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

FINAL SAFETY EVALUATION REPORT

DOCKET NO. 72-1040
HOLTEC INTERNATIONAL
HI-STORM UMAX
CERTIFICATE OF COMPLIANCE NO. 1040
AMENDMENT NO. 4

SUMMARY

This safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's review and evaluation of the request to amend Certificate of Compliance (CoC) No. 1040 for the HI-STORM UMAX storage system. By letter dated September 28, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18285A820), as supplemented on May 21, 2019 (ADAMS Accession No. ML19144A140), November 1, 2019 (ADAMS Accession No. ML19311C514), December 20, 2019 (ADAMS Accession No. ML20002A425), March 30, 2020 (ADAMS Accession No. ML20104C014), and April 13, 2020 (ADAMS Accession No. ML20111A237), Holtec International (Holtec), from here on referred to as the "applicant," requested that NRC amend the CoC to include the following changes:

Change #1 - Update the Technical Specifications (TS) for Radiation Protection regarding the Dose Rate Limit for the Vertical Ventilated Module (VVM) Lid.

Change #2 - Update the TS for the Vent Blockage Limiting Condition for Operation (LCO).

Change #3 - Add a Type 1 version of the Multi-purpose Canister (MPC)-37.

The amended CoC, when codified through rulemaking, will be denoted as Amendment No. 4 to CoC No. 1040. This SER documents the review and evaluation of the proposed amendment. The staff follows the guidance of NUREG-1536, Revision 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility" when performing technical reviews of spent fuel storage and transportation packaging licensing actions.

The staff's evaluation is based on a review of the applicant'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 to the CoC and TS requested in the amendment as supported by the submitted revised updated final safety analysis report (UFSAR) (see ADAMS Accession Nos. ML18285A814, ML19311C519, ML20104C014) and did not reassess previous revisions of the UFSAR nor previous amendments to the CoC.

The NRC staff determined that not all disciplines described in NUREG-1536 are affected by this amendment, and therefore, the following SER sections are not needed: 2) Principal Design Criteria, 3) Structural, 5) Confinement, 8) Materials, 9) Operating Procedures, 10) Acceptance Tests and Maintenance Program, and 14) Quality Assurance. This amendment only requires evaluations on Thermal, Shielding, Criticality, Radiation Protection and Accident Analysis as described in Sections 4, 6, 7, 11 and 12, respectively, of this SER.

1.0 GENERAL DESCRIPTION

The objective of this chapter is to review the changes requested to CoC No. 1040 for the HI-STORM UMAX storage system to ensure that the applicant provided an adequate description of the pertinent features of the storage system and the changes requested in the application. The specific changes requested by the applicant are described and evaluated in the following sections of this SER.

4.0 THERMAL EVALUATION

The staff's thermal review ensures that the cask components and fuel material temperatures of the HI-STORM UMAX storage system will remain within the allowable values under normal, off-normal, and accident conditions. These objectives include confirmation that the fuel cladding temperature will be maintained below specified limits throughout the storage period to protect the cladding against degradation that could lead to gross ruptures. This portion of the review also confirms that the cask thermal design has been evaluated using acceptable analytical techniques and/or testing methods. The review was conducted against the appropriate regulations as described in 10 CFR 72.236 that identify the specific requirements for spent fuel storage cask approval and fabrication. The unique characteristics of the spent fuel to be stored are identified, as required by 10 CFR 72.236(a), so that the design basis and the design criteria that must be provided for the structures, systems and components (SSCs) important to safety can be assessed under the requirements of 10 CFR 72.236(b). This application was also reviewed to determine whether the HI-STORM UMAX storage system design is consistent with the acceptance criteria listed in Sections 2, 4 and 12 of NUREG-1536, Revision 1, as well as interim staff guidance (ISG) 11, Rev. 3 "Cladding Considerations for the Transportation and Storage of Spent Fuel."

The following changes under amendment request No. 4 are applicable to the thermal evaluation:

Change #2 **-** Update the TS for the Vent Blockage LCO

Change #3 **-** Add a Type 1 version of the MPC-37

4.1 Specifications for Components

The staff reviewed the applicant's specifications for SSCs important to safety for the HI-STORM UMAX storage system. Based on the information provided in the application regarding specifications for components, the staff determines that the application is consistent with guidance provided in Section 4.4.2 (Material and Design Limits) of NUREG-1536 that provides that cask components and fuel materials should be maintained between their minimum and maximum temperature limits for normal, loading, off-normal, and accident-level conditions to enable all components to perform their intended safety function. The staff concludes that the

specifications for components are acceptable because the material temperature limits are consistent with NUREG-1536.

