is looking at an old version (pre-Revision 7) of the HI-STORM 100 FSAR. See scanned pages for additional comments on this Section.

Please check 1st paragraph of Section 6.0 since it would appear this is referencing Transportation requirements.

Please clarify that the HI-STORM overpack is made of concrete and steel in first sentence of 6.1.1. See scanned pages for complete comments.

Section 8.1.11 Title has a "B" instead of a "-"

storage under normal, off-normal, and accident conditions.

F3.5 The applicant has met the requirements of 10 CFR 72.236(l), "Specific Requirements for Spent Fuel Storage Cask Approval." The design analysis and submitted bases for evaluation acceptably demonstrate that the cask and other systems important to safety

will reasonably maintain confinement of radioactive material under normal, off-normal, and credible accident conditions.

F3.6 The applicant has met the requirements of 10 CFR 72.120, "General Considerations," and 10 CFR 72.122, "Overall Requirements," with regard to inclusion of the following provisions in the structural design:
- design, fabrication, erection, and testing to acceptable quality standards
- adequate structural protection against environmental conditions and natural phenomena, fires, and explosions
- appropriate inspection, maintenance, and testing
- adequate accessibility in emergencies
- a confinement barrier that acceptably protects the spent fuel cladding during storage
- structures that are compatible with appropriate monitoring systems
- structural designs that are compatible with ready retrievability of spent fuel

F3.7 The applicant has met the specific requirements of 10 CFR 72.236(e), (f), (g), (h), (i), (j), (k) and (m), as they apply to the structural design for spent fuel storage cask approval. The cask system structural design acceptably provides for the following required provisions:
- redundant sealing of confinement systems
- adequate heat removal without active cooling systems
- storage of the spent fuel for a minimum of 20 years
- compatibility with wet or dry spent fuel loading and unloading facilities
- acceptable ease of decontamination
- inspections for defects that might reduce confinement effectiveness
- conspicuous and durable marking
- compatibility with removal of the stored fuel from the site, transportation, and ultimate disposition by the U.S. Department of Energy

4.0 THERMAL EVALUATION

4.1 Review Objectives

The objectives of this review were to assess the safety analysis of the thermal design features, the thermal design criteria, and the thermal analysis methodology used to evaluate the expected thermal performance capabilities under normal operations, off-normal operations, accident conditions and natural phenomena events for those SSCs important to safety included in this application.

The MPC-68M is designed for storage under the array of uniform and regionalized heat load. The MPC-68M thermal design is the same as that of the currently licensed MPC-68 and is pressurized with helium to the same backfill pressure of 31.3 psig, defined for the MPC-68 in FSAR Table 4.4.14. The principal differences between the proposed MPC-68M and the licensed MPC-68 are:

4.4.12 max.

This is based on CoC amendments prior to #5
For CoC#5 and above MPC-68 max. backfill pressure is 48.5 psig

MPC-68M max backfill = 48.5 psig.

- the basket panel in MPC-68M is made of Metamic-HT, instead of the composite cell walls for MPC-68,
- the aluminum basket shims are inserted between the basket external cell walls and the MPC shell for the MPC-68M basket. No aluminum shims were present in the MPC-68 basket design, and
- the fuel storage cell dimension, basket wall thickness, and size of the flow holes in MPC-68M basket are different from the MPC-68 basket.

In Supplement III for LAR 1014-8, the applicant evaluated the thermal performance of MPC-68M under normal, off-normal, and accident conditions, and during short-term operations.

4.2 Evaluation of MPC-68M

4.2.1 Input Parameters

The applicant applied the material properties, applied loads, specified boundary conditions, and component geometries in the thermal analysis. The applied loads includes decay heat loads of 36.9 kW and solar heat loads, as described in FSAR 4.4.1.1.8 as well as the quantities of backfill gas and gaseous fission products contained within the MPC. The boundary conditions include the normal and off-normal ambient temperatures, 27°C (80°F) and 38°C (100°F). The exposed surface heat transfer coefficients are also defined in Holtec HI-STORM 100 FSAR. The material properties, applied loads and boundary conditions used in all of the analyses for the MPC-68M are identical to those used for MPC-68. The thermal properties of fuel basket (Metamic-HT) and basket shims (Aluminum Alloy 2219) for MPC-68M are provided in Table 4.III.1 of HI-STORM 100 FSAR, Report HI-2002444, Supplement III for LAR 1014-8.

