REQUEST FOR SUPPLEMENTAL INFORMATION
RARE ELEMENT RESOURCES, INC.
SOURCE MATERIAL LICENSE APPLICATION
Docket Number: 04038413

Request for Supplemental Information (RSI)-1

Provide the following information on determining compliance with public dose limits:

1. Clarify which dosimetry models will be used for public dose exposure calculations and submit an exemption request, if necessary.

Discussion

In Appendix F, "Radiological Dose Evaluation," of the Environmental Report (ER), the applicant stated that it used inhalation dose conversion factors (DCFs) from International Commission on Radiological Protection (ICRP) publications 68 and 72 to estimate public dose from operations.

The dose limits in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," are based on DCFs presented in ICRP publications 26 and 30. Other DCFs are not allowed unless specifically approved. See, for example, NRC staff guidance in Regulatory Guide (RG) 4.20, Section C.2(e). See, also, the exemption request in the Agencywide Documents Access and Management System Accession No. ML042750086 for background.

The applicant should either use approved DCFs or submit an exemption request to use alternate DCFs.

2. Discuss how compliance with public dose limits will be demonstrated.

Discussion

The requirements in 10 CFR 20.1302, "Compliance with dose limits for individual members of the public," specify how to demonstrate compliance with the annual public dose limit.

In Table 7, Proposed routine radiological surveys and monitoring, of the Technical Report (TR), the applicant indicated airborne effluent release monitoring to be used in a public dose assessment. These include:

PUG/Sample Storage Facility

- Mobile, continuous area air sampling outside of the south side of the building during Physical Upgrade (PUG) processing for emissions/public dose assessment.

Main Process Facility

- Weekly, isokinetic stack monitoring for radon from each scrubber stack for emissions/public dose assessment
- Semi-annual particulate emission evaluation for stack by a third party for emissions/public dose assessment

Other Facilities

- Passive radon track etch monitoring at site boundary fence near parking lot over project duration for public dose assessment

In Section 3.3 in Appendix F of the ER, the applicant provided results of its estimate of a maximum dose to a *hypothetical* maximally exposed member of the public. The NRC staff notes that estimating a dose to a hypothetical member of the public can be useful for licensing purposes, but during operations a licensee must make an effort to determine who, or what group, receives the highest exposures based on actual operating conditions (refer to NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 - Standards for Protection Against Radiation," 10 CFR 20.1302).

It is not clear to the NRC staff how either of the two methods specified in 10 CFR 20.1302 will be incorporated into the applicant's monitoring program for determining the maximum dose to an actual member of the public.

For example, under "other facilities" above, a radon detector is placed at the site boundary fence for public dose purposes (NRC staff referred to Map 4 in the ER). However, this location is not at the boundary of the unrestricted area and has not been demonstrated to be the location of a maximally exposed member of the public, so it does not appear that it can be used for demonstrating compliance with 10 CFR 20.1302.

In addition, the applicant does not address external exposure for members of the public in its monitoring program.

In both cases above, it is also not clear what the background reference values would be, if any, for determining the maximum public dose from operations.

3. Provide additional details for the basis of the source term for the public dose estimate due to airborne particulates.

Discussion

In Section 1.3.3.2 in Appendix F of the ER, the applicant described its assumptions for the public dose estimate due to airborne particulate emissions from the PUG/sample storage facility. One assumption was that 10^{-4} of the total activity of the exploration sample was released.

The applicant should provide a technical basis for the assumed particulate release fraction.

4. Provide additional details for the basis of the source term for the public dose estimate due to radon and its decay products.

Discussion

In Section 1.3.3.2 in Appendix F of the ER, the applicant described its assumptions for the public dose estimate due to radon emissions. The applicant stated: "Because the PUG/Sample Storage Facility will be partially open to the outside, radon was modeled in the public dose evaluation with the same total release activities as particulates." However, in describing

emission controls, the applicant also stated: “the ambient diffusion of radon (either Rn-222 or Rn-220) from open areas and active ventilation of enclosed process buildings are expected to control radon and its decay products to acceptable levels.”

In Table 6 in Appendix F of the ER, the applicant indicated that radon was not considered in the dose estimate for workers inside the PUG/sample storage facility and the main process facility. This indicates to the NRC staff that the applicant assumes that practically all of the radon from the exploration sample will be removed from the buildings due to ventilation (either active or natural from open areas).

The NRC staff notes that previous NRC estimates assume that all of the accumulated radon in ore is released during the processing of that ore.[1] As the applicant did not discuss an emission control device for removing radon prior to exiting the buildings, it is not clear to the NRC staff why the particulate release fraction of 10^{-4} of the total activity of the exploration sample was used for radon.

The applicant should provide a technical basis for the assumed radon release fraction, accounting for all accumulated radon and subsequent buildup of radon due to radioactive decay.

