COLORADO OFFICE
10758 W. CENTENNIAL RD., STE. 200
LITTLETON, CO 80127
TEL: (866) 981-4588
FAX: (720)-981-5643

WYOMING OFFICE
5880 ENTERPRISE DR., STE. 200
CASPER, WY 82609
TEL: (307) 265-2373
FAX: (307) 265-2801

LOST CREEK ISR, LLC

February 17, 2012

Document Control Desk,
Director, Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**Re: Lost Creek Project, NRC License SUA-1598, Docket No. 40-9068**
**REQUEST FOR ADDITIONAL INFORMATION-REQUESTED CLARIFICATIONS AND TECHNICAL REPORT PAGE CHANGES-LOST CREEK ISR; (December 22, 2011)**

Dear Dr. Oxenberg:

Please find behind this cover, Lost Creek ISR, LLC's responses to your Request for Additional Information dated December 22, 2011.

Please contact me or Dr. Charles Kelsey at the Casper office if you have any questions regarding this submittal.

Regards,

Steve Hatten
President
Lost Creek ISR, LLC

Cc: Theresa Horne – Ur-Energy USA Inc., Littleton

Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission
Mail Stop T-8F5
11545 Rockville Pike, Two White Flint North
Rockville, MD 20852-2738

Tanya Palmateer Oxenberg, Ph.D., Project Manager
Uranium Recovery Licensing Branch
Decommissioning and Uranium Recovery Licensing Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission
Mail Stop T-8F5
11545 Rockville Pike, Two White Flint North
Rockville, MD 20852-2738



FSME20

**Lost Creek Project, NRC License SUA-1598, Docket No. 40-9068; February 17, 2012**
**RESPONSES TO:**
**REQUEST FOR ADDITIONAL INFORMATION-REQUESTED CLARIFICATIONS AND TECHNICAL REPORT PAGE CHANGES-LOST CREEK ISR; (December 22, 2011)**

By letters dated November 11 (ML 103210590), November 16 (ML 103280186), and December 3, 2010 (ML 103490862), LCI submitted clarifications and page changes to the technical report for the Lost Creek Project, an in situ recovery (ISR) uranium facility in Sweetwater County, Wyoming, to the NRC staff. These changes were not included in the review of the application and issuance of the source material license, SUA-1598, dated August 17, 2011 (ML 111940049). LCI requested in its email and letter dated September 13 (ML 112580267) and November 8, 2011 (ML 11319A 196), respectively, that these submittals be considered as fulfilling requirements of license conditions 9.7 (providing the training program for the designee) and 12.13 (providing for NRC review and approval a revised decommissioning, decontamination and reclamation plan within 90 days of receipt of license).

**NRC staff completed its technical review of this request and offers the following request for additional information (RAI). The staff organized individual RAIs by the section in which the subject matter was in the technical report. The staff provided a basis for requesting the information for each section of the RAI.**

## NRC's RAI (#1):

### Section 2.5 Meteorology, Climatology, and Air Quality

LCI's letters dated November 11 and 16, 2010, submitted changes to the technical report (TR) that removed its commitment to continue to operate meteorological stations at both the Lost Creek and Lost Soldier sites until sufficient data was collected to support site operations without further measurements at one or both of the stations. This commitment was included in the changes to the TR provided to the NRC in an email dated June 24, 2010 (ML 101820155), and is included in LC 9.2 of SUA-1598. LCI has not provided the staff with any rationale for removing this commitment, which conflicts with the email and letter providing clarification dated September 13 and November 8, 2011, respectively. Nor has LCI provided data demonstrating that it has met the requirements in LC 12.8.

Regulatory Guide 3.63 defines the minimum amount of meteorological data needed to be that amount of data collected on a continuous basis for a consecutive 12-month period that is representative of long-term (e.g., 30 years) meteorological conditions in the site vicinity. To verify if the period of record is characteristic of long-term meteorological conditions, the regulatory guide suggests comparing a concurrent period of meteorological data from a National Weather Service (NWS) station with the long-term meteorological data from that same NWS station. Twelve months is the minimum period of data collection. If the 12-month period is not representative of long-term conditions, then the licensee needs to collect additional data until it has the licensee has demonstrated that the sample collection period is representative of longterm conditions.