The applicant utilized the conservative backfill gas pressure of 48.5 psig at 21°C (70°F) for the MPC internal pressure calculations and a conservative operating pressure of 5 atm (or 73.5 psia) for the MPC temperature distribution calculations. The staff reviewed HI-STORM 100 FSAR, and FSAR Supplement III and confirmed that adequate information are provided to satisfy the general requirements of thermal evaluation, in accordance with 72.122(h)(1), and 72.236(f).

4.2.2 Thermal-Hydraulics Model for MPC-68M

The MPC-68M thermal design in the amendment request is the same as that of the currently licensed MPC-68 with MPC basket design to hold 68 BWR fuel assemblies. The applicant modeled MPC-68M with key features:

- The decay heat is non-uniformly distributed over the active fuel length based on the design basis axial burnup distributions,
- The MPC internal helium circulation is considered laminar flow,
- The heat transport from MPC interior to its outer surface is by a combination of conduction through the MPC basket metal grid structure, and conduction and radiation heat transfer in the relatively small helium gaps between fuel assemblies and basket cell walls,
- The heat dissipation across the gap between MPC basket periphery and MPC shell is by a combination of conduction and radiation,

- The heat rejection from the MPC outer surface to the ambient air is primarily accomplished by convective heat transfer to a buoyancy driven airflow through the MPC-to-overpack annular gap,
- The heat rejection from the MPC outer surface to the ambient air is secondly accomplished by thermal radiation heat transfer across the annular gap, radial conduction through the overpack cylinder, and combined natural convection and thermal radiation from the overpack outer surface to the environment,
- The air flow through the annular gap between the MPC and the overpack is characterized by the k-ω turbulence model with the transitional option enabled,
- The air flow in the inlet and outlet vents, and annular gap between the MPC and the concrete inner shell is in transitional regime which allows the circulation of air through the annulus,
- The flow resistance in the fuel assembly is simulated as the 3-zone porous media hydraulic resistance for the porous media to represent the loaded fuel basket in the MPC, which is based on the rigorous Computational Fluid Dynamics modeling of the fuel assembly geometry, and
- The underside of the HI-STORM 100 concrete pad is assumed to be supported on a subgrade at 25°C (77°F).

The staff reviewed Supplement III for LAR 1014-8 and found that the model approach for MPC-68M is consistent with the Holtec CoC No.1014, Amendment No. 5, as previously found to be acceptable by NRC.

4.2.3 Thermal Interference

The applicant designed the MPC-68M with adequate gaps to permit free thermal expansion of the fuel basket and MPC in axial and radial directions, and determined the changes in gaps using the temperature field, calculated from the FLUENT thermal model, in the MPC-68M and HI-STORM overpack. The staff reviewed the initial minimum gaps (cold gaps) and their corresponding thermal expansion values (differential expansion) tabulated in Supplement III, Table 4.III.8, and found that the thermal expansions and the thermal stresses of the fuel basket and the MPC are within the safety margins of the package.

4.2.4 Removal of Time Limit for MPC-68M during Moisture Removal Operations

The applicant determined the maximum cladding temperature of the MPC-68M under the following vacuum drying scenarios:

(A) MPC-68M is loaded with Moderate Burnup Fuel assemblies (as defined in the FSAR) generating heat at the maximum permissible rate under the bounding regionalized storage scenario (decay heat of 36.9 kW), and
(B) MPC-68M is loaded with one or more high burnup fuel assemblies, and the decay heat is less than a conservatively defined threshold heat load of 29.0 kW.

The staff reviewed the maximum MPC-68M temperatures under the vacuum drying scenarios (Table 4.III.5 of Supplement III and Table K.5 of Holtec Report HI-2043317) and determined that all the component temperatures are below the corresponding temperature limits for both scenarios (A) and (B).