5. Provide additional details for the determination of the equilibrium fraction for the public dose estimate due to radon and its decay products.

Discussion

In footnote A to Table 7 in the TR, the applicant stated: “Conservative assumptions will be used for equilibrium fractions.”

The applicant should discuss how it will derive a conservative equilibrium fraction for use in determining public dose estimates.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CFR 20.1101(d), “Radiation protection programs,” requires:

  > To implement the ALARA requirements of § 20.1101 (b), and notwithstanding the requirements in § 20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to § 50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in § 20.2203 and promptly take appropriate corrective action to ensure against recurrence.

[1] NUREG-0706, Volume III, “Final Generic Environmental Impact Statement on Uranium Mining,” September 1980, ML032751669.

- 10 CFR 20.1301, "Dose limits for individual members of the public," requires:

  (a) Each licensee shall conduct operations so that—

  (1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation, from any administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003, and

  (2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with § 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

  (b) If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

- 10 CFR 20.1302 requires:

  (a) The licensee shall make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in § 20.1301.

  (b) A licensee shall show compliance with the annual dose limit in § 20.1301 by—

  (1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or

  (2) Demonstrating that—

  (i) The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to part 20; and

  (ii) If an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

RSI-2

Provide the following information on determining compliance with occupational exposure limits:

1. Clarify which dosimetry models will be used for occupational exposure calculations and submit an exemption request, if necessary.

Discussion

In Section 1.3.4 in Appendix F, Radiological Dose Evaluation, of the ER, the applicant stated that it used inhalation DCFs from ICRP publications 68 and 72 to estimate occupational dose from operations due to inhalation and ingestion. In addition, the applicant stated in footnote B to Table 7, DCFs for radionuclides of interest, that the U.S. Environmental Protection Agency (EPA), Federal Guidance Report No. 15 (FGR 15), will be used to estimate occupational dose from operations due to external exposure from the exploration sample.

The dose limits in 10 CFR Part 20, "Standards for Protection Against Radiation," are based on DCFs presented in ICRP publications 26 and 30. Other DCFs are not allowed unless specifically approved. See, for example, the exemption request in ML042750086 for background.

See, also, guidance in RG 8.34, Monitoring Criteria and Methods to Calculate Occupational Radiation Doses, and question and answer to Question 458 in ML093240410.

The NRC staff notes that, according to FGR 15, ICRP publication 103 weighting factors were used to derive external DCFs.

The applicant should either use approved DCFs or submit an exemption request to use alternate DCFs.

2. Provide additional details for basis of external dose estimates.
   a. Discuss application of external DCFs to the exploration sample.
   b. Provide additional details on predicted external dose rate from stored waste.

Discussion

External DCFs provided by the EPA in FGR 15, Table 4-5 (and FGR 12), are based on an infinite isotropic plane source (contaminated soil) and a human phantom is standing on the soil at the air-ground interface. This does not appear to describe the external radiation source (above ground exploration sample) at the applicant's facility.

The applicant should justify the use of the approach used in EPA's FGR for the current application.

According to Table 4 in Appendix F to the ER, the applicant did not evaluate external exposure to workers standing or working near stored waste. In footnote B to Table 4 in Appendix F to the ER, the applicant stated: "Due to the lower concentration of all radionuclides in total tailings compared to the exploration sample (due to the addition of water, neutralizing agent, and absorber media) and additional shielding provided by waste containers, exposures in the waste storage area are predicted to be much lower than in the PUG/Sample Storage Facility."

The applicant should provide details on calculations or other methods used to justify this prediction.

3. Describe the chemical forms of uranium anticipated throughout the demonstration project process and whether there will any 10 CFR Part 20, Appendix B, inhalation class D or W uranium compounds for which the limit specified in 10 CFR 20.1201(g), "Occupational dose limits for adults," for soluble uranium applies.

Discussion

In footnote A to Table 7 in Appendix F to the ER, the applicant stated: “All DCFs are for the least soluble form.” For uranium compounds, applying DCFs in this manner [i.e., using the inhalation classification (Y, in 10 CFR Part 20, Appendix B, “Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage,”) with the lowest annual limit intake (ALI)] will result in the highest estimated internal dose. However, this method does not demonstrate compliance with the requirement in 10 CFR 20.1201(g) for soluble uranium.

RG 8.22 provides guidance on how to evaluate listed (i.e., tabulated in 10 CFR Part 20, Appendix B) and unlisted (i.e., not tabulated in 10 CFR Part 20, Appendix B) uranium compounds for solubility.

The applicant should discuss expected chemical forms of uranium compounds and an analysis of whether, and to what extent, the limit specified in 10 CFR 20.1201(g) for soluble uranium (inhalation class D or W) applies to its operations.

