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Submitted electronically and via US Mail

Attention: Mr. James Smith, Senior Project Manager
United States Nuclear Regulatory Commission
Uranium Recovery and Materials Decommissioning Branch
Division of Decommissioning, Uranium Recovery and Waste Programs
Office of Nuclear Material Safety and Safeguards

Dear Mr. Smith,

Reference: Responses to Request for Additional Information on the Application for Amendment of USNRC Source Material License SUA-1475 for the United Nuclear Corporation Mill Site, McKinley County, New Mexico

On behalf of United Nuclear Corporation and the General Electric Company (UNC/GE), this letter transmits responses to the USNRC request for additional information on the *Application for Amendment of USNRC Source Material License SUA-1475 for the United Nuclear Corporation Mill Site* dated September 24, 2018. USNRC provided the request to UNC/GE via a letter dated May 7, 2019. The responses and associated revised sections of the application have been submitted electronically via the USNRC Electronic Submissions System and the requested modeling files have been submitted on CD via US Mail.

Please contact me with questions on accessing the documents and contact Roy Blickwedel (UNC/GE) with questions on the submittal.

Regards,

Stantec Consulting Services Inc.

Melanie M. Davis

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Project Manager
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Attachment: Responses to USNRC Comments on the Application for Amendment of USNRC Source Material License SUA-1475 for the United Nuclear Corporation Mill Site

CC: Roy Blickwedel, GE
Jason Cumbers, Stantec
Toby Leeson, Stantec
Steve Dwyer, Dwyer Engineering

ATTACHMENT

Responses to USNRC Comments on the Application for Amendment of USNRC Source Material License SUA-1475 for the United Nuclear Corporation Mill Site

Request for Additional Information – Group 1
Safety Evaluation Report (SER) Chapter 2

RAI 2.2-1 Revise the slope stability analysis output files in Attachment G.2 to clearly demonstrate the material properties used in the analysis or provide alternate output files.

NUREG-1620, Section 2.2, acceptance criteria (2b) states the shape of the slope and material properties should be considered in the slope stability analysis performed by the licensee. The licensee adequately presented the information in the narrative discussing the slope stability analysis in Attachment G.2. However, the output files from the slope stability analysis do not include sufficient detail for the NRC staff to be able to confirm that the material properties identified in the narrative were actually used in the analysis.

The information is required for the NRC staff to determine that 10 CFR Part 40 Appendix A, Criterion 5(A)5 is met, which relates to the structural integrity of dikes used to form a surface impoundment. Criterion 6(1) identifies the timeframe that radiological hazards shall be controlled at uranium mill tailings sites.

RESPONSE: *The slope stability analysis output files have been revised to show the material properties used in each case. The model inputs are provided in a table with each output file. The information provided in the table is a direct output from the SLOPE/W file and updates automatically if a material or property is changed. Revised slope stability output files are provided in Attachment 1.*

RAI 2.2-2 Revise the slope stability analysis in Attachment G.2 to include the cross section of the repository during construction (i.e., an interim condition). Alternatively, explain how the analysis currently presented in the license amendment request (LAR) bounds a construction scenario.

NUREG 1620, Section 2.2, acceptance criteria (2c) states appropriate slope stability failure modes during and after construction should be evaluated by the licensee. The NRC staff is not able to locate a slope stability evaluation that covers interim conditions during construction in the LAR.

The information is required for NRC staff to determine 10 CFR Part 40 Appendix A, Criterion 5(A)5 is met, which relates to the structural integrity of dikes used to form a surface impoundment.

RESPONSE: *The slope stability analysis, as currently presented, is based on the maximum Repository waste volume and height, which represents the worst-case scenario. In the drawings, Sheets 7-02 through 7-04 show the mine waste placement sequence for each phase. As shown on Sheet 7-04, the Repository during construction, is at a 1-percent slope with a 5-percent slope on the north side of the Repository. The Repository at maximum height has a 5 percent slope that is*

a significantly longer slope than in the interim condition. The minimum recommended static factor of safety for the interim construction condition is 1.2. The worst-case scenario with completed Repository construction for cross-section C (global stability of the Repository) exceeds this minimum requirement.

Cross-sections A and B also represent the worst-case scenario by using the maximum volume and height of the Repository. This scenario includes the longest slope lengths and steepest slopes. The slopes during the interim condition would be less steep, and shorter in length, than the slopes shown on cross-sections A and B and, therefore, the factors of safety would likely remain the same, or increase during the interim condition. The factor of safety for both cross-sections A and B in the static condition, exceed the minimum required interim factor of safety of 1.2.

RAI 2.2-3 Revise the slope stability analysis in Attachment G.2 to include a slope stability analysis that considers a probable maximum flood (PMF) event. Alternatively, explain how the currently presented analysis account for the PMF event. If the currently presented analyses do include a PMF event, describe or explain how parameters in the PMF influenced analysis are different from those in the other stability analyses.

NUREG 1620, Section 2.2, acceptance criteria (2d) states adverse conditions, such as a probable maximum flood event, should be considered in a slope stability evaluation. Attachment G.2 states that cross sections B and C were analyzed for PMF conditions, however, it is not apparent to the NRC staff how the PMF is incorporated into the analysis. The material properties and slope geometry appears unchanged and the output files do not contain sufficient detail for the NRC staff to confirm that a PMF scenario has been evaluated.

This information is required for the NRC staff to determine 10 CFR Part 40 Appendix A, Criterion 5(A)5 is met, which relates to the structural integrity of dikes used to form a surface impoundment.

