



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

Safety Evaluation Report

Docket No. 72-1014  
Holtec International  
HI-STORM 100 Cask System  
Certificate of Compliance No. 1014  
Amendment No. 10

**SUMMARY**

By letter dated January 5, 2015 (ADAMS Accession No. ML15007A435), Holtec International (Holtec) submitted an amendment request to the U.S. Nuclear Regulatory Commission (NRC) for the HI-STORM 100 Certificate of Compliance (CoC) No. 1014. The proposed changes include the following:

1. Addition of new 16x16B and 16x16C fuel classes to the approved contents,
2. Change the ASME Code Alternative table to allow use of more recent code versions of material SA-516/516A Grade 70, and
3. Minor editorial edits to the CoC.
4. Additionally, the NRC staff (staff) is revising CoC Condition No. 9 to provide additional clarity and guidance. The applicant agreed with this change in correspondence dated November 20, 2015, (ADAMS Accession No. ML15327A043).

This revised CoC, when codified through rulemaking, will be denoted as Amendment No. 10, to CoC No. 1014.

This safety evaluation report (SER) documents the review and evaluation of the proposed revision. The staff followed the guidance of NUREG-1536, Revision 1, "Standard Review Plan for Dry Cask Storage Systems," Interim Staff Guidance (ISG) -11 "Cladding Considerations for the Transportation and Storage of Spent Fuel," ISG-21 "Use of Computational Modeling Software" in performing its regulatory evaluation, and ISG-23 "Application of ASTM Standard Practice C1671-07 when performing technical reviews of spent fuel storage and transportation packaging licensing actions."

The staff's evaluation 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 evaluation focused only on modifications requested in the amendment as supported by the submitted revised final safety analysis report (FSAR) and did not reassess previously approved portions of the FSAR or CoCs through Amendment No. 9.

ENCLOSURE

## **1.0 GENERAL DESCRIPTION**

The objective of this chapter is to review the requested design changes made to CoC No. 1014, Amendment No. 10 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 requested 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, Regulatory Guide 3.61, 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.

## **2.0 PRINCIPAL DESIGN CRITERIA EVALUATION**

There were no requested changes requiring evaluating the principal design criteria related to the Structures, Systems, and Components (SSCs) important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

## **3.0 STRUCTURAL EVALUATION**

There were no requested changes requiring evaluating the structural criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

## **4.0 THERMAL EVALUATION**

The staff revised Condition No. 9 (Special Requirements for First Systems in Place) to provide an adequate location to perform air velocity measurements. The previous language in the CoC 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 behaviour of air velocity (this is especially true in a location close to the top of the canister). The revised condition directs 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 staff also revised Condition No. 9 regarding the Supplemental Cooling System (SCS). The revised condition also specifies that measurements are to be used to validate the analytical methods described in the FSAR for the cask where measurements are taken. Therefore, it will be necessary for the user to develop a thermal model of this cask using the analytical methods described in the FSAR. This will avoid unnecessary approximations in the thermal model that could add additional uncertainty in the predicted results.

These revisions were necessary because the current CoC language does not clearly capture the staff's expectations for testing and analysis. Therefore, 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 has also been 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 9(a) 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 Findings

- F4.1 CoC No. 1014 continues to be designed with a heat-removal capability having verifiability and reliability consistent with its importance to safety.
- F4.2 The spent fuel cladding continues to be protected against degradation leading to gross ruptures by maintaining the cladding temperatures below 400°C (752°F) for normal conditions and 570°C (1058°F) for off-normal and accident conditions, and other cask component temperatures continue to be maintained below the allowable limits for the accidents evaluated.

### 5.0 CONFINEMENT EVALUATION

There were no requested changes requiring evaluating the confinement criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

### 6.0 SHIELDING EVALUATION

The objective of the shielding review is to ensure that there is adequate protection to the public and workers against direct radiation from the cask contents. The review intends to ensure that the proposed shielding features and contents provide adequate protection against direct radiation to the operating staff and members of the public, and that direct radiation exposures can satisfy regulatory requirements during normal operating, off-normal, and design-basis accident conditions.