4. Describe the chemical forms of thorium (Th) and actinium (Ac) anticipated throughout the demonstration project process and whether there will any 10 CFR 20, Appendix B, inhalation class D (Ac) or W (Ac and Th) compounds.

Discussion

In footnote A to Table 7 in Appendix F to the ER, the applicant stated: “All DCFs are for the least soluble form.” The NRC staff notes that applying DCFs in this manner will, generally, result in the highest estimated internal dose from radionuclides with stochastic ALIs. However, the ALIs for the isotopes of Th and Ac expected at this facility are lower for the more soluble forms of compounds containing these isotopes. In addition, the DCF for the effective dose equivalent in FGR No. 11 is higher for the less soluble forms of Th-230 and Th-232, making an assumption using the least soluble forms of these isotopes not conservative.

The applicant should discuss expected chemical forms of Th compounds and how this information will be incorporated into the radiation protection program, including compliance with 10 CFR 20.1201(a)(1)(ii).

5. Clarify radiation dose estimate for maximally exposed workers.

Discussion

In Table 4 in Appendix F to the ER, the applicant indicated that external (Thorium-Cerium Separation (TCS) tailings mixing) and internal (emissions from open systems into building air) occupational exposures in the main process facility were evaluated in the dose assessment.

In Section 1.3.3.2 in Appendix F to the ER, the applicant stated that there would be negligible particulate emissions and that radon was not considered further in the dose evaluation. This assumption was incorporated in Table 6 of Appendix F to the ER.

In Table 8 in Appendix F to the ER, the applicant provided radiation dose estimate for maximally exposed workers. This estimate only addressed exposure related to the PUG/sample storage facility.

The applicant should clarify if occupational exposure for activities associated with the main process facility marked as “yes” in Table 4 in Appendix F to the ER were evaluated or not. If occupational exposure for activities associated with the main process facility were evaluated, those evaluations should be provided.

6. Clarify expected radon levels in the pug/sample storage and main process facilities.

Discussion

In Section 1.3.3.2 in Appendix F to the ER, the applicant stated that radon and its decay products will be controlled to “acceptable levels”.

NUREG-1556, Volume 12, Section 8, “Contents of an Application,” states, in part, “The application should document ALARA considerations, including establishing administrative action levels and monitoring programs.”

Please provide expected radon concentrations in work areas of these facilities and any administrative action levels that will be established, including actions to be taken in case administrative action levels are exceeded.

7. Discuss surveys to ensure monitoring and control systems for the facilities are located to optimize their intended function.

NUREG-1556, Volume 12, Section 8.6, “Purpose(s) for Which Licensed Material Will Be Used,” states, in part, “Applicants must demonstrate that their facilities and equipment provide sufficient engineering controls and barriers to protect the health and safety of the public and its employees, keep exposures to radiation and radioactive materials ALARA, and minimize the danger to life and property from the uses of the types and quantities of radioactive materials to be used.”

NUREG-1556, Volume 12, Appendix M, “Radiation Safety Survey Topics,” discusses air monitoring in the workplace and references RG 8.25, Revision 1, Air Sampling in the Workplace.

The applicant should describe any surveys that will be performed to determine the correct location of airborne monitoring devices and the efficiency of control devices.

Discussion

Applicants must demonstrate that their facilities and equipment provide sufficient engineering controls and barriers to protect the health and safety of the public and its employees, keep exposures to radiation and radioactive materials ALARA, and minimize the danger to life and property from the uses of the types and quantities of radioactive materials to be used.

8. Provide details of policy and procedures for declared pregnant women.

Discussion

In Section 2 in Appendix F to the ER, the applicant stated that there is a potential for workers to receive more than 100 millirem (mrem) per year (yr).

In Section 10.1.1 in the TR, ALARA Program, the applicant stated: “ALARA action levels for evaluation of process and radiation protection practices will be established at 10% of any applicable radiation dose limit”.

NUREG-1556, Volume 12, Section 8.10.4, “Occupational Dose,” states, in part, “Licensees should also perform prospective evaluations of the doses that may be received by occupationally exposed minors and declared pregnant women.”

The NRC staff notes that 10 percent of the dose equivalent limit to the embryo/fetus during the entire pregnancy is 50 mrem (10 CFR 20.1208, “Dose equivalent to an embryo/fetus.”) In addition, 10 percent of the monitoring requirements for declared pregnant women in 10 CFR 20.1502, “Conditions requiring individual monitoring of external and internal occupational dose,” is 10 mrem deep dose equivalent and 10 mrem committed effective dose equivalent during the entire pregnancy.

In Section 8.1 of the TR, Initial Training, the applicant stated that trainees will be provided with the guidance in RG 8.13, “Instruction Concerning Prenatal Radiation Exposure,” (NRC, 1999). However, the applicant did not discuss any specific aspects of its radiation protection program as it relates to declared pregnant women.

