RAI 2-40-S: Discuss in detail the methodology used to calculate the effective elastic modulus of the subgrade under the support foundation pad using only the estimated long-term settlement, as provided in Holtec Position Paper DS-338, "A Methodology to Compute the Equivalent Elastic Properties of the Subgrade Continuum to Incorporate the Effect of Long-Term Settlement."

The response to RAI 2-40 uses a methodology to derive an effective elastic modulus for the soil column under the support foundation pad. The methodology is described in detail in Holtec Position Paper DS-338, which has not been submitted as part of the application.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.103, and 72.122.

Holtec Response:
Holtec Position Paper DS-338, "A Methodology to Compute the Equivalent Elastic Properties of the Subgrade Continuum to Incorporate the Effect of Long-Term Settlement" has been provided for review. The same Position Paper is used in the HI-STORM UMAX FSAR (see Subsection 3.4.4.1.2) to compute the long-term settlement associated with the HI-STORM UMAX ISFSI and determine an "effective" elastic modulus of the subgrade.

RAI 4-2: Provide the ITS classification for the slings used during transfer operations of the multipurpose canister (MPC) from the transportation cask to the HI-TRAC.

Table 4.2.1 describes the ITS classifications for lifting devices and special lifting devices associated with the movement and transfer of the MPC, but does not describe the ITS classification for the slings used when transferring the MPC from the transportation cask to the HI-TRAC using the cask transfer building (CTB) crane. These slings are a component that provides, in part, the capability to lift, handle, and transfer spent nuclear fuel, and should therefore be classified.

This information is needed to determine compliance with 10 CFR 72.24(b).

Holtec Response: Holtec agrees that the slings used for movement and transfer of the MPC are important to safety. The slings are classified as ITS-A, and are added to Table 4.2.1 of the HI-STORE SAR as shown below. The safety classification of the slings is consistent with the classification specified in the HI-STORM UMAX FSAR.
From revised Table 4.2.1:

MPC Slings	Rigging used for movement and transfer of the MPC.	ITS-A	HS

RAI 7-17: Provide the output files for the HI-TRAC CS and the VVM models to show how the subcritical neutrons and the secondary gammas were accounted for in the shielding calculations and demonstrate that the calculations have properly converged.

In its response to the staff's first round RAIs, the applicant submitted revised shielding calculations (ML21004A242). In the revised calculations, the applicant provided a graphic representation of the MCNP model it created for the HI-TRAC CS transfer cask and the calculated dose rates around the

transfer cask and storage VVM. The applicant states that the subcritical multiplication neutrons and the secondary gammas are included in the shielding calculations. However, there is no information in the SAR that shows how the subcritical neutrons and the secondary gammas were accounted for in the shielding calculations and that the calculations have properly converged. An output file for each of the calculations that produced the results as shown in Table 7.4.1, Table 7.4.2, and Table 7.4.3 of the revised SAR will provide the information necessary for the staff to determine the reliability and accuracy of the results. Please note that only the output file is needed for each model that produces the results as presented in Table 7.4.1, Table 7.4.2, and Table 7.4.3 of the SAR.

This information is necessary to determine compliance with 10 CFR 72.104 and 72.106(a) and (b).

Holtec Response:
The requested input and output files are contained in an attachment to the letter that submits these RAI responses.

RAI 9-3-S: Clarify the content in Section 9.2.2, "Operational Activities," (Page 9-7) of the HISTORE SAR. In the response to RAI 9-3, Section 9.2.2 of the HI-STORE SAR was revised to state that "no credible normal, off-normal or accident conditions" could challenge the integrity of the canister confinement integrity and result in a release of any radioactivity. However, Section 9.2.2 should consistently address normal, off-normal and accident conditions while on-site prior to, or during receipt inspection. Clarify how this was addressed in the following sentence from Section 9.2.2 (the text below is underlined for added emphasis).

> *"Hence once the canisters have passed the receipt inspection, also discussed in Subsection 9.2.1, there is no credible normal, off-normal, or accident conditions that could challenge the integrity of the canister confinement system and result in a release of any radioactivity."*

If there is/are (a) normal, off-normal, or accident condition(s) that could challenge the canister confinement system while on-site prior to, or during, receipt inspection, those should be described in the SAR. Explain how the statement in Section 9.2.2 is consistent with Section 9.2.1, "Storage Systems," (Page 9-4) which states:

> *"All normal, off-normal and accident conditions relevant to confinement integrity for which the canister is certified in the HI-STORM UMAX docket are equal to or less severe at the HI-STORE facility. Therefore, there are no new conditions for the HI-STORE CIS facility that would require additional confinement analyses."*

This information is needed to determine compliance with 10 CFR 72.104(a) and 72.106(b).