LCI did not perform the proper statistical analysis to determine whether the data collected at the Lost Creek Project is representative of long-term climate trends per Regulatory Guide 3.63. Statistical approaches may include testing summary statistics, such as the mean from the short and long-term data, and testing the statistics for similarity or validity of the data by using a statistical method such as the Student's T test, Chi square test for distribution, Kolmogrov-Smirnov test for distribution, etc. Thus, the NRC staff cannot determine if the applicant collected the minimum amount of data or if the data collected is sufficient to represent long-term conditions. Because the applicant did not provide the necessary statistical analyses, continued collection of data will be required by LC 12.8 until the licensee has demonstrated that sufficient data has been collected to represent long-term conditions, which is needed to demonstrate compliance with 10 CFR Part 40, Appendix A, Criterion 7.

**Therefore, the staff requests the following:**

1. **Provide the statistical analyses demonstrating that sufficient meteorological data has been collected and is representative of long-term conditions, or**
2. **Revise the first paragraph in TR Section 2.5 to include the following text from the revision of the TR provided in LCI's correspondence dated June 24, 2010:**

   ***Because of the observed microclimatological differences between project sites and regional stations, Ur-energy is committing to operation of both the Lost Soldier and Lost Creek meteorological stations indefinitely until such time as collected site specific and regional data has been demonstrated sufficient to support site operations without further measurements at one or both of the stations. Data collection at both site stations has been on-going (except for brief interruptions) since installation (Lost soldier, April 2006; Lost Creek, May 2007).***

   **and**

**3. Other changes proposed in LCI's letter dated November 16, 2010.**

***Section 2.5 Meteorology, Climatology, and Air Quality – Lost Creek ISR, LLC Response:***

Lost Creek ISR, LLC (LCI) agrees that meteorological data has been collected at the Lost Creek Station for a minimal duration, and proper supportive statistics have not been presented to fully determine that data from the National Weather Service (NWS) Station at Rawlins is sufficiently representative of the Lost Creek Permit Area. Therefore, Lost Creek ISR, LLC, commits to operating the Lost Creek Meteorological Station indefinitely until such time as collected site specific and regional data have been demonstrated sufficient to support site operations without further measurements. **Page 2.5-2 of the Lost Creek ISR, LLC, Technical Report has been accordingly revised and is included with this submission as an attachment.**

## NRC's RAI (#2):

### Section 4.2.5.6 Activity Concentration Cleanup Criteria

**LCI** provided clean-up criteria for U concentrations in soils to cleanup following spills. The basis of the criteria was exposure limits to members of the public and workers as stated in 40 CFR 190.10 and 10 CFR Part 20, and was determined using RESRAD. The natural uranium concentrations in soils that comply with the regulatory exposure limits for workers and the public were determined to be 1,500 pCi/g and 300 pCi/g, respectively, for the thickener and yellowcake, and 1,000 pCi/g and 120 pCilg, respectively, for pregnant lixiviant. The licensee may be using concentrations for workers in operational areas that are restricted from public access and comply with 10 CFR Part 20. However, it is not clear to the staff whether these concentrations exceed exposure limits (i.e., 25 mrem/yr per 40 CFR 190.10) for the public in areas that the public has unrestricted access (e.g. a hunter). **LCI will need to determine if these concentrations can be used in the decommissioning plan as required by LC 12.13.**

### *Section 4.2.5.6 Activity Concentration Cleanup Criteria - Lost Creek ISR, LLC Response:*

Lost Creek ISR, LLC provided the results of its RESRAD analysis (Technical Report Section 5, Attachment 5.7-4) to determine Activity Concentration Cleanup Criteria which would guide ALARA efforts, and which would ensure compliance with the 10 CFR Part 20 and 40 CFR Part 190.10 worker (100mrem) and public (25mrem) exposure limits. However, transcription errors in the Technical Report text were inconsistent with the RESRAD results and consequently the Criteria in the Technical Report appeared to be elevated above the levels which would be consistent with the exposure limits. **To provide consistency with the RESRAD analysis, we have revised pages 4-21 and 4-22 and Table 4.2-2 of the Lost Creek ISR, LLC, Technical Report. Revised Section 4.2.5.6 (includes pages 4-21 and 4-22) and revised Table 4.2-2 are included with this submission as an attachment.**

**NRC's RAI (#3):**

**Section 5.3.1.1 Daily Inspections**

The licensee's description of the precise scope of the daily inspections is not consistent with RG 8.31 regarding areas inspected, and therefore is in conflict with LC 9.7, which requires that LCI follow guidance in RG 8.31. RG 8.31 states:

