UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

Preliminary Safety Evaluation Report
DOCKET No. 72-1040
HI-STORM UMAX Canister Storage System
Holtec International, Inc.
Certificate of Compliance No. 1040
Amendment No. 2

SUMMARY

By letter dated March 31, 2015 (ADAMS Accession No. ML15092A783), as supplemented June 19 (ADAMS Accession No. ML15170A434), and November 30, 2015 (ADAMS Accession No. ML15334A496), Holtec International (Holtec) submitted an amendment request to the U.S. Nuclear Regulatory Commission (NRC) to revise Certificate of Compliance (CoC) No. 1040 for the HI-STORM Underground Maximum (UMAX) Canister Storage System. The amendment request seeks provide the following TS changes:

1. Appendix B - Revise, Table 2.1-1 to allow up to 37 undamaged 16X16A fuel assemblies in damaged fuel containers (DFCs) for the multipurpose canister (MPC)-37 permitted for storage in the HI-STORM UMAX Canister Storage System. An updated heat load pattern is also included for loading up to 37 intact 16X16A fuel assemblies in DFCs.

2. Appendix B - Add new 16x16 fuel types to approved contents, in CoC No. 1040, named 16x16B and 16x16C.

3. Appendix B - Revise 15x15I fuel types to include those with guide tubes.

4. Appendix B, Table 3-4 – Revise to clarify the “Top Surface Pad” term.

This safety evaluation report (SER) documents the review and evaluation of the proposed amendment. The NRC staff (staff) followed the guidance of NUREG-1536, Revision 1, “Standard Review Plan for Dry Cask Storage Systems,” specifically sections 4, 6, and 7, Interim Staff Guidance (ISG) -11 “Cladding Considerations for the Transportation and Storage of Spent Fuel” and ISG-21 “Use of Computational Modeling Software in performing its regulatory evaluation.

The staff’s assessment is based on a review of Holtec’s application and whether it meets the applicable requirements of Title 10, Code of Federal Regulations (10 CFR) Part 72 for independent storage of spent nuclear fuel. The staff’s assessment focused only on modifications requested in the amendment as supported by the submitted revised Final Safety Analysis Report (FSAR) and did not reassess previously evaluated portions of the FSAR.

1 GENERAL DESCRIPTION

The objective of this chapter is to review the design changes made to the HI-STORM UMAX Canister Storage System to ensure that Holtec has provided a description that is adequate to familiarize reviewers and other interested parties with the pertinent features of the system,

including the changes. The specific changes are described and evaluated in later sections of this SER.

1.1 Findings

F1.1 The staff concludes that the information presented in the proposed FSAR pages satisfy the requirements for the general description under 10 CFR Part 72. This finding is reached on the basis of a review that considered the regulation itself, Regulatory Guide 3.61, and NUREG-1536, Rev. 1. The staff concludes that the applicant's information is sufficiently detailed to allow reviewers to familiarize themselves with the pertinent features of the system and the changes requested.

2 PRINCIPAL DESIGN CRITERIA EVALUATION

The applicant did not propose any changes that affect the staff's principal design criteria evaluation provided in the SER supporting CoC No. 1040, approved April 6, 2015 (ADAMS Accession No. ML15093A498). Therefore, the staff determined that a new evaluation was not required.

3 STRUCTURAL EVALUATION

The applicant did not propose any changes that affect the staff's structural evaluation provided in the SER supporting CoC No. 1040, Amendment No. 1 (ADAMS Accession No. ML15252A426) approved September 8, 2015. Therefore, the staff determined that a new evaluation was not required.

4 THERMAL EVALUATION

The applicant proposed the following TS changes that affect the thermal evaluation:

1. Appendix B - Revise, Table 2.1-1 to allow up to 37 undamaged 16X16A fuel assemblies in damaged fuel containers (DFCs) for the MPC-37 permitted for storage in the HI-STORM UMAX Canister Storage System. This change is limited to 16Xl6A fuel only. An updated heat load pattern is also included for loading up to 37 intact 16X16A fuel assemblies in DFCs.