RESPONSE: *The slope stability analysis includes scenarios for the PMF event in cross-sections B and C as detailed in Attachment G.2 of the LAR. The PMF slope stability output results are included in Figures D.11 and D.15 in the revised stability analysis, Attachment 1.*

To model the PMF condition, the elevation of the flood at each cross-section was obtained from the figures and analysis in Appendix I of the LAR. A piezometric surface was added to the SLOPE/W files at the PMF elevation for cross-sections B and C and was applied to all materials except the bedrock. The SLOPE/W model automatically applies the weight of the ponded water in the analyses, and also applies the pore water pressure to each material that the piezometric surface is applied to. The output file results show the ponded water and critical slip surface for the PMF condition on both cross-sections B and C.

RAI 2.2-4 Please revise the slope stability analysis in Attachment G.2 to include a slope stability analysis that considers a scenario with surface runoff effects. Alternatively, please explain how the currently presented analysis accounts for surface runoff effects, or justify how surface runoff effects are not relevant to the design.

NUREG 1620, Section 2.2, acceptance criteria (2e) states surface runoff effects, such as toe erosion or incision at the base of a slope, should be considered in a slope stability evaluation. The NRC staff is not able to verify and confirm that these effects are considered in the slope stability evaluation. The NRC staff recognizes the potential for erosion or movement of the pipeline arroyo, which could impact Cross Section B and the presence of the 5H:1V side slope in Cross Section A.

This information is required for the NRC staff to determine 10 CFR Part 40 Appendix A, Criterion 5(A)5 is met, which relates to the structural integrity of dikes used to form a surface impoundment. This information is also needed to determine Criterion 6(1) is met.

RESPONSE: *The PMF and 100-year floods are anticipated to overtop the Pipeline Arroyo and the floodplain extents include the Pipeline Canyon Road that parallels the arroyo north of the TDA (as stated in Appendix I of the LAR). The PMF floodplain extents are also anticipated to encroach the north edge of the TDA, the base of the Repository, and the North Cell Drainage Channel. Under existing conditions, the North Cell Drainage Channel could experience velocities up to 5 ft/s. To reduce velocities in this channel in large flood events and thus decrease potential for scour at the base of the Repository, the access road that runs along the north side of the North Cell Drainage Channel will be raised as a protective berm to hydraulically isolate the North Cell Drainage from the alluvial area to the north (see Sheets 9-02 and 9-07).*

The runoff control ditch on the northwest side of the Repository, at the base of the 5:1 Repository slope, and the East Repository Channel on the east side of the Repository will also be improved and supplemental controls added to provide capacity and scour protection against the PMF. Hydraulic calculations indicate that the existing Runoff Control Ditch has sufficient capacity to convey the PMF flow, but the D_{50} riprap size is proposed to increase in order to maintain erosional stability during the PMF. See Sheets 9-02 and 9-04 and Appendix I for details of typical channel sections and riprap to protect from scour during the PMF event.

Based on the existing and proposed protection in each channel surrounding the Repository, Stantec does not anticipate surface runoff effects will impact the stability of the Repository slopes.

RAI 2.2-5 Provide electronic copies of calculations described in LAR, Appendix I, “Mill Site Stormwater Controls,” Attachment I.1, “Estimation of Flood Flows for Design of

Interim and Final Surface Water Controls for the Removal Action at the NECR Mine Site and Church Rock Mill Site," and Attachment I.6, "Upper Pipeline Arroyo Hydraulic Model." Specifically, electronic versions of the input files and calculations supporting the (1) Pipeline Arroyo Watershed Model for Post-RA conditions and (2) Mill Site Sub-Catchments Model for Post-RA conditions would facilitate the NRC staff's review.

In LAR, Appendix I, "Mill Site Stormwater Controls," in both Attachment I.1, "Estimation of Flood Flows for Design of Interim and Final Surface Water Controls for the Removal Action at the NECR Mine Site and Church Rock Mill Site," and Attachment I.6, "Upper Pipeline Arroyo Hydraulic Model," the licensee stated under Section "Location and Format," "Electronic copies of these calculations are located on the project team site." The licensee described calculations using the following software:

1. HEC-RAS version 5.0.3
   a. including Cooper Aerial Surveys Company GeoTIFF files
2. Arizona Department of Water Resources (ADWR) PMP Evaluation Tool
3. ESRI ArcMap 10.2.2
4. Microsoft Excel 2013
5. HEC-HMS version 4.3.1, build 28

This information is required for NRC staff to evaluate the applicant's hydraulic modeling, and to determine if the criteria in 10 CFR Part 40 Appendix A, are met, including: Criterion 1, which relates to consideration of site features that minimize erosion, disturbance, and dispersion by natural forces over the long term; Criterion 3, which relates to isolation of above grade disposal cells from natural erosion forces; Criterion 4, which relates to site and design criteria which consider upstream rainfall catchment areas and erosion potential, and Criterion 6(1), which identifies the timeframe that radiological hazards shall be controlled at uranium mill tailings sites.

RESPONSE: *The requested electronic copies of calculations, models, and data used in Attachment I.1, "Estimation of Flood Flows for Design of Interim and Final Surface Water Controls for the Removal Action at the NECR Mine Site and Church Rock Mill Site," and Attachment I.6, "Upper Pipeline Arroyo Hydraulic Model" are provided in Attachment 2 (submitted on CD via US Mail).*

RAI 2.5.3-1 Explain how the proposed cover over the mine waste repository ties in to the existing tailings cover system. Alternatively, revise detail number 6 on engineering drawing 7-09 to show the transition between the two cover systems.

NUREG-1620, Section 2.5.3, acceptance criteria (3) directs the NRC staff to evaluate termination at boundaries of the cover system, and to understand how subsurface flows will be considered. Detail 6 on engineering drawing 7-09 appears to show an idealized termination of the proposed cover system where it meets the existing radon barrier. However, the NRC staff observes that multiple cover profiles are planned for the mine waste repository and that the cover system components have different thicknesses. Additionally, detail 6 may not

fully represent the existing cover system over the tailings impoundment. The NRC staff needs additional information about this transition that demonstrates that surface runoff will not be concentrated and that any subsurface flow from the mine waste will not damage the cover.