> *The RSO or designated health physics technician should conduct a daily walk-through (visual) inspection of all work and storage areas of the facility to ensure proper implementation of good radiation safety procedures, including good housekeeping and cleanup practices that would minimize unnecessary contamination. Problems observed during all inspections should be noted in writing in an inspection logbook or other retrievable record format. The entries should be dated, signed, and maintained on file for at least* 1*year.*

**Please provide a specific list of items to be included in the daily inspections, and, if this list is not consistent with RG 8.31, please provide a justification.**

***Section 5.3.1.1 Daily Inspections - Lost Creek ISR, LLC Response:***

In TR Section 5.3.1.1, Lost Creek ISR, LLC complied with the guidance of RG 8.31 by committing to: "The RSO, HPT, or an individual designated by the RSO (hereafter referred to as the Designee) will conduct a daily inspection of all Plant areas where radioactive materials are present and/or where direct radiation levels may be elevated." To be more specific Technical Report Section 5.3.1.1 is amended to include reference to an inspection checklist, TR Attachment 5.7-5, "Daily Radiation Safety Inspection Checklist", which will serve as the initial daily inspection tool, per LCI SOP, which may be modified, as necessary, through the LCI SOP change process to better meet the intent of the RG 8.31 guidance. **Revised Section 5.3.1.1 and the new TR Attachment 5.7-5 are included with this submission as an attachment.**

**NRC's RAI (#4):**

**Section 5.4.3.2 Designee**

RG 8.31 specifies that either an RSO or a health physics technician (HPT) perform the daily inspections. Both of these positions require specific specialized training beyond a high school education and work experience, including a demonstration of knowledge and refresher training. The staff wants to ensure that the licensee's use of a designee that does not meet the education and experience of an HPT provides an equivalent level of protection to that of Regulatory Guide 8.31. The staff's specific questions regarding the designee are, as follows:

1. LCI states that designees will rely on a checklist to complete the inspections. **Please provide this checklist for the staff's review. Note that revisions of the checklist will not be subject to license amendments, but will be part of the licensee's usual process for amending standard operating procedures.**

2. Designee Training.

   a. **Please provide the training program for designees that is in addition to the standard radiation worker training required for all employees**. Considering that RG 8.31 provides academic and experience requirements for radiation safety staff, the designee training should be a subset of the academic training, facility-specific training, and experience required by full radiation staff.

   b. **Please provide the objective manner in which the RSO assesses a potential designee's ability to perform the required tasks**. The licensee must develop this assessment in a manner that will allow the NRC staff to determine compliance with LCI's commitments.

   c. **Please discuss the manner in which the licensee will document a designee's qualifications, to allow the NRC staff to determine whether a designee has successfully completed the required qualifications program and is maintaining such qualifications.**

      i. The designee will only be required to have a high school education and 3 months experience as a radiation worker. The licensee proposes only two days of inspection in a year to maintain designee status. Two days per year is insufficient to ensure the designee will be proficient in identifying radiation safety or other potentially hazardous problems.

      ii. It is not clear that the licensee's proposal provides sufficient academic and experience requirements to address the licensee's proposed daily inspection program. For example, the licensee specifically commits to performing checks on the ventilation system and the continuous working level monitoring device.

3. Unusual Conditions. The designee is acting as an agent of the radiation safety staff, when the RSO and HPT are not present at the facility. As such, certain unusual or emergency conditions may occur in the absence of the RSO and HPT including leaks, spills, and skin contamination. Furthermore, LCI commits the RSO to performing certain daily functions, such as setting contamination monitoring alarms after determining survey meter efficiency. **In the absence of the radiation safety staff, who will respond to unusual conditions and fulfill certain daily commitments of the radiation safety staff? If these will be the designee's responsibilities, then please provide the academic and experience requirements necessary to address the aforementioned situations.**

***Section 5.4.3.2 Designee - Lost Creek ISR, LLC Response:***

**As an Attachment with this submission, Lost Creek ISR, LLC provides a revision to TR Section**

**5.4.3.2 to incorporate the functional elements of the following bullet-by-bullet response to this RAI:**

1 Please see the inspection checklist provided in response to RAI 5.3.1.1 Daily Inspections.

2a The Designee's qualifications and training will be commensurate with their level of responsibility and significance of the hazards they are attempting to recognize and mitigate. Beyond normal radiation worker duties, the Designee's duties shall be limited to completing and documenting the daily radiation safety inspection during the absence of both the RSO and HPT. The Designee shall not perform more than three consecutive days of inspection. The Designee may not perform any other RSO or HPT specific radiation safety duties (For example, the Designee will not have authority to release materials for unrestricted use or to approve a RWP.). The Designee training shall consist of the following as a minimum:

- A high school diploma.
- A minimum of three months experience working at the Lost Creek Project as a radiation worker.
- Annual radiation worker training in compliance with Reg. Guide 8.31 Section 2.5.
- A line by line review of the Daily Inspection SOP with the RSO or HPT.
- On the job-training performing daily inspections under the direct supervision of the RSO or HPT. An individual shall complete a minimum of five (5) directly supervised inspections before becoming qualified to be a Designee. In order to remain qualified as a Designee, the individual must complete at least five (5) daily inspections under the direct supervision of the RSO or HPT annually. The on the job training will consist of the following:
  - ✓ How to complete the inspection check list;
  - ✓ A review of each inspection item in the field so the potential designee understands what they are inspecting and what upset situations require notification of the RSO or HPT;
  - ✓ A discussion of findings and corrective actions resulting from recent inspections;
  - ✓ How to contact the RSO or HPT if needed;
  - ✓ A discussion of how each item on the inspection checklist affects employee safety; and
  - ✓ The candidate must accompany the RSO or HPT on at least five complete inspections before being appointed a Designee.

LCI does not believe it is appropriate to send a Designee candidate to RSO training since this position does not perform the technical duties of an RSO that are commonly taught during RSO training (such as dose calculation, instrument calibration, LLD calculation, unrestricted release surveys, employee training, etc.)

2b The RSO shall determine if an individual is qualified to be a Designee by:

- Documenting that the training requirements outlined above in 2a have been satisfactorily completed.
- Proffering a written test to determine if the individual is able to properly use the inspection sheet, recognize hazards, and report hazards to individuals responsible for implementing corrective action. The candidate must demonstrate an advanced proficiency of each of these topics before being appointed Designee.

2c The RSO shall maintain a file for each designee containing their education, training and testing qualifications as described in items 2a and 2b above. The file shall be maintained in a manner that is easily inspectable by the NRC.

2ci LCI understands the NRC's concern regarding the requirement of the Designee to participate in only two supervised inspections per year. As discussed in item 2(a) above, LCI is willing to require the Designee to perform at least five (5) daily inspections per year under the direct supervision of

the RSO or HPT in order to maintain their qualifications. Designees will be radiation workers and will therefore be engaged in recognizing and correcting radiation hazards on a daily basis. These daily duties are similar to the duties they would perform as a Designee. Therefore, performing five (5) supervised inspections per year is sufficient to ensure the Designee's qualifications.

2cii The inspection tasks required of the Designee are not highly technical in nature. The tasks consist of checking for proper signage, looking for leaks, housekeeping, etc. The RAI specifically questions the academic and experience requirements necessary to properly inspect the ventilation systems and continuous working level monitoring device. The inspection of the ventilation system will require simply ensuring all of the necessary ventilation systems are on and they are running normally; minimal noise and vibration. The inspection of the continuous working level monitoring device will simply require documenting that the light stack is operating properly. It is not necessary or practical for the Designee, or the RSO for that matter, to perform a detailed inspection of the continuous working level monitoring device on a daily frequency. In conclusion, the experience and education requirements proposed by LCI are adequate to ensure the Designee is qualified to complete the simple tasks necessary during the daily inspection.

3 The Designee will not act as an RSO or HPT in any way other than the completion of daily inspections. Certainly, a qualified RSO may determine that, in order to increase overall staff efficiency, certain routine radiation safety functions can be performed by a radiation worker other than the RSO or HPT. In such a case the RSO will use appropriate process, such as the SOP change process or even SERP, to adjust for an alternate radiation worker to perform the task. Regardless, the change will be documented and documentation of adequate training will be on file for NRC inspection. The Designee will not serve as a radiation expert with the qualifications necessary to serve as an RSO or HPT in the event of an emergency or upset condition. ISR facilities have successfully operated for decades without the presence of an RSO or HPT on nights, weekends and holidays. This work practice has historically been approved by the NRC and is consistent with the relatively low radiation risks associated with ISR facilities where radiation exposures are typically a small fraction of regulatory limits. The plant and wellfield employees (including the Designee) working at Lost Creek will be trained as radiation workers and as such will have daily responsibility for recognizing, reporting, and correcting radiation hazards.