Holtec Response:

RAI 9-3-S is addressed with the following editorial clarifications and additions to Subsections 9.2.1 and 9.2.2:

The sentence in Section 9.2.2 referenced in RAI 9-3-S is reworded to the following two sentences,

"Once the canisters have passed the receipt inspection, also discussed in Subsection 9.2.1, the design basis site-specific off-normal or accident conditions that could challenge the integrity of the canister confinement system are evaluated in Chapter 15, Accident Analysis. Chapter 15 concludes that as a result of the design basis off-normal or accident conditions that could challenge the integrity of the confinement system, there is no effect on the confinement function of the MPC, and all pressure boundary stresses remain within allowable ASME Code values."

The sentences in Section 9.2.1 referenced in RAI 9-3-S are reworded to the following,

"All normal, off-normal and accident conditions relevant to confinement integrity for which the canister is certified in the HI-STORM UMAX docket are equal to or less severe at the HI-STORE facility. A summary of the design basis site-specific off-normal and accident conditions that could challenge the integrity of the canister confinement system is provided in Chapter 15 and incorporates by reference the evaluated off-normal and accident events considered in the HI-STORM UMAX FSAR. Chapter 15 concludes that as a result of the design basis off-normal or accident conditions that could challenge the integrity of the confinement system, there is no effect on the confinement function of the MPC, and all pressure boundary stresses remain within allowable ASME Code values."

RAI 17-2-S: Provide justification that the proposed flaw-analysis approach (absent material acceptance testing) can be used to demonstrate adequate fracture toughness of steels used for special lifting devices.

In the response to RAI 17-2, SAR Section 4.5.1.2 was revised to state that the fracture toughness of steels for special lifting devices will be demonstrated by (1) complying with the toughness testing requirements of ASME Code Section III, Subarticle NF-2300 or (2) performing an analysis that shows that a maximum permissible flaw (per inspection) will not propagate under the maximum load condition.

Explain how, for option 2, the maximum permissible flaw would be established without acceptance testing to confirm the fracture toughness of the material.

This information is needed to demonstrate compliance with 10 CFR 72.120(a).

Holtec Response:
Option 2, as identified above, has been deleted from SAR Section 4.5.1.2 and replaced with a detailed description of the alternate method for demonstrating adequate fracture toughness of steels used specifically for special lifting devices. The newly described method, which is adapted from NUREG/CR-1815, is based on Charpy impact testing, and it is not dependent on a maximum permissible flaw size. In short, the alternate method described in SAR Section 4.5.1.2 leverages the fact that special lifting devices are subject to lower stress levels due to the increased design factors per ANSI N14.6, which in turn benefits (raises) the required NDT for the material.

RAI 17-8-S: Clarify the testing criteria used to demonstrate adequate fracture toughness of the ferritic steel subcomponents of the transfer cask, tilt frame, CTF, and VCT.

HI-STORE Consolidated Interim Storage Facility
Requests for Additional Information Round 2
Attachment 2 Holtec Letter 5025066

The response to RAI 17-8 provided fracture testing criteria for the ferritic steel SSCs at the HISTORE site. The staff requires clarifying information, as follows:

- Address the initial request related to the ferritic steel portions of the VCT designed to ASME Code Section III, Subsection NF.
- In the new SAR Tables 17.4.1, 17.4.2, and 17.4.3, clarify the entries for the test temperature for the weld coupons. The test temperature entries refer to a requirement that the nil ductility transition temperature (NDT) be 0 °F. However, the referenced test method (per NF-2430) is a Charpy impact test, which does not measure NDT. As a result, clarify what is intended by defining the impact test temperature in terms of a required NDT.
- SAR Section 17.4.3 states that the transfer cask, transfer facility, and the tilt frame may only be used if the 3-day average daily temperature at the HI-STORE site is above the 0 °F impact test temperature of the ferritic steels. However, neither SAR Chapter 3, "Operations at the HI-STORE Facility," nor the Technical Specifications include any reference to this operating limit; clarify how site personnel would be aware of, and implement, this limit. Also, clarify whether the site personnel are to use the average from the 3 prior days before verifying that transfer operations can be initiated, and if so, why those prior temperatures would be a useful measure of the steel fracture performance at the time of the operations (specifically, if the temperature of the operations may be significantly below that average).