This information is required for the NRC staff to determine 10 CFR Part 40 Appendix A, Criteria 4(c) and 6(1) are met.

RESPONSE: *The detail on drawing sheet 7-09 has been revised to show the transition between the two cover systems. Additional details have been added to show how the different cover slopes (A through D) transition to the existing cover or ground surface. The updated details are shown on Sheet 7-10, included in Attachment 3 to this response.*

SER Chapter 6

RAI 6.1-1 Revise the LAR to explain and justify how values of porosity shown in Attachment G.7, "Cover System Design Report," Table 18, "Radon Flux Input Parameters" are measured or calculated.

Criterion 6(1) of 10 CFR 40, Appendix A, describes requirements for earthen covers to limit releases of radon-222. In Attachment G.7, "Cover System Design Report," Section 9.1, "Input Data for Radon Flux Modeling," the licensee explained that the porosities shown in Table 18, "Radon Flux Input Parameters," were taken from numerical average value of porosities shown in Table 11, "Borrow Cover Soil Laboratory Measured Soil Properties," Table 12, "Adjusted Borrow Soil Laboratory Measured Soil Properties for 33% Rock by Volume," and Table 15, "Mine Spoils Measured Soil Hydraulic Properties." However, porosity was not included among the parameters listed in Tables 11, 12, and 15. The NRC staff was unable to estimate the values of porosity in Table 18 using either the saturated volumetric moisture contents in Tables 11, 12, and 15 or the values in Appendix Z, Pre-Design Studies Northeast Church Rock Mine Site Removal Action/Church Rock Mill Site," Table 3-5, "Summary of Geotechnical Laboratory Data – Borrow Areas."

This information is required for NRC staff to determine if the requirement in 10 CFR 40.31(h) is met.

RESPONSE: Response from Dwyer Engineering: *The porosity values utilized as input parameters for analysis of the radon flux through the determined cover profile are listed in Table 18. Specifically, the porosity values are 0.3774 for the mine spoils, 0.5216 for the bottom layer of the cover, and 0.34945 for the top layer (admixture) of the cover.*

The mine spoils porosity value used in the radon attenuation analysis was estimated based on laboratory testing of a mine spoils sample (TT-205-GT1) collected from the Interim Removal Area at the Mine Site as part of an investigation conducted in 2011. Figure 2 in Appendix A3 to MWH (2014) shows the test pit (TT-205) location. The porosity value was estimated to be equal to the saturated moisture content as calculated via the RETC code (van Genuchten et al., 1991) based on laboratory measurements of the material by an approved soils laboratory used to produce a moisture characteristic curve for the material. Sample TT-205-GT1 was remolded to 90 percent of the standard Proctor maximum dry density for the moisture characteristic curve testing, which is specified placement density for the mine spoils in the Repository. Table 4 in Appendix A3 to MWH (2014) shows the measured hydraulic properties, including the saturated volumetric water content for sample TT-205-GT1. These results are also shown in Table 15 of Attachment G.7 to Appendix G of the LAR. The laboratory testing report (DB Stephens, 2011) is provided as Attachment 4 to these responses.

The porosity value used in the radon attenuation analysis for the bottom layer of the cover was estimated as the numerical average value of the measured

saturated volumetric water contents for the borrow soil samples listed in Table 11. The porosity of each soil texture was estimated to be equal the saturated moisture content. The materials summarized in Table 11 are representative of each of the characterized borrow sources for cover soil. The saturated moisture content was calculated via the RETC (van Genuchten et al., 1991) based on laboratory measurements of the material by an approved soils laboratory used to produce a moisture characteristic curve for the material. The laboratory results are presented in Appendix B.1.2 to MWH (2014). Please note that Table 3-5 in MWH (2014) does not present the saturated volumetric water contents for samples tested for moisture characteristic curves. Saturated water contents by mass are presented in Table 3-5. The porosity values for each respective borrow source are 0.4951, 0.5093, 0.6281, 0.5191, and 0.4563. The average of these values is 0.5216; the value used as the porosity for bottom layer of the cover in the radon attenuation analysis.

The top layer in the radon attenuation analysis is the rock/soil admixture portion of the cover profile. This layer has 33% volume of rock added to the cover soil. The saturated moisture content values (porosity) for the cover borrow sources are summarized in Table 12. These values were adjusted for the addition of rock utilizing Equation 14. Thus, each respective saturated volumetric water content from Table 11 was multiplied by 0.67 to obtain the saturated moisture content (porosity) value shown in Table 12. The porosity values for each respective borrow source are 0.3317, 0.3412, 0.4208, 0.3478, and 0.3057. The average of these values is 0.34945; the value used as the porosity for top layer (admixture) of the cover in the radon attenuation analysis.

RAI 6.1-2 Revise the LAR to explain how freeze-thaw events were considered in the long-term dry bulk mass density, and any other parameters, used in the radon flux attenuation analysis.

In Attachment G.7, “Cover System Design Report,” Section 9.1, “Input Data for Radon Flux Modeling,” the licensee did not explain how freeze-thaw events were considered in design of the evapotranspirative (ET) cover. NUREG-1620, acceptance criterion 5.1.3(5), states if a portion of the modeled cover could be affected by freeze-thaw events, that portion is represented in the model with lower density and corresponding higher porosity values than the unaffected portion.

This information is required for NRC staff to determine if the requirement in 10 CFR Part 40, Appendix A, Criterion 6(1).