2. Appendix B - Add new 16x16 fuel types to approved contents, in CoC No. 1040, named 16x16B and 16x16C.

3. Appendix B - Revise 15x15I fuel types to include those with guide tubes.

To support the requested change to allow up to 37 undamaged 16x16A fuel assemblies in DFC's for the MPC-37, change 1 above, the applicant performed additional thermal analysis. The thermal analysis performed by the applicant demonstrated that the calculated peak cladding temperature (PCT) with the additional undamaged fuel assemblies is 50°C lower than the guidance limit specified in NUREG-1536, Rev. 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility" (SRP). The applicant stated this available margin accounts for uncertainty in the thermal model. The applicant's thermal analysis provided an additional margin of 30°C to account for wind effect. Therefore the applicant's calculated PCT during storage for 37 intact fuel assemblies stored in DFCs under the heat load pattern

shown in the CoC is 80°C lower than the guidance specified in the SRP. The applicant also provided responses to staff's request for additional information that demonstrated the adequacy of the effective thermal properties used in the thermal evaluation and permissible design temperature limits for the DFCs.

The staff reviewed the analyses provided by the applicant to justify the allowance of up to 37 undamaged 16x16A fuel assemblies in DFC's for the MPC-37 and verified the applicant's conclusion that the predicted temperatures remain below the guidance limit specified in NUREG-1536, Rev. 1, with adequate margin for the heat loads considered. Based upon this review, and the analysis demonstrating that, even with the proposed change, the predicted temperatures remain below the allowable limit specified in NUREG-1536, Rev. 1, the staff finds change no. 1 acceptable.

The staff reviewed the applicant's analysis and proposed changes nos. 2 and 3 above, and verified that the additional contents remain bounded by the FSAR thermal evaluation for the Westinghouse 17 X 17 design basis fuel previously evaluated by the staff in CoC No. 1032 approved June 13, 2011 (ADAMS Accession No. ML111950103). In responses to requests for additional information, the applicant clarified that the Westinghouse 17 X 17 fuel remained the design basis fuel, and verified that the effective properties used in the FSAR thermal evaluation bound the new contents. The staff verified that the applicant corrected the FSAR inconsistencies regarding the DFCs permissible design temperature limits.

Based upon the staff's review of the information submitted by the applicant, the staff concludes that changes nos. 2 and 3 are also acceptable because the changes do not impact the applicant's original FSAR thermal evaluation that was previously approved by the staff.

4.1 Evaluation Findings

F4.1 The staff finds that that the thermal design of CoC No. 1040 remains in compliance with 10 CFR Part 72 and that the applicable design and acceptance criteria have been satisfied. The evaluation of the thermal design provides reasonable assurance that CoC No. 1040 will continue to provide safe storage of spent nuclear fuel. This finding is reached on the basis of a review that considered NUREG-1536, Rev. 1

5 CONFINEMENT EVALUATION

The applicant did not propose any changes that affect the staff's confinement evaluation provided in the SER supporting CoC No. 1040, approved April 6, 2015. Therefore, the staff determined that a new evaluation was not required.

6 SHIELDING EVALUATION

The applicant requested to add two new fuel types (16x16B and 16x16C) to the approved contents in CoC 1040, Appendix B (referred to in the summary as proposed TS change 2) that potentially affected the applicant's original shielding analysis. These fuel types have different fuel rod dimensions and a different layout of the guide tubes from the previously authorized 16X16 content (now classified 16X16A). The applicant stated that shielding evaluations are performed on a site specific basis and therefore there were no changes to the FSAR shielding evaluation. In response to a NRC request for supplemental information, the applicant clarified that it was not proposing any changes to the burnup and cooling times or limits approved April

6, 2015 (ADAMS Accession No. ML15093A498).in this amendment request. The applicant stated the proposed changes involve minor changes to the fuel parameters, and would not affect the system's ability to meet applicable dose requirements.