This information is required to demonstrate compliance with 10 CFR 72.24(c)(3) and (d).

Holtec Response:
The requested clarifications from the staff are provided as follows (in the same order as the RAI):

- The fracture toughness testing criteria for the ferritic steel portions of the VCT designed to ASME Code Section III, Subsection NF have been added to the SAR in new Table 17.4.4.
- SAR Tables 17.4.1, 17.4.2, and 17.4.3 have been revised to clarify the test temperature for the weld material. In particular, the former reference to Note 1 has been deleted, and the test temperature for the weld material is directly stated as 0°F in all three tables. Also, the acceptance criterion for the weld material has been changed from "Per NF-2330" to "Per NF-2331" to be more precise.
- The minimum ambient temperature restriction for the transfer cask, the cask transfer facility, and the tilt frame is captured in Section 4.2.4 of the previously submitted Proposed Technical Specifications, which states:

  PRE-TRANSFER OPERTIONS, TRANSPORT OPERATIONS, and SHIPMENT OPERATIONS shall only be conducted with working area Ambient Temperature ≥ 0°F.

  Per the definitions in Section 1.1 of the Proposed Technical Specifications, Pre-Transfer/Shipment Operations and Transport Operations encompass all loading/unloading activities that involve the transfer cask, the cask transfer facility, and the tilt frame. Therefore, these components may not be used if the ambient temperature is below 0°F.

Regarding the ambient temperature, it is also defined in Section 1.1 of the Proposed Technical Specifications as follows:

AMBIENT TEMPERATURE for Short Term Operations (operations involving use of the HI-TRAC, a Lifting device, and/or an on-site transport device) is defined as the 72 hours average of the local temperature as forecast by the National Weather Service.

The above definition is in agreement with the minimum and maximum reference temperatures for Short Term Operations as specified in SAR Table 2.7.1, which also rely upon 72-hour (3-day) average temperature data. Furthermore, the use of 3-day averages to establish/evaluate environmental temperature limits is consistent with other NRC-approved FSARs (e.g., HI-STORM FW and HI-STORM UMAX).

Lastly, the first paragraph in SAR Section 17.4.3 has been updated to refer to SAR Table 2.7.1 as the basis for the 0°F impact test temperature. SAR Chapter 3, "Operations at the HI-STORE Facility", has not been revised as a result of this RAI since the minimum ambient temperature restriction is appropriately captured in the Proposed Technical Specifications.

RAI 17-12-S: Provide a technical justification that demonstrates that the proposed periodic inspection of one MPC is capable of assessing potential degradation of up to 500 MPCs that originate from several storage sites.

The response to RAI 17-18 justified the proposed inspection of one MPC every 5 years by stating that NRC guidance indicates that examining one canister is appropriate.

The staff notes that the guidance in NUREG-1927 and NUREG-2214, which recommend that at least one canister be examined at each site, was established to ensure that each storage site included an inspection to capture the effects of site-specific conditions and storage system design features that may affect susceptibility to stress corrosion cracking (SCC). Based on the current population of loaded MPC-37 and MPC-89 canisters, the HI-STORE site may receive MPCs from at least 9 different sites, each with unique environmental conditions and potentially unique design features (e.g., above ground vs below-ground storage). The number of potential originating sites could grow if additional sites adopt the MPC-37 or MPC-89 designs. Some conditions, such as deposits on the canisters, could carry over to the HI-STORE site.

Also, as stated in RAIs 17-12 and 17-18, the HI-STORE site has its own unique conditions that determine susceptibility to SCC, such as the proximity to chloride sources. Considering the variety of conditions at the originating storage sites, the HI-STORE site conditions associated with salt-containing playas, and the uncertainty in how these conditions may promote SCC, clarify how an inspection sample size of one MPC was determined to be sufficient to ensure that confinement is maintained for the potential 500 MPCs at the HI-STORE site.

This information is needed to demonstrate compliance with 10 CFR 72.120(a).

Holtec Response:

Holtec agrees that inspection of one canister is not sufficient for assessing potential degradation of MPCs from multiple sites that would be stored at HI-STORE. Therefore, in accordance with the guidance provided in NUREG-1927 and NUREG-2214, MPC AMP Element 4 "Detection of Aging Effects" in the Holtec Report HI-2167378 has been updated to include the inspection criteria for MPCs. The inspection criteria states that a minimum of one canister from each originating site shall be inspected every 5 years to ensure that site-specific conditions (deposits on the canisters, proximity to chloride sources, above or below ground storage, etc.) unique to each originating storage site are taken into consideration. Additionally, the canister sample size in Table 18.5.1 of HI-STORE SAR has been updated to reflect the above change.