The applicant should provide details of its radiation protection program addressing the requirements for declared pregnant women including how its ALARA action levels will be applied.

9. Clarify requirements for occupational external dose monitoring.

Discussion

The applicant provided proposed external monitoring for occupational dose assessment in Table 7 of the TR. According to Table 7, all personnel on site for “≥ 5 days” will be issued a personal dosimeter. Footnote A to Table 7 states that personnel onsite for less than five days are very unlikely to receive an external dose exceeding 10 mrem.

It is not clear if the “≥ 5 days” refers to a single onsite visit or a cumulative number of expected days onsite per year.

Without knowing the specific work activities for the onsite personnel and associated external exposure rates, it is not clear to the NRC staff how a five-day minimum was chosen for issuing a personal dosimeter.

The applicant should:

1) clarify the meaning of “≥ 5 days”, and
2) provide a basis for the statement “very unlikely to receive an external dose exceeding 10 mrem”.

10. Clarify requirements for radiation work permits (RWPs).

Discussion

In Section 10.6.2 of the TR, Radiation Work Permits, the applicant discusses the use of RWPs. According to the applicant, an RWP will be prepared "…for any non-routine activity not covered by an SOP and where there is the potential for exposure to licensed materials above a control limit." This description is also provided in footnote A to Table 7 in the TR.

It is not clear to the NRC staff what the "control limit" refers to. It appears to be a threshold to preparing an RWP. The NRC staff notes that guidance in RG 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposure at Uranium Recovery Facilities Will be As Low As Reasonably Achievable," does not provide a threshold for preparing RWPs. This guidance states, in part, "…when the potential for exposure to radioactive material exists and for which no standard written operating procedure already exists, a radiation work permit (RWP) should be used."

The applicant should provide details on the control limit that will be used for the preparation of RWPs.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CR 20.1201 requires, in part:

  (a) The licensee shall control the occupational dose to individual adults, except for planned special exposures under § 20.1206, to the following dose limits.

  (1) An annual limit, which is the more limiting of—

  (i) The total effective dose equivalent being equal to 5 rems (0.05 Sv); or

  (ii) The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

  (d) Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in table 1 of appendix B to part 20 and may be used to determine the individual's dose (see § 20.2106) and to demonstrate compliance with the occupational dose limits.

  (e) In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of appendix B to part 20).

- 10 CFR 20.1204, "Determination of internal exposure," requires, in part:

  (c) When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior or the material in an individual is known, the licensee may—

(1) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and

(2) Upon prior approval of the Commission, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material (e.g., aerosol size distribution or density); and

(3) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide (see appendix B to part 20) to the committed effective dose equivalent.

(e) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours must be either—

(1) The sum of the ratios of the concentration to the appropriate DAC value (e.g., D, W, Y) from appendix B to part 20 for each radionuclide in the mixture; or

(2) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

(f) If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture must be the most restrictive DAC of any radionuclide in the mixture.

(g) When a mixture of radionuclides in air exists, licensees may disregard certain radionuclides in the mixture if—

(1) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in § 20.1201 and in complying with the monitoring requirements in § 20.1502(b), and

(2) The concentration of any radionuclide disregarded is less than 10 percent of its DAC, and

(3) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

- 10 CFR 20.1207, "Occupational dose limits for minors," requires:

  The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers in § 20.1201.

- 10 CFR 20.1208 requires, in part:

  (a) The licensee shall ensure that the dose equivalent to the embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For recordkeeping requirements, see § 20.2106.)

(b) The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section.

- 10 CFR 20.1501(a), "General," requires:

  Each licensee shall make or cause to be made, surveys of areas, including the subsurface, that—

  (1) May be necessary for the licensee to comply with the regulations in this part; and

  (2) Are reasonable under the circumstances to evaluate—

  (i) The magnitude and extent of radiation levels; and

  (ii) Concentrations or quantities of residual radioactivity; and

  (iii) The potential radiological hazards of the radiation levels and residual radioactivity detected.

- 10 CFR 20.1502 requires, in part:

  Each licensee shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this part. As a minimum—

  (b) Each licensee shall monitor (see § 20.1204) the occupational intake of radioactive material by and assess the committed effective dose equivalent to—

  (1) Adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI(s) in table 1, Columns 1 and 2, of appendix B to §§ 20.1001-20.2402;

  (2) Minors likely to receive, in 1 year, a committed effective dose equivalent in excess of 0.1 rem (1 mSv); and

  (3) Declared pregnant women likely to receive, during the entire pregnancy, a committed effective dose equivalent in excess of 0.1 rem (1 mSv).

