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

November 14, 2019

Ms. Kim Manzione, Licensing Manager
Holtec International
Holtec Technology Campus
One Holtec Boulevard
Camden, NJ 08104

SUBJECT: HOLTEC INTERNATIONAL'S APPLICATION FOR SPECIFIC INDEPENDENT SPENT FUEL STORAGE INSTALLATION LICENSE FOR THE HI-STORE CONSOLIDATED INTERIM STORAGE FACILITY FOR SPENT NUCLEAR FUEL – FIRST REQUEST FOR ADDITIONAL INFORMATION, PART 5

Dear Ms. Manzione:

By letter dated March 30, 2017 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML17115A431), as supplemented on April 13, October 6, December 21, and 22, 2017; and February 23, 2018 (ADAMS Accession Nos. ML17109A386, ML17310A218, ML17362A097, ML18011A158, and ML18058A617, respectively), Holtec International submitted to the U.S. Nuclear Regulatory Commission (NRC) an application for a specific independent spent fuel storage installation license to construct and operate the HI-STORE Consolidated Interim Storage Facility, in Lea County, New Mexico, in accordance with the requirements of Part 72 of Title 10 of the *Code of Federal Regulations*, "*Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste and Reactor-Related Greater than Class C Waste.*" The license application seeks NRC approval to store up to 8,680 metric tons of commercial spent nuclear fuel in the HI-STORM UMAX Canister Storage System for a 40-year license term.

The NRC staff is conducting a detailed technical review of your application and has determined that additional information is necessary in connection with its review. The information needed by the staff is discussed in the enclosed request for additional information (RAI). We request that you provide responses within 60 days from the date of this letter. If you are unable to meet these deadlines, please notify NRC staff in writing, within two weeks of receipt of this letter, of your new submittal date and the reasons for the delay.

As discussed in our February 28, 2018, letter notifying you of our decision to docket the application and begin a detailed technical review, the NRC staff expects to issue its first round RAIs in several parts. The enclosed RAIs only address selected portions of the NRC staff review completed to date, and additional RAIs will be issued in the future as the staff's detailed review progresses.

Please reference Docket No. 72-1051 and CAC/EPID No. 001028/07201051/L-2018-NEW-0001 in future correspondence related to the technical review for this licensing action. If you have any questions, please contact me at 301-415-0606.

Sincerely,

/RA/

Jose R. Cuadrado, Project Manager
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No.: 72-1051
CAC/EPID Nos.: 001028/07201051/
L-2018-NEW-0001

Enclosure:
1st RAI - Part 5

SUBJECT: HOLTEC INTERNATIONAL'S APPLICATION FOR SPECIFIC INDEPENDENT SPENT FUEL STORAGE INSTALLATION LICENSE FOR THE HI-STORE CONSOLIDATED INTERIM STORAGE FACILITY FOR SPENT NUCLEAR FUEL – FIRST REQUEST FOR ADDITIONAL INFORMATION, PART 5

DOCUMENT DATE: November 14, 2019

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First Request for Additional Information, Part 5

Docket No. 72-1051
Application for specific independent spent fuel storage installation license for the HI-STORE Consolidated Interim Storage Facility in Lea County, New Mexico

By letter dated March 30, 2017 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML17115A431), as supplemented on April 13, October 6, December 21, and 22, 2017; and February 23, 2018 (ADAMS Accession Nos. ML17109A386, ML17310A218, ML17362A097, ML18011A158, and ML18058A617, respectively), Holtec International submitted to the U.S. Nuclear Regulatory Commission (NRC) an application for a specific independent spent fuel storage installation license to construct and operate the HI-STORE Consolidated Interim Storage Facility (CISF), in Lea County, New Mexico, in accordance with the requirements of Part 72 of Title 10 of the *Code of Federal Regulations* (10 CFR 72), "*Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste and Reactor-Related Greater than Class C Waste.*" The license application seeks NRC approval to store up to 8,680 metric tons of commercial spent nuclear fuel in the HI-STORM UMAX Canister Storage System for a 40-year license term.

This request for additional information (RAI) identifies additional information needed by the NRC staff in connection with its safety and environmental review of the HI-STORE CISF license application. The requested information is sorted by the specific part of the license application, or the specific chapter or section number in the safety analysis report (SAR), environmental report, or their respective supporting analyses. The staff used the guidance in NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," and NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs," for its review of the application.

<u>Safety Analysis Report, Chapter 2, "Site Characteristics"</u>

[Note: RAI 2-1 and 2-2 issued on March 30, 2018 (ADAMS Accession No. ML18088A030).]

RAIs for SAR Sections 2.1 through 2.2:

RAI 2-3: Clarify the contradictory statements in the SAR regarding the existence of a producing oil/gas well in the southwest portion of the proposed CISF site. Additionally, clarify whether the former producing well, as stated in SAR Section 2.1.2, "Site Description," is the same well described as an active oil/gas well in SAR Section 2.2.2, "Pipelines," in the southwest portion of the proposed CISF site.

Section 2.2.2 of the SAR, "Pipelines," states that an oil/gas producing well exists at the proposed site. The SAR Figure 2.1.2 also shows a producing well in the southwest corner of the facility.
However, SAR Section 2.1.2, "Site Description," and SAR Section 6.5.2 (d), "Potential Fire Hazards," state "[t]here are no active wells on the site…" SAR Section 2.1.2 also lists a former producing gas and distillate well near the communication tower.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.98.

RAI 2-4: Confirm whether there is a telephone line within the proposed site.

Section 2.1.2 of the SAR, "Site Description," does not list a telephone line going through the proposed site; however, SAR Figure 2.1.21 shows a telephone line.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.98.

RAI 2-5: Clarify how the structures currently on the proposed site would be dealt with during construction and operation phases of the proposed facility in SAR Section 2.1.2, "Site Description."

Section 2.1.2 of the SAR identifies several existing structures at the proposed site. However, no information has been presented in the SAR as to what happens to the following existing structures at the site during construction and operation phases of the proposed facility: (1) a communication tower, (2) two oil recovery facilities with associated hardware, and (3) a producing oil/gas well. The applicant should describe the proposed plan(s) to deal with each of the existing structures at the proposed site during the construction and/or operational phases of the proposed facility. The description should include detailed characteristics of the existing structures and assessments of potential hazards posed by them to the proposed facility if they would not be dismantled or, in the case of the producing oil/gas wells, abandoned and plugged.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.98.

RAI 2-6: Provide information and design characteristics of each pipeline near the proposed facility site, including the new proposed pipeline, as described in SAR Section 2.2.2, "Pipelines." Information is also necessary for the temporary flexible pipeline currently at the site if the pipeline would be simply moved to an offsite location near the proposed facility during construction and operational phases of the proposed facility and would continue to operate in the new location. In addition, information is needed for other temporary flexible pipelines close to the proposed site.

Although some information has been provided in SAR Section 2.2.2, "Pipelines," additional information about the characteristics of every pipeline near the proposed site is necessary. Additionally, SAR Section 6.5.2 (d), "Potential Fire Hazards," states that the temporary flexible pipeline at the proposed site would be moved prior to, or during, the early construction phases of the proposed facility. However, it is not clear to where this pipeline would be moved during construction and facility operation. If the new location is just outside the boundary of the proposed site, this pipeline can still pose a credible hazard to the proposed facility depending on its distance to important to safety structures and systems. Similarly, other temporary flexible pipelines near the proposed site may also pose a credible hazard to the proposed facility.

The information of the characteristics of the pipelines should include, at a minimum, the following:

a) Size, rated and operating pressure, flow rate, depth of burial, and other characteristics of each pipeline;

b) Location of each pipeline with respect to the important to safety structures and systems at the proposed CISF, including the route taken by the loaded cask transporter enroute to the storage pads;

c) Location(s) of the nearest shut-off valves and the pipeline control room for leak or break detection and taking necessary action(s) for each pipeline, and;

d) Expected time delay between leak detection and necessary actions taken to prevent further gas leakage.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.122.

RAI 2-7: Provide an assessment that evaluates the explosion hazards and consequences to important to safety structures or systems at the proposed CISF from a rupture of any pipeline resulting in release and subsequent ignition of the natural gas. (SAR Section 2.2.2, "Pipelines"). The assessment should specifically consider the released natural gas forming a vapor cloud, which can float away from the pipeline under the prevailing atmospheric conditions and subsequently ignite close to an important to safety structure or system.

The assessment should consider, at a minimum, the following:

a) Worst type of breakage of the pipeline, for example, a guillotine break of a pipeline;

b) Release of natural gas through the pipe break for the longest time possible, given the time to detect at the control room and rectify the situation by closing the flow at both ends of the break;

c) Worst-case meteorological conditions at the site that would carry the resulting vapor cloud the maximum distance with minimum turbulence or mixing and the justification for the selection;

d) Surrounding ground characteristics along with justification;

e) Methodology(ies) selected and the rationale for the selection; and

f) Assumptions made in the assessment along with the appropriate rationale for each assumption.