4.2 HI-STORM UMAX Storage System

4.2.1 General Description

The applicant stated in Section 1.2.1 of the UFSAR that the MPC-37 Type 1 is identical in design and manufacturing to the MPC-37 (previously approved), except for the basket flow holes on the periphery of the basket. In the MPC-37 Type 1 version, these periphery basket flow holes are not required to be open during normal operation.

The staff reviewed the description of the thermal design and finds it is consistent with NUREG-1536.

4.2.2 Design Criteria

The permissible aggregate heat load of MPC-37 Type 1 version is provided in Table 2.1.12 of the UFSAR and the permissible per cell heat load is shown in Figure 2.1.26 of the UFSAR.

The staff reviewed the applicant's general description and design criteria of the HI-STORM UMAX storage system. Based on the information provided in the application regarding these items, the staff determines that the application is consistent with guidance provided in Section 4.4.1 (Decay Heat Removal System) of NUREG-1536 which provides that the applicant should present a detailed description of the proposed cask heat removal system and its passive cooling characteristics. Here, the applicant has provided a detailed description of decay heat removal system and its passive cooling characteristics. Therefore, the staff concludes that the description of the decay heat removal system is acceptable because the description is consistent with NUREG-1536.

4.3 Thermal Model

The applicant used the FLUENT program to evaluate the thermal performance of the HI-STORM UMAX storage system. FLUENT is a finite volume computational fluid dynamics (CFD) program with capabilities to predict fluid flow and heat transfer phenomena in two and three dimensions. Section 4.4.12 of the UFSAR provides a general description of MPC-37 Type 1 thermal model of the MPC-37 Type 1 canister developed by the applicant. The thermal model assumes that the flow holes on the basket periphery are closed.

The staff reviewed the applicant's description of the MPC-37 Type 1 canister thermal model. Based on the information provided in the application regarding the thermal model, the staff determines that the application is consistent with guidance provided in Section 4.4.4 (Analytical Methods, Models, and Calculations) of NUREG-1536 that provides that the applicant should present a thermal analysis clearly demonstrating the storage system's ability to manage specified heat loads and have the various materials and components remain within temperature limits. The applicant provided a detailed description of the thermal models used to perform the evaluation of the storage cask and the results of the model, as confirmed by staff. The applicant demonstrated the storage system's ability to manage specified heat loads and have the materials and components remain within temperature limits. Therefore, the staff concludes that the description of the thermal model is acceptable.

4.4 Thermal Evaluation for Normal Conditions of Storage

The applicant used the thermal model described in the previous section to determine temperature distributions under long-term normal storage conditions for the MPC-37 Type 1 canister. UFSAR Table 4.4.19 provides key thermal and pressure results. The results presented by the applicant show that the temperature distribution in the HI-STORM UMAX canister storage system with a loaded MPC-37 Type 1 canister containing heat emitting spent nuclear fuel complies with all regulatory temperature limits. The staff determined the thermal environment in the HI-STORM UMAX storage system is in compliance with UFSAR design criteria. Per the UFSAR, all HI-STORM UMAX VVM and MPC-37 Type 1 materials of construction will satisfactorily perform their intended function in the storage mode under a minimum temperature condition of -40°F.

The staff reviewed the applicant's thermal evaluation of the HI-STORM UMAX storage system during normal conditions of storage. Based on the information provided in the application regarding the thermal model and evaluation, the staff determines that the application is consistent with Section 4.4.4 (Analytical Methods, Models, and Calculations) of NUREG-1536. This section of NUREG-1536 provides guidance on how a thermal analysis should demonstrate the storage system's ability to manage UFSAR-specified heat loads and have the various materials and components remain within temperature limits. The applicant has provided a thermal evaluation showing that calculated maximum temperatures remain below the recommended limits described in the application.