RESPONSE: Response from Dwyer Engineering: *The applicable soil input parameters to the RAECOM model for the determination of radon flux through the cover profile are not known to have any significant change when subjected to freeze/thaw cycles. The long-term moisture content based on the wilting point method that was used is generally conservative when compared to the calculation of long-term moisture content using the soils fines content. The soil remolded density for laboratory*

testing of the various soil samples was set at the perceived long-term density. Consistently, the cover profile is specified to be constructed at this long-term density. Furthermore, the soil dry bulk density and thus porosity in alluvium soils such as the borrow soils proposed are largely unaffected by freeze/thaw action (USDA 2008, Chengsong et al 2003).

RAI 6.3-1 Clarify whether LAR, Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," replaces or supplements the licensee's existing plan provided in Section 7.5, "Radiation Protection Program," of the 1991 Tailings Reclamation Plan (UNC 1991).

The licensee's existing radiation protection program at the UNC Church Rock Mill Site was approved by NRC in license conditions 34 and 35. The licensee explained in Section 4.10, "Radiation Safety," of the LAR that several appendices to the LAR address radiation safety for the project, including that Appendix L contains the Health and Safety Plan for Stantec staff. However, the LAR should describe whether the LAR, Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," replaces or supplements the previously-approved plan described in license conditions 34 and 35.

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1101(d) is met.

RESPONSE: *The LAR, Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan is intended to supplement the existing radiation protection program at the UNC Church Rock Mill Site which was approved by the NRC in license conditions 34 and 35. This supplemental "Radiation Protection Plan" will be implemented at the time of the construction described in the LAR, following NRC approval.*

RAI 6.3-2 Revise the LAR to clarify the method the licensee proposes to use to annually demonstrate compliance with public dose limits in 10 CFR 20.1301 and the 10 CFR 20.1101(d) ALARA constraint on air emissions of 10 mrem (0.1 mSv) per year to the member of the public likely to receive highest dose.

The regulations in 10 CFR 20.1302 describe two acceptable methods to demonstrate compliance with public dose limits. The method in 10 CFR 20.1302(b)(1) involves measuring or calculating a dose to the individual likely to receive the highest dose. The method in 10 CFR 20.1302(b)(2) involves a demonstration of acceptable concentrations of radionuclides in effluents at the boundary of the unrestricted area, and dose from external sources in unrestricted areas. The licensee should clarify which method it proposes to use.

The licensee's proposed placement of air samplers at or near the licensed area boundary, as described in LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 5.8, "Compliance with Dose Limits for Individual Members of the Public," appears to be consistent with 10 CFR 20.1302(b)(2)(i), except that the sample results compared to the values in 10 CFR 20, Appendix B, Table 2, should be collected at the "boundary of the unrestricted area." As defined in 10 CFR 20.1003, the unrestricted area means

an area, access to which is neither limited nor controlled by the licensee. If the licensee intends to use the method in 10 CFR 20.1302(b)(2), the licensee should clarify the proposed locations of boundaries of unrestricted areas. LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 3.1, "Designated Controlled Areas," includes a description of "exclusion areas" (a term not defined in either the LAR or in 10 CFR Part 20) and controlled areas. However, the licensee's description of "controlled areas" as areas "...established to limit radiation exposure to visitors and the general public," is similar to NRC's definition of "restricted area" in 10 CFR 20.1003.

If the licensee is able to establish a controlled area coincident with the licensed area boundary, then the licensee's air sample results at the controlled area boundary (i.e., boundary of the unrestricted area) could be compared to the values in 10 CFR 20, Appendix B, Table 2, to determine compliance with public dose limits. Likewise, the direct radiation exposure values described in Section 6.2, "Monitoring for External Exposure to General Public," could be used in comparison to the values in 10 CFR 20.1302(b)(2)(ii).

In LAR Appendix Q, "Dust Control and Air Monitoring Plan," Section Q.4, "Air Monitoring Plan," the licensee explained that two downwind air monitoring stations would be placed near each residence downwind of the Mine Site. The licensee showed the locations of all air samplers in Figure Q.4-1, "Air Monitoring Station Locations," including air samplers near each residence and two downwind sample locations (Mill Downwind and Borrow Downwind), which appear to be near the Mill Site licensed area boundary. The NRC staff noted that nearby residences are not in the predominant downwind direction from the licensed site. If the licensee anticipates using these air stations to demonstrate compliance in accordance with 10 CFR 20.1302(b)(1), then the licensee should provide additional justification that demonstrates that one of these residences is the location of the individual likely to receive the highest dose.

Regardless of which method the licensee chooses to meet the requirements in 10 CFR 20.1301, the licensee should also revise the LAR to explain how it will meet the 10 CFR 20.1101(d) ALARA constraint on air emissions of 10 mrem (0.1 mSv) per year to the member of the public likely to receive highest dose. Methods acceptable to meet this requirement are contained in Regulatory Guide 4.20, "Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees other than Power Reactors" (NRC 2012).

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1301 is met.

RESPONSE: *As indicated in Section 5.8 of the LAR, a method consistent with 10 CFR 20.1302(b)(2)(i) will be used to demonstrate compliance with the public dose limit. The net annual average airborne concentration at the controlled area predominant downwind boundary, where the unrestricted area starts, will be compared to the DAC (effluent concentration limiting a TEDE of 50 mrem/year) specified in Appendix B to Part 20 Table 2, for screening and demonstrating compliance with the public dose limit. A figure is included in the revised Attachment L-1 "Radiation Protection Plan" to show proposed locations of the*

controlled area boundary and unrestricted area boundary. The revised Attachment L-1, "Radiation Protection Plan" is included in Attachment 5.

The LAR Attachment L-1, "Radiation Protection Plan" was developed to address radiation protection for Removal Action (RA) activities at the NECR Mine Site as well as associated activities in the tailings area of the NECR Mill licensed site. The Mine Site RA area, which includes haul roads and a construction support area, will be designated as a Controlled area. The exclusion areas/zones within the Mine Site Controlled Area may be designated consistent with EPA/OSHA guidelines for health & safety and radiation protection during the RA activities at the Mine Site, outside the Mill licensed area. The fenced NRC Mill licensed area is designated as a Controlled Area. The Repository work area and the evaporation pond area within the Controlled Area will be designated as a restricted area during the implementation of construction described in the LAR. The LAR Attachment L-1, "Radiation Protection Plan" is revised to include a figure showing the restricted and controlled areas within the Mill licensed area.