RAI-17-14-S: Provide a technical justification that demonstrates that the proposed periodic inspection of the internal surfaces one VVM is capable of assessing potential degradation of the steel surfaces, coatings, and divider shell insulation of up to 500 VVMs on the HI-STORE site for the 40-year license term.

The maintenance activities in SAR Table 10.3.1 and aging management activities in SAR Section 18.7 describe the 5-year inspection of the interior surfaces of one VVM to assess the condition of the carbon steel internal passages, coatings, and divider shell insulation.

SAR Section 18.3 states that corrosion of the painted carbon steel surfaces at the HI-STORE site is expected, which is consistent with the conclusion of NUREG-2214 for carbon steel exposed to outdoor environments. Considering the SAR statement, the staff concerns regarding potential airborne salts (see RAI 17-12-S), and the large number of VVMs, clarify how a sample size of one VVM was determined to be sufficient to verify the condition of the potential 500 VVMs at the HI-STORE site over the 40-year license term. Additionally, since the one inspection is expected to be performed on the same VVM each interval, explain how the examination of the single VVM will be capable of verifying the structural, shielding, and heat transfer functions of all VVMs at the site.

This information is needed to demonstrate compliance with 10 CFR 72.120(a).

Holtec Response:

To address reviewer's concerns the VVM AMP Element 4 "Detection of Aging Effects" in the Holtec Report HI-2167378 has been updated to state those inspections shall be performed on all the VVMs that contain the MPCs designated for the MPC AMP, see above response.

The revised chapter 10 including the updated Table 10.3.1 to reflect the above change will be submitted with the next set of responses in mid-August.

RAI-17-17-S: [

PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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Holtec Response:

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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RAI 17-19-S-1: [

PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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Holtec Response:

[PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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RAI 17-19-S-2: [

PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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Holtec Response:

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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RAI 17-20-S: [

PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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Holtec Response:

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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RAI 17-21-S: Provide the technical justification for receiving MPCs that may have experienced aging degradation prior to arriving at the HI-STORE site or propose activities that are capable of evaluating the integrity of the arriving canisters.

The response to RAI 17-21 stated that there is no mechanism that could challenge the integrity of the canisters, citing the NRC's certification of the HI-STORM UMAX design for the 20-year life of that system. The response did not address MPCs in service longer than 20 years.

The staff notes that the original certification of the UMAX storage system for 20 years relied, in part, on the demonstration of the integrity of the as-built canister through ASME Code ultrasonic, surface, and volumetric examinations and pressure testing (and approved alternatives). However, for storage terms greater than 20 years, the NRC has determined that SCC has the potential to challenge canister integrity.

Explain how potentially aged MPCs will be determined to be suitable for storage of spent fuel at the HI-STORE site under normal, off-normal, and accident conditions. As stated in RAI 17-21, while the proposed canister leak testing provides information on the state of confinement at the time of receipt, this testing does not provide information on the integrity of the MPCs (e.g, partial through-wall flaws) at the time of

receipt. The staff notes that the HI-STAR 190 transportation cask CoC includes inspections of some MPCs prior to transport that may inform canister integrity; however, these inspections are not performed on MPCs that do not contain high-burnup fuel.

The staff needs information on analyses or proposed inspection activities that demonstrate the integrity of the MPCs arriving at the HI-STORE site. If the integrity of the MPCs relies, in part, on inspection results or other operational practices at the originating storage site, then the HI-STORE safety analysis should specifically identify the requirements for those prior activities.

This information is needed to demonstrate compliance with 10 CFR 72.120(a).

Holtec Response:

Suitability for storage of potentially aged MPCs is ascertained prior to placement in HI-STORE VVMs. For this purpose, the following steps are incorporated in Chapter 18 of the SAR:

- Inspection of quality records from originating site including operating, maintenance, inspection and aging management records
- Adoption of the HI-STAR 190 inspection checklist as a mandatory requirement for all MPCs including those not containing high-burnup fuel.

RAI 17-26-S: [

PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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Holtec Response:

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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RAI-17-28-S: [

PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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Holtec Response:

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PROPRIETARY INFORMATION WITHHELD PER 10CFR2.390

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