4.5 Thermal Evaluation for Short-Term Operations

The applicant stated that since the design basis fuel type and heat load bound the MPC-37 Type 1, it could be reasonably expected that the same would be true for short term operations. The staff agrees with this reasoning especially because of the larger margin in predicted temperatures provided for the MPC-37 Type 1 version for normal conditions of storage. This increased margin is due to the lower heat load permitted for the MPC-37 Type 1 compared to the design basis heat load.

4.6 Off-Normal and Accident Events

The applicant stated that since the design basis fuel type and heat load bound the MPC-37 Type 1, it could be reasonably expected that the same would be true for off-normal and accident conditions. The staff agrees with this reasoning especially because of the larger margin in predicted temperatures provided for the MPC-37 Type1 version for normal conditions of storage. This increased margin is due to the lower heat load permitted for the MPC-37 Type 1 compared to the design basis heat load.

The staff reviewed the applicant's thermal evaluation during off-normal and accident conditions and verified the maximum cladding temperatures predicted by the applicant would remain below ISG-11 Rev. 3 recommended limit of 1058°F for all postulated off-normal and accident events. Based on the information provided in the application regarding off-normal and accident events, the staff determines that the application is consistent with NUREG-1536, Section 4.4.4 (Analytical Methods, Models, and Calculations). This Section of NUREG-1536 provides guidance on how a thermal analysis should demonstrate the storage system's ability to manage specified heat loads and have the various materials and components remain within temperature limits. The applicant demonstrated this ability by performing the calculations and demonstrating

that the analysis results are lower than the recommended limit of 1058°F. Therefore, the staff concludes that the thermal evaluation during off-normal and accident events is acceptable.

4.7 Confirmatory Analysis

The staff reviewed the applicant's thermal models used in the analyses. The staff checked the code input in the calculation packages and confirmed the material properties and boundary conditions that were used. The staff verified that the applicant's selected code models and assumptions were adequate for the flow and heat transfer characteristics prevailing in the HI-STORM UMAX storage system geometry and analyzed conditions. The engineering drawings were also reviewed to verify that geometry dimensions were representative in the analysis models. The material properties presented in the UFSAR were reviewed to verify that they were appropriately referenced and used. Finally, through request for additional information the staff verified the applicant provided complete and accurate information in the UFSAR. Therefore, the staff made a safety determination on the adequacy of the HI-STORM UMAX storage system thermal design.

4.8 Evaluation Findings

Some of the key findings from the staff's review of Amendment No. 4 include:

F4.1 UFSAR Chapter 2 describes SSCs important to safety to enable an evaluation of their thermal effectiveness. Cask SSCs important to safety remain within their operating temperature ranges.

F4.2 The HI-STORM UMAX storage system is designed with a heat-removal capability having verifiability and reliability consistent with its importance to safety. The cask is designed to provide adequate heat removal capacity without active cooling systems.

F4.3 The spent fuel cladding is protected against degradation leading to gross ruptures under long-term storage by maintaining cladding temperatures below 752°F. Protection of the cladding against degradation is expected to allow ready retrieval of spent fuel for further processing or disposal.

F4.4 The spent fuel cladding is protected against degradation leading to gross ruptures under off-normal and accident conditions by maintaining cladding temperatures below 1058°F. Protection of the cladding against degradation is expected to allow ready retrieval of spent fuel for further processing or disposal.

The staff finds that the thermal design of the HI-STORM UMAX storage system is 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 the cask will allow safe storage of spent fuel throughout the CoC term. 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.

6.0 SHIELDING EVALUATION

In reviewing the HI-STORM UMAX design changes that affect the system shielding capability, the staff followed the guidance in Chapter 6 of NUREG-1536, Rev. 1. This report documents the basis for the staff's approval for the proposed changes with respect to shielding and meeting

the applicable dose limits in 10 CFR Part 72. The applicant's requested changes and the staff's evaluation follows.

The following changes under amendment request No. 4 are applicable to the shielding evaluation:

Change #1 – Update TS Dose Rate Limit for VVM Lid

Change #3 **–** Add a Type 1 version of the MPC-37

6.1 Change No. 1 – Update TS Dose Rate Limit for VVM Lid

The staff performed a routine inspection from May 14-18, 2018 (Inspection Report EA-18-151, "U.S. Nuclear Regulatory Commission Inspection Report 07201014/2018-201," Holtec International, ADAMS Accession No. ML18306A853), and found that the applicant had added a new VVM closure lid (Version B) via the change process under 10 CFR 72.48. As part of this inspection, the staff found that the TS dose rate at the VVM lid was not applicable to the analysis conducted in the UFSAR for the system. In addition, the location of the dose rate measurement was not appropriate for the new lid. This amendment is one of the corrective actions to address the inspection issues.