In scenario (A), the calculated cladding temperature of 401°C (754°F) is above 400°C (752°F), the evaluation guidance provided in Interim Staff Guidance (ISG)-11, Rev. 3. This is based on (1) the condition of hoop stress and hydride reorientation in ISG-11, and (2) the cladding temperature limit of 570°C (1058°F) for Moderate Burnup Fuel under short term operations such as the moisture removal process as described in the FSAR. However, based on the staff's evaluation, it is expected that the fuel assemblies with the moderate burnup, as described in scenario (A), are not likely to have a significant amount of hydride reorientation due to limited hydride content. Furthermore, most of the low or moderate burnup fuel has hoop stresses below 90 MPa. Even if hydride reorientation occurred during storage, the network of reoriented hydrides is not expected to be extensive enough in moderate burnup fuel to cause fuel rod failures. Given the conditions of hydride reorientation and hoop stress described above and the fact that the calculated temperature is just 1°C (2°F) over the allowable limit, the staff finds the evaluation acceptable based on engineering judgment and conservative assumptions (e.g., the water in the HI-TRAC annulus is conservatively assumed to be boiling with a water temperature of 111°C (232°F). The hydrostatic head of water at the annulus with the MPC bottom surface insulation causes boiling at higher than 100°C (212°F) used in the model analyses, and that the fuel rods in MPC-68M should not fail during the moisture removal operations in Scenario (A). In scenario (B), the calculated cladding temperature of 389°C (732°F) is well below the allowable limit of 400°C (752°F).

The staff found the evaluations of scenarios of (A) and (B) acceptable based on two conservative assumptions: (1) the water in the HI-TRAC annulus is assumed to be boiling 111°C (232°F) under the hydrostatic head of water at the annulus bottom and (2) the bottom surface of the MPC is insulated. The staff confirmed that the maximum cladding temperatures under scenarios (A) and (B) are in compliance with thermal limits identified in ISG-11.

4.2.5 HI-TRAC Onsite Transfer Operation

The applicant evaluated the thermal performance of the MPC-68M contained in a HI-TRAC (with decay heat of 36.9 kW and HI-TRAC annulus filled with air) and found that a supplemental cooling system (SCS) is not necessary for ensuring cladding safety under the onsite transfer of the MPC-68M. The staff reviewed Table 4.III.6 of Supplement III and Table K.4 of Holtec Report HI-2043317 and determined that the maximum cladding temperature of 338°C (640°F) is below the temperature limit of 400°C (752°F) for normal conditions of storage and short-term loading operations, per the guidance of ISG-11, Rev. 3. The staff found that the MPC-68M has:

(1) lower component temperatures on the fuel cladding, the MPC basket, and the MPC shell and gives a higher temperature margin when compared to the MPC-68,

(2) higher HI-TRAC shell temperature of 166°C (331°F), but still below the limit of 500°C (932°F), and

(3) the aluminum shim temperature of 276°C (528°F) is lower than the short-term operation temperature limit of 500°C (932°F). Therefore from a thermal evaluation perspective, a SCS is not required for the MPC-68M.

The applicant calculated the pressures of 102.1 psig, for 1% rods rupture, which is above the allowable limit of 100 psig and 106.9 psig for 10% rods rupture, which is below the allowable limit of 110 psig. Given the conditions that instead of 31.3 psig defined in FSAR, a higher backfill pressure of 48.5 psig is used for evaluation; therefore a predicted pressure of 102.1 psig for 1% rods failure is conservative and acceptable for HI-TRAC onsite transfer operation.

4.2.6 Impact of Fuel Debris on the Intact Fuel Assemblies

The applicant stated that up to 16 damaged fuel containers (DFCs) containing BWR damaged fuel assemblies and/or up to 8 DFCs containing fuel debris may be stored in the MPC-68M with the remaining fuel storage locations filled with intact BWR fuel assemblies. 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. Although the fuel debris is not required to meet cladding temperature limits, its effects on the fuel rods stored in the interior cells must be assessed. Therefore, the applicant performed the thermal analysis to ensure that both pressure and fuel cladding temperatures are below the limits for the impact of fuel debris on the intact fuel assemblies.

The applicant performed the thermal analysis by assuming that:

(1) the fuel debris is completely pulverized and compacted into a bar enclosed by DFC,

(2) the height of the bar emitting heat is minimized to maximize the linear thermal loading of DSC and the co-incident local heating of the fuel basket and neighboring storage cells,

(3) the fuel debris is assumed to be completely composed of UO_2 with a lower thermal conductivity relative to cladding and therefore the heat dissipation is understated, and

are assumed to

(4) all 16 peripheral storage locations (not just 8 permitted in CoC) contain fuel debris emitting the maximum heat permitted by TS and all interior cells are emitting design heat under the uniform loading storage scenario.

