STRUCTURAL QUESTIONS

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CRITICALITY QUESTIONS

RAI-21: Provide additional justification or analyses to support how the 24PT1-DSC meets the criteria of double contingency within the proposed HI-STORM UMAX amendment.

The proposed HI-STORM UMAX amendment has no discussion or analysis that addresses double contingency (e.g., water intrusion) into the 24PT1-DSC. The safety basis submitted by the applicant, and stated throughout Supplement I.6 of the FSAR, is that the 24PT1-DSC is only analyzed for dry conditions, which the applicant believes leads to a sufficient margin of safety to address uncertainties in its approach. This approach does not adequately address the double contingency principle due to the unanalyzed condition of the 24PT1-DSC stored in an underground vertical configuration and does not provide for defense in depth.

The requirement in 10 CFR 72.124(a) states "Spent fuel handling, packaging, transfer, and storage systems must be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety." This criterion is also stated in the American National Standards Institute (ANSI)/American Nuclear Society (ANS) 8.1, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors." Two unlikely events need to be identified and the system has to be designed in order to be subcritical given one unlikely event occurs (e.g., water intrusion into canister). This is important for evaluating criticality safety since the applicant's analysis relies on only one parameter (i.e., maintaining a dry internal configuration), and does not address any failure mechanisms that may challenge this configuration. This is especially important due to the now underground placement of the canister in the UMAX system, which differs from the original 24PT1-DSC analyses completed by TransNuclear for the NUHOMS system. The applicant has not provided a separate analysis related to double contingency for this proposed amendment.

Further, the review for the MPC stored in the UMAX, Amendment 0 system for double contingency took into account the known engineering features that contributed to the overall safety of the system, including the materials, initial conditions (manufacturing, closing), the physical protection of the MPC, as well as the potential for stress corrosion cracking of the MPC and the effects of mechanical impacts compromising the containment boundary to justify the unlikelihood of water entering into the cannister. These same engineering features are not specified in the analysis provided by the applicant for the 24PT1-DSC.

This information is needed to evaluate compliance with 10 CFR 72.124(a).

Holtec Response:

The two unlikely events that would need to occur for water to intrude into the DSC would be 1) Water entering the annulus in the HI-STORM UMAX cavity where the canister is stored and 2) the confinement barrier of the DSC being breached to allow water intrusion.

For item 1, this is considered to be unlikely based on both system design and also because the system has been tested and demonstrated to prevent water from entering the HI-STORM UMAX cavity. This test procedure and acceptance criteria is documented in the FSAR Section 10.3. This test has already been performed on the first constructed VVM as required and demonstrated that water does not enter the cavity. Additional detailed description on why the design of the HI-STORM UMAX system considers

water accumulation within the UMAX cavity to be unlikely was provided to the staff during the initial licensing of the HI-STORM UMAX System in the updated response to RAI 6-1 (ML14015A145). The information related to water in the HI-STORM UMAX cavity is unchanged regardless of the type of canister stored inside, so this information continues to be applicable.

For item 2, the confinement barrier for the DSC is described in Supplement I.7 of the proposed HI-STORM UMAX FSAR. As concluded in that supplement, the evaluations conclude that confinement is maintained under all normal, off-normal, and accident conditions. This conclusion is based on an evaluation of the DSC canister in storage. Also, the DSC canisters stored in the HI-STORM UMAX are required to be within their initial 20 year life, which eliminates concerns due to long term storage (such as stress corrosion cracking). Since there are no credible events that could cause a breach of the confinement barrier, this event is considered unlikely.

Since it would take an occurrence of both of these unlikely, independent events to have water enter the canister, assuming the canister remains dry is in accordance with the double contingency principle.

RAI-22: Provide information on how loading and unloading conditions will be handled for the 24PT1-DSC when stored in the HI-STORM UMAX. In addition, provide information as to how fuel contained in the 24PT1-DSC would be transportable.

The application does not contain any postulated accident condition analysis associated with loading and unloading conditions with respect to their submitted criticality safety analysis. Fuels may experience any number of perturbations (e.g. fuel reconfigurations, damage to the cannister, etc.) that may challenge the criticality safety of the canister during onsite movement of the 24PT1-DSC. This information is necessary to ensure that any stored fuel can be removed at a later date.

This information is needed to evaluate the compliance with 10 CFR 72.236(b), as well as 72.236(m).

Holtec Response:

All operations are performed with single failure-proof equipment, so no drop events have to be considered for the canister, and hence it is reasonable to assume that all assemblies initially loaded as intact assemblies into the canister would remain in the form of a regular assembly. Other accidents, (for example fire) have been evaluated and documented in Supplement 12.I that temperatures remain well below their allowable limits and no additional fuel damage will occur. Based on this, no further damage to the assemblies need to be considered in the criticality analyses (even though as a defense-in-depth such damage is being assumed, see response to RAI-23), and the transportability of the canisters would remain unaffected.

RAI-23: Justify the modeling of accident conditions used in Supplement I.6 of the FSAR to evaluate the reactivity of the 24PT1-DSC.