In this amendment, the applicant requested to change the TS dose rate limit in Section 5.3.4.a of Appendix A of the CoC for the VVM standard and Version B closure lids. The applicant proposed to change the dose rate limit of the standard lid to 66 mrem/hr and the Version B lid to 22 mrem/hr. The applicant also proposed changes to the measurement location of the dose rate in Section 5.3.8.a of the TS in Appendix A of the CoC. For the standard lid, the measurements are to be taken "[o]n the side of the closure lid approximately midheight and approximately 90 degrees apart." For the HI-STORM UMAX Version B lid, the measurements are to be taken "[o]n the side of the closure lid approximately midheight and adjacent to the inlet vent. One measurement per each lid side, rotationally symmetric by approximately 90 degrees."

The staff reviewed the analysis for the standard lid documented within the existing UFSAR that shows the calculated dose rates using the standard lid. The dose rate proposed by the applicant (66 mrem/hr) for the TS measurement limit is equivalent to the maximum calculated dose rate for the VVM lid. The proposed measurement location specified in Section 5.3.8.a of the TS (CoC Appendix A) for the standard lid is equivalent to Location 1 from Figure 5.1.1 of the UFSAR. In addition, the dose rate in Table 5.1.1 of the UFSAR at this location is equivalent to the proposed TS dose rate in TS Section 5.3.4.a (Appendix A to the CoC).

The applicant submitted the analysis for the Version B lid that shows the calculated dose rates in a report designated HI-2125194, Revision 10, "Shielding Analysis of the HI-STORM UMAX," (ADAMS Accession No. ML18285A815). The staff reviewed the report and confirmed that the TS dose rate limit (22 mrem/hr) and measurement location proposed by the applicant are equivalent to the highest calculated dose rate for the Version B lid from Table I-1 of HI-2125194. The measurement location specified in proposed TS 5.3.8.a for the Version B lid is equivalent to Location 5 from HI-2125194 Figure I-1. In addition, the dose rate in Table I-1 of the HI-2125194 at this location is equivalent to the proposed TS dose rate in TS Section 5.3.4.a (Appendix A to the CoC).

6.1.1 Modeling of the Version B Lid

The staff reviewed the modeling of the Version B lid within Appendix I of HI-2125194. The staff reviewed the assumptions in Section I-4 and found that they are appropriate with respect to the design documentation in the HI-STORM UMAX UFSAR, with the exception of the source term, as discussed later in this SER. Section I-5 states: "The UMAX Version B material densities and compositions are the same as those in the UMAX UFSAR." The applicant states that it used the design drawings in developing the model, so the staff reviewed drawing 10017 Rev. 5 from the HI-STORM UMAX UFSAR to compare it to the design assumptions of the Version B lid.

Table 5.3.2 of the HI-STORM UMAX UFSAR states that the concrete density used within the shielding model is 2.4 g/cm^3 (150 lb/ft^3). In the bill of materials for the closure lid, the "Closure lid outer shield," and "closure lid inner shield" materials are specified by Notes 9 and 10. Note 10 states that the concrete is specified in Table 2.3.2 of the UFSAR which states that the minimum nominal dry density is 150 lb/ft^3. Note 9 says material requirements are defined in Section 8.2 of the UFSAR. Section 8.2.2.i of the UFSAR states that: "the shielding performance of the plain concrete is maintained by ensuring that the minimum concrete density is met during construction." The staff found that the concrete density modeled for the UMAX Version B lid is appropriate because it is consistent with the specified minimum concrete density.