The applicant submitted the following request that required a shielding evaluation:

- Addition of new 16x16B and 16x16C fuel classes to the approved contents.

The applicant provided a revised HI-STORM 100 Criticality Analysis Report along with the results of this analysis in supplied proposed revised FSAR pages to support its conclusions. This is discussed in detail in Section 7.0 below. The applicant stated that new fuel types were

determined to be bounded by the design basis fuel previously analyzed in the FSAR for shielding.

The staff reviewed the details of the two new requested fuel classes as provided in the applicants HI-STORM 100 Criticality Analysis Report. The staff determined that the applicant's analysis was performed in accordance with processes previously analyzed and accepted by the staff. The staff determined that the analysis supports the applicant's conclusion that the shielding evaluation is bounded by the previously evaluated classes of 16X16 fuel.

Based upon its review, the staff has reasonable assurance the applicant's request for CoC No. 1014, Amendment No. 10, to support new fuel classes (16x16B and 16x16C) to the approved contents, is in compliance with 10 CFR Part 72 and the applicable design and acceptance criteria have been satisfied.

#### 6.1 Findings:

- F6.1 The evaluation of the shielding system design provides reasonable assurance that the HI-STORM 100 Dry Cask Storage System will allow continued safe storage of spent fuel in accordance with 10 CFR 72.236(d).
- F6.2 The contents, enrichment, weight and dimensions of the new classes are all bounded by previous approved fuel classes. The staff has reasonable assurance that the new fuel classes are consistent with the appropriate 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.

### 7.0 CRITICALITY EVALUATION

The applicant requested to add two new fuel types to the HI-STORM 100 named 16x16B and 16x16C, which are similar in configuration to the already approved 16x16A fuel type.

#### 7.1 Criticality Design Criteria and Features

No changes were made by the applicant to the design criteria and features of the HI-STORM 100 cask system.

#### 7.2 Fuel Specification

The applicant identified the new fuel types in Table 2.1-2 that indicated the parameters important for safety. The applicant further stated that, for the 16x16B and 16x16C fuel types, slight differences between the 16x16A fuel configurations slightly affected reactivity of the fuel over the fuel that NRC had previously evaluated.

### 7.3 Model Specification

The applicant used a similar modeling approach for the two new fuel types that has been previously used for the other fuel types and this methodology continues to be acceptable to staff. The applicant used three-dimensional calculation models for its criticality analyses.

### 7.4 Findings

The NRC staff reviewed the information provided by the applicant to support this amendment and determined that it is in compliance with the requirements of 10 CFR 72.24, 72.40, 72.124, and 72.236(c). Staff also determined that the calculated maximum  $k_{\text{eff}}$  results of the 16x16B and 16x16C fuel types are statistically similar to the already approved 16x16A fuel, and are both well bounded by the design basis fuel.

F7.1 Based on the information provided in the amendment, the staff concludes that the HI-STORM 100 Cask System continues to meet the acceptance criteria specified in NUREG-1536, and will continue to remain subcritical under all credible conditions and provide reasonable assurance for safe storage of spent fuel. This finding considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.

## 8.0 MATERIALS EVALUATION

The materials evaluation determines the acceptability of using material specification ASME SA-516/516M, Grade 70 from the ASME Boiler and Pressure Vessel Code (Code), 2007 Edition, in lieu of the current ASME 1995 Edition with Addenda through 1997.

The applicant has stated that the change to the ASME 2007 and 2010 Code for material SA-516, Attachment 1, Table 2 only provides a marginal increase in manganese content with an associated marginal reduction in carbon content. Specifically the 2007 and 2010 Editions provide for each reduction of 0.01 percentage point below the specified maximum for carbon, an increase of 0.06 percentage point above the specified maximum for manganese to be permitted, up to a maximum of 1.50% by heat analysis and 1.60% by product analysis. Metallurgically there is no deleterious effect, no change in material strength, density, or thermal properties. The applicant has stated there are no safety analyses impacted by the minor changes in chemistry and no changes to the properties used in the original CoC No. 1014 technical basis.