RSI-3

Provide the following information on the contamination control program:

1. Describe the proposed acceptable surface contamination levels (alpha and beta) in units of disintegrations per minute per 100 centimeters squared (dpm/100 cm^2) that will be used for personnel monitoring, surveys of restricted and unrestricted (e.g., eating rooms, offices, etc.) areas, and releasing equipment and items for unrestricted use.

a. Discuss expected individual radionuclides and radionuclide mixtures generated from operations to support the proposed acceptable surface contamination levels.

b. Discuss assumptions (e.g., equilibrium status) and any proposed characterization surveys to support the proposed mixtures and acceptable surface contamination levels.

Discussion

NUREG-1556, Volume 12, Section 8.10.6, "Safe Use of Radionuclides and Emergency Procedures," recommends, in part, that licensees have written procedures that include personnel and area monitoring (including limits).

NUREG-1556, Volume 12, Appendix M, states, in part, "When it is not possible to get to background levels, the licensee must ensure that the amounts do not exceed the contamination levels listed in Table M–2, taken from "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material" (August 1987) (ML030590504)."

The applicant provided footnote B to Table 7 of the TR, *Proposed routine radiological surveys and monitoring*. This footnote stated that radioactivity levels on surfaces for unrestricted release will meet the levels listed in Table M-2 of Appendix M to NUREG-1556, Volume 12.

However, Table M-2 does not provide site-specific release limits based on the radioactive materials encountered at an individual facility. In addition, Table M-2 does not address personnel (e.g., skin and clothing) or restricted or unrestricted area surveys, or administrative limits associated with ALARA programs.

2. Provide example calculations demonstrating the radionuclide-weighted surface contamination detection capability (minimum detectable concentration (MDC)) for radiation survey instruments, including scan MDC for portable instruments, used for releasing equipment and materials for unrestricted use, personnel contamination monitoring, and other routine surveys. The detection capability for static and scanning modes should be provided in terms of dpm/100 cm^2 for the alpha and beta radiation expected at the facility as discussed in 1.a above.

Discussion

NUREG-1556, Volume 12, Appendix H, "Radiation Monitoring Instrument Specifications and Model Radiation Survey Instrument Calibration Program," states, in part, "The characteristics of the instrument, including principles of operation and expected efficiency for the type and energy of the radiation being measured, should be understood by the licensee prior to use." and "Licensees should possess and use calibrated and operable radiation detection and measurement instruments that are sufficiently sensitive to detect and measure the type and energy of the radiation used."

For the MDC demonstrations, typical background values may be assumed, or a maximum background value may be calculated to achieve the desired MDC. The demonstration of MDC should include the following information, as a minimum:

- Provide a technical basis for assigning an instrument efficiency to any radionuclide.

- Provide the radionuclide(s), dimensions, and pedigree (e.g., National Institute of Standards and Technology traceable) of any radioactive source(s) used for determining instrument efficiency.

- Assign surface efficiencies to radionuclides consistent with NUREG-1507, Revision 1, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," or a technical basis for assigning other values.

- MDC calculations for portable instruments should take probe area into account.

- The response should include a description of how any assumptions used in determining MDC will be incorporated into the health physics program. For example, scan speed and distance from source are relevant to ensuring that field measurements are consistent with derived scan MDC values. In addition, background radiation levels exceeding assumed levels can impact MDC values.

For examples, see NRC staff discussion of MDCs in ML18072A029 and ML15295A045.

3. Provide a rationale for the proposed monthly frequency for contamination surveys of process areas for the main process facility.

Discussion

In Table 7 in the TR, *Proposed routine radiological surveys and monitoring*, the applicant stated that monthly contamination surveys would be performed in the process areas of the main process facility. Table M-1 of Appendix M to NUREG-1556, Volume 12, provides a suggested contamination survey frequency based on the amount of licensed material in use at any one time at any particular location.

4. Describe additional personnel contamination survey locations, if any.

    a. If there is only one personnel contamination survey location, please describe controls that will be in place to ensure potentially contaminated workers don't return to offices or leave the restricted area without performing a survey.

Discussion

Figure 5 of the TR depicts one personnel contamination survey location in the "clean room", which is not attached to the PUG/sample storage facility or the main process facility.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CFR 20.1501(a) requires:

Each licensee shall make or cause to be made, surveys of areas, including the subsurface, that—

(1) May be necessary for the licensee to comply with the regulations in this part; and

(2) Are reasonable under the circumstances to evaluate—

(i) The magnitude and extent of radiation levels; and

(ii) Concentrations or quantities of residual radioactivity; and

(iii) The potential radiological hazards of the radiation levels and residual radioactivity detected.

- 10 CFR 20.1501(c) requires licensees to periodically calibrate instruments and equipment used for quantitative measurements for the radiation measured.