6.1.2 Use of "Representative" Source Term

The applicant states in Section 5.0 of the UFSAR that it used "representative" (rather than bounding) analyses within the UFSAR because only site-specific evaluations can be performed to show compliance with the controlled area boundary dose limits in 10 CFR 72.104 and 10 CFR 72.106. Although 10 CFR 72.212(b)(5)(iii) requires site-specific evaluations to be performed by the general licensee to ensure the requirements of 10 CFR 72.104 are met, 10 CFR 72.236(d) requires that the certificate holder and applicant for a CoC ensure the system shielding is sufficient to meet dose limits in 10 CFR 72.104 and 10 CFR 72.106. Therefore, the staff does not usually accept a "representative" analysis to demonstrate that the system's shielding meets dose limits in 10 CFR 72.104 and 10 CFR 72.106. Section 6.5.2 of NUREG-1536 Revision 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility," recommends that the reviewer verify that applicants use a bounding source term. The staff has accepted the use of a non-bounding source term for this application based on risk informed insights and the TS dose rate limit as discussed below.

6.1.3 Use of TS Dose Rate Limit to Show that the Design Meets 10 CFR 72.104 Annual Dose Limits

The applicant has determined that if this system is loaded with fuel that meets the TS dose rates at the lid, then it can meet the regulatory limits in 10 CFR 72.104. Since the user must perform an analysis to demonstrate that 10 CFR 72.104 is met and must also perform measurements to ensure the TS limits are met, the staff found that the TS lid dose rate limit provides enough assurance that the controlled area boundary doses will be met, for this application.

The staff notes that using TS dose rate limits as a means of demonstrating compliance with 10 CFR 72.236(d) is not currently within the review guidance prescribed in NUREG-1536. In the case of the HI-STORM UMAX, the applicant performed its dose rate evaluations using a uniform loading pattern, and the locations of the TS dose rate measurements are at the locations where the UFSAR documented the highest dose rates. The staff found that this shows that the highest calculated UFSAR dose rates correspond to the areas with least shielding.

For other systems that use a bounding source term in their analysis, the staff relies more on the allowable content limits and less on the dose rate TS limit to demonstrate that the design can meet controlled area boundary dose rate limits. For this application, the TS dose rate limit and measurement locations coincide with the highest dose rate values documented within the UFSAR, and thus for this reason, the staff has accepted non-limiting locations and dose rate values above that analyzed within the UFSAR for other systems.

Although there is still uncertainty in the contribution to the controlled area boundary dose rate when loading a higher source term than analyzed within the UFSAR (but still authorized by Table 2.1-1 of the TS, Appendix B of the CoC), the staff found the HI-STORM UMAX capable of meeting regulatory controlled area dose limits based on the relatively low calculated controlled area boundary dose as compared to other systems. The estimated controlled area boundary doses are documented in Table 5.1.3 of the UFSAR for the standard lid and Table I-3 for the Version B lid. Given these low controlled area boundary doses, the staff determined that the risk for exceeding the regulatory controlled area annual dose limit to the public is very low. Staff found that using “representative” source terms (rather than bounding) together with the TS dose rate limits for determining compliance with 10 CFR 72.236(d) is acceptable given the low amount of likely exposure to the public.

6.1.4 Accident Condition Dose Limits, 10 CFR 72.106

The TS dose rate ensures that the normal condition off-site dose limit will be met in 10 CFR 72.104, yet there is no connection to the accident condition dose rate in 10 CFR 72.106. The staff cannot determine if the accident condition source term is appropriate for the allowable contents as it appears this evaluation was also performed using a non-bounding source term. However, in the absence of a bounding analysis the staff identified other grounds that provide reasonable assurance that the accident condition dose rates would be met. Specifically, the Staff examined the calculated dose from accident conditions in Table 5.1.4 of the UFSAR and Table I-7 of HI-2125194. This table shows the relatively low accident dose rates from the limiting accident for the overpack, a missile that causes displacement of the soil. There is at least an order of magnitude margin between the dose rate from the limiting accident and the regulatory limit, therefore, the staff determined that the dose limit from 10 CFR 72.106 would be met.

The limiting accident for the transfer cask is the loss of the neutron shield. The HI-STORM UMAX uses the same transfer casks approved for the HI-STORM FW (Docket No. 72-1032) and this system is referenced within the HI-STORM UMAX UFSAR. The accident analyses for the transfer cask for this system are performed with source terms that are bounding for the HI-STORM UMAX’s allowable contents in TS Table 2.1-1 of Appendix B of the CoC (HI-STORM FW UFSAR, October 21, 2019, ADAMS Accession No. ML19317D392). The staff found that this provides assurance that 10 CFR 72.106 accident dose limits will be met for transfer cask events.