Section 4.III.4.4 or Table 4.III.11

The staff reviewed the revised FSAR 4.III.11 for HI-STORM temperatures under fuel debris storage, and found that the peak cladding temperature of 306°C (583°F) is below the allowable limit of 400°C (752°F) and the temperatures of basket and aluminum shims are well below the allowable limits.

4.2.7 Normal Long-Term Storage

The applicant calculated the cask component temperatures and the maximum pressure of the MPC-68M for a decay heat of 36.9 kW and tabulated them in Tables 4.III.3 and 4.III.4 of Supplement III and Tables K.1 and K.3 of Holtec Report HI-2043317 and specified that the temperatures of the cladding and other cask components are below the allowable limits and the MPC internal pressures are within the safety margins for intact rods and 1% rods rupture. The staff checked the allowable limits in HI-STORM FSAR and the calculated data in Supplement III, and confirmed that 1) the MPC-68M has lower maximum temperatures of fuel cladding, basket, and MPC shell. Therefore, MPC-68M provides higher temperature margins than MPC-68, and 2) all the cask components are maintained within their temperature limits and MPC internal pressure is below the criteria of 100 psig for the long-term normal storage conditions. The staff confirmed that the calculated temperatures of the cask components comply with the design criteria and meet the requirements of 10 CFR 72.122(h)(1), and 10 CFR 72.236(f).

4.2.8 Off-Normal Conditions

Elevated Ambient Air Temperature

The principal effect of the elevated ambient temperature is a rise of the HI-STORM 100 temperatures from the baseline normal storage temperatures by the difference between elevated ambient and normal ambient temperatures. The normal storage temperature under MPC-68M storage in the HI-STORM 100 overpack is bounded by the temperatures of the MPC-68 (FSAR 4.4). The staff accepted this conclusion because of the better heat transfer capability of MPC-68M in which the fuel basket is entirely made of the highly conducting Metamic-HT.

Partial Blockage of Air Inlets

The principal effect of the partial inlets blockage is a rise in the HI-STORM 100 annulus temperatures from the baseline normal storage temperatures and to a similar rise in the MPC temperatures. The normal storage temperature under the MPC-68M storage in the HI-STORM 100 overpack is bounded by the temperatures of the MPC-68 (HI-STORM 100 FSAR 4.4). The staff accepted this conclusion because of better heat rejection capability of the MPC-68M which uses the highly conducting Metamic-HT fuel basket.

Off-Normal Pressure

The off-normal pressure event is defined as a combination of (a) maximum helium backfill pressure, (b) 10% fuel rods rupture, and (c) limiting fuel storage configuration. The applicant predicted a pressure of 100.5 psig (Supplement III, Table 4.III.4) which is below the off-normal design pressure of 110 psig. The staff checked the HI-STORM 100 FSAR Table 2.2.1 and accepted the pressure margin of 9.5 psi because a conservative value of 48.5 psig is used as the initial backfill pressure. The staff confirmed that the MPC-68M meets the requirements for the off-normal pressure event.

4.2.9 Accidental Conditions

The applicant provided the evaluation of the following accidental conditions to demonstrate that the MPC-68M meets the design criteria limits, in compliance with Part 72.

(a) Fire

The principal effect of the fire accident is a temperature increment in both stored fuel and MPC during HI-STORM storage or under on-site transfer in the HI-TRAC. The applicant stated that the temperatures in the MPC-68M are bounded by those in the MPC-68. Given the same decay heat load, but the better heat rejection capability of the MPC-68M with the Metamic-HT as the fuel basket material, it's possible that (1) the steady-state fuel cladding temperature field for MPC-68M can be lower than that for MPC-68, and (2) more heat can be transferred into MPC-68M than into MPC-68 during a fire event.

The applicant performed a new safety evaluation for the targeted fire accident when the Metamic-HT is used as the fuel basket. The staff performed the confirmatory calculation of temperature rise and checked the resulting fire accident pressure documented in Table 4.III.9 and the fuel temperature rise computed in Supplement 4.III.6.2 in the revised FSAR. The staff found that the maximum pressure of 104.5 psig is below the allowable limit of 200 psig and the

HI-STORM fire result
Suggest replacing w/ HI-TRAC fire result 24.7°F given in 4.III.6.2(a)(ii)

small fuel temperature rise of 0.6°C (1.0°F) does not adversely affect the temperature of the MPC or contained fuel.