The Mine Downwind 1 and Mine Downwind 2 air monitoring stations shown in Figure Q.4-1 are not in the predominant downwind direction from the NRC licensed site. The nearest residence in the predominant downwind direction from the NRC licensed site is approximately 1.8 miles from the control area boundary of the licensed site as shown in the revised Figure Q.4-1(included in Attachment 6). This residence is also in the same general downwind direction as, and beyond, the Mill Downwind air monitoring station and is likely to receive the highest dose from the NRC Mill licensed site. As discussed below, UNC intends to use monitoring data collected at the Mill Downwind air sampling monitoring station to demonstrate compliance in accordance with 10 CFR 20.1302(b)(2).

The 10 CFR 20.1101(d) ALARA constraint on air emissions of 10 mrem per year to members of the public likely to receive the highest dose will be demonstrated by comparing the annual average airborne concentrations at the Mill Downwind air monitoring station, located at the unrestricted area boundary (controlled area predominant downwind boundary) to 20% of the effluent concentration limiting a TEDE of 50 mrem/year specified in Appendix B to Part 20 Table 2. This will assure the highest dose received by members of the public in the unrestricted area from the radionuclide is less than 10 mrem/year. If monitoring at the control area downwind boundary during the first few months indicates that the average concentrations may exceed 20% of DACs, air particulate monitoring will be implemented at the Mill Downwind Nearest Residence air monitoring station, as shown in Figure Q.4-1. If needed, additional dust control measures may be implemented to address air particulate emissions. The licensee may use dose calculations for demonstrating compliance with the 10 mrem per year dose constraint.

RAI 6.3-3 Revise LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 5.2, "Internal Radiation Dose from Inhalation," to address the following: (1) apparently incorrect description of the stochastic allowable limit on intake (SALI) for thorium-230; (2) use of non-stochastic ALIs (NALI) for radium-226 and thorium-230 which are either not correct or not the most restrictive; (3) insufficient justification for not including thorium-230 in the determination of committed dose equivalent (CDE) to the lung.

The NRC staff identified several concerns in LAR Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Section 5.2, “Internal Radiation Dose from Inhalation”:

1. The dose factor (in units of mrem/µCi) for stochastic effects shown in Section 5.2 for thorium-230 is the dose factor for Class W material, not Class Y material. The value shown may be acceptable, but the licensee should correct what appears to be a typographic error identifying the factor as that for “Th--230(Y),” rather than Th-230(W).

2. The NALIs for radium-226 and thorium-230 shown in Section 5.2 appear to be incorrect or are not the most restrictive. The most restrictive NALI dose conversion factor for radium-226 is 5.96E+04 mrem/µCi; and the most restrictive NALI dose conversion factor for thorium-230, which is for Class W material, not Class Y, is 7.99E+06 mrem/µCi.

3. The licensee stated that committed dose equivalent (CDE) to the lungs from radium-226 and U-nat will be summed to demonstrate compliance with the organ dose limit. However, the licensee should revise Section 5.2 to either include thorium-230 in the lung dose calculation or justify why thorium-230 is not included.

This information is needed to determine compliance with 10 CFR 20.1201.

RESPONSE: *1. Typographic error is corrected to read Th-230(W) in Section 5.2.*

2. NALI dose conversion factors in Section 5.2 are revised to 5.96E+04 mrem/µCi for Ra-226(W) and 7.99E+06 mrem/µCi for Th-230(W).

3. Work at the Repository over the covered tailings area consists of handling uranium ore-impacted materials. Thorium compounds in uranium ore dust are likely to be insoluble oxides. About 97% of insoluble Th-230 is excreted following inhalation exposure by exhalation and through excretion into the intestines by ciliary clearance. Therefore, Th-230 is not included in the dose calculations.

The revised Attachment L-1, “Radiation Protection Plan” is included in Attachment 5.

RAI 6.3-4 Revise the description of the applicable 10 CFR 20, Appendix B, Table 2, effluent concentration for radon-222.

In LAR Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Section 5.8, “Compliance with Dose Limits for Individual Members of the Public,” and LAR Appendix Q, “Dust Control and Air Monitoring Plan,” the licensee provides a list of effluent concentrations for radionuclides used to calculate public dose. The license cites a value for radon-222 of 1.0E-08 µCi/mL for radon with daughters removed. The licensee explained it chose this value because track etch detectors are manufactured “with a filter that removes the daughters.” However, the choice of effluent concentration to demonstrate compliance with 10 CFR 20.1301 is based on which radionuclides

are actually present, not which radionuclides are measured by the licensee's choice of detector.

The NRC staff published draft guidance on the correct treatment of radon and radon progeny in FSME-ISG-01, "Evaluations of Uranium Recovery Facility Surveys of Radon and Radon Progeny in Air and Demonstrations of Compliance with 10 CFR 20.1301" (NRC 2014).

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1301 is met.

RESPONSE: *Rn-222 annual average effluent concentration in Section 5.8 is revised to 1.0E-10 uCi/ml (with daughters present). Methods for surveying radon and progeny in air and options shown in FSME-ISG-01 for demonstrating compliance with the public dose limit will be used. The revised Attachment L-1, "Radiation Protection Plan" is included in Attachment 5.*

RAI 6.3-5 Revise the LAR to include lead-210 analysis and reporting for environmental air samples, or justify why no lead-210 analysis is necessary.