6.1.5 Conclusion

Having TS allowable contents that are not justified by analysis is not specifically endorsed by the staff review guidance (NUREG/CR-1536), and the staff does not endorse this as a generic strategy going forward without further qualification. However, for the context of this amendment, this underground system has relatively low reported dose rates as compared to above ground systems with similar source term loadings. The staff found that it has reasonable assurance

that the HI-STORM UMAX, associated analyses, and TS limits are sufficient to demonstrate that 10 CFR 72.236(d) has been met and that the system will be able to meet the regulations in 10 CFR 72.104 and 72.106. The staff notes that it may review future amendments that require changes in the contents, loading patterns, or shielding design of the HI-STORM UMAX system consistent with the review guidance in NUREG-1536 Rev. 1 (or later revisions such as NUREG-2215).

6.2 Change No. 3 – MPC-37 Type 1

The applicant proposed to add the Type 1 version of the MPC-37. The applicant states that the only difference between the MPC-37 and MPC-37 Type 1 is that the Type 1 version is evaluated assuming the periphery basket flow holes are closed. This would have no effect on the shielding of the system. The only change associated with implementing the Type 1 MPC-37 that could affect conclusions associated with the shielding capability is that the applicant has developed a new decay heat loading pattern to accommodate this MPC to account for the changes in heat transfer due to the blocked flow holes. Since there is no direct relationship between decay heat and dose rate, changing the decay heat pattern alone does not affect the system's dose rates which will continue to be limited by the TS dose rate limits.

6.3 Evaluation Findings

Some of the key findings from the staff's review of Amendment No. 4 include:

F6.1 Sections 1 and 5 of the UFSAR describe shielding structures, systems, and components (SSCs) important to safety in sufficient detail to allow evaluation of their effectiveness. The staff reviewed the drawings in Section 1.5 of the UFSAR. In reviewing the Version B lid, the staff referenced Drawing 10017, and for the Version 1 MPC-37 the staff referenced Drawing 6505.

F6.2 Section 5 of the UFSAR provides reasonable assurance that the radiation shielding features are sufficient to meet the radiation protection requirements of 10 CFR Part 20, 10 CFR 72.104 and 10 CFR 72.106.

F6.3 Operational restrictions to meet dose and as low as reasonably achievable (ALARA) requirements in 10 CFR Part 20, 10 CFR 72.104, and 10 CFR 72.106 are the responsibility of the site licensee. The HI-STORM UMAX shielding features are designed to assist in meeting these requirements.

Based upon its review, the staff has reasonable assurance that the design of the shielding system of the HI-STORM UMAX complies with 10 CFR Part 72 and satisfies the applicable design and acceptance criteria. The applicant's evaluation of the shielding system design provides reasonable assurance that the HI-STORM UMAX will allow safe storage of spent fuel in accordance with 10 CFR 72.236(d).

7.0 CRITICALITY EVALUATION

In reviewing the changes requested in Amendment No. 4 to the HI-STORM UMAX design that affect the criticality safety of the system, the staff followed the guidance in Chapter 7 of NUREG-1536,Rev. 1 This SER documents the basis for the staff's approval for the proposed changes with respect to criticality safety and meeting the subcriticality criterion in 10 CFR 72.236(c). The applicant's requested changes and the staff's evaluation follows.

The following change under amendment request No. 4 is applicable to the criticality evaluation:

Change #3 **–** Add a Type 1 version of the MPC-37

7.1 Change No. 3 – MPC-37 Type 1

The applicant proposed to add the Type 1 version of the MPC-37. The applicant states that the only difference between the MPC-37 and MPC-37 Type 1 is that the Type 1 version is evaluated assuming the periphery basket flow holes are closed. This change may have an impact on the criticality safety of the system with respect to preferential flooding of the system. In some cases, reactivity can increase when specific parts of the system experience flooding while others remain dry. This is termed preferential flooding.

Based on the information submitted on May 21, 2019 (ADAMS Accession No. ML19144A140), the MPC-37 contains blocked flow holes for the shims but the inner basket flow holes remain open, and therefore preferential flooding of the basket is still prevented. Although it is possible that the shims are drained while the rest of the basket is flooded, based on the drain line within the basket shim (shown in Figure 1.1.1 of the UFSAR). However, because the drained part of the basket is outside of the fuel region, the design would still be bounded by the fully flooded condition.