(b) Burial under debris

The applicant used a lumped capacitance model that combines the thermal capacity of the MPC and the HI-STORM to analyze this accidental condition of the complete burial of the HI-STORM system under an indeterminate material. The staff agreed that the previously approved evaluation of the MPC-68 remains bounding for the MPC-68M because the initial storage temperatures under the MPC-68M are less than the initial storage temperatures under the MPC-68.

(c) 100% blockage at air ducts

This accident is defined as 100% blockage of the air inlet ducts for 32 hours. The applicant evaluated the MPC-68M under this accident under the decay heat of 36.9 kW and computed the 32-hour temperature rise of the MPC and the stored fuels. The staff reviewed the maximum temperatures and the maximum pressure of Table 4.III.7 of Supplement III and Table K.6 of Holtec Report HI-2043317, and ensured that the MPC internal pressure of 111.6 psig is below the allowable limit of 200 psig and both fuel cladding and component temperatures also remain below their respective accident limits that are specified in HI-STORM FSAR Table 2.2.1 for a 32-hour 100% air inlets blockage accident.

(d) Flood

The flood accident is defined as a deep submergence event. The worst flood from a thermal perspective is one where the water rises to the top of the inlets to prevent airflow without providing the benefit of MPC cooling by water. The staff found that this event is bounded by the 100% inlet ducts blockage accident.

(e) Extreme Environmental Temperature

The principal effect of the elevated ambient temperature is a rise of the temperature in HI-STORM 100 Cask System from the baseline normal storage temperatures by the difference between the elevated ambient and the normal ambient temperatures. The applicant stated that as the normal storage temperature under MPC-68M storage in the HI-STORM 100 overpack are bounded by the temperatures in the HI-STORM 100 Cask System; the temperatures under this event are also bounded by the extreme ambient evaluation. The staff found this conclusion acceptable because of better heat rejection capability of the MPC-68M in which the fuel basket is entirely made of the highly conducting Metamic-HT material.

(f) 100% fuel rods ruptured

The applicant evaluated the 100% rods failure accident by assuming the release of 100% of the rods fill gases and fission gases in accordance with NUREG-1536, REV. 1, release fractions. A computed MPC-68M internal pressure of 145.8 psig is listed in Supplement III Table 4.III.4. The staff reviewed the HI-STORM 100 FSAR and ensured that the maximum internal pressure of 145.8 psig is below the allowable limit of 200 psig.

(g) Jacket Water Loss

The principal effect of the jacket water loss accident is a temperature rise in the stored fuel inside the MPC from the baseline conditions while being transferred in the HI-TRAC. The applicant stated that as the temperature limit in the MPC-68M is bounded by the MPC-68 temperatures, the jacket water loss temperatures in MPC-68M are therefore bounded by the HI-TRAC jacket water loss evaluation in MPC-68 system. The staff found this acceptable because of the better heat rejection capability of the MPC-68M.

4.3 Addition of the CE 15x15 (15x15I) Fuel Assembly Array to MPC-32

The applicant proposed to add a new PWR fuel assembly to CoC No.1014 for loading into the MPC-32. The allowable heat load limits per assembly remain unchanged for the MPC-32. Therefore all thermal analyses already performed for the MPC-32 in the HI-STORM 100 Cask System bound the addition of the 15x15I fuel assembly array/class. The staff found this acceptable from a thermal perspective because the heat load is unchanged.

4.4 Evaluation Findings

400°C (752°F) 570°C (1058°F)

F4.1 The staff found that the calculated fuel cladding temperatures are below the ISG-11 temperature limits of Moderate Burnup Fuel (Scenario A) and High Burnup Fuel (Scenario B) for normal conditions and 570°C (1058°F) for off-normal and accident conditions, and other cask component temperatures are maintained below the allowable limits for the accidents evaluated. The staff found that the thermal-hydraulic performance of the MPC-68M system components is acceptable from thermal-hydraulic perspective and meets the requirements of 10 CFR 72.122(h)(1) and 72.236(f).