The guidance in Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills," (NRC 1980) states that air particulate samples should be analyzed for natural uranium, thorium-230, radium-226 and lead-210. Lead-210 is a long-lived decay product in the uranium series which decays to polonium-210, an alpha-emitting radionuclide. The licensee should include this radionuclide in LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 5.8, "Compliance with Dose Limits for Individual Members of the Public," and LAR Appendix Q, "Dust Control and Air Monitoring Plan," or justify why lead-210 analysis and reporting isn't necessary.

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1301 is met.

RESPONSE: *Pb-210 is included in Section 5.8 and Po-210 concentrations in air particulate samples will be determined from gross alpha activity.*

RAI 6.3-6 Revise LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 6, "External Radiation Dose Assessment," to explain how the licensee will meet 10 CFR 20.1501(d) regarding use of an accredited dosimetry processor.

In Section 6 of Attachment L-1, there is no discussion regarding accreditation of dosimeter processors.

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1501(d) is met

RESPONSE: *Section 6 is revised to indicate that the dosimeter processor will be NVLAP accredited. We intend to use LANDAUER, which is a NVLAP accredited*

dosimeter processor. The revised Attachment L-1, "Radiation Protection Plan" is included in Attachment 5.

RAI 6.3-7 Revise the equations for minimum detectable concentration used in LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Attachment 2, Standard Operating Procedure (SOP)-2, "Occupational Airborne Radioactive Particulate Monitoring," "Air Particulate Field Data Sheets" and LAR Appendix Q, "Dust Control and Air Monitoring Plan," Attachment Q.2, "Air Particulate Sampling Field Data Form."

The licensee used a formula for lower limit of detection (LLD) in Attachment Q.2 and a formula for minimum detectable concentration (MDC) in SOP-2. The LLD and MDC are not equivalent expressions, and it appears that both documents mean to state the MDC. An acceptable approach to evaluating the MDC of radionuclides in air samples is provided in Regulatory Guide 8.25, "Air Sampling in the Workplace," Regulatory Position C.6.3 (NRC 1992).

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1501 is met.

RESPONSE: *The MDC calculation equation in LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Attachment 2, Standard Operating Procedure (SOP)-2, "Occupational Airborne Radioactive Particulate Monitoring," "Air Particulate Field Data Sheets" and LAR Appendix Q, "Dust Control and Air Monitoring Plan" is revised to be consistent with NUREG-1400, the source of Regulatory Guide 8.25. The revised Attachment L-1, "Radiation Protection Plan" is included in Attachment 5. The revised Appendix Q is included in Attachment 6.*

RAI 6.3-8 Correct the gross alpha action limit contained in LAR Appendix Q, "Dust Control and Air Monitoring Plan," Section Q.4.1.2, "Radiation Criteria," to ensure that the limit in 10 CFR 20.1302(b)(2) would be met. This should take into account: the unity rule, which is that the sum of the fractions of individual radionuclide concentrations over their respective effluent concentrations should be less than one; and all potential alpha-emitting radionuclides in the uranium decay series.

In LAR Appendix Q, "Dust Control and Air Monitoring Plan," Section Q.4.1.2, "Radiation Criteria," the licensee assumed that alpha-emitting radionuclides in ore dust would be uranium-234, uranium-238, thorium-230, and radium-226. The licensee derived a gross alpha concentration limit of 1.2×10^{-13} µCi/mL using a method that assures only the most restrictive of the individual effluent concentrations for uranium-234, uranium-238, thorium-230, and radium-226 would not be exceeded. As noted in note 3 of 10 CFR 20, Appendix B, the licensee may use the derived air concentration (DAC) for ore dust to account for activity from uranium-238, uranium-234, thorium-230, and radium-226. However, as explained by the Commission (40 FR 50705), separate measurements of the concentration of airborne radionuclides beyond radon-222 are required, including separate measurements of lead-210 and its daughters. An alpha-emitting daughter of lead-210 is polonium-210.

Therefore, a correct method employs: the unity rule, which ensures that a mixture of all radionuclides would not result in a dose exceeding 50 mrem/year; and includes consideration of lead-210 and its alpha-emitting daughter (i.e., polonium-210).

If the licensee assumes the radionuclides that comprise gross alpha concentrations in air are equal parts uranium-234, uranium-238, thorium-230, radium-226, and polonium-210, then the requirement of 10 CFR 20.1302(b)(2) is met if:

$$\frac{[U-234]}{E.C._{U-234}} + \frac{[U-238]}{E.C._{U-238}} + \frac{[Th-230]}{E.C._{Th-230}} + \frac{[Ra-226]}{E.C._{Ra-226}} + \frac{[Po-210]}{E.C._{Po-210}} \leq 1,$$

where the concentrations of each radionuclide is assumed to be equal to 20% of the gross alpha concentration, and the effluent concentrations (E.C.s) for radionuclides (e.g., $E.C._{U-234}$) are those for Class Y material from 10 CFR 20, Appendix B, Table 2. The equation above can be re-written:

$$0.20\ x\ [gross\ \alpha]\ x\ \left[\frac{1}{E.C._{U-234}} + \frac{1}{E.C._{U-238}} + \frac{1}{E.C._{Th-230}} + \frac{1}{E.C._{Ra-226}} + \frac{1}{E.C._{Po-210}}\right] \leq 1$$

Solving the inequality for gross alpha concentration yields a value of about 6.9×10^{-14} µCi/mL, not 1.2×10^{-13} µCi/mL, based on information presented by the licensee. Similarly, one could conservatively assume no Po-210 in the equation above such that the remaining radionuclides are present at 25% of the total alpha activity. This would calculate out to 5.5×10^{-14}, not 1.2×10^{-13} as presented by the licensee.

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1501 is met.

