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

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PRELIMINARY SAFETY EVALUATION REPORT

DOCKET NO. 72-1014
HOLTEC INTERNATIONAL
HI-STORM 100
MULTIPURPOSE CANISTER STORAGE SYSTEM
CERTIFICATE OF COMPLIANCE NO. 1014
AMENDMENT NO. 13

SUMMARY

This safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's (staff) review and evaluation of the amendment request to amend Certificate of Compliance (CoC) No. 1014 for the HI-STORM 100 Multipurpose Canister (MPC) Storage System submitted by Holtec International (Holtec) by letter dated July 18, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML18205A179), as supplemented on November 19, 2018 (ADAMS Accession Number ML18325A154). The proposed change applies to Table 2.1-1, "PWR Fuel Assembly Characteristics," and would:

(1) Update the initial uranium weight for the 16x16B and 16x16C fuel assembly classes to match the value for 16x16A in HI-STORM 100 CoC Appendix B.

This revised CoC, when codified through rulemaking, will be denoted as Amendment No. 13 to CoC No. 1014.

This SER documents the staff's review and evaluation of the proposed amendment. The staff followed the guidance in NUREG-1536, Revision 1, "Standard Review Plan for Dry Cask Storage Systems at a General License Facility," July 2010 (ADAMS Accession No. ML101040620). The staff's evaluation is based on a review of Holtec's application and whether it meets the applicable requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste," for dry storage of spent nuclear fuel. The staff's evaluation focused only on modifications requested in Amendment No. 13 and did not reassess previous revisions of the final safety analysis report (FSAR) nor previous amendments to the CoC.

The NRC staff determined that the following areas of review are not affected by this amendment: 1) general description, 2) principal design criteria, 3) structural, 4) thermal, 5) confinement, 8) materials, 9) operating procedures, 10) acceptance tests and maintenance program, 11) radiation protection, 12) accident analyses, and 14) quality assurance. Therefore, this SER only requires evaluations on 6) Shielding, 7) Criticality, 13) Technical Specifications and 15) Conclusions.

6.0 SHIELDING EVALUATION

This shielding review evaluates the proposed change requested in Amendment No. 13 to CoC No. 1014 for the HI-STORM 100 to determine the ability of the shielding features to provide adequate protection against direct radiation from the dry storage system (DSS) contents. The evaluation ensures the shielding features limit the dose to the operating staff and members of the public so that the dose remains within regulatory requirements during normal operating, off-normal, and design-basis accident (DBA) conditions.

The staff reviewed the information provided by the applicant and evaluated the proposed change requested to increase the maximum uranium weight (kg/assembly) allowed for the 16x16B and 16x16C fuel assembly classes to match the maximum uranium value for 16x16A. This review seeks to ensure that the shielding design with the proposed change in the contents is sufficient and reasonably capable of meeting the operational dose requirements of 10 CFR 72.104 and 72.106 in accordance with 10 CFR 72.236(d).

6.1 Shielding Design

The HI-STORM 100 cask system design is unchanged from previous amendments. There are no proposed physical changes to the fuel assembly designs that are requested to increase the maximum uranium weight allowed.

6.2 Radiation Source

In Amendment No. 10 to CoC No. 1014, the NRC approved fuel assembly classes 16x16B and 16x16C as authorized contents. The contents, enrichment, weight, and dimensions of the fuel assembly classes were determined to be bounded by fuel assembly class 16x16A.

6.3 Shielding Model

The applicant stated that the shielding analysis as described by the staff's SER (ADAMS Accession No. ML16144A181) for the approval of fuel assembly classes 16x16B and 16x16C in Amendment No. 10 to CoC No. 1014 is bounded by the existing evaluations for 16x16A.

The staff reviewed the information provided in this amendment application and determined that the three fuel assembly classes are geometrically similar. The 16x16A fuel assembly class was used by the applicant in the initial application for CoC No. 1014 to demonstrate that the annual dose meets the limits of 10 CFR 72.104 and 10 CFR 72.106. In Amendment No. 10, the applicant relied on the dose analysis for the 16X16A fuel assembly class to add the 16x16B and 16x16C fuel assembly classes. The staff found that the new fuel assembly classes, which contained a smaller mass of uranium than the 16x16A fuel assembly class, were bounded by the 16x16A analysis. In analyzing the proposed increase of the fuel limits in this amendment, staff referred to NUREG/CR-1617, "Recommendations on Fuel Parameters for Standard Technical Specifications for Spent Fuel Storage Casks," which documents the results of a study performed to determine the fuel parameters important for calculating dose rates. The study concluded that other than burnup, enrichment and cooling time, the only other significant fuel parameter important for evaluating dose rate was uranium mass. Since there is no difference in these other parameters (i.e., burnup, enrichment and cooling time) between the 16x16A fuel assembly class and the 16x16B or 16x16C fuel assembly classes, the staff determined that the