The assessment should estimate the expected air overpressure from a potential vapor cloud explosion due to a pipeline breakage at the important to safety structures and systems including the loaded cask transporter enroute to the cask storage pad area at the proposed CISF and associated damage potential. The applicant may select to demonstrate the safety of the proposed facility from breakage of any natural gas pipelines using an alternative approach with appropriate justifications.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.122.

RAI 2-8: Justify why having oil and gas exploration and production activities near the proposed facility would not pose a hazard in SAR Section 2.1.4, "Land and Water Use."

As discussed in RAI 2-3, SAR Section 2.2.2, "Pipelines," states that one oil/gas well is currently producing in the southwest portion of the property. Additional wells may also be drilled in nearby oil/gas leases in the future which could possibly travel below the proposed site. In addition, activities associated with well completion and production may pose hazard to the proposed facility; for example, leakage of gas from the wellhead or gas flaring operation. Additionally, SAR Section 2.1.4, "Land and Water Use," states that multiple horizontal holes will be drilled to the Bone Spring formation from the Belco Shallow and Belco Deep drill islands. These drill islands are very close to the proposed site, approximately 400 m [1,320 ft] and 800 m [2,640 ft], respectively. Similarly, holes were drilled from the Green Frog Café drill island just east of the proposed site. The potential for subsidence due to corrosion of the casings of the abandoned drill holes is illustrated by the formation of the Wink and Jal sinkholes described in SAR Section 2.1.4. The hazards from potential land subsidence induced by casing failure, any future horizontal drilling beneath the site, or from oil/gas production from nearby wells should be evaluated and assessed to demonstrate that important to safety structures at the proposed facility and facility operations are not affected.

This information is necessary to determine compliance with 10 CFR 72.24, 72.90(a) through (d), 72.94, and 72.98.

RAI 2-9: Provide the exact location of the Intrepid East Mine and other past mining-related activities around the proposed CISF site, including their current status in SAR Section 2.1.4, "Land and Water Use." Additionally, provide the location of all nearby mine shafts, currently in operation or abandoned, near the proposed CISF.

Section 2.1.3 of the SAR, "Population Distribution and Trends," lists the Intrepid East Mine at a distance of 7.8 km [4.9 mi] east of the proposed CISF; however, SAR Section 2.1.4, "Land and Water Use," states that the Intrepid East facility is nearly 9.6 km [6 mi] to the southwest of the proposed site. This discrepancy should be resolved. Additionally, the location of all mines near the proposed site, including the National Potash Mine, as stated in SAR Section 2.2, "Nearby Industrial, Transportation, Military, and Nuclear Facilities," should be plotted in a scaled map and appropriately labeled for identification. In addition, SAR Section 2.2 states that the potash ore is mined by boring machines and raised to the surface through mine shafts at the National Potash Mine, approximately 6.7 km [4.2 mi] west of the proposed site. Locations of these mine shafts at the National Potash Mine, or other mine shafts currently in operation or abandoned near the proposed facility, are not identified in the SAR.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.98.

RAI 2-10: Provide the status of activities associated with extraction of potash ore from the remnant pillars using the solution mining technique, as described in SAR Section 2.1.4, "Land and Water Use." Describe the mining process and the extraction ratio achieved, including the date of completion of the solution mining operations in nearby mines, and any additional surface subsidence resulting from solution mining activities.

Section 2.1.4 of the SAR, states that Intrepid Potash LLC was recently approved to extract a portion of the remaining potash ore from the suspended mines using solution mining technology. However, this information dates from 2012, and information on the current status of potash extraction using solution mining technology is not given. Any additional subsidence at the surface due to potash extraction from remnant pillars using solution mining technology is needed to assess the potential effects on the proposed storage facility.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.98.

RAI 2-11: Describe the operations to extract potash ore and the resulting subsidence based on observations at mines near the proposed site.

Section 2.1.4 of the SAR, "Land and Water Use," does not mention the specific mining method(s) used in the nearby mines to extract potash ore. Although several potential methods are mentioned (e.g., room and pillar, longwall, cut and fill, and open stopping), the SAR does not specify which is used. Additionally, the height of the mine openings in the nearby mines is not specified in the SAR to estimate the maximum subsidence that may be realized at the surface. In addition, SAR Section 2.1.4 mentions use of mine roof control practices, such as backfilling, to limit the surface subsidence. It is not clear from the discussion given in the SAR whether any or all of the nearby mines adopted some type of roof control practices. Specific information about the option(s) adopted as roof control measures at the nearby mines is needed to estimate the potential maximum surface subsidence.

In addition, SAR Section 2.1.4, states that the maximum surface subsidence observed in the southeastern New Mexico potash mines is nominally 4 ft for an average mining height of 6 ft using the room and pillar mining method. Use of the solution mining technique to extract the remnant pillars from the existing room and pillar mines would induce additional subsidence, as the support provided by these remnant pillars would be removed. As stated in SAR Section 2.1.4, Intrepid Potash LLC has been authorized to use the solution mining technique to extract additional potash ore from the remnant pillars, including mines where potash mining was suspended in the past. It is not clear from the SAR whether any of the nearby mines has used this technique to extract potash and the resulting additional surface subsidence.

The description of operations to extract potash ore and the resulting subsidence based on observations at mines near the proposed site should include, at a minimum, the following information:

1. Thickness and depth of the potash bearing strata near the site;

2. Mining method(s) used to extract potash in the vicinity of the site;

3. Dimensions of mine workings (height, width, and length), especially in the vicinity of the proposed site;

4. Roof control practice(s) used;

5. Extraction ratio(s) of the potash mining. If room and pillar method is/was used to extract potash, provide the extraction ratio in the first mining pass and the second mining pass along with the overall extraction ratio;

6. Whether any of the nearby surface mines has used or is using the solution mining technique to extract potash from the remnant pillars, and;

7. Observed surface subsidence from original mining and additional subsidence if solution mining technique was used or will be used to extract potash from the remnant pillars.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a)–(d), 72.94, and 72.98.

RAI 2-12: Provide a rationale for why mining operations at nearby underground potash mines or extraction of oil and gas from underneath the CISF would not pose any hazard to the proposed facility from surface subsidence. Also, justify why mining of potash would not be feasible beneath or around the proposed CISF site for the proposed duration of the license.

Section 2.1.4 of the SAR, "Land and Water Use," states that for potash mining at a depth of 900 m [3,000 ft], the horizontal extent of the surface subsidence would be another 900 m [3,000 ft] extended outward from the farthest mine workings undergoing collapse of the overlying strata, assuming an angle of influence of 45°. Consequently, the applicant states that any subsidence from the nearby mines would not pose any hazard to the proposed facility. However, current locations of the mine workings nearest to the proposed facility site are not provided in the SAR. Section 2.1.4 of the SAR states that the mine workings of the Intrepid East Mine are nearly 9.6 km [6 mi] southwest of the proposed site, citing the proposed GNEP Siting Study (Reference 2.1.3 of SAR). Additionally, SAR Figure 2.1.17, citing a figure from the 2007 GNEP Siting Study (Reference 2.1.3 of the HI-STORE SAR), states that the nearest underground potash mine working is 3.2 km [2 mi] from the proposed site. Information on the distance of the nearest mine working from the proposed site dates from 2007. Therefore, information on any progress of the mine workings in the ensuing years should be described and the current location(s) as well as any projected future mine workings should be used and provided in assessing the potential subsidence hazards to the proposed site.

Sections 2.1.4 and 2.6.4 of the SAR, "Stability of Subsurface Materials," state that Intrepid will not conduct any potash mining on the site and cites an agreement between the applicant and Intrepid Potash LLC. The application should discuss the rationales for the conclusion that potash would not be extracted under and around the site during the licensed life of the project. Similarly, SAR Section 2.6.4 states that there would be no subsidence concerns from any future oil and gas extraction beneath the site. The application should also discuss the rationale for why future oil and gas extraction beneath the site would not present a subsidence concern.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.98.

RAI 2-13: Clarify in SAR Section 2.1.4, "Land and Water Use," whether there are any brine wells used for mining salt near the proposed site. If there are brine wells near the site, provide an assessment of the hazards these could pose to the proposed CISF.

Section 2.1.4 of the SAR discusses extraction of salt using brine wells; however, it is not clear from the discussion whether any past, present, or future salt extraction using brine wells has occurred or will occur near the site. Additionally, no assessment is provided regarding potential hazards to the proposed CISF from brine wells near the site.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a)–(d), 72.94, and 72.98.

RAI 2-14: Justify in SAR Section 2.2.4, "Ground Transportation," that hazardous cargo transported through U.S. Highway 62/180 would not pose any credible hazard to the proposed CISF.

Section 2.2.4 of the SAR states that hazardous cargo that may be transported through U.S. Highway 62/180 includes: gasoline, diesel fuel, acids, carbon dioxide, nitrogen, chlorine gas, refrigerants, fuel gases, oxygen, explosives, and low-level radioactive waste for disposal at the Waste Isolation Pilot Plant facility. The applicant states that the State of New Mexico does not keep records of the specific types and quantities of hazardous materials on this highway. However, an assessment is necessary to demonstrate that all safety-related structures and systems would continue to operate in a safe manner even in a worst-case accident involving hazardous materials on transport via the U.S. Highway 62/180.