### 8.1 Findings

The NRC staff concludes carbon is the primary hardening constituent in steel. Manganese contributes to strength and hardness, but to a lesser extent than does carbon. The efficacy of manganese in increasing mechanical properties depends on and is proportional to the carbon content of the steel. Additionally the NRC has endorsed the ASME Code, Section II, 2007 Edition at Title 10 *Code of Federal Regulations* 50.55a(a)(1)(i)(E) via its reference to ASME Code, Section III. No change in mechanical properties is cited as part of this request; no

change to form, fit or function as a result therefore the staff finds the requested exemption for the affected structures, systems, and components of CoC No. 1014 acceptable.

F8.1 The staff concludes the material properties of the structures, systems, and components of the HI-STORM 100 Cask System remain in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied. The evaluation of the material properties provides reasonable assurance the cask will allow safe storage of spent nuclear fuel for a licensed life of at least 40 years. 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.

## **9.0 OPERATING PROCEDURES EVALUATION**

There were no requested changes requiring an operating procedures evaluation to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

## **10.0 ACCEPTANCE TESTS AND MAINTANANCE PROGRAM EVALUATION**

There were no requested changes requiring an acceptance tests and maintenance program evaluation for the principal design criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

## **11.0 RADIATION PROTECTION EVALUATION**

There were no requested changes requiring a radiation protection evaluation for the principal design criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

## **12.0 ACCIDENT ANALYSIS EVALUATION**

There were no requested changes requiring an accident analysis evaluation for the principal design criteria related to the SSCs important to safety to ensure compliance with the relevant general criteria established in 10 CFR Part 72.

## **13.0 TECHNICAL SPECIFICATIONS**

### **13.1 Review Objective**

The objectives of this review were to ensure that the changes to the operating controls and limits or the Technical Specifications (TS) in CoC No. 1014, Amendment No. 10, continue to meet the requirements of 10 CFR Part 72. The evaluation is based on information provided by the applicant in this revision request, a review of the FSAR, as well as consideration of accepted practices. Specifically, the proposed changes were reviewed to ensure that they acceptably supported the equipment changes requested by the applicant. The technical and safety aspects of these changes were evaluated by the staff in previous sections of this SER and were found to

be acceptable. The applicant proposed technical and editorial TS changes. Equipment changes and additions that required TS change evaluations were as follows:

- (1) Addition of new 16x16B and 16x16C fuel classes to the approved contents,
- (2) Revise the ASME Code Alternative table to allow use of more recent code versions of material SA-516/516A Grade 70, and
- (3) Minor editorial edits to the CoC TS.
- (4) Additionally, the NRC is revising CoC Condition No. 9 to provide additional clarity and guidance to the applicant and general licensed users. The applicant agreed with this change in correspondence dated November 20, 2015.

The corresponding CoC and TS changes are:

- (1) TS, Appendix A, A-100U, Section 3.3.1.
- (2) TS, Appendix B, B-100U, Tables 2.1-2 and 2.4-3.
- (3) TS, Appendix B, Table 3-1.
- (4) TS, Appendix A, definition of "Dummy Rod" was clarified to allow for rods that displace approximately the same amount of water as the active fuel region, as the system safety analyses only consider the active region.
- (5) TS, Appendix B, B-100U, Section 3.6.2.2 was clarified to show that the 75 psia limit is for drying only and not for helium backfill.
- (6) Revised CoC No. 1014, Amendment No. 10, Condition 9.

## 13.2 Findings

F13.1 The staff finds that CoC No. 1014, continues to identify necessary TS to satisfy 10 CFR Part 72 and that the applicable criteria of 10 CFR 72.236 have been satisfied. The proposed TS changes provide assurance that the HI-STORM 100 Cask System will continue to allow safe storage of spent nuclear fuel.

## 14.0 CONCLUSIONS

Based on its review of the revision request to CoC No. 1014, Amendment No. 10, 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 revision should be approved.

May 31, 2016