



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

SAFETY EVALUATION REPORT

DOCKET No. 72-1032
HI-STORM Flood/Wind
Multipurpose Canister Storage System
Holtec International, Inc.
Certificate of Compliance No. 1032
Amendment No. 2

1 SUMMARY

By letter dated March 31, 2015 (ADAMS Accession No. ML15092A130), as supplemented on April 9, 2015 (ADAMS Accession No. ML15114A423) June 19, 2015 (ADAMS Accession No. ML15170A433), and August 14, 2015 (ADAMS Accession No. ML15233A038), Holtec International (Holtec) submitted an amendment request to the U.S. Nuclear Regulatory Commission (NRC) to revise Certificate of Compliance (CoC) No. 1032 for the HI-STORM Flood/Wind (FW) Multipurpose Canister Storage (MPC) Storage System. Generally, the amendment request seeks to:

1. Add new fuel types to the HI-STORM FW MPC Storage System,
2. Include criticality calculations performed in support of the HI-STORM UMAX amendment request No.2,
3. Update an existing fuel type description, and
4. Include changes approved in revision No. 1 CoC No. 1032, Amendment No. 0.

The specific detailed changes associated with items 1-4 listed above are:

- a. Add new Combustion Engineering (CE) 16 X16 fuel types to approved contents, in CoC 1032, Appendix B, named 16x16B and 16x16C.
- b. Add criticality evaluations to the HI-STORM FW Final Safety Analysis Report (FSAR) Chapter 6 for the storage of up to 37 intact 16X16A fuel assemblies in an MPC-37.
- c. Revise 15x15I fuel type to include those with guide tubes.
- d. Reduce the limit for vacuum drying system (VDS) use with high burnup fuel in Appendix A, Table 3-1 and Appendix B, Table 2.3-3 and 2.3-4). Specifically, revise Appendix A, Table 3-1 to limit the MPC heat load limit for using VDS with high burnup fuel to a lower value, and revise Appendix B, Tables 2.3-3 and 2.3-4 for the per cell heat load limits to correspond to the lower MPC heat load limit.
- e. Revise the note on Limiting Condition for Operation (LCO) 3.1.2 in CoC 1032, Appendix A to clarify that the inlet and outlet vents should be 50% unblocked.

Additionally, the NRC staff (staff) proposed the following:

- f. Revise CoC Condition No. 8 to provide additional clarity and guidance. Holtec agreed to this change in correspondence dated February 29, 2016, (ADAMS Accession No. ML16061A410).

This safety evaluation report (SER) documents the review and evaluation of the proposed amendment, specifically changes a-f. The staff followed the guidance of NUREG-1536, Revision 1, "Standard Review Plan for Dry Cask Storage Systems," and Interim Staff Guidance (ISG)-11 "Cladding Considerations for the Transportation and Storage of Spent Fuel".

The staff's assessment is based on a review of Holtec's application and whether it meets the applicable requirements of 10 CFR Part 72 for independent storage of spent fuel. The staff's assessment focused only on modifications requested in the amendment as supported by the submitted revised FSAR and did not reassess previously approved portions of the FSAR.

1.0 GENERAL DESCRIPTION

The objective of this chapter is to review the design changes made to the HI-STORM FW MPC 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 satisfies 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, NUREG 1536, Rev. 1, and accepted practices. 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 SERs supporting CoC No. 1032 issued June 13, 2011 (ADAMS Accession No. ML111950103) and Amendment Number 1, Revision 1, issued on June 2, 2015 (ADAMS Accession No. ML15152A358). 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. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 2015. Therefore, the staff determined that a new evaluation was not required.

4. HI- STORM FW SYSTEM THERMAL EVALUATION

For the HI-STORM FW MPC Storage System, the applicant is proposing the following changes that affect the thermal evaluation:

- d. Reduce the thermal limit for VDS use with high burnup fuel in Appendix A, Table 3-1 and Appendix B, Tables 2.3-3 and 2.3-4. Specifically, revise Appendix A, Table 3-1 to limit the MPC heat load limit for using VDS with high burnup fuel to a lower value, and

revise Appendix B, Tables 2.3-3 and 2.3-4 for the per cell heat load limits to correspond to the lower MPC heat load limit.

e. Revise the note on LCO 3.1.2 in CoC No. 1032. Appendix A to clarify that each of the inlet and outlet vent should be 50% unblocked.