The staff reviewed this proposed change, following the guidance in NUREG-1536, Revision 1. The staff determined that this change does not involve any changes to the shielding design of the system. To evaluate potential impacts on dose, the NRC staff reviewed the parameters of the 16X16B and 16X16C fuel and determined that the source term for these fuel assemblies is similar to the source term for the previously approved CE 16X16A fuel. The design basis zircaloy clad fuel assemblies used for calculating the dose rates presented in chapter 5 of the HI-STAR FW MPC Storage System FSAR, Revision 0, are Westinghouse 17x17 pressurized water reactor (PWR) fuel types, that bound all other PWR fuel types including 16x16A, 16X16B, and 16X16C fuel. The staff previously evaluated and approved the use of Westinghouse 17X17 fuel in CoC 1040, approved on April 6, 2015. Because 16X16B and 16X16C fuel parameters are bounded by the 17X17 fuel, the staff determined that these new fuels will not have a significant effect on dose, and are bounded by the previous authorized content of HI-STORM UMAX Canister Storage System.

6.1 Staff Evaluation Findings

Based on its review of the statements and representations in the application, the staff finds reasonable assurance that the shielding design has been adequately described and evaluated and meets the dose requirements of 10 CFR Part 72.

F6.1 The evaluation of the shielding system design provides reasonable assurance that the HI-STORM UMAX Canister Storage System will allow continued safe storage of spent fuel in accordance with 10 CFR 72.236(d).

F6.2 The staff has reasonable assurance that the new fuel types are consistent with the applicable standards for shielding analyses and NRC guidance, and that the package design and contents satisfy the radiation protection requirements in 10 CFR 72.104 and 10 CFR 72.106.

7 CRITICALITY EVALUATION

The HI-STORM UMAX Canister Storage System utilizes the HI-STORM FW MPC and its associated approved contents to store spent nuclear fuel. The applicant requested to add new 16x16 fuel types (16x16B and 16x16C) to approved contents of the HI-STORM UMAX Canister Storage System and the HI-STORM FW MPC storage system, along with additionally requesting a revised 15x15I fuel type to include those with guide tubes. These changes required a staff criticality evaluation.

7.1 Fuel Specification

The applicant stated that the fuel material to be used for the 16x16B, 16x16C and 15x15I fuel assemblies is identical to the fuel material for the contents approved in CoC 1032 (uranium dioxide pellets sealed in zirconium alloy cladding). The applicant listed the new 16x16B, 16x16C fuel types, and revised 15x15I fuel types in Appendix B, Table 2.1-2 that includes the parameters important for safety. The staff reviewed these listed parameters and determined that they are consistent with the guidance found in NUREG-1536, Revision 1. For example, the

Table 2.1-2 uranium enrichment parameter is consistent with the NUREG-1536, Revision 1, Section 7.5.2, guidance that the uranium enrichment should not be greater than 5.0 weight percent ^{235}U. Because the listed parameters are consistent with NUREG-1536, Revision 1, the staff finds the proposed Table 2.1-1 table revisions acceptable.

7.2 Model Specification

The applicant submitted calculations related to the proposed16x16 fuel type (16x16B and 16x16C) and 15x15I fuel type revisions using the three-dimensional Monte Carlo code MCNP5 and continuous energy cross-section data to support the HI-STORM FW MPC Storage System, Amendment No. 2, and HI-STORM UMAX Canister Storage System, Amendment No. 2, requests. The applicant added the results of the applicant's models were added to the HI-STORM FW MPC Storage System FSAR Chapter 6, for fuel assembly contents previously approved in CoC No. 1032. The applicant used the same models to also support CoC No. 1040. This modeling approach consists of three-dimensional calculation models for all criticality analyses. These models explicitly define the fuel rods and cladding, the guide tubes, water rods, neutron absorber walls of the basket cells, and the surrounding MPC shell and overpack. The staff continues to find this methodology acceptable because the new fuel types the applicant seeks to add through this amendment are bounded by those fuel types approved in CoC No. 1032.