The applicant may assess the potential hazards posed by each hazardous material considering the maximum amount that may be legally transported on U.S. highways. The assessment should consider the effects on important to safety structures and systems at the proposed facility, in addition to the loaded cask transporter enroute to the cask storage pad area. Alternatively, the applicant may select a bounding scenario(s), with appropriate assumptions for the types and quantities of hazardous materials, to assess the potential for fire, explosion, or release of noxious gases while being transported through the U.S. Highway 62/180.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.122.

RAI 2-15: Justify in SAR Section 2.2.4, Ground Transportation, that hazardous cargos while being transported by rail cars near the proposed site would not pose any credible hazard to the proposed CISF.

Section 2.2.4 of the SAR states that the nearest operating railroad transports potash ore from the mines to the refinery; however, shipments by rail could also include gasoline, diesel fuel, acids, carbon dioxide, nitrogen, chlorine gas, refrigerants, fuel gases, oxygen, and explosives. The applicant states that the State of New Mexico does not keep records of the specific types and quantities of hazardous materials on this railroad. However, an assessment is necessary to demonstrate that all safety-related structures and systems at the proposed CISF would continue to operate in a safe manner even in a worst-case accident scenario involving hazardous materials transported via the nearby railroad.

The applicant may assess the potential hazards from each type of hazardous material by considering the maximum amount that may be legally transported on U.S. highways. Alternatively, the applicant may select a bounding scenario(s), with appropriate assumptions for the types and quantities of hazardous materials, to assess the potential for fire, explosion, or release of noxious gases during transport via the nearby railroad. The assessment should consider the effects on important to safety structures and systems at the proposed facility in addition to the loaded cask transporter enroute to the cask storage pad area.

This information is necessary to determine compliance with 10 CFR 72.24(a), 72.90(a) through (d), 72.94, and 72.122.

RAIs for SAR Section 2.4

RAI 2-16: Provide additional information to justify the use of a 24-hour, 7.5-inch rain storm to reach the 'flood dry' conclusion on the basis of the water mass-balance analysis, as outlined in SAR Section 2.4.2, "Floods."

Section 2.4.2 of the SAR states that the storm water mass-balance analysis summarized therein is to determine the amount of flooding that would occur at the proposed CISF site with a 7.5-inch, 24-hour rain storm. The applicant also states that this rain storm is the maximum precipitation at the site. In SAR Table 2.4.1, the applicant reports that the estimated 24-hour, 100-year rain storm at Hobbs, New Mexico varies from less than 6.4 inches to more than 7.0 inches, based on Atlas 14 Point Precipitation Frequency Estimates of New Mexico by the National Oceanic and Atmospheric Administration (NOAA). A point precipitation estimate generally differs from areal precipitation estimates (see discussion in HMR 52, NOAA, 1982). For example, the National Weather Service Hydrometeorological Report No. 51 suggests that, in the New Mexico High Plain area, the all season 24-hour and 72-hour probable maximum precipitation (PMP) events could be as high as 34 inches and 40 inches for a watershed of 10 $mile^2$ (NOAA, 1978, Figures 20 and 22), respectively. Figure 2.4.11 of the SAR indicates that the areas of the two sub-watersheds associated with Laguna Plata and Laguna Gatuna are in the order of 50 square miles.

In the GNEP siting report (Eddy-Lea Energy Alliance, 2007), the 7.5-inch rain storm is identified as the largest rainfall event ever recorded, by citing an unidentified report (WUSRCC, 2000.) No record length was cited from the data source to explain why the 24-hour, 7.5-inch rain storm was selected as design-basis precipitation for water mass-balance analysis. The application should provide additional information supporting the identification of the storm as the basis for flood water level analyses. It should also identify or determine the return period of the 7.5-inch, 24-hour rain storm and clarify the rationale for how this may relate to the design basis, the term of the license for the proposed CISF, and the suggestion that the storm is the maximum precipitation under all probable hydrological conditions.

In SAR Section 2.4.3, the applicant states that the proposed CISF site can be considered "flood-dry." The American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.8-1981 (ANSI/ANS, 1981) defines a flood-dry site as a site where safety-related structures are so high above potential sources of flooding that safety is obvious or can be documented with minimum analysis. However, the application does not discuss how the site can be considered "flood-dry" under all circumstance and combinations of hydrological conditions, including PMP events of the watershed areas under consideration. The application should provide a justification that an extreme event, such as PMP's of various durations (e.g., 6 hours, 24 hours, and 72 hours) would not result in flood water levels that are higher than those presented in SAR Section 2.4.2.

This information is necessary to demonstrate compliance with 10 CFR 72.90(b) through (c), 10 CFR 72.92(a) through (b), 72.98(a), and 72.122(b)(2)(A) through (B).

<u>Reference</u>

1. Eddy-Lea Energy Alliance, 2007. Final Detailed Siting Report, Eddy-Lea Siting Study.

2. National Oceanic and Atmospheric Administration (NOAA), 1978. Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, National Weather Service Hydrometeorological Report No. 51.

3. National Oceanic and Atmospheric Administration (NOAA), 1978. Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian, National Weather Service Hydrometeorological Report No. 52.

4. American National Standards Institute/American Nuclear Society (ANSI/ANS), 1981. Standards for Determining Design Basis Flooding at Power Reactor Sites, ANSI/ANS 2.8-1981.

RAI 2-17: Provide additional information to justify that the storm water mass-balance approach with a 50% reduction of infiltration depth to the restrictive soil layer is acceptable and conservative. Specifically, justify the rationale for selecting the storm water mass-balance approach versus other industry used methods, and the basis for selecting the 50% capacity/depth reduction as conservative. The justification should take into consideration all phases of the site development.

In SAR Section 2.4.2, the applicant provided a storm water mass-balance approach to determine flood water levels in Laguna Gatuna and Laguna Plata. Two HUC-12 watersheds, associated with the two lagunas, and an infiltration capacity of 50% of the soil water capacity above the restrictive soil layer were used to determine the balance of storm water in each watershed that can be stored in the two lagunas. The applicant states that a 50% reduction in the soil saturation capacity/depth to restriction was added into the mass-balance model as a conservative measure.

This information is necessary to demonstrate compliance with 10 CFR 72.90(a), 72.90(b), and 72.92(c).

<u>Reference</u>

1. Natural Resources Conservation Service, United States Department of Agriculture, 1986. Urban Hydrology for Small Watersheds, TR-55.

2. United States Army Corps of Engineers, Hydrologic Engineering Center, 2015. Hydrologic Modeling System, HEC-HMS, User's Manual, 600pp.

3. Beven, J. K., 2001. Rainfall – Runoff Modeling. England: Wiley, p. 360.

4. Liu, Q. Q., Chen, L., Li, J. C., and Singh, V. P., 2004. Two-dimensional kinematic wave model of overland-flow. Journal of Hydrology, 291, 28–41.

RAI 2-18: Provide additional information describing the topographic, hydraulic, and hydrologic characteristics of the two HUC-12 watersheds associated with Laguna Plata and Laguna Gatuna.

In SAR Section 2.4.2, the applicant described a storm water mass-balance analysis to determine flood water levels in Laguna Plata and Laguna Gatuna. Two HUC-12 watersheds associated with the lagunas were identified, and two digital elevation maps were created for the watersheds at one-foot contour interval. Soil attributes, such as depth to restriction and saturated hydraulic conductivity, were obtained from the NRCS. Infiltration to soil layers down to 50% of restriction was subtracted from the 24-hour, 7.5-inch rain storm. Excess rainfall depth from the infiltration was accumulated spatially and applied to the capacity of the two lagunas, from which flood water levels on the west and east sides of the CISF were calculated. The applicant assumed that the playas were dry prior to the 24-hour/7.5-inch rain event. The two sub-watersheds, Laguna Plata and Laguna Gatuna, were identified in SAR Figure 2.4.11. Soil types near the CISF were shown in SAR Figure 2.1.7, with hydrologic and hydraulic characteristics of these soils provided in Appendix D of the Environmental Report and summarized in SAR Section 2.1.2.

In order to evaluate the safety of the proposed CISF against probable flooding events, the staff needs additional information regarding the sensitivity of the calculated flood water levels to individual soil attributes when generic NRCS soil hydrologic and hydraulic characteristics are used in place of data obtained specifically for the proposed CISF site. The application should provide additional information on the areas of the watersheds and the areal coverage of individual soil groups inside and outside the CISF. Outside the immediate proximity of the proposed CISF, additional information is also needed on the soil groups and their spatial coverage, their depths to restriction, and their soil hydrologic and hydraulic characteristics. The application should also (1) clarify the assumption applied to the infiltration capacity or hydraulic conductivity of the lake bed sediment of the two lagunas, (2) provide additional information on the storage-elevation curves of the two lagunas, and (3) justify the assumption that the playa lakes were dry before the rain event. The application should provide digital information or figures regarding the one-foot contour maps created for the two watersheds.

This information is necessary to demonstrate compliance with 10 CFR 72.90(a), 72.92(b), and 72.92(c).