In addition, the NRC staff identified the following change:

f. Revise CoC Condition No. 8. to provide additional clarity and guidance.

The applicant provided reasons for the proposed changes, justification for the changes, as well as additional thermal evaluations for the 50% blocked vent configuration. The staff reviewed the proposed changes, justification for the changes, and the additional thermal analyses provided to support the 50% blocked vent configuration.

Proposed change d) has already been reviewed and approved by NRC in its review of CoC No. 1032, Amendment No. 0, Revision 1. Change d) would add this approved change from Amendment 0, Revision 1 to Amendment 2.

The staff reviewed the thermal analyses provided by the applicant for proposed change e) and verified that the predicted temperatures remain below the allowable limit guidelines in ISG-11.

Therefore, the staff concludes that the proposed changes have either already been approved by NRC in previous reviews or have been adequately justified with the thermal evaluation provided in the application.

CoC Condition No. 8 (proposed change f)

The staff revised Condition No. 8 (Special Requirements for First Systems in Place) to provide an adequate location to perform air velocity measurements. The staff has provided a similar revised condition in its approval of HI-STORM 100, Amendment No. 10. The condition in the HI-STORM, Amendment No. 10, system and proposed CoC 1032, Amendment No. 2 system are similar.

The language in CoC No. 1032, Amendment No. 1, required a specific location (annular gap between the canister and the overpack) to obtain the measurements. This location is difficult to access and the measured data are not reliable due to the chaotic behavior of air velocity (this is especially true in a location close to the top of the canister). The revised condition would direct the user to perform the measurements in a location (inlet vents) where the total mass flow rate can be obtained, and which allows a meaningful comparison with predicted results to be performed. The revised language provides, more precisely, the parameters that are to be measured and the analysis that is to be performed to satisfy the condition.

The CoC language would be revised to require cask users to submit the thermal validation test and analysis results in a letter report to the NRC pursuant to 10 CFR 72.4 within 180 days of either the user's loading of the first cask or within 180 days of the user's first transfer operation. The revised condition also states that to satisfy condition 8 for casks of the same system type, users may document in their 10 CFR 72.212 report a previously performed test and analysis that has demonstrated adequate validation of the analytic thermal methods.

4.1 Technical Specifications Evaluation

The following proposed TS changes that correspond to changes d-f were evaluated by the staff:

- a) Reduce limit for VDS use with high bumup fuel.
 - 1) Appendix A, Table 3-I - revise to limit the MPC heat load limit for using VDS with high bumup fuel to a lower value.
 - 2) Appendix B, Tables 2.3-3 and 2.3-4 - revise for the per-cell heatload limits to correspond to the lower MPC heatload limit.
- b) Revise Appendix A, Limiting Condition for Operation (LCO) 3.1.2 to clarify that each of the inlet and outlet vents should be 50% unblocked.
- c) Revise CoC Condition No. 8 to provide additional clarity and guidance.

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

4.2 Evaluation Findings

- F4.1 The staff finds that the thermal design of CoC No. 1032 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. 1032 will continue to provide safe storage of spent nuclear fuel. The finding is reached on the basis of a review that considered the regulation itself and applicable guidance.
- F4.2 The staff finds that the proposed thermal TS changes identify necessary TS to satisfy 10 CFR Part 72. The finding is reached on the basis of a review that considered the regulation itself and applicable guidance.

5 CONFINEMENT EVALUATION

The applicant did not propose any changes that affect the staff's confinement evaluation provided in the SERs supporting CoC No. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 2015. Therefore, the staff determined that a new evaluation was not required.

6 SHIELDING EVALUATION

The applicant requests to add two new fuel types to the approved contents in CoC 1032, Appendix B, named 16X16B and 16X16C (change a). 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. 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 proposed change a. following the guidance in NUREG-1536, Revision 1. The staff determined that change a. 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 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 1032, approved on June 13, 2011. 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 FW MPC Storage System.

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 meet the dose requirements of 10 CFR Part 72.

- F6.1 The evaluation of the shielding system design provides reasonable assurance that the HI-STORM FW MPC 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 72.106.