RESPONSE: *Section Q.4.1.2 of the LAR Appendix Q is revised to add Po-210, an alpha emitting daughter of Pb-210, to include all potential alpha-emitting radionuclides in the uranium decay series. The airborne dust will be from the uranium ore impacted material. The airborne concentration of U-234, U-238, Th-230, Ra-226, and Po-210 in air particulate samples will be determined from their activity fraction of the gross alpha activity in the air particulate samples. Since these radionuclides (U-234, U-238, Th-230, Ra-226 and Po-210) are in secular equilibrium in uranium ore dust, their airborne concentrations will be determined by multiplying the air particulate sample gross alpha activity by 0.20.*

Section Q.4.1.2 of the LAR Appendix Q is revised to indicate the limiting gross alpha activity of 6.9E-14 µCi/mL of the air particulate sample to consider the unity rule, which is that the sum of the fractions of individual radionuclide concentrations over their respective effluent concentrations to be less than one.

The revised Appendix Q is included in Attachment 6.

RAI 6.3-9 Revise the equation for calculating gross alpha concentrations in air for workplace air monitoring shown in LAR Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Attachment 2, Standard Operating

Procedure (SOP)-2, “Occupational Airborne Radioactive Particulate Monitoring, ” “Air Particulate Field Data Sheets” to include a self-absorption correction, or explain why none is necessary.

In Appendix Q, Attachment Q.2, the licensee included a self-absorption factor in the calculation of gross alpha concentrations in environmental air samples. This factor does not appear in the similar calculation for gross alpha concentrations in air shown in SOP-2. The licensee should correct this inconsistency or explain why no correction is necessary for workplace air samples taken in accordance with SOP-2.

This information is required for NRC staff to determine if the requirement in 10 CFR 20.1201 is met.

RESPONSE: *A self-absorption correction factor similar to the one included in Appendix Q, Attachment Q.2 is included in Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Attachment 2, Standard Operating Procedure (SOP)-2, “Occupational Airborne Radioactive Particulate Monitoring,” “Air Particulate Field Data Sheet”.*

RAI 6.3-10 Revise the Radiation Protection Plan to resolve inconsistencies in the description of occupational radiation protection controls for airborne radionuclides.

In LAR Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Section 3.3, “Airborne Radioactivity Areas,” the licensee stated that airborne radioactivity areas include areas where ore dust exceeds 5×10^{-11} µCi/mL. However, the ore dust DAC is 6×10^{-11} µCi/mL, as stated by the licensee in Section 5.1, “Internal Radiation Exposure from Inhalation,” and 10 CFR 20, Appendix B, paragraph 3 of the Note. The licensee should clarify whether airborne radioactivity areas will be areas with ore dust greater than 5×10^{-11} µCi/mL or 6×10^{-11} µCi/mL.

LAR Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Section 5.2, “Internal Radiation Dose from Inhalation,” the licensee stated it would calculate dose to individuals if the exposure exceeds 12 DAC-hours in any week. However, 10 CFR 20.1502(b) requires the licensee to monitor occupational intake of radioactive material and assess the committed effective dose equivalent to adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable allowable limits on intake (ALI(s)) in 10 CFR 20, Appendix B, Table 1, Columns 1 and 2. A value of 10 percent of the applicable ALIs corresponds to about 200 DAC-hours of exposure over a year, or an average exposure of about 4 DAC-hours per week. The licensee should clarify the airborne exposure above which it would perform individual monitoring to comply with 10 CFR 20.1502(b).

In LAR Appendix L, “Health and Safety Plan,” Attachment L-1, “Radiation Protection Plan,” Section 5.4, “Surveys and Monitoring for Internal Radiation Exposure,” last paragraph, the licensee describes an airborne gross alpha activity action level of 1.48×10^{-11} µCi/mL for radiation protection for activities associated with mine site material. This value is approximately 25% of the ore dust DAC of 6×10^{-11} µCi/mL. The licensee also stated in LAR Appendix L,

"Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 5.7, "Administrative Control Limits" that it proposes an administrative control limit of 25 percent of the DAC. The licensee's proposed action level concentration of 1.48 x 10^{-11} µCi/mL is above the concentration above which individual monitoring is required under 10 CFR 20.1502(b) (which is 10% of an ALI, which corresponds to an average exposure of about 200 DAC-hours in a year), and less than the concentration above which the licensee would require respiratory protection (see LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 5.6, "Respiratory Protection"). The licensee should clarify the "action level" and "administrative control limit" concentration and what actions it proposes to take if these levels are exceeded.

RESPONSE: *The Airborne Radioactivity Area uranium ore dust gross alpha concentration in Section 3.3 Appendix L, "Health and Safety Plan," Attachment L-1 is revised to 6 x 10^{-11} µCi/ml consistent with the ore dust DAC stated in Section 5.1, and 10 CFR 20, Appendix B, paragraph 3 of the Note.*

Section 5.2 of Appendix L, "Health and Safety Plan," Attachment L-1 is revised to indicate that intake will be monitored and dose will be assessed if an individual is likely to receive intake in excess of 10% of the Annual Limit of Intake (ALI) of 1.44E-01 uCi for uranium ore dust (equivalent to ALI from 6.0E-11 uCi/ml DAC) or an exposure of 200 DAC hours in a year. The revised Attachment L-1, "Radiation Protection Plan" is included in Attachment 5.

The 10% of the ALI or 200 DAC hours/year action level discussed above and specified in Section 5.2 triggers personal monitoring and dose assessment for compliance with 10 CFR 20.1502(b). The 25% administrative control limit stated in Section 5.7 is intended to prevent any inadvertent overexposure. The control measures for administrative control limit includes access control and engineering controls, such as dust control.

RAI 6.3-11 Revise the LAR to be consistent with existing license condition 11.