RAI 2-19: Provide additional information on storage and movement of surface water by the ephemeral washes described in SAR Figure 2.1.9, specifically describing (1) the hydrologic and hydraulic characteristics of the two ephemeral washes, (2) the effect of extreme weather events on water flow in the ephemeral washes and water level within and around the proposed CISF, and (3) soil erodibility along the ephemeral washes and other exposed soil surface on the CISF during extreme weather events.

Two ephemeral washes drain from the west and north of the proposed CISF (SAR Figure 2.1.9). SAR Section 2.4.1 states that “a topographic high is present within the central portion of the property with ephemeral washes draining from this point; one to the west into Laguna Plata and another to the east into Laguna Gatuna.” The application should provide additional information to evaluate (1) the likelihood that water may flow in the washes, and (2) back-water effects may occur in the washes, affecting surface water levels within and around the proposed CISF during extreme weather events. It should also evaluate the effects of soil erosion along and around the ephemeral washes on the stability of the proposed CISF during extreme weather events, given the proximity of the ephemeral washes to the proposed facility (SAR Figures 2.1.9).

This information is necessary to demonstrate compliance with 10 CFR 72.90(a), 72.92(b), and 72.92(c).

RAI 2-20: Provide additional information regarding existing hydraulic structures between the proposed CISF and Laguna Gatuna, including their status and functions.

Section 2.4.3 of the SAR states that two ephemeral washes drain from the local topographic high near the proposed CISF; one to the west into Laguna Plata and another to the east into Laguna Gatuna. On SAR Figures 2.1.2 and 2.1.7, existing hydraulic structures between Laguna Gatuna along the ephemeral wash east of the proposed CISF are clearly visible in the satellite pictures of the site.

The application should provide additional information on the status and functions of the hydraulic structures, the effect of the hydraulic structures on probable maximum flood in the ephemeral wash flowing east into Laguna Gatuna, particularly during PMP events.

This information is necessary to demonstrate compliance with10 CFR 72.90(a), and 72.122(b)(2)(A) and (B).

RAI 2-21: Provide additional information describing modifications to site topography, and the elevations of on-site structures, including the UMAX systems, the security building, and the cask transfer facility. Provide additional information that determines their effects on flood water levels in Laguna Gatuna and Laguna Plata before and after site modification. This should include all phases of the proposed CISF with all UMAX systems installed and in place.

Section 2.1.2 of the SAR states that "plot views of the HI-STORE CIS Facility with all phases complete are shown in Figures 2.1.6(a), (b), and (c)." Figure 2.1.6(a) indicates the proximity of the proposed CISF to Laguna Gatuna. Figure 2.1.6(b) of the SAR shows four above-ground buildings to the south and southeast of the facility. Figure 2.1.6(c) of the SAR identifies the buildings as administrative, security, cask transfer, and storage buildings. However, no topographical information, such as elevation or surface contours, were provided in the figures. The application should provide additional information about the elevations of on-site structures and any modifications to the site topography to assess the flooding hazards of important to safety structures at the site. The application should include assessment with all planned on-site structures for all phases in place to evaluate the bounding flood hazards as a result of site modification, whereby the footprint of the entire UMAX systems will be backfilled with low permeability materials.

This information is necessary to demonstrate compliance with 10 CFR 72.122(b)(2).

RAI 2-22: Provide additional information describing the proposed rail track and embankment that will connect the proposed CISF with the existing railway spur (SAR Figure 2.1.5). The information should include elevations of railroad embankment, any hydraulic structures incorporated into the embankment, and design parameters of the hydraulic structures if applicable. Also, provide information on the likelihood of failure for the rail track and embankment during extreme weather events, e.g., a PMP, and the effect of such failure to the flooding of proposed CISF on-site structures, systems, and components.

Given the proximity of the rail track to the southern high point of the site, storm water during extreme weather events may result in storm water build-up behind the embankment, impacting the surface water level within and around the proposed CISF. The application should provide additional information about the proposed rail line and embankment and any embedded hydraulic structures. The application should further evaluate the likelihood of failure for the rail track and embankment during extreme weather events, e.g., a PMP, and the effect of such failure to the flooding of proposed CISF on-site structures, systems, and components.

Section 2.1.3 of the SAR states that "topography of the site shows a high point located on the southern border of the site and gentle slopes leading to the two drainages (Laguna Plata and Laguna Gatuna)." Section 2.4.1 of the SAR states that "site topography is irregular, with a slight slope toward the north." The topography of the site suggests that surface storm water may flow north and northwest from the topographic high points on the southern border of the site across the boundary of the proposed CISF and towards the two playa lakes.

Section 2.1.2 of the SAR stated that "aerial view of the site is shown in Figure 2.1.5 and several plot views of the HI-STORE CIS Facility with all phases complete are shown in Figures 2.1.6(a), (b), and (c)." Figure 2.1.5 of the SAR indicates that a rail track is proposed to connect the proposed CISF to an existing rail spur to the west of the site. Figure 2.1.6(a) of the SAR indicates that the proposed rail track will run between the proposed CISF and Laguna Gatuna but does not provide the elevation of the rail track and any potential hydraulic structure incorporated into the railroad embankment.

This information is necessary to demonstrate compliance with 10 CFR 72.122(b)(2).

RAI 2-23: An aqueduct runs through the southeast portion of the proposed CISF (SAR Figure 2.1.9). Provide additional information to clarify (1) the function, structural integrity, and status, and (2) effects of the aqueduct on flood water build-up within and around the proposed CISF, particularly during extreme weather events.

Section 2.1.2 of the SAR stated that "a small water drinker (livestock) is located along the aqueduct in the northern half of the Site." The aqueduct was clearly identified in SAR Figures 2.1.8 and 2.1.9 and is clearly visible in satellite picture in SAR Figure 2.1.7. In southeast New Mexico, the Pecos River Flume, an aqueduct, was constructed to provide water to the Carlsbad Irrigation System and may sometimes hold standing water (Carlsbad Irrigation District, 1905). It is likely that standing water may also occur in the aqueduct on the CISF site. Additional information is needed to determine if standing water in the aqueduct, particularly during extreme weather events, may impact land surface flood water build-up within and around the proposed CISF.

This information is necessary to demonstrate compliance with 10 CFR 72.122(b)(2).

<u>Reference</u>

1. Carlsbad Irrigation District, 1905. Pecos River Flume - Photographic copy of historic photo. https://www.loc.gov/resource/hhh.nm0202.photos/?sp=19.

RAIs for SAR Section 2.5:

RAI 2-24: Provide additional information to demonstrate that spatially and temporally variable hydrologic conditions in the sub-grade soils would not affect the structural performance of the UMAX pad system, such as differential settling or the consequences of earthquakes. Provide a description of possible hydrologic effects on the site-specific geotechnical properties that influence the stability of the under-grade (residual soil), support pad foundation, and subgrade components.

In SAR Section 2.6, the geotechnical properties related to the stability of the under-grade and subgrade materials are described in terms of processes related to differential settlement and to earthquakes. Some of the geomechanical conditions and properties (see RAIs for SAR Section

2.6.4) depend on hydrological conditions, particularly the water content of the material. Varying groundwater conditions that change in both time and space may lead to heterogeneous saturation conditions below the under-grade and lateral to both the under-grade and subgrade. Potential interaction of the hydrologic conditions in the natural sediments with the support foundation pad and subgrade are not described in the SAR.

Sections 2.5 and 2.6 of the SAR state that site specific saturated groundwater levels are in the Chinle and Santa Rosa units of the bedrock below the facilities. The groundwater system in the shallow, quaternary sediments is said to generally be unsaturated, but may locally be perched (i.e., saturated). However, information about water wells near the site of the facility provided in SAR Figure 2.5.2 suggests that the hydrological conditions may vary in the subsurface environment in and around the under-grade, support foundation pad, and subgrade in response to precipitation events, and seasonal and annual climatic variations. Temporal patterns may vary due to recharge in the highly permeable shallow alluvial sediments, and spatial patterns may exist due to the influence of the caliche horizons. In addition, groundwater brine levels adjacent to the playas are expected to vary during and after precipitation events due to infiltration adjacent to the playas and runoff submerging the playas. Perched water and transient lateral drainage towards the playas in the subsurface, possibly channelized, may interact with or be impeded by the under-grade, support foundation, and subgrade. The residual sediments of the under-grade in the design are projected to be at 3500 ft elevation and above. The brines supported by the playa is stated to be at the same elevation. The present-day ground surface at the site is at 3520 to 3540 ft elevation above sea level.

This information is necessary to demonstrate compliance with 10 CFR 72.90(a), 72.92(a), and 72.122(b).

RAIs for SAR Section 2.6:

RAI 2-25: Provide additional information on the potential for surface deformation due to past, present or future human activities at the proposed site. Specifically, clarify whether there are any oil and gas extraction activities, including casing corrosion or failure leading to dissolution of carbonate or evaporite deposits in the subsurface, that could result in surface deformation. Justify the basis for the 5,000 ft minimum depth of oil drilling or fracking activities; clarify the depth to the shallowest oil or gas field in the site subsurface; and characterize the potential for surface deformation at the site due to drilling or fracking at the depth of the shallowest oil or gas field in the site subsurface. Discuss the potential for surface deformation due to mineral or resource mining exploration or extraction activities in the subsurface for the licensed life of the proposed facility.