7. CRITICALITY EVALUATION

The applicant requested to add new 16x16 fuel types (16x16B and 16x16C) to approved contents of the HI-STORM FW MPC Storage System and a revised 15x15I fuel type (changes a. and c.). The applicant's proposed 16x16B and 16x16C fuel types include parameter changes to fuel cladding design, rod pitch and guide/instrument tubes. In addition, the 15x15I fuel assembly class includes versions with guide tubes and reduced number of fuel rods in specific locations. The applicant also requested to add criticality evaluations to the HI-STORM FW FSAR related to the storage of intact 16X16A fuel assemblies (change b). These evaluations are for loading 16X16A damaged fuel in canisters in all of the MPC-37 cell locations.

7.1 Criticality design Criteria and Features

No changes were made by the applicant to the NRC-approved criticality design criteria and features of the HI-STORM FW MPC Storage System, CoC 1032, approved June 13, 2011. Therefore, the staff determined that a new evaluation of the criticality design features and criteria was not needed.

7.2 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 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, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility". 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.

7.3 Model Specification

The applicant used a modeling approach for the new fuel types that is similar to the one used for fuel assembly contents previously approved in CoC No. 1032. 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 are bounded by those fuel types approved in CoC No. 1032.

The applicant stated that its criticality safety calculations were based on conservative evaluations. The applicant's 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 FW MPC 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.

7.4 Computer Programs

The applicant performed calculations related to the proposed 16x16 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 NRC approved benchmark analysis in CoC 1032. The previously approved analysis compared MCNP5 with select experimental data encompassing the design parameters of the HI-STORM FW 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 1032, 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.

7.5 Technical Specifications Evaluation

The following proposed TS revisions that correspond to changes a-c were evaluated by the staff:

- d) Appendix A, LCO 3.3.1, MPC-37: Minimum soluble boron concentration – Change the Array/Class from 16X16A to 16X16 to apply to all 16X16 fuel types.
- e) Appendix B, Table 2.1-2, PWR [pressurized water reactor] Fuel Assembly Characteristics – Add 16X16B and 16X16C fuel types.
- f) Appendix B, Table 2.1-2 – Revise note 4 to add “assemblies have up to 8 fuel rods removed or replaced by Guide Tubes” to apply to the 15x15I fuel type 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.

7.6 Findings

- F7.1 The NRC staff reviewed the information provided by the applicant and determined that CoC 1032 will remain in compliance with the criticality safety requirements of 10 CFR, 72.124, and 72.236(c). This finding considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.
- F7.2 The staff finds that the proposed criticality TS changes identify necessary TS to satisfy 10 CFR Part 72. The finding is reached on the basis of a review that considered the regulation itself and applicable guidance.

8. MATERIALS EVALUATION

The applicant did not propose any changes that affect the staff's materials evaluation provided in the SERs supporting CoC No. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 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 SERs supporting CoC No. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 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 SERs supporting CoC No. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 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 SERs supporting CoC No. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 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 SERs supporting CoC No. 1032 issued June 13, 2011 and Amendment Number 1, Revision 1, issued on June 2, 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 its 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.

The proposed CoC and TS changes to support the changes a-f in SER section 1 are:

- a. Reduce limit for VDS use with high bumup fuel.
 - 1) Appendix A, Table 3-I - revise to limit the MPC heat load limit for using VDS with high bumup fuel to a lower value.
 - 2) Appendix B, Tables 2.3-3 and 2.3-4 - revise for the per-cell heatload limits to correspond to the lower MPC heatload limit.
- b. Revise Appendix A, Limiting Condition for Operation (LCO) 3.1.2 to clarify that each of the inlet and outlet vents should be 50% unblocked.
- c. Revise CoC Condition No. 8 to provide additional clarity and guidance.

- d. Appendix A, LCO 3.3.1, MPC-37: Change the minimum soluble boron concentration – Change the Array/Class from 16X16A to 16X16 to apply to all 16X16 fuel types.
- e. Appendix B, Table 2.1-2, PWR Fuel Assembly Characteristics – Add 16X16B and 16X16C fuel types.
- f. Appendix B, Table 2.1-2 – Revise note 4 to add “assemblies have up to 8 fuel rods removed or replaced by Guide Tubes” to apply to the 15x15I fuel type to include those with guide tubes.

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

13.2 Evaluation Findings

F13.1 The staff concludes that the conditions for use of the HI-STORM FW MPC Storage System 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 is reached on the basis of a review that considered the regulation itself and applicable guidance.

14 CONCLUSION

Based on its review of CoC No. 1032, Amendment No. 2, the staff has determined that there is reasonable assurance that: (i) the activities authorized by the revised 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: 10/25/16