The staff found that the proposed change to add the MPC-37 Type 1 does not affect the criticality safety of the system and that the system still meets the regulations with respect to maintaining subcriticality in 10 CFR 72.236(c).

7.2 Evaluation Findings

Some of the key findings from the staff's review of Amendment No. 4 include:

F7.1 Structures, systems, and components important to criticality safety are described in sufficient detail in Chapters 1 and 7 of the UFSAR to enable an evaluation of their effectiveness.

F7.2 The cask and its spent fuel transfer 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.

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.

For the reasons discussed above, the staff concludes that the criticality design features for the HI-STORM UMAX complies with 10 CFR Part 72 and satisfies the applicable design and acceptance criteria. The applicant's evaluation of the criticality design provides reasonable assurance that the HI-STORM UMAX will allow safe storage of spent fuel.

11.0 RADIATION PROTECTION EVALUATION

In reviewing the changes requested in Amendment No. 4 to the HI-STORM UMAX design that affect the radiation protection of the system, the staff followed the guidance in Chapter 11 of NUREG-1536, Rev. 1. This SER documents the basis for the staff's approval for the proposed changes with respect to system's capability of meeting occupational dose limits in 10 CFR Part 20. The applicant's requested changes and the staff's evaluation follows.

The following changes under amendment request No. 4 are applicable to the radiation protection evaluation:

Change #1 – Update TS Dose Rate Limit for VVM Lid

Change #3 **–** Add a Type 1 version of the MPC-37

11.1 Change No. 1 – Update TS Dose Rate Limit for VVM Lid

The applicant proposed changes to the TS to modify the maximum dose rate and location for measuring it for the standard and Version B lid. As discussed in Section 6.1 of this SER, this change is made in response to an inspection that found that previous TS dose rate limits at this location are not based on an UFSAR analysis that demonstrates the system's capability of meeting the controlled area boundary dose limits in 10 CFR 72.104. The TS dose rate limit for the storage lid has a very small impact on the system's capability of meeting occupational dose limits in 10 CFR Part 20. The dose rate limits are relatively low, and the plant should be able to limit personnel and time for performing work time near the storage lid to the extent that occupational exposure limits in 10 CFR 20.1201 can be met. The change in limits are still low enough that any occupational personnel performing work near the lid would be able to meet the 10 CFR 20.1201 limits.

11.2 Change No. 3 – Add a Type 1 version of the MPC-37

The applicant proposed to add the Type 1 version of the MPC-37. The applicant states that the only difference between the MPC-37 and MPC-37 Type 1 is that the Type 1 version is evaluated assuming the periphery basket flow holes are closed. As discussed in Section 6.2 of this SER, this would have no effect on the shielding of the system and therefore no effect on the radiation protection of the occupational personnel. With this proposed change, the staff found that occupational personnel performing work would be able to meet the 10 CFR 20.1201 limits.

11.3 Evaluation Findings

Some of the key findings from the staff's review of Amendment No. 4 include:

F11.1 The HI-STORM UMAX provides radiation shielding features that are sufficient to meet the requirements of 10 CFR 72.104 and 72.106.

F11.2 The design and operating procedures of the HI-STORM UMAX provide acceptable means for controlling and limiting occupational radiation exposures within the limits given in 10 CFR Part 20 and for meeting the objective of maintaining exposures ALARA.

For the reasons discussed above, the staff concludes that the design of the radiation protection system of the HI-STORM UMAX complies with 10 CFR Part 72 and satisfies the applicable

design and acceptance criteria. The applicant's evaluation of the radiation protection system design provides reasonable assurance that the HI-STORM UMAX will allow safe storage of spent nuclear fuel.

12.0 ACCIDENT ANALYSIS EVALUATION

Off-normal and accident events are evaluated in Sections 4.6 and 6.1.4 of this SER.

13.0 TECHNICAL SPECIFICATIONS

The applicant updated the TS for Radiation Protection, Vent Blockage LCO, and added a Type 1 version of the MPC-37. The staff found the modifications acceptable based on the staff's findings for the Thermal, Shielding, Criticality, Radiation Protection and Accident Analysis sections of this SER.

15.0 CONCLUSIONS

Based on its review of the amendment request to CoC No. 1040, Amendment No. 4, 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.

Issued with Certificate of Compliance No. 1040, Amendment No. 4
on January 4, 2021.