Section 2.6.4 of the SAR, “Stability of Subsurface Materials,” states that “[t]here are no surface, drillhole, or mining indications that subsidence and collapse chimneys occur at the Site or surrounding area.” However, SAR Section 2.1.4, “Land and Water Use,” states that “because of the extent of the evaporites (salt and anhydrite), drilling and completion operations have to be conducted in a manner that prevents the dissolution of the salt and protects the well during drilling and through the productive lives of the wells, often 20 to 30 years or more.” SAR Section 2.1.4 also states that “[t]here are several examples in the Permian Basin of catastrophic subsidence as a result of suspected oil field casing corrosion and dissolution of salt,” including the Wink Sinks and Jal Sink, both of which have similar subsurface stratigraphy to the HI-STORE CISF site. Despite the occurrence of past catastrophic subsidence at these locations, and potential for future oil and gas extraction activities at the site, the application does not address the potential for catastrophic subsidence at the CISF site due to current and future oil and gas extraction activities or describe actions to prevent future catastrophic subsidence. Section 2.6.4 of the SAR further states that "any future oil drilling or fracking beneath the Site would occur at greater than 5,000 feet depth, which ensures there would be no subsidence concerns." However, public information from the State of New Mexico's Energy, Minerals and Natural Resources Department shows the presence of nearby active oil and gas wells within a three-mile radius of the site that are less than 5,000 ft depth. In addition, the application does not consider surface deformation from the exploration or extraction of minerals or other resources other than potash, oil, or gas.

This information is necessary to determine compliance with 10 CFR 72.98(c)(2) and 72.103(f)(2)(ii).

RAI 2-26: Related to origin of potential dissolution features at the site

Explain the origin of the features circled in red in Figures 2.1.2 and 2.1.5, particularly with respect to dissolution of the Capitan Reef or other subsurface carbonate and evaporite deposits either through natural process or human activities. Also, assess the future potential for similar surface deformation as a result of natural processes or human activities in the site area.

Figure 2.6.2 of the SAR shows the site is underlain by over 1,000 feet of the Capitan Reef, a carbonate formation in the site region that is well-known for the large-scale karst features that have developed at the surface and at depth. Most notable of these features is the Carlsbad Caverns, approximately 65 miles southwest of the site. The staff also notes the presence of additional carbonate and evaporite rocks both above and below the Capitan Reef and the association of subsurface halite dissolution above the Capitan Reef with several sinkhole features in southeastern New Mexico. Additionally, SAR Figures 2.1.2 and 2.1.5 show numerous circular features throughout the site and surrounding areas but the application does not discuss the origin of these features. On Figures 2.1.2 and 2.1.5, these features are indicated by red circles. The green box on Figure 2.1.5 is the general outline of the area covered by Figure 2.1.2.

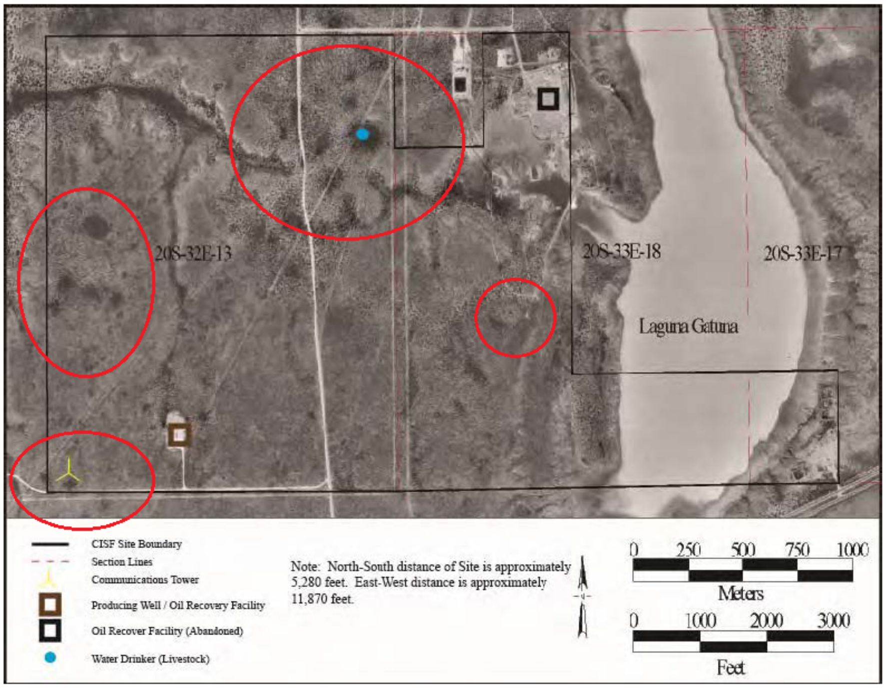

Figure 2.1.2: HI-STORE CIS Facility Site Boundaries [2.1.3]

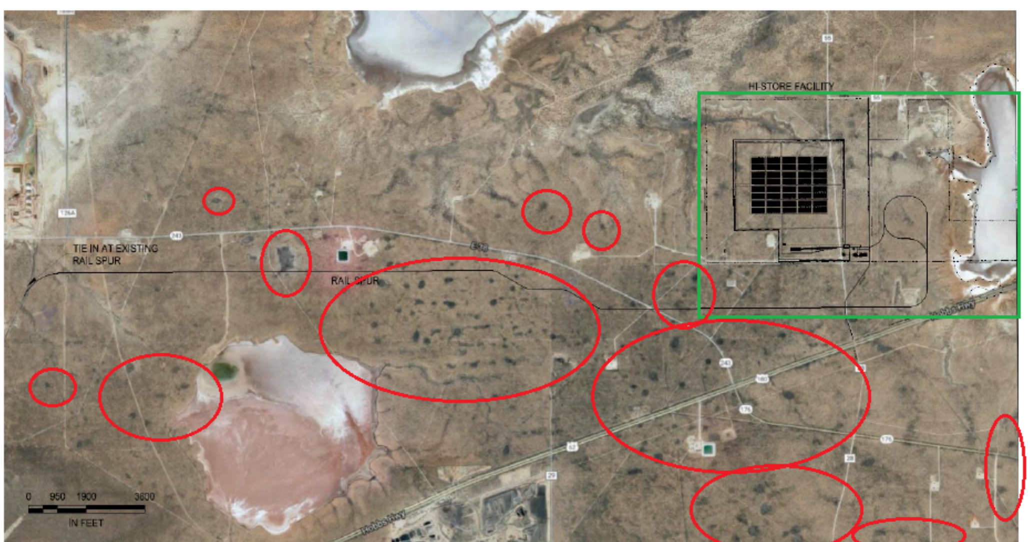

Figure 2.1.5: Aerial View of the Site (Full Build-Out) [2.1.8]

This information is necessary to determine compliance with 10 CFR 72.103(f)(2)(ii).

RAI 2-27: Related to Mescalero caliche

Justify the conclusion that "dissolution of this unit [Mescalero caliche] may have resulted in the development of a number of small shallow depressions in the area; however, this is not regarded as an active or significant karst process at the Site." Specifically, provide a figure showing the location of these small shallow depressions relative to the site. Also, explain how it was determined that dissolution of the caliche layer and not dissolution of deeper layers resulted in the observed “small shallow depressions.”

Section 2.6.4 of the SAR states that the “[…] Mescalero caliche is soluble and situated at or near land surface […]” and goes on to state that “[…] dissolution of this unit may have resulted in the development of a number of small shallow depressions in the area; however this is not regarded as an active or significant karst process at the Site.” The staff reviewed the reference cited for this conclusion (SAR Reference 2.1.3) and a reference cited therein (Bachman, 1976). Bachman (1976) noted that although dissolution of soluble rocks has caused subsidence and surface collapse in southeastern New Mexico, these processes have been active in this area for long intervals in geologic time. Bachman (1976) further concludes that the Mescalero caliche is a “widespread datum for determining the relative time of solution and collapse of many modern karst features.” Although deformation of the Mescalero caliche records three episodes of solution and collapse, Bachman (1976) does not attribute the deformation of the Mescalero caliche to dissolution of the Mescalero caliche.

This information is necessary to determine compliance with 10 CFR 72.103(f)(2)(ii).

RAI 2-28: Related to subsurface stratigraphy

Section 2.6.1 of the SAR describes the geology of the HI-STORE CISF site, including the underlying stratigraphic units. Clarify the stratigraphic units present in the subsurface of the site, including their correlative units at a regional scale, as discussed below:

a) Describe subsurface layer at the site, including the formation name, composition or lithology, US Geological Survey (USGS) designation, if appropriate, and age; and provide an updated stratigraphic column based on this information. Include whether each unit is indurated or unconsolidated, and if so, whether the unit is saturated or unsaturated.
b) Clarify which subsurface units correlate to the Upper and Lower Gatuna Formation and the Ogallala Formation, as these units are included in the stratigraphic column in SAR Figure 2.6.5 but are not identified in the text of SAR Section 2.6.1 nor in the boring subsurface profiles (SAR Figures 2.6.6 through 2.6.8 and in the Geotechnical Data Report).
c) Identify and describe the geologic units of the Dockum Group in the subsurface and clarify the correlation of those geologic units to other recognized layers within the Dockum Group (such as the Redonda, Cooper Canyon, Trujillo and Tecovas Formations).