proposed increase to the mass limits of the 16x16B and 16x16C fuel assembly classes to match the mass limit for the 16x16A fuel assembly class, is bounded by the analysis for the 16X16A fuel assembly class. Because the dose rates due to the proposed increase in uranium mass of the 16x16B and 16x16C fuel assembly classes will not exceed the dose rates of the bounding fuel assembly class 16x16A the staff determined that the change to the uranium weight limit (kg/assembly) for the 16x16B and 16x16C fuel assembly classes will have no negative impact on shielding performance, and the HI-STORM 100 System will continue to fulfill the shielding acceptance criteria as listed in Section 6.4 of NUREG 1536 Rev. 1.

6.4 Findings

F6.1 On the basis of review of the proposed change and the submitted documents, the staff concludes that the proposed changes have no negative impact on the shielding system and that the HI-STORM 100 System continues to meet the shielding requirements of 10 CFR Part 72.

7.0 CRITICALITY EVALUATION

The NRC staff evaluated the reduced scope of Amendment No. 13 to CoC No. 1014 for the Holtec HI-STORM 100 that limited the amendment request, for criticality safety purposes, to increasing the maximum uranium mass allowed in fuel assembly classes 16x16B and 16x16C to match the maximum uranium mass allowed in fuel assembly class 16x16A. This increased uranium mass will apply to both previously loaded canisters and canisters to be loaded in future campaigns.

7.1 Description of the Criticality Design

The HI-STORM 100 cask system design is unchanged from previous amendments. There are no proposed physical changes to the fuel assembly designs that are requested to increase the maximum uranium mass allowed. The cladding, initial enrichment of the fuel, number of fuel rods, fuel length, and all dimensions and tolerances are unchanged; only the uranium mass of 16x16B and 16x16C fuel assembly classes are increased. The staff evaluated the applicant's proposed changes to Table 2.1-2 of the SAR for the maximum uranium mass allowed in fuel assembly classes 16x16B and 16x16C and reviewed it against the original limits cited in the FSAR for completeness of information, description of the package design features, parameters, and dimensions, and found them to be sufficient to perform the review.

7.2 Spent Fuel Specification

As specified in Table 2.1-2, the applicant requested an increase in the maximum uranium mass for fuel assembly classes 16x16B and 16x16C to match the limit on fuel assembly class 16x16A (i.e., ≤ 427 kg for 16x16B and ≤ 426 kg for 16x16C, up to ≤ 448 kg, which is ~ 5% increase per assembly). Staff notes that the initial uranium mass is not used explicitly in the criticality safety analysis, but is calculated from the density of the fuel and the dimensions used in the modeling analysis.

The applicant did not provide a fuel density in Table 2.1-2. The dimensions provided in the table are similar for all of the 16x16 fuel assembly classes (i.e., 16x16A, 16x16B, and 16x16C), with the exception of the fuel pellet diameter (0.3225" for 16x16B and 16x16C, vs. 0.3255" for 16x16A), fuel cladding thickness (.045" for 16x16B and 16x16C, vs. 0.047" for 16x16A), and fuel rod pitch (0.506" for 16x16A and 16x16B, vs. 0.485" for 16x16C). Other dimensions, such as

the active fuel length, number of rods per assembly, and number of guide tubes are either identical or are conservatively bounded (i.e., result in less uranium mass per assembly) by the 16x16A fuel assembly class parameters.

Staff determined that the difference in fuel pellet diameter between the various 16x16 fuel assembly classes could account for a difference in fuel volume of approximately 2% at any given fuel density, which would equate to a difference in uranium mass of the same magnitude. Assuming a conservative density at 97% of the theoretical density of UO_2 (i.e., 10.96 g/cm^3 as defined in the SCALE Standard Composition Library), a single 16x16B fuel assembly with 236 fuel rods (one more than the 235 in a 16x16C fuel assembly, and thus bounding for both), would have a uranium metal mass of 443.1 kg. Staff determined that even if the 16x16B and 16x16C fuel assembly classes met the highest uranium mass possible given the most conservative dimensional tolerances in Table 2.1-2, the assemblies would not be able to achieve the proposed higher uranium mass limit of 448 kg without extraordinary measures to increase the density to almost 98% of theoretical, and therefore, the established 16x16A mass limit is bounding for all 16x16 type fuel assembly classes allowed in the HI-STORM 100 under this amendment.