F4.2 The supplemental cooling system is not required for MPC-68M during HI-TRAC onsite transfer operation because the increased thermal conductivity of the Metamic-HT basket maintains the steady-state fuel cladding temperatures below allowable limits.

F4.3 The spent fuel cladding is protected against degradation that leads to gross ruptures by maintaining the cladding temperature for the approved contents below 570°C (1058°F) for normal, off-normal, and vent-blockage accident. Protection of the cladding against degradation will allow ready retrieval of spent fuel assembly for further processing or disposal as required by 10 CFR 72.122(h)(1).

F4.4 As applicable as part of this amendment request, the application includes acceptable analyses of the design and performance of SSCs important to safety under normal, off-normal and accident scenarios, in compliance with 10 CFR 72.122.

F4.5 The MPC-68M, designed to accommodate 16 DFCs containing BWR damaged fuel assemblies and/or up to eight DFCs containing fuel debris, is evaluated to have no impact on the adjacent intact fuel assemblies or the cask and meet the requirements of 10 CFR 72.122(h)(1).

F4.6 The analyses of off-normal and accident events and conditions and reasonable combinations of these and normal conditions show that the design and operation of the DC ISFSI, as requested in the amendment, will meet the requirements without

5.1 Evaluation Findings

Based on the NRC staff's review of information provided in the HI-STORM 100 Cask System application, the staff finds the following:

F5.1 Chapter 7 of the FSAR describes confinement structures, systems, and components important to safety in sufficient detail to permit evaluation of their effectiveness.

F5.2 The design of the HI-STORM 100 Cask System adequately protects the spent fuel cladding against degradation that might otherwise lead to gross ruptures. Section 4 of the SER discusses any relevant temperature considerations.

F5.3 The design of the HI-STORM 100 Cask System provides redundant sealing of the confinement system closure joints using dual welds on the MPC lid and the MPC closure ring.

F5.4 The MPC has no bolted closures or mechanical seals. The confinement boundary contains no external penetrations for pressure monitoring or overpressure protection. No instrumentation is required to remain operational under accident conditions. Because the MPC uses an entirely welded redundant closure system no direct monitoring of the closure is required.

F5.5 The confinement system has been evaluated by analysis. Based on successful completion of specified testing and examination procedures, described in FSAR Chapters 7, 8 and 9 and the CoC, the staff finds that the confinement system will reasonably maintain confinement of radioactive material under normal, off-normal, and credible accident conditions.

F5.6 The staff finds that the design of the confinement system of the HI-STORM 100 Cask System continues to remain in compliance with 10 CFR Part 72 and that the applicable design and acceptance criteria have been satisfied. The evaluation of the confinement system design provides reasonable assurance that the HI-STORM 100 Cask System will continue to allow safe storage of spent fuel. This finding considered the regulation itself, the appropriate regulatory guides, applicable codes and standards, Holtec's analysis, the staff's confirmatory review, and acceptable engineering practices.

6.0 SHIELDING EVALUATION

The objective of this review is to verify that the proposed amendment to the Holtec HI-STORM 100 License meets the external radiation requirements of 10 CFR Part 1 under normal conditions of transport (NCT) and hypothetical accident conditions (HAC). The proposed changes affecting the shielding analysis are: addition of new BWR (10x10F and 10x10G) and PWR (15x15I) assemblies to the list of authorized contents; addition of the MPC-68M as an authorized canister; use of a METAMIC fuel basket.

← Should be Part 72 not transpor applicati

The staff shielding review evaluated the changed features in conjunction with the findings from previous staff analysis to determine they provide adequate protection from the radioactive contents within. This review looked at the methods and calculations employed by Holtec to determine the expected gamma and neutron radiation at locations near the cask surface and at specific distances away from the cask.

6.1 Shielding Design Description

6.1.1 Design Features

+steel

The HI-STORM 100 Cask System consists of a steel canister with a concrete overpack. Gamma shielding is provided by the steel and concrete, with the concrete also providing neutron shielding.

The MPC-68M is a variation of the MPC-68 BWR canister previously approved. The Metamic HT basket design of the MPC-68M consists of aluminum oxide and ground boron carbide

dispersed in a metal matrix of pure aluminum. The differences between the MPC-68M and the MPC-68 important to shielding are:

- MPC-68M has slightly higher B-10 content
- MPC-68M is lighter since the basket contains no steel
- In the enclosure shell, the MPC-68M is surrounded by aluminum basket shims

The MPC-24 and MPC-32 classes of PWR fuel canisters remain unchanged.