The staff uses the stratigraphic information in SAR Section 2.6.1 as input to its confirmatory calculations as part of the review of SAR Sections 2.6.2 and 2.6.4. Section 2.6.1 of the SAR states that most boreholes penetrate a top soil layer, caliche layer, residual layer, Chinle layer and Santa Rosa layer. The application also states that the near-surface layers consisted of Surface soil, Mescalero caliche, Quaternary sands, and Dockum Group in the upmost 25 feet at the site. Figure 2.6.5 of the SAR shows the uppermost layers at the site as Quaternary Pediments, Valley Fills, Upper Gatuna Formation, Tertiary Lower Gatuna Formation, and Ogallala, all of which overlie the Triassic Dockum Group. Although SAR Figures 2.6.2 and 2.6.5 list formation names, the application does not describe the composition of the individual units.

The applicant divides the Dockum Group into the Chinle Formation and Santa Rosa Sandstone, however, the USGS geologic map of the Tucumcari Sheet further subdivides the Dockum Group into the Chinle, Trujillo, and Tecovas Formations overlying the Santa Rosa Sandstone, each with a distinct composition. Additionally, a 2004 geology report for a nearby site (ML041910489) states that some strata that were previously identified as Chinle Formation have been more recently identified as Cooper Canyon Formation, and divides the Chinle Formation into the Cooper Canyon, Trujillo and Tecovas Formations.

This information is necessary to determine compliance with 10 CFR 72.103(f)(1)-(3).

RAI 2-29: Related to information in the Geotechnical Data Report

Supplement the Geotechnical Data Report and/or SAR Section 2.6 to provide the following additional information:

a) Provide high-quality photos of all recovered core for the borings completed at the site.
b) Describe the portions of B101 that do not include photos in the Geotechnical Data Report (depths of 104.5-106 ft, 110-111 ft, 209-210 ft, 259-260 ft, 310-310.5 ft, and 324-325.5 ft).
c) Describe the fractures encountered in the rock in the context of the subsurface stratigraphy described in SAR Section 2.6.1 and presented in SAR Figures 2.6.2 and 2.6.5 through 2.6.8.
a) Discuss the origin of the fractures in the context of the geologic history described in SAR Section 2.6.1 including any associated geologic or tectonic events which may have influenced the formation of these fractures.
b) Discuss any anticipated effects of the fractured rock in the subsurface particularly the potential for surface deformation due to the same mechanism that caused the fractures in the rock.
c) Discuss the slickensides encountered at similar elevations in boreholes B102, B105 and B106, including their origin and any associated geologic structures and the current or future potential for surface deformation.

The boring logs provided in the Geotechnical Data Report describe the presence of numerous areas of fractured rock and several occurrences of slickensides. Section 2.6.1 of the SAR describes the subsurface materials but does not mention fractures or slickensides observed in the rock units at the site. The Geotechnical Data Report also does not include the observed fractures or slickensides in the description of the materials encountered in the borings. The SAR and Geotechnical Data Report do not describe the origin of these fractures and slickensides and do not assess the potential for surface deformation at the site or settlement of the storage pads and the Canister Transfer Facility associated with the mechanism(s) that formed the fractures and slickensides.

This information is necessary to determine compliance with 10 CFR 72.103(f)(2)(ii).

RAI 2-30: Provide details about how the potential for induced seismicity was considered when developing the site design basis earthquake.

Section 2.6.2 of the SAR, "Vibratory Ground Motion," discusses the approach taken to develop the site seismic design ground motion. The seismic design ground motion was developed by taking the USGS National Seismic Hazard Mapping Project (NSHMP) results for the site location and using a Regulatory Guide 1.60 spectrum anchored at 0.15g as the design basis earthquake (DBE), as defined in Table 2.7.1 and Table 4.3.3 of the SAR. However, this approach to developing the DBE does not account for the potential for induced seismicity in the site region, because the NSHMP approach removes induced and potentially induced seismicity from its earthquake catalog prior to performing the hazard analysis. Because the site is located within a region of both induced seismicity and extensive oil and gas production (along with any associated wastewater disposal), the potential for induced seismicity should be included in the development of the DBE.

This information is necessary to determine compliance with 10 CFR 72.103.

RAI 2-31: Justify not incorporating site-specific subsurface geologic and geophysical properties through a site response analysis for the development of the site-specific design basis earthquake (DBE).

Section 2.6.2 of the SAR describes the applicant's approach used to develop the site's DBE. However, the applicant relies on results of the USGS NSHMP, which is performed on a grid across the United States for a subset of pre-defined subsurface conditions that may not adequately capture the subsurface properties of the Holtec site. A site-specific probabilistic seismic hazard assessment (PSHA) performed by the NRC staff, which incorporates at-site and regional velocity and stratigraphic information, indicates an exceedance of the DBE at frequencies greater than 15 Hz. Given the lack of site-specific hazard development, this exceedance should be justified.

This information is necessary to determine compliance with 10 CFR 72.103.

RAIs for SAR Section 2.6.4, "Stability of Subsurface Materials":

RAI 2-32: Provide the corrected blow count N-values from the Standard Penetration Test (SPT) for each borehole drilled at the site, as described in the Geotechnical Data Report: HI-STORE CISF Phase 1 Site Characterization, Lea County, New Mexico (GEI, 2017), as a function of depth and justify the conclusion in SAR Section 2.6.4, "Stability of Subsurface Materials," that the strata beneath the storage pads and the Cask Transfer Facility (CTF) are not liquefiable.

Section 2.6.4 of the SAR states that corrected SPT blow count N-values have been used to assess the potential for liquefaction of the strata beneath the storage pads and the CTF. However, Attachment F of the Geotechnical Data Report: HI-STORE CISF Phase 1 Site Characterization, Lea County, New Mexico (GEI, 2017), shows only correction for the hammer energy (C_E), as per equation (8) of Youd et al. (2001) (Reference 2.6.12 of SAR), that has been done for the field-measured N-values from the SPT test. It is not clear whether other corrections to the measured N-values, as shown in equation (8) of Youd et al. (2001) (Reference 2.6.12 of SAR), have been conducted to estimate the $(N_1)_{60\text{ Clean Sand}}$ values for assessing the geotechnical properties of the subsurface and the liquefaction potential. The methodology of Youd et al. (2001) (Reference 2.6.12 of SAR) requires all the necessary corrections be made to the field-measured N-values to determine the $(N_1)_{60\text{ Clean Sand}}$ values for assessing the liquefaction potential. Therefore, corrected SPT blow count N-values are needed to assess whether the strata beneath the storage pads and the CTF could liquefy.

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

RAI 2-33: Justify why the material properties, as given in Table 5.3 of the report HI-STORE Bearing Capacity and Settlement Calculations (Report No. HI-2188143), are appropriate to represent the materials at the proposed site.

First, Table 5.3 of Report No. HI-2188143 states that only a few properties were directly measured on samples obtained from the proposed site and most of the remaining properties were estimated using the Standard Penetration Test (SPT) blow count N-values and empirical relationships available in Bowles (1997) (Reference [8] of HI-2188143). For example, friction angle ϕ for the Residual Soil and Chinle Formation was estimated using the SPT blow count N-values and an empirical equation (Equation 3-5) given in Bowles (1997) (Reference [8] of HI-2188143). However, Bowles (1997) gives three empirical equations (3-5) to estimate ϕ from the selected N-value. Report No. HI-2188143 did not identify which equation was used to estimate the friction angle ϕ for the Residual Soil and Chinle Formation. It is also not clear whether all the necessary corrections were carried out to adjust the field-measured SPT N-values prior to using the empirical equation. Additionally, the Report No. HI-2188143 does not provide the specific N-values that were used to estimate the friction angles ϕ of the Residual Soil and Chinle Formation. Moreover, discuss why the selected N-values would represent the characteristics of the entire Residual Soil and Chinle Formation (mudstone) of the proposed site when the borehole logs, given in the Geotechnical Data Report (GEI, 2017), show considerable variation with depth and spatially from one borehole to another.

Moreover, these empirical equations given in Bowles (1997) (Reference [8] of HI-2188143) use the SPT blow count of N_{70} values, indicating an energy ratio of 70. Attachment F to the Geotechnical Data Report (GEI, 2017) shows that the field-measured SPT blow counts were normalized to 60% of the hammer energy (N_{60}). It is not clear whether appropriate conversions were carried out before using the empirical equation from Bowles (1997) to estimate the friction angle ϕ of the Residual Soil and Chinle Formation. Therefore, a justification is needed to demonstrate that the estimated friction angles of the Residual Soil and the Chinle Formation have been appropriately estimated and represent the strata behavior appropriately.