In LAR Appendix L, "Health and Safety Plan," Attachment L-1, "Radiation Protection Plan," Section 7.0, "Release of Equipment and Material," the licensee described its proposed procedure for surveying potentially contaminated items for release for unrestricted use. The licensee's proposed procedures are based on limits in Regulatory Guide 8.30, Table 2. However, the limits in Regulatory Guide 8.30, Table 2 are for surveys conducted before potentially contaminated equipment is released to <u>unrestricted areas</u>, not for release for unrestricted use and therefore use of this standard appears to be inappropriate. License condition 11 provides that for the release of equipment or packages for unrestricted use based on the 1987 Guidelines (NRC 1987). The 1987 Guidelines contain separate limits for: natural uranium and its associated decay products; and beta-gamma emitters, which apply separately.

This information is required for NRC staff to determine that the requirement in 10 CFR 20.1501(d) and license condition 11 is met.

RESPONSE: *Regulatory Guide 8.30, Table 2 specifies surface Contamination Level limits for uranium and daughters on equipment to be released for unrestricted use, not just*

for potentially contaminated equipment released to unrestricted areas. In addition, access or use cannot be restricted, or intended to be controlled, if any equipment is released to an unrestricted area. Similar to Table 2 of the Regulatory Guide 8.30, Table 1 of the 1987 Guidelines specified in the License Condition 11 specifies acceptable surface contamination levels for uranium and associated decay products prior to release for unrestricted use. Of course, there is also a requirement to reduce surface contamination to ALARA levels below the limits. Therefore, Section 7 of the Appendix L, "Health and Safety Plan," Attachment L-1 has not been revised for RAI 6.3-11.

SER Chapter 7

RAI 7.2-1 Clarify whether the mine waste contains listed hazardous wastes described in 40 CFR 261, "Identification and Listing of Hazardous Waste." The Administrative Settlement Agreement and Order on Consent for Design and Cost Recovery (AOC) (EPA 2015) includes the statement that the U.S. Environmental Protection Agency (EPA) does not anticipate encountering hazardous waste during the relocation of mine waste to the licensed site, but the LAR does not discuss the handling or disposition of hazardous waste, if encountered.

Additionally, please provide copies of written documentation containing awareness or approval of UNC's plans from other affected regulators. It would be helpful for UNC to clearly state which Federal or State agencies have regulatory authority over the mine waste, and which approvals have been received and when pending approvals are anticipated.

As currently presented, the LAR does not discuss the information described in criterion 3 in RIS 2000-23. Specifically, criterion 3 requests that the licensee identify whether the non-11e.(2) material contains any listed hazardous wastes. The LAR does not state whether or not the mine waste contains any listed hazardous wastes. Additionally, criterion 3 states that the licensee should provide approval of other affected regulators. The LAR identifies several Federal and State regulators that were involved in the development of UNC's LAR. However, the LAR does not contain documentation of either awareness or explicit approval from these Federal and State regulators. The NRC staff observes that page 5 of the Environmental Report (ER) states that "...the plan for complying with applicable regulatory requirements and permits" is contained in "Appendix N of the LAR." However, Appendix N was not included in the LAR.

This information is necessary to assess the licensee's waste handling procedures and the status of associated, necessary approvals, consistent with NRC guidance. Specifically, this request is related to criterion 3 in NUREG 1620, Appendix I.

RESPONSE: *Table 1.3-1 has been revised to state, for Criterion 3: that hazardous wastes as described in 40 CFR 261, "Identification and Listing of Hazardous Waste", have not been detected in the non-11e.(2) material that will be moved to the Repository.*

USEPA Region 9 is the lead agency for the CERCLA action at the mine site and USEPA Region 6 is the cooperating agency and lead agency for the CERCLA action at the Mill Site. The USEPA directly communicates with the other involved agencies (DOE, NNEPA, and NMED). The DOE is a cooperating agency responsible for long-term care and maintenance of the Mill Site after final closure and license transfer. NNEPA and NMED are support agencies to USEPA Regions 9 and 6, respectively. USEPA received comments from the other agencies and these comments were incorporated into one comment package that was provided to UNC. UNC received an approval letter with attached consolidated agency comments from USEPA dated May 25, 2018 on the 95 percent design deliverables. The approval letter from USEPA encompasses approval from the other involved agencies since USEPA is the lead agency. The

approval letter stipulated that USEPA's approval was contingent upon the final 95 percent design documents being submitted to USEPA with the consolidated agency comments addressed.

The 95 percent design documents were updated to address agency comments and the final version of the report was submitted to the USEPA on July 25, 2018 with a note that one appendix would be updated at a later date to incorporate the supplemental cultural resource survey, which had not yet been completed. When the supplemental survey was completed, the associated appendix was updated and submitted on December 19, 2018. The involved agencies and their roles have been described in Section 3.1 of the LAR.

The revised main text of the LAR is included as Attachment 7. The approval letter and consolidated agency comments are included in Attachment 8 and have been added as Appendix AA to the LAR. The text reference to Appendix N will be removed from the ER, as it was determined not to be relevant to the LAR and was intentionally omitted.

RAI 7.2-2 Revise the LAR to remove requests for an exemption from the regulations in 10 CFR Part 61.

Section 1.3 of the LAR describes UNC's approach to the guidance in Appendix I of NUREG 1620. In response to criterion 6, the licensee states that the mine waste proposed to be relocated to the existing tailings impoundment is not subject to jurisdiction under the Rocky Mountain Low-Level Radioactive Waste Board. However, in its response to criterion 8, the licensee requests and exemption from the requirements of 10 CFR Part 61. If the mine waste is not low level radioactive waste and is not subject to regulation under the Rocky Mountain Low-Level Radioactive Waste Board, then an exemption from 10 CFR Part 61 is not needed.

This information is necessary to evaluate the LAR consistent with the referenced guidance.

RESPONSE: *Under criterion 8, the request for an exemption from the regulations in 10 CFR Part 61 has been removed from Table 1.3-1 in the LAR. The revised main text of the LAR is included as Attachment 7.*

References

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