6.2 Radiation Source

The two BWR fuel assembly designs/classes added to the HI-STORM 100 Cask System are the 10x10F and 10x10G. In terms of radiological characteristics, the 7x7 class of BWR fuel was bounding. The new BWR designs have been grouped with fuel classes with a larger heavy metal loading. The stricter limits on burnup are conservative when applied to a fuel assembly class with a lower mass of uranium.

The PWR fuel assembly design/class added is the 15x15I. The applicant has listed the characteristics of the 15x15I in Table 2.1-2 of the CoC and shown them to be bounded by the B&W 15x15 class of assemblies on the basis of heavy metal loading.

6.3 Shielding Model

No additional shielding model was supplied by the applicant.

6.4 Shielding Evaluation

The applicant supplied a series of qualitative analyses to show the bounding shielding evaluation is still applicable to the MPC-68M. The applicant references the previously reviewed shielding analysis which states that the inner 32 assemblies, comprising 47% of the spent fuel, contribute 2% of the gamma dose and 27% of the neutron dose due to the shielding of the outer assemblies. This effect minimizes the impact that the basket material has on external dose rates. Neither the MPC-68 nor the overpack are being changed in this amendment, and given that the 10x10F and 10x10G source term is bounded by the B&W 7x7 class. Given the additional shims in the annulus surrounding the basket, the applicant shows that the total shielding provided by the MPC-68M is not significantly changed from the MPC-68.

6.4.1 Confirmatory Analyses

The staff compared the newly added assembly designs to the design-basis assembly in the previous analyses. Using the SAS2H module in SCALE 5.1, the staff was able to confirm that the new BWR assemblies are bounded by the 7x7 class. The PWR 15x15I, while not strongly demonstrated to be bounded by the design-basis analysis, will likely yield a source term comparable to the B&W 15x15 class burnup and enrichment.

The staff also conducted a shielding comparison using an arbitrary gamma line source to determine the effect of using an aluminum basket in the MPC-68M. The distance from a point on the edge of zone 1 was chosen and a path drawn radially outward to the enclosure vessel inner surface. Since the vessel itself is unchanged, the shielding characteristics have already been evaluated. Microshield models were made using the thickness of the materials encountered on several paths outward from this point. The difference among these models depends on geometry and material assumptions. In all cases the steel enclosure vessel provided significant gamma shielding. During operation, the magnitude of this difference compared to the shielding provided by the overpack or transfer vessel is small.

6.5 Evaluation Findings

Based on the information provided by the applicant, the staff has determined that Sections 1, 2 and 5 of the FSAR describe the shielding structures, systems, and components important to safety in sufficient detail to allow evaluation of their effectiveness.

The staff finds that the proposed LAR 1014-8 changes to the shielding system of the HI-STORM 100 are in compliance with 10 CFR Part 72 and that the applicable design and acceptance criteria including 10 CFR Part 20 have been satisfied. The evaluation of the shielding system design provides reasonable assurance that the HI-STORM 100 Cask System will continue to allow safe storage of spent fuel. This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

7.0 CRITICALITY EVALUATION

The objectives of this review were to assess the criticality safety analyses provided in LAR 1014-8 under normal operations, off-normal operations, accident conditions and natural phenomena events for those SSCs important to safety. The staff's evaluation of the criticality safety of the amendment follows.

7.1 Addition of MPC-68M

The MPC-68M is distinguished from the other HI-STORM 100 BWR fuel baskets (MPC-68, MPC-68F and MPC-68FF) in that the basket is made of METAMIC-HT material. This material acts as the structural material as well as the neutron absorber material.

7.1.1 Fuel Specification

The MPC-68M is designed to accommodate up to 68 intact BWR fuel assemblies. The DFCs are allowed in the peripheral fuel locations described in Section 1.III.2.3 and Figure 1.III.2 of the FSAR.

The fuel assemblies that are authorized to be stored in the MPC-68M are the 7x7B, 8x8B, 8x8C, 8x8D, 8x8E, 8x8F, 9x9A, 9x9B, 9x9C, 9x9D, 9x9E, 9x9F, 9x9G, 10x10A, 10x10B, 10x10C,