Similarly, elastic modulus E of the Residual Soil is estimated using an empirical relationship given by Bowles (1997) (Reference [8] of HI-2188143), correlating with the Plasticity Index and SPT blow count at 55% energy ratio, or N_{55}. Values of Plasticity Index and N_{55} used are not given. It is also unclear why the elastic modulus of the Residual Soil changed from 27.81 ksf, as given in Table 5.3, to 39.68 ksf in page A.2 of Report No. HI-2188143, and in subsequent uses. Therefore, a justification is needed to demonstrate that the elastic modulus of the Residual Soil has been estimated appropriately considering the characteristics of the stratum at the proposed site.

Next, the elastic modulus E of the Chinle Formation in Table 5.3 of Report No. HI-2188143 appears to be measured on Sample C6 from Boring B107, as shown in Table 4 of the Geotechnical Data Report (GEI, 2017). However, another test using a sample from the same depth interval shows significantly lower elastic modulus (2,727 ksf vs. 900 ksf). It is not clear why one value was preferred over another. Additionally, the strength test, by its very nature, was conducted on relatively intact rock samples. The Chinle Formation, especially the upper portion, is highly fractured with fracture spacing as low as 1 inch (GEI, 2017). Most of these fractures are horizontal or sub-horizontal (less than 30° from the horizontal), as given in the boring logs in GEI (2017). These fractures are expected to make the rock mass (Chinle Formation) more deformable, especially in the vertical direction. Therefore, to estimate the settlement beneath the storage pads, the rock mass modulus instead of the intact rock modulus, may be more appropriate to capture the deformation characteristics from the vertical load imposed by the pad structures and the multipurpose canisters. Accordingly, a justification is necessary to demonstrate that the elastic modulus of the Chinle Formation has been estimated appropriately, taking into consideration the characteristic of the stratum at the proposed site.

Additionally, Poisson's ratio μ for the Residual Soil and Chinle Formation were adopted from literature (e.g., Bowles, 1997, Table 2-7) (Reference [8] of HI-2188143). Unfortunately, Bowles (1997) (Reference [8] of HI-2188143) provided values of Poisson's ratio in terms of broad material types (e.g. clay, rock). It is not clear what would be the appropriate values of Poisson's ratio for the Residual Soil (mostly CL or sandy clay) and mudstone from the possible ranges given in Bowles (1997) (Reference [8] of HI-2188143). Additionally, property values listed in Table 5.3 of the Report No. HI-2188143 indicate the Residual Soil to be an extremely soft clay material compared to mudstone (Chinle Formation) in the axial direction only (almost 70 to 100 times softer); however, it is stiffer than mudstone in the lateral direction (Poisson's ratio of the Residual Soil is 0.2 versus 0.3 for mudstone in Table 5.3 of HI-2188143). The report does not discuss why these Poisson's ratio values would be appropriate for the materials available at the proposed site. Therefore, a justification is needed to demonstrate that the estimated values of Poisson's ratio of the Residual Soil and the Chinle Formation appropriately represent the strata at the proposed site.

Lastly, it is not clear how the cohesion C of Residual Soil and Chinle Formation were determined, as given in Table 5.3 of Report No. HI-2188143. Report No. HI-2188143, where it states that Equation (2.93) of Das (2016) (Reference [4] of HI-2188143), was used to estimate the cohesion values. However, Equation (2.93) of Das (2016) (Reference [4] of HI-2188143) is for unconsolidated-undrained tests when friction angle $\phi = 0$ for saturated clays. Table 5.3 of HI-288143 shows the friction values ϕ for both the Residual Soil and Chinle formation, estimated from the SPT N-values. No explanation is provided for the selected approach to estimate cohesion of the Residual Soil and Chinle Formation assuming zero friction. Additionally, both the Residual Soil and Chinle Formation are assumed cohesionless in Report No. HI-2188143 when estimating the elastic or immediate settlement after construction of the storage pads and the CTF without any explanation. Therefore, a justification is needed to demonstrate that the methodology used to estimate the cohesion of the Residual Soil and the Chinle Formation is appropriate and the estimated values appropriately represent the characteristics of the strata at the proposed site. Additionally, assumptions used about the strata behavior should be consistent throughout the analysis and appropriately justified.

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

RAI 2-34: Justify why Equation 10.6.2.4.2-1, given in the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications (Reference [1] in Report No. HI-2188143, "HI-STORE Bearing Capacity and Settlement Calculations"), is appropriate to estimate the elastic or immediate settlement of the storage pads and the CTF at the proposed facility.

AASHTO LRFD Bridge Design Specifications (Reference [1] in Report No. HI-2188143) provides the equation 10.6.2.4.2-1 to estimate the elastic settlement in cohesionless soils in Section 10.6.2.4.2, "Settlement of Footings on Cohesionless Soils." However, Table 5.3 of Report No. HI-2188143, which lists the values of different geotechnical parameters used in estimating the settlement of the storage pads and the CTF, shows both the Residual Soil and Chinle Formation have cohesion (4,000 and 8,060 psf, respectively). Therefore, a justification is needed why it is appropriate to use the methodology given in AASHTO LRFD Bridge Design Specifications (Reference [1] in Report No. HI-2188143) for cohesionless soils to estimate the elastic or immediate settlement of cohesive soils.

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

RAI 2-35: Justify the weighting scheme adopted in Report No. HI-2188143, "HI-STORE Bearing Capacity and Settlement Calculations," to estimate the weighted average of the elastic modulus and Poisson's ratio for calculating the elastic or immediate settlement of the storage pads and the CTF.

Report No. HI-2188143 uses a weighting scheme, as given in Bowles (1997) (Reference [8] of HI-2188143), for estimating the weighted average of the elastic modulus E and Poisson's ratio μ for multi-layered strata. The methodology described in page 308 of Bowles (1997) indicates that the weighting scheme at the proposed site should follow the alternative approach because the Chinle Formation is almost 70 to 100 times stiffer than the Residual Soil (Table 5.3 of HI-2188143). Therefore, the Chinle Formation should be considered as the hard stratum for estimating the immediate or elastic settlement by the applicant, based on Bowles (1997). The immediate settlement would be controlled by the Residual Soil layer only with a thickness of 12 ft, measured from the bottom of the storage pads to where the hard stratum (Chinle Formation) is encountered, not up to 5 times the pad width, as used in Report No. HI-2188143. Therefore, a justification is needed why it would be appropriate to use the adopted weighting scheme for estimating the immediate or elastic settlement of the storage pads and the CTF.

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

RAI 2-36: Justify why the consolidation settlement estimated at the upper 6 ft of the Residual Soil layer (measured from the bottom of the storage pad) would be the total consolidation settlement of the entire Residual Soil layer (total thickness of 12 ft) below the storage pads.

Report No. HI-2188143, "HI-STORE Bearing Capacity and Settlement Calculations," states that the thickness of the Residual Soil layer is 12 ft; however, it has estimated the increase of vertical stress due to construction of a storage pad only at a depth of 6 ft from the bottom of the storage pads (Page A.8 of HI-2188143) and associated consolidation settlement. The report does not provide an explanation why the lower 6 ft of Residual Soil would behave as a rigid body and would not undergo any consolidation settlement when it can sustain elastic or immediate settlement (Page A.6 of HI-2188143). Therefore, a justification is needed to explain why the consolidation settlement of the top 6 ft of the Residual Soil would be the total consolidation settlement of the entire 12 ft thick Residual Soil.

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

RAI 2-37: Justify why the consolidation-related properties measured in mudrock (Chinle Formation) are appropriate for estimating the consolidation settlement of the Residual Soil layer below the storage pads and the CTF.

The consolidation-related properties include the Preconsolidation Stress or the maximum past vertical stress σ_c, Compression Ratio, and the Recompression or Swelling Ratio. Report No. HI-2188143, "HI-STORE Bearing Capacity and Settlement Calculations" has taken the consolidation-related properties of the Residual Soil that are measured on two samples from the Chinle Formation obtained from two different depths. For estimating the consolidation settlement, the Residual Soil layer beneath the storage pads has been replaced by a layer of

Chinle Formation with a thickness of 6 ft. This is followed by a 6 ft thick rigid layer of Residual soil over the original Chinle Formation. The report does not provide an explanation for why a layer of the Chine Formation placed just beneath the storage pads would represent the consolidation processes in the Residual Soil in reality. As such, Page A.9 of HI-2188143 states that the Chinle Formation is considered bedrock. It would undergo consolidation settlement, although significantly lower than the Residual Soil. Therefore, a justification is needed to explain why it would be appropriate to use the consolidation-related properties of the Chinle Formation to estimate the consolidated settlement of the Residual Soil.

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

RAI 2-38: Justify the methodology used to estimate the consolidation-related settlement underneath the storage pads and the CTF.