- 10 CFR 20.1406, "Minimization of contamination," requires applicants to describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

- 10 CFR 40.32(c), "General requirements for issuance of specific licenses," requires an applicant's proposed equipment, facilities and procedures are adequate to protect health and minimize danger to life or property.

RSI-4

Provide the following information on the radiation monitoring instrument program:

1. Provide instrument sensitivities in Table 6 of the TR in units used for regulatory compliance (e.g., dpm/100 cm^2, µCi/ml, etc.).

Discussion

NUREG-1556, Volume 12, Section 8.10.2, "Radiation Monitoring Instruments", recommends, in part, that instruments used for quantitative radiation measurements must be calibrated periodically for the radiation measured and that radiation monitoring instruments are defined as any device used to measure the radiological conditions at a licensed facility.

The use of generic units from the manufacturer, such as counts per minute, does not provide the NRC staff with the information necessary to determine compliance with applicable regulatory requirements for site-specific surveys.

2. Indicate how the exposure rate limit in Note 6 in NUREG-1556, Vol. 12, Table M-2, "Acceptable Surface Contamination Levels for Equipment," will be demonstrated.

Discussion

Note 6 in NUREG-1556, Vol. 12, Table M-2, specifies that: “The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.”

NUREG-1556, Volume 12, Section 8.10.2, recommends, in part, that instruments used for quantitative radiation measurements must be calibrated periodically for the radiation measured.

The applicant identifies the Ludlum Model 19 exposure rate meter in Table 6 of the TR. According to the manufacturer’s website (https://ludlums.com/products/all-products/product/model-19#documents), this detector is not sensitive to beta radiation.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CFR 20.1501(a) requires:

  Each licensee shall make or cause to be made, surveys of areas, including the subsurface, that—

  (1) May be necessary for the licensee to comply with the regulations in this part; and

  (2) Are reasonable under the circumstances to evaluate—

  (i) The magnitude and extent of radiation levels; and

  (ii) Concentrations or quantities of residual radioactivity; and

  (iii) The potential radiological hazards of the radiation levels and residual radioactivity detected.

- 10 CFR 20.1501(c) requires licensees to periodically calibrate instruments and equipment used for quantitative measurements for the radiation measured.

- 10 CFR 40.32(c) requires an applicant's proposed equipment, facilities and procedures are adequate to protect health and minimize danger to life or property.

RSI-5

Provide the following information on the proposed facilities and equipment:

1. Clarify where berm(s) will be constructed.

Discussion

NUREG-1556, Volume 12, Section 8.9, “Facilities and Equipment,” states, in part, “Applicants must demonstrate that their facilities and equipment provide sufficient engineering controls and barriers to protect the health and safety of the public and its employees, keep exposures to radiation and radioactive materials ALARA, and minimize the danger to life and property from the uses of the types and quantities of radioactive materials to be used.”

In Section 9.2 in the TR, the applicant stated: “The restricted area (Figure 5) will be graded appropriately and bermed to prevent the discharge of water potentially contacting licensed material.”

The NRC staff reviewed TR, Figure 2, Proposed Site Plan for the Demonstration Project (also ER, Map 3), and notes that there is a berm annotated around the site boundary, but not the restricted area.

2. Provide the location of the waste storage area.

Discussion

The applicant refers to the “waste storage area” in several places (e.g., TR: Section 10.6.3 and Table 7; ER: Table 4). However, the NRC staff could not locate the waste storage area on any figure or map.

Provide the location of the waste storage area on a figure or map or indicate where in the application the location is specified.

3. Provide additional details on emission control equipment.

Discussion

NUREG-1556, Volume 12, Section 8.9, states, in part, “Describe the facilities and equipment to be made available at each location where radioactive material will be possessed or possessed and used (see Appendix F of this NUREG for topics to consider). This information should be from the point of view of performance criteria. For example, state the purpose of any filtration equipment and the associated acceptance criteria to accomplish this purpose (such as the ventilation flow rate trying to be maintained).”

In Section 9.2 in the TR, the applicant described, generally, the emission control equipment to be used at its facility. The equipment includes dust collectors, bag houses, scrubbers, and high efficiency particulate air filtration systems.

However, the applicant did not provide any design or operational information for the proposed emission control devices.

The applicant should provide designs and operational information for the proposed emission control equipment. The applicant should also state the purpose and the associated acceptance criteria to accomplish this purpose for each proposed emission control device.

4. Clarify all locations of potential radiological effluent releases from facilities and, if there are additional locations, whether they will be monitored.

Discussion

The applicant described emission points for its facilities in Section 9.2 and Figure 5 in the TR. In addition, the applicant described proposed airborne effluent release monitoring for these facilities in Table 7 in the TR.