Additionally, the RSO will be responsible for overseeing the writing of Standard Operating Procedures (SOP) that will address unusual or emergency conditions such as leaks, spills, and skin contamination. In addition to all radiation workers (including the Designee) being training on how to handle emergency conditions, the RSO or HPT will be contacted in such events so additional instruction can be provided as needed. Depending on the circumstances, the RSO or HPT may choose to go to the site to assist with the corrective action if they deem it necessary.

**NRC's RAI (#5):**

**Section 6.2 Plans for Reclaiming Disturbed Lands**

The staff finds that the applicant's plans for reclaiming disturbed lands are acceptable and consistent with the acceptance criteria in NUREG-1569 Section 6.2.3, except acceptance criterion (1). Contrary to acceptance criterion (1), however, the applicant omitted soil cleanup criteria for radionuclides other than radium-226. LC 12.13 required the applicant to submit the soil cleanup criteria to the NRC for review and approval. LCI's submission in November 2010 does not include clean-up criteria for soils. The staff is reasonably assured that LCI will properly decommission the Lost Creek Project contingent upon LCI's providing soil clean-up criteria consistent with 10 CFR 40, Appendix A, Criterion 6(6) and its commitment to submit a final decommissioning plan pursuant to 10 CFR 40.42(g)(1). **Please provide the soil clean-up criteria in accordance with 10 CFR Part 40 and LC 12.13.**

***Section 6.2 Plans for Reclaiming Disturbed Lands - Lost Creek ISR, LLC Response:***

LCI, in a letter dated November 11, 2010 (ML 103210590) submitted that TR Section 6 is the initial LCI Decommissioning Plan and as such fulfills the requirement of Preoperational Condition 12.3 of the LCI Materials License SUA-1598. **TR Section 6.5.1** discusses methods for "Determination of Soil Cleanup Criteria". However, actual cleanup criteria were not specified in TR Section 6 and there was no cross reference to **TR Section 4.2.5.6** Activity Concentration Cleanup Criteria (revision provided in response to RAI (#2) above) where the cleanup criteria were presented and discussed. The analysis **(TR Attachment 5.7-4)** by which the Cleanup Criteria were determined was in support of the discussion of "Impacts and Response to Spills in the Mine Units" in TR Section 5.6.6 Plant and Mine Unit Control.

As discussed in response to **NRC's RAI (#2)** above, there were errors in the text of **TR Section 4.2.5.6** so that the current values in the text are not consistent with the RESRAD Analysis **(TR Attachment 5.7-4).** As stated in the above response to **NRC's RAI (#2) "To provide consistency with the RESRAD analysis, we have revised pages 4-21 and 4-22 and Table 4.2-2 of the Lost Creek ISR, LLC, Technical Report. Revised Section 4.2.5.6 (includes pages 4-21 and 4-22) and revised Table 4.2-2 are included with this submission as an attachment." Therefore the RESRAD analysis (TR Attachment 5.7-4) and the revised discussion, attached Section 4.2.5.6, do provide the "soil cleanup criteria for radionuclides other than radium based on the radium benchmark method" required to fulfill the Preoperational Condition 12.3**

## ATTACHMENTS

Revised Page 2.5-2 of the Lost Creek ISR, LLC, Technical Report

Revised Section 4.2.5.6 and revised Table 4.2-2 of the Lost Creek ISR, LLC, Technical Report

Revised Section 5.3.1.1 and new Attachment 5.7-5 of the Lost Creek ISR, LLC, Technical Report

Revised Section 5.4.3.2 of the Lost Creek ISR, LLC, Technical Report

Additional Information (RAI) from NRC (Nov 2008 RAI Section 2.5)], and that information has also been incorporated. The original presentation of the data (in either tables or figures) has been retained, and the more recent comparisons added. For example, the original comparison of temperature data from the LS and Muddy Gap stations was included in **Table 2.5-1**. That table has been renumbered as **Table 2.5-1a**, and the comparison of temperature data from the LC, LS, Muddy Gap, Jeffrey City, and Rawlins stations added as **Table 2.5-1b**. In addition, a statistical study was conducted to verify that the short-term meteorological data used to compare the LC site to the Rawlins station were representative of the long-term Rawlins meteorology. The comparison statistics are presented in **Attachment 2.5-1**. This comparison suggests that, compared over the time same interval, the Rawlins station meteorology is representative of the LC station meteorology, and that the short-term Rawlins data are representative of the long-term Rawlins meteorology. However, until such time as collected site specific and regional data have been demonstrated sufficient to support site operations without further measurements the LC station will continue to operate (In November of 2010 the LS station was dismantled.)