Report No. HI-2188143, "HI-STORE Bearing Capacity and Settlement Calculations," uses Equation 2.67 of Das (2016) (Reference [4] in HI-2188143) to estimate the long-term consolidation settlement under the storage pads and the CTF. According to Das (2016) (Reference [4] in HI-2188143), the value of Preconsolidation Stress or the maximum past vertical stress σ_c determines whether the soil is normally consolidated or overconsolidated. Additionally, the preconsolidation stress with respect to the initial effective vertical stress before construction and the additional effective vertical stress imposed by the storage pads with the storage modules or the CTF would determine which equation should be used if the soil is normally consolidated or overconsolidated (Das, 2016, Reference [4] of HI-2188143). In Report No. HI-2188143, the preconsolidation stress σ_c of the Residual Soil is taken as the value estimated in sample SW1 obtained at depth 73.9 to 74.6 ft of the Chinle Formation, and Equation 2.67 of Das (2016) (Reference [4] in HI-2188143) has been used. However, it is not clear whether any standard practice (e.g., ASTM International) has been followed to determine the preconsolidation stress from the laboratory-measured test results. Additionally, other consolidation-related parameters, Compression Ratio and Recompression or Swelling Ratio, are measured in Sample SW2 obtained at a depth of 100.5 to 101.1 ft of the Chinle Formation. It is not clear how parameter values measured on two different samples from two different depths in mudrock (Chinle Formation) are appropriate to represent the consolidation characteristics of the Residual Soil. Therefore, a justification is necessary for the appropriateness of the estimated Preconsolidation Stress value and for why the approach adopted would provide acceptable estimates of the consolidation settlement under the storage pads and the CTF.

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

RAI 2-39: Justify why the secondary settlement of the storage pads and the CTF would be negligible at the proposed site.

AASHTO LRFD Bridge Design Specifications (2012) (Reference [1] in HI-2188143) specifies total settlement would be the summation of three components: (1) elastic settlement, (2) primary consolidation settlement, and (3) secondary settlement (Equation 10.6.2.4.1-1 of Reference [1] in HI-2188143). However, the secondary settlement under the storage pads and the CTF has not been estimated in Report No. HI-2188143 and no explanation has been provided. A justification is necessary to explain why the secondary settlement at the proposed site would be negligible.

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

RAI 2-40: Demonstrate that the Residual Soil beneath a spent fuel storage pad would not undergo settlement more than the maximum allowable of 0.2 inch, as per the HI-STORM UMAX Canister Storage System FSAR, considering the construction sequence and operational timeframes.

The construction sequence of a storage pad starts with the placement of the Support Foundation Pad (SFP) over the prepared surface. This is followed by placing the Cavity Enclosure Container (CEC) shells on the SFP. Then, Controlled Low Strength Material (CLSM) is placed. After the CLSM pour is complete, concrete for the ISFSI pad is poured. Later, one loaded multi-purpose canister (MPC) is placed in each of the 250 cavities with other components of the Vertical Ventilated Module (VVM).

Report No. HI-2188143, "HI-STORE Bearing Capacity and Settlement Calculations" estimates the total settlement of the SFP in terms of two components: (1) immediate or elastic settlement and (2) consolidation settlement. By estimating the immediate or elastic settlement of the SPF from the total load of the storage pad-(SFP + CLSM + Top ISFSI Pad + 250 VVMs), the report inherently assumes that the construction of the storage pad structure and placement of 250 VVMs would be complete in a very short time before appreciable consolidation settlement from any of the load components begins. As per Bowles (1997) (Reference [8] of HI-2188143), the construction and placement of 250 VVMs need to be over within approximately 7 days from placement of the SFP before the consolidation settlement of the Residual Soil beneath the SFP starts, first from the load imposed by the SFP and later by the other components in the order they were placed. Neither Report No. HI-2188143 nor the SAR provide the time taken by the construction process of the pad structure, in addition to placement of all 250 VVMs. It is, therefore, not clear whether the consolidation settlement from loads already placed would start before the next load component is placed over the SFP causing immediate or elastic settlement of the Residual Soil underneath.

It is also not clear whether the long-term settlement of the SFP can be the only consolidation settlement component, as assumed in Report No. HI-2188143, as some components of the total load may be placed after significant time has elapsed since the SFP has been constructed. The soil below the SFP may undergo consolidation settlement from the load(s) already placed when a new load is placed on the SFP. Therefore, an assessment is necessary to determine whether the long-term settlement of the SFP would be comprised only of the consolidation settlement from the individual load components, or if it may include some of the immediate or elastic settlement from loads placed later in time. If that is not the case, an assessment is necessary to determine whether the SFP would be able to sustain the immediate or elastic settlement imposed by the subsequent load components, in addition to the consolidation settlement as the long-term settlement (less than 0.2 in as per HI-STORM UMAX FSAR).

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

RAI 2-41: Provide an assessment(s), using site-measured geotechnical properties, to demonstrate that the strata at the subgrade and under-grade of the storage pads and the CTF would have sufficient bearing capacity and would not undergo excessive differential settlement, both immediately and in the long-term, due to spatial and vertical variation of the subsurface geotechnical properties.

In response to RAI 2-2, dated March 28, 2018, the applicant submitted Report No. HI-2188143, “HI-STORE Bearing Capacity and Settlement Calculations.” However, the analysis in this report did not address the potential effects of spatial variation of the subsurface geotechnical properties on the bearing capacity and estimated settlement. The proposed storage pads to be constructed at the HI-STORE CISF are large and spatial variations of the geotechnical properties may significantly affect the settlement of the Support Foundation Pads. Similarly, the borehole logs in GEI (2017) show significant variations with depth. However, Report No. HI-2188143 assumed the materials underneath the storage pads to be vertically uniform. Therefore, a justification is necessary to demonstrate that the spatial and vertical variation of the geotechnical properties are small enough to affect the immediate or elastic as well as the consolidation settlement substantially.

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

RAI 2-42: Justify why a two-layer system, as used in the Report No. HI–2188143, “HI-STORE Bearing Capacity and Settlement Calculations,” would be appropriate for estimating the bearing capacity and settlement of the storage pads.

Geotechnical Data Report: HI-STORE CISF Phase 1 Site Characterization, Lea County, New Mexico (GEI, 2017) (Section 5.2.1.3, Residual Soil) states that the difference between the Residual Soil and underlying Chinle Formation was made “based upon hammer refusal in the Standard Penetration Test, difficulty in advancing augers, and visual and gradational changes in the stratigraphy.” Boring logs given in Attachment C of this report show that the material in each borehole immediately below the Residual Soil–Chinle Formation is classified as Lean or Sandy Lean Clay CL, following the Unified Soil Classification System. The depth at which this CL soil changes to mudstone of the Chinle Formation varies from boring to boring with a range of 2 (B106) to 66 ft (B101). Below this boundary between the CL Soil–Mudstone, the mudstone is moderately weathered and severely to moderately fractured. Section 2.4.6.4, “Stability of Subsurface Materials,” of NUREG–1567 defines rock as having shear wave velocity at least 1,166 m/s [3,500 ft/s]. However, the measured shear wave velocity at the proposed site does not reach 1,166 m/s [3,500 ft/s] even at a depth of 31.5 m [105 ft] from the surface (Table 2.6.4 and Figure 2.6.10 of SAR). Consequently, a two-layer system may not be representative of the subsurface strata below the pad; instead, the Chinle Formation overlain by the Residual Soil divided into three sub-layers with a CL soil layer on top, followed by a moderately fractured layer, and a less fractured layer, with material properties for each sub-layer, may be more appropriate. Therefore, a justification is necessary why a two-layer system of Residual Soil–Chinle Formation with one set of material properties would be appropriate for assessing the bearing capacity and expected settlement at the proposed site.

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

HI-STORE CIS Environmental Report (ER)

RAI ER-GEN-2: Clarify whether Holtec qualifies for National Pollutant Discharge Elimination System (NPDES) General Permits for construction and industrial stormwater. If Holtec qualifies for both General Permits, confirm that no additional State water quality authorization is required.

If Holtec does not qualify for both General Permits, describe Holtec's plans and schedule for applying for individual NPDES stormwater permits, a water quality certification under Section 401 of the Clean Water Act (CWA), or for requesting a waiver from the State for the Section 401 water quality certification.

Section 1.4.2.1 of the HI-STORE CISF Environmental Report identifies the need for a National NPDES Construction Stormwater Permit during construction to prevent impacts to jurisdictional waters, and a NPDES General Permit for Industrial Stormwater or an individual NPDES permit during operations for stormwater runoff to waters of the State.

A NPDES permit pursuant to Section 402 of the CWA is subject to a CWA Section 401 water quality certification. Under Section 401 of the CWA, a federal agency may not issue a permit or license to conduct activity that may result in discharge into waters of the U.S. unless a Section 401 certification is issued verifying compliance with existing water quality requirements, or a waiver is issued from the State.

This information is necessary to determine compliance with 10 CFR 51.45(b), (c), and (d).

RAI ER-WR-8: Clarify the status of the determination of jurisdictional wetlands by the U.S. Army Corps of Engineers within the proposed CISF project boundary.

Section 3.5.1 of the Environmental Report states that there are no sensitive riparian habitats or jurisdictional wetlands at the site. Provide information regarding any wetland surveys performed at the site or why none were needed. Provide the basis for the statement that there are no jurisdictional wetlands at the site or clarify the current status of any pending jurisdictional determination. Also, clarify whether, based on the National Wetland Inventory, any riverine habitat, freshwater pond habitat, and/or lake habitat is present within the proposed project area.

This information is necessary to determine compliance with 10 CFR 51.45(b), (c), and (d).