In Section 9.2.1 of the TR, the applicant stated: “The south side of the PUG/Sample Storage Facility is open to the environment; therefore, any air emissions will come from ground level on the south side (Figure 5).” This south side emission point is shown on Figure 5 and described in Table 7. However, it is not clear from Table 7 whether the emission point outside the south side of the PUG/Sample Storage Facility is monitored for particulates or radon or both.

In addition, in Section 1.3.3.2 in Appendix F of the ER, the applicant takes credit for active ventilation to control radon and its decay products. It is not clear where this active ventilation is being vented. If there is active ventilation being vented, it also does not appear that there is monitoring planned for this emission point.

The applicant also takes credit for an “extensively ventilated” main process building to control occupational exposure to radon and its decay products. Although the applicant describes the emission point for the general ventilation in Section 9.2.2 of the TR, there does not appear to be any monitoring for radon or particulates from this emission point.

The applicant should review the description of all potential emission points, update the text, tables, and figures, as appropriate, and ensure that there is appropriate effluent monitoring for all emission points.

5. Discuss any accident controls associated with the effluent control system designs.

Discussion

NUREG-1556, Volume 12, Appendix F, “Facilities and Equipment,” states, in part:

- Where appropriate, ventilation systems should be designed such that, in the event of an accident, they can be shut down to prevent the spread of radioactivity. If appropriate, supply and exhaust fans can be interlocked such that if exhaust fans shut down, the shutdown of supply fans is also triggered, this interlock system is to prevent laboratory and work areas from becoming positively pressurized with respect to the surrounding parts of the facility.

The NRC staff notes that this is one example and is looking for any such designs that are anticipated to be designed into the facility, as appropriate.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CFR 20.1003, "Definitions," defines, in part:

  Controlled area means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

  Restricted area means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

  Unrestricted area means an area, access to which is neither limited nor controlled by the licensee.

- 10 CFR 20.1101(b) requires:

  The licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

- 10 CFR 20.1406(a) requires:

  Applicants for licenses, other than early site permits and manufacturing licenses under part 52 of this chapter and renewals, whose applications are submitted after August 20, 1997, shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

- 10 CFR 40.32(c) requires:

  The applicant's proposed equipment, facilities and procedures are adequate to protect health and minimize danger to life or property

RSI-6

Provide the following information on the baseline radiological conditions:

1. Provide data for all site-specific sampling performed for baseline radiological investigations for the demonstration plant.

Discussion

Table 3-32 in the ER provides a summary of baseline radiological investigations performed for the demonstration plant, but the NRC staff did not find actual data sets for these investigations.

2. Provide additional discussion on using baseline radiological investigations performed for the Bear Lodge Project site and applying them to the Demonstration plant site.

Discussion

The applicant stated that the values reported in Table 3-32 of the ER are "considered to be similar for the Demonstration Plant site."

The applicant should provide a justification for this statement. In addition, the applicant should provide all data sets from the Bear Lodge Project site investigation that will be used for the Demonstration plant site.

Basis

This information is needed to determine compliance with the following requirement:

10 CFR 20.1402, "Radiological criteria for unrestricted use," requires, in part –

> A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

RSI-7

Provide a more complete description of the proposed action and associated environmental impacts.

1. Clarify aspects of Rare Element Resources, Inc.'s (RER) process related to mass balance issues.

Discussion

RER's application (ER Section 1) states that approximately 1,000 short tons of exploration sample containing rare element oxides (REOs) would be processed at the Upton, WY facility. The applicant should clarify if the entire 1,000 short tons will be comminuted and fed into RER's processing facility. The applicant should clarify the approximate mass of product to be temporarily stored at the Upton facility and ultimately delivered to the client.

In the footnote to page B6 to the TR Appendix B, it states that RER expects a total tailings mass volume of 2448 short tons. The applicant should clarify if the intended waste shipment rate of one 30-ton roll-off bin per week (see section 4.13.3 of the ER) would be expected to dispose of the total tailings mass volume. The applicant should clarify if the "30-ton roll off bin" is the same as a "30-cubic yard roll-off dumpster."

2. Provide additional information on RER's proposed facility and process description.

Discussion

ER Figure 17 presents an overhead picture of the Upton facility as it currently exists. ER Map 3 shows the layout of the facility buildings once readied for RER's planned demonstration plant. The applicant should provide a description of and discussion for the additional features shown on ER Map 3 that do not appear in ER Figure 17. These include the auxiliary plant, the building expansion, the scrubber area, and the electrical control room.

Section 9.1.1 of the TR states that the exploration sample would undergo physical upgrading over an approximately two-week period, at a rate of approximately 100 tons per day, with the comminuted product stored in super sacks. The applicant should clarify how the super sacks are filled with the comminuted product, how replacement super sacks are provided to continue filling and storage, and how filled sacks are removed and placed into storage within the PUG/Sample Storage Facility.