The applicant stated that its criticality safety calculations were based on conservative evaluations. According to the applicant, the design basis assumed the worst combination of manufacturing tolerances, calculational biases and uncertainties, and a fully flooded cask. The staff reviewed this information and determined that the applicant's criticality safety calculations and design basis assumptions are adequate because they are consistent with NUREG-1536, Revision 1, Section 7.5.3. The applicant also stated that its computer analyses demonstrate that the HI-STORM FW MPC Storage System with the new fuel assembly types remains subcritical, with the most reactive configuration not exceeding an effective multiplication factor of 0.95. The staff performed its own confirmatory analyses, and determined that the proposed fuel assemblies will remain subcritical under all credible conditions with the most reactive configuration not exceeding an effective multiplication factor of 0.95. The staff finds this acceptable because it is consistent with NUREG-1536, Revision 1, Section 7.4.

In summary, based on its review of the information provided, the staff concludes that the HI-STORM UMAX Canister Storage System continues to be consistent with the acceptance criteria specified in NUREG-1536, Revision 1, and will continue to remain subcritical under all credible conditions.

7.3 Computer Programs

The applicant performed calculations related to the proposed16x16 fuel type (16x16B and 16x16C) and 15x15I fuel type revisions using the three-dimensional Monte Carlo code MCNP5 and continuous energy cross-section data. The applicant provided representative criticality input and output files. The staff reviewed the applicant's calculations and determined that the new fuel assembly types are bounded by the previously approved benchmark analysis in CoC No. 1032 that is applicable to CoC No. 1040 because CoC No. 1040 utilizes MPCs and fuel contents approved for the HS FW MPC Storage System (CoC No. 1032.) The previously approved analysis compared MCNP5 with select experimental data encompassing the design

parameters of the HI-STORM FW MPC Storage System and determined the biases and uncertainties included in all reported k_{eff} results.

The staff also performed confirmatory calculations using the same version of MCNP as the applicant (version 5), as well as the latest version 6 which contains the latest development capabilities. The results of the staff's calculations using versions 5 and 6 of MCNP were similar. These staff k_{eff} results confirmed that the k_{eff} will remain below the 0.95 guidance specified in NUREG-1536, Rev. 1. Because the applicant's new fuel assembly types are bounded by the previously approved benchmark analysis in CoC No. 1032 that is applicable to CoC No. 1040, and the results of the computer program calculations are consistent with NUREG-1536, Rev.1, the staff finds the applicant's use of MCNP and analysis of the proposed fuel type revisions acceptable.

The applicant also performed evaluations for storage of intact 16X16A fuel assemblies in damaged fuel canisters in MPC-37 cell locations. The staff's confirmatory calculations of this analysis also produced k_{eff} results below the 0.95 guidance specified in NUREG-1536, Revision 1. The staff finds that the applicant's evaluation of intact 16X16 fuel acceptable because it is consistent with applicable guidance in NUREG-1536, Revision 1.

7.4 TS Evaluation

The following proposed TS revisions that correspond to changes 2 and 3 were evaluated by the staff:

2. Appendix B - Add new 16x16 fuel types to approved contents, in CoC No. 1040, named 16x16B and 16x16C.

3. Appendix B - Revise 15x15I fuel types to include those with guide tubes.

The staff reviewed the proposed revisions against the applicant's proposed changes and determined that they are consistent and accurately reflect the proposed revisions.

7.5 Findings

F7.1 The NRC staff reviewed the information provided by the applicant and determined that CoC No. 1040 will remain in compliance with the criticality safety requirements of 10 CFR 72.124, and 72.236(c). This finding considered the regulation itself, and NUREG 1536, Rev. 1.

F7.1 The staff finds that the proposed criticality TS changes identify necessary TS to satisfy 10 CFR Part 72. This finding considered the regulation itself, and NUREG 1536, Rev. 1.

8. MATERIALS EVALUATION

The applicant did not propose any changes that affect the staff's materials evaluation provided in the SER supporting CoC No. 1040 issued April 6, 2015. Therefore, the staff determined that a new evaluation was not required.

9. OPERATING PROCEDURES EVALUATION

The applicant did not propose any changes that affect the staff's operating procedures evaluation provided in the SER supporting CoC No. 1040 issued April 6, 2015. Therefore, the staff determined that a new evaluation was not required.

10. ACCEPTANCE TESTS EVALUATION

The applicant did not propose any changes that affect the staff's acceptance tests evaluation provided in the SER supporting CoC No. 1040 issued April 6, 2015. Therefore, the staff determined that a new evaluation was not required.

11. RADIATION PROTECTION EVALUATION

The applicant did not propose any changes that affect the staff's radiation protection evaluation provided in the SER supporting CoC No. 1040 issued April 6, 2015. Therefore, the staff determined that a new evaluation was not required.

12.0 ACCIDENT ANALYSIS EVALUATION

The applicant did not propose any changes that affect the staff's accident analysis evaluation provided in the SER supporting CoC No. 1040 issued April 6, 2015. Therefore, the staff determined that a new evaluation was not required.

13 TECHNICAL SPECIFICATIONS AND OPERATING CONTROLS AND LIMITS EVALUATION

13.1 Objective

The review of the TS, and it's operating controls and limits, ensures that the operating controls and limits of the TS, including their bases and justification, meet the requirements of 10 CFR Part 72. Detailed evaluations are provided in SER Sections 4 and 7.

1. Appendix B - Revise, Table 2.1- Appendix B - Revise, Table 2.1-1 to allow up to 37 undamaged fuel assemblies in DFCs for the MPC-37 permitted for storage in the HI-STORM UMAX Canister Storage System. This change is limited to 16Xl6A fuel only. An updated heat load pattern is also included for loading up to 37 intact 16X16A fuel assemblies in DFCs.

2. Appendix B - Add new 16x16 fuel types to approved contents, in CoC No. 1040, named 16x16B and 16x16C.
3. Appendix B - Revise 15x15I fuel types to include those with guide tubes.

4. Appendix B, Table 3-4 – Revise to clarify the "Top Surface Pad" term.

The staff reviewed the applicant's TS revisions against the proposed changes 1 – 3 that the staff evaluated in SER sections 4 and 7 and determined that they are consistent and accurately reflect the proposed changes.

Regarding change 4, the staff finds that the current term "Top Surface Pad" in Appendix B, Table 3-4 is not consistent with the terminology in the HI-STORM UMAX Canister Storage System licensing drawings, FSAR, and supporting calculations. The licensing drawings, FSAR,

and supporting calculations refer to the ISFSI Pad, which is a minimum of 30 inches, and then an additional curb which is a minimum of 4 inches (for the total minimum of 34 inches). The staff concludes, therefore, that the editorial changes proposed for Table 3-4 reflect the correct terminology and are provided for clarification purposes.

13.2 Evaluation Findings

F13.1 The staff concludes that the conditions for use of the HI-STORM UMAX Canister Storage System continues to identify necessary TS to satisfy 10 CFR Part 72 and that the applicable acceptance criteria have been satisfied. The TS provide reasonable assurance that the system will continue to provide for safe storage of spent fuel. This finding considered the regulation itself, and NUREG 1536, Rev. 1.

14 CONCLUSION

Based on its review of CoC No. 1040, Amendment No. 2, the staff has determined that there is reasonable assurance that: (i) the activities authorized by the amended certificate can be conducted without endangering the health and safety of the public and (ii) these activities will be conducted in compliance with the applicable regulations of 10 CFR Part 72. Therefore, the amendment should be approved.

Dated: June 14, 2016