7.3 Model Specification

The applicant did not perform any additional calculations based on this amendment request, and referred to the model specifications for the 16x16 fuel assembly classes that were used in Amendment No. 10 that added the 16x16B and 16x16C fuel assembly classes. No changes to the computer model geometry based on the increased mass limits of 16x16B and 16x16C fuel assembly classes were identified, and all of the 16x16 fuel assembly classes remain bounded by the 16x16A fuel assembly class analysis that was performed by the applicant.

7.4 Criticality Analysis

Staff reviewed the FSAR sections affected by this proposed amendment and the previous criticality analysis performed for Amendment No. 10. As noted above in Section 7.2 and 7.3 of this SER, the increased mass limits for the 16x16B and 16x16C fuel assembly classes remain bounded by the 16x16A fuel assembly class analysis based on the maximum uranium mass that could be present in the assemblies taking all dimensions and tolerances of the fuel geometry into account. The 16x16A fuel assembly class was previously approved by Amendment No. 10 and found to meet the criteria for being subcritical under all required conditions under 10 CFR Part 72. Since the analysis for the16x16A fuel assembly class continues to bound the 16x16B and 16x16C fuel assembly classes at the higher uranium mass limit, the 16x16B and 16x16C are subcritical as well under the conditions of 10 CFR Part 72.

7.5 Burnup Credit

The applicant did not request any changes to this amendment of the HI-SSTORM 100 storage cask that would allow for burnup credit of the 16x16B and 16x16C fuel assembly classes.

7.6 Evaluation Findings

F7.1 Structures, systems, and components important to criticality safety are described in sufficient detail in the SAR to enable an evaluation of their effectiveness.

F7.2 The cask systems are designed to be subcritical under all credible conditions.

F7.3 The criticality design is based on favorable geometry, fixed neutron poisons, and soluble poisons of the spent fuel pool [as applicable]. An appraisal of the fixed neutron poisons has shown that they will remain effective for the term requested in the CoC application and there is no credible way for the fixed neutron poisons to significantly degrade during the requested term in the CoC application; therefore, there is no need to provide a positive means to verify their continued efficacy as required by 10 CFR 72.124(b).

F7.4 The analysis and evaluation of the criticality design and performance have demonstrated that the cask will enable the storage of spent fuel for the term requested in the CoC application.

F7.5 The criticality design features for the HI-STORM 100 continue to be in compliance with 10 CFR Part 72 and the applicable design and acceptance criteria have been satisfied.

F7.6 The evaluation of the criticality design provides reasonable assurance that the HI-STORM 100 will continue to allow for the safe storage of spent fuel with the modifications proposed by this amendment. 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.

13.0 TECHNICAL SPECIFICATIONS AND OPERATING CONTROL AND LIMITS EVALUATION

13.1 Appendix B: Table 2.1-2: PWR Fuel Assembly Characteristics

The applicant updated the initial uranium weight for the 16x16B and 16x16C fuel assembly classes to match the value for 16x16A. The 16x16B and 16x16C fuel assembly classes are bounded by the already existing evaluations for 16x16A. Therefore, the staff found the modification acceptable based on the staff's findings for the Shielding and Criticality sections of this SER.

15.0 CONCLUSIONS

Based on its review of the amendment request to CoC No. 1014, Amendment No. 13, the staff has determined that there is reasonable assurance that: (1) the activities authorized by the amended certificate can be conducted without endangering the health and safety of the public, and (2) these activities will be conducted in compliance with the applicable regulations of 10 CFR Part 72.

(Date)

SUBJECT: PRELIMINARY SAFETY EVALUATION REPORT, DOCKET NO. 72-1014, HOLTEC INTERNATIONAL HI-STORM 100 MULTIPURPOSE CANISTER STORAGE SYSTEM, CERTIFICATE OF COMPLIANCE NO. 1014, AMENDMENT NO. 13. DOCUMENT DATE:

ADAMS Accession No. **ML18351A178**

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