In Table 4 in Section 9.1.5 of the TR, various acids, ammonia water, and organic reactants are indicated as being stored in the Chemical Containment Area. Please indicate and describe what changes to this containment area would be needed to store these materials safely and securely in preparation for their use in RER's process. The applicant should discuss how each of these materials would be transferred to the Main Process Building as needed and in time to support RER's process. The applicant should discuss aspects of the Chemical Containment Area that would be relied on to contain spills should they occur.

In Table 4 in Section 9.1.5 of the TR, the total inventory of the process-related acids, ammonia water, and organic reactants is provided. The applicant should clarify if this means the cumulative mass of these materials to be stored at the site over the course of RER's processing of the REOs or the maximum mass of these materials to be stored at any point during RER's operations. Section 9.1.5 of the TR also mentions the potential use of bentonite to absorb excess liquid in the process tailings. The applicant should clarify if RER intends to store bentonite at the Upton site, and if so, where on the site, and if not, how would RER receive the bentonite for its in-time use.

In Table 5 in Section 9.2.5 of the TR, ventilation of the Chemical Containment Area is stated as routing through the Main Processing Facility scrubber. This implies that the Chemical Containment Area will be enclosed, a state that ER Figure 17 does not show. The applicant should describe the activities to enclose the Chemical Containment Area and how the routing to the Main Processing Facility scrubber would be accomplished.

In Section 9.2 of the TR, a laydown yard is identified as one of areas outside the restricted area but within the site boundary. ER Map 3 does not show the laydown area. The applicant should indicate where the laydown area would be located within the site boundary and how RER intends to dispose of equipment and supplies that are stored in this area.

In Section 1.4.3 of Appendix B to the TR, physical upgrading (i.e., PUG) equipment is identified for early decontamination and demobilization. The applicant should discuss the activities to accomplish this and any environmental effects of doing so. The applicant should discuss its planned uses for the PUG/Sample Storage Facility following removal of the PUG equipment and as the stockpile of comminuted exploration sample is reduced over time during RER's operational period.

Section 9.1.5 of the TR is entitled “Chemical Recycling and Waste Facilities.” The applicant should identify where these facilities would be located. The applicant should confirm that the four produced solid waste and wastewater streams would be combined, along with organic liquid wastes from the Thorium-Cerium Separation stage, into a single waste product for offsite disposal. The applicant should discuss how the non-radioactive organic liquid waste from the Neodymium/Praseodymium Separation stage would be stored and how it would be disposed.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CFR 51.45(b), “Environmental considerations,” requires, in part that “[t]he environmental report shall contain a description of the proposed action, …” and

- 10 CFR 51.45(b)(1) requires that the environmental report should also discuss “[t]he impact of the proposed action on the environment.”

RSI-8

Provide a more complete discussion of the alternatives to the proposed action and the impacts of these alternatives in comparison to those from the proposed action.

Discussion

RER’s ER should include further discussion of the no-action alternative and impacts related to it. For example, Section 2.1.1 of the ER states [the] “No action would include the following… No project-related increases in local employment and tax revenues.” However, Section 4.10.1 Socioeconomic Impacts to the No-Action alternative does not include a discussion of associated impacts.

Section 2.4 of the ER includes comparison of the predicted environmental impacts which includes Table 2-3 discussing each of the alternatives included in the analysis. The discussion of the No-Action alternative lists no environmental impacts, this conflicts with the information provided in Section 2.1.1.

Basis

This information is needed to determine compliance with the following requirements:

- 10 CFR 51.45(b)(3), “Alternatives to the proposed action,” requires “[t]he discussion of alternatives shall be sufficiently complete to aid the Commission in developing and exploring, pursuant to section 102(2)(E) of NEPA, ‘appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.’ To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form.”

Administrative Issues

1. Section 7.3.1 in the TR specifies the specialized knowledge for the Radiation Safety Officer. This includes "…how the hazards are generated and controlled during the ***uranium recovery*** [emphasis added] process." This appears to be a typographical error.

2. Section 7.3.2 in the TR specifies the education, training, and experience necessary for a safety technician. This includes: "The safety technician(s) will have one of the combinations of education, training, and experience in Table 2 consistent with Section ***2.4.1*** [emphasis added] of RG 8.31 (NRC 2002)." This appears to be a typographical error as the recommended qualifications for health physics technicians are provided in Section 2.4.2 of RG 8.31.

3. In Sections 2.2 and 3.2.5 in Appendix F in the ER, the applicant refers to Section 1.1.1.1 (presumably also in the ER). This appears to be a typographical error as there is no Section 1.1.1.1 in the ER. The NRC staff notes that clicking on the link brings the reader to Section 1.3.3.2 in the ER.