The applicant modeled one configuration of fuel assemblies, neglecting all internal components, and does not include any internal structural design information for the 24PT1-DSC in Supplement I.6 as required by 10 CFR 72.236(b). It is unclear to NRC staff whether this is a bounding configuration for criticality.

In addition, the applicant does not evaluate perturbations to the system with regard to accident conditions, including shifting of contents and damaged fuel assemblies as described in Section I.6.4.3 of the FSAR commensurate with the modeling methodology used for other approved canisters in the UMAX system. This deviation from the methodology currently used for other canisters authorized for use in the UMAX system should be adequately justified and provide enough information to determine the safety of the 24PT1-DSC during possible fuel reconfiguration due to postulated accident events (e.g., tolerances, fuel shifting, bounding configurations, etc.) as well as any potential fuel damage that may occur.

In addition, the applicant claims that the safety margin is substantial and is sufficient to address any uncertainties not explicitly considered within the FSAR. Staff is unable to make this same determination based on the information provided by the applicant. Without additional analyses by the applicant that demonstrate that this is the most reactive configuration of the fuel, the staff is unable to determine the 24PT1-DSC is subcritical in the HI-STORM UMAX. The applicant's approach does not provide information on known uncertainties in canister construction and tolerances, nor a bounding analysis, that can be used for the staff to consider the safety margins of the actual nuclear criticality parameters in its assessment of keff for the proposed storage system. While NRC staff has analyzed the safety of the 24PT1-DSC in a TN NUHOMS system, the analyses have not been independently provided by the applicant for NRC staff to make similar findings for the 24PT1-DSC in the proposed UMAX amendment.

This information is needed by the staff to determine compliance with 10 CFR 72.236(a), 72.236(b), 72.236(c), and 10 CFR 72.124(a).

Holtec Response:

We recognize the difficulty trying to characterize the dry system from a criticality safety perspective based on a single, presumably bounding or sufficiently conservative result. To support an informed decision, we performed numerous calculations and sensitivity studies, with results presented further below. Overall, the goal is to demonstrate that under dry condition, the system is subcritical with sufficient margin, even if the models do not necessarily represent the exact geometry inside the canister. For that, the approach is to perform calculations and studies over a wide range of parameters, showing that the variations in the calculated k_{eff} are comparatively small and that in all cases, a significant margin to the regulatory limit exists. This then should give reasonable assurance that for the actual geometry, and any reasonable variations and tolerances thereof, there would be similar margin to the limit, and hence the criticality safety of the system is assured under the dry conditions.

The following sets of calculations and studies have been evaluated:

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- Damaged fuel: Damaged fuel assemblies would be placed into damaged fuel containers, which would restrict the amount of fuel no longer in the form of a regular assembly, and also limit the volume that would contain such fuel. Additionally, since all operations are performed with single failure-proof equipment, no drop events would have to be considered for the canister, and hence it is reasonable to assume that all assemblies initially loaded as intact assemblies into the canister would remain in the form of a regular assembly. [

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Despite the large range of configurations analyzed, most results are in the range of 0.5 to 0.6, with the maximum value calculated to be ~0.63. Although fuel damage during the storage period is not considered a credible situation, such hypothetical fuel damage would be inconsequential in the dry condition, which is demonstrated by the fuel reconfiguration analysis. The analysis of variation of the fuel assembly parameters confirms that the safety margin is substantial and sufficient to address the uncertainties not explicitly considered within the FSAR.

Overall, the calculations and results should provide assurance that there is a significant margin for fuel in a dry canister, including for conditions and dimensions that are not well known.

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PUBLIC MEETING QUESTIONS

Issue #1 - Staff seeks to define CoC boundary by specifying clear and specific transition points and understand the implications for these defined transition points.

Holtec Response:

The HI-STORM UMAX CoC applies to the DSC from when the canister is transferred into the HI-TRAC through storage in the UMAX cavity, and applicability ends when the DSC is removed from the HI-TRAC transfer cask into another licensed component. The DSC may be removed into a licensed transportation cask, or a licensed wet or dry unloading location. Note that this is the same boundary that would apply to any canister in any of Holtec's storage systems, the CoC applicability begins when a canister is put into the transfer cask, continues through the transfer and storage phase, and would end when the canister is removed from the transfer cask to be placed in another licensed component, either for transportation or unloading.

Clarification regarding this has been added to the CoC description and to Supplement 9.I to make the boundaries more clear.

Issue #2 - Staff seeks to understand the proposed language; "canister in service greater than 20 years" as a license condition or TS, whichever is appropriate.

Holtec Response:

The proposed HI-STORM UMAX CoC, Appendix C, Item 5.4.2 requires that prior to storage the canister's license life must be checked and ensured to be within 20 years. Additional language has been added to this Technical Specification to reinforce the 20 year limit.

AMENDMENT 4 CHANGES

The changes from the now approved HI-STORM UMAX Amendment 4 have been incorporated into the draft HI-STORM UMAX Amendment 3 CoC and appendices.