Meteorological instrumentation at the LS and LC stations consists of the following sensors mounted on a 10 m tower:

- Vaisala Temperature and Relative Humidity Probe: temperature range of -40 to 60°C; accurate to ±2% at 10-90% relative humidity and to ±3% at greater than 90% humidity; shielded by RM Young 10-Plate Gill Solar Radiation Shield and mounted at 2 m.
- Dual Met One Model 062 Temperature Probes: used for measurement of differential temperature (ΔT) for dispersion and inversion modeling; temperature range of -50 to 50° C; sensors accurate to ±0.05° C; sensors co-calibrated for a maximum error per degree of differential temperature of 0.02° C; shielded by Met One Model 077 Aspirated Shields and mounted at 2 m and 10 m.
- Met One 3-Cup Anemometer and Wind Vane: range of 0 to 50 m/s (0 to 110 mph); anemometer accurate to ±0.11 m/s when less than 10.1 m/s or ±1.1% of true when greater than 10.1 m/s; vane accurate to ±4°; mounted at 10 m.
- Texas Electronics Tipping Bucket Rain Gage with 8" Orifice: accurate to ±1% at rain fall rates up to 1 inch/hour; resolution of 0.01 inches; mounted on freestanding post approximately 1 m high, and 5 m from tower.
- LI-COR Silicon Pyranometer: measures incoming radiation with wavelengths in the daylight spectrum; measures wavelengths between 400 and 1100 nm; accurate to within 3-5%; mounted at 10 m.

The sensors were connected to a Campbell Scientific CR10X data logger at the LS station and a CR1000 data logger at the LC station. The data recovery rate for each station was greater than 90 percent.

**Spill Response and Remediation**

In the event of a spill of mining or process solutions, LC ISR, LLC will recover as much of the fluid as possible using equipment designated for this purpose. SOPs will be established to provide ALARA methods for spill recovery. The RSO or HPT will be notified of the spill immediately so they can visit the site and perform an assessment of the radiologic risks. The assessment will include:

- A drawing of the affected area so the location can be identified at decommissioning;
- a determination of the amount of fluid spilled;
- a calculation or analysis to determine the concentration of radionuclides in the soil;
- a determination of the cause of the spill;
- a determination of safety precautions that need to be taken immediately, if any;
- a determination of the extent and timing of soil cleanup; and
- a determination as to whether or not reporting is required pursuant to 10 CFR 20.2202 and 20.2203 and 10 CFR 40.60. If reporting is necessary the RSO shall complete the report in the time frame designated in the applicable regulations.

The RSO or HPT may call upon the expertise of the area supervisor to assist with the assessment. The results of the assessment will be filed in a decommissioning file until the license is terminated.

At least once per year, the Manager of Environmental Health and Safety (EHS) and Regulatory Affairs will convene a Spill Committee to review the cause of recent spills. The Spill Committee will consist of at least three individuals with experience in operations. After reviewing the causes of recent spills, the Committee will send a report to mine management detailing reasonable recommendations on how to prevent and minimize future spills.

## *4.2.5.6 Activity Concentration Cleanup Criteria*

Accident scenarios for ISR facilities are described in detail in NUREG/CR-6733 (NRC, 2001). Potential doses from such incidents are estimated based on the assumption that a spill would not be cleaned up immediately and would be allowed to dry (The term $U_3O_8$ has historically been used by both the industry and the NRC to refer to uranyl peroxide and various uranium oxides. Technically, $U_3O_8$ does not exist but the term is commonly used in marketing the end product. When LC ISR, LLC refers to $U_3O_8$, it is referring to uranyl peroxide in solution, slurry, or dried yellowcake... This usage of the term is consistent with the analysis performed in NUREG/CR-6733. A further review of other

portions of NUREG/CR-6733 reveals that the terms uranyl peroxide and $U_3O_8$ are used interchangeably.). In such a case, the most significant potential route of exposure to workers and members of the public would be limited to inhalation of airborne radioactive material. However, with regard to residual contamination remaining after spill cleanup is completed, the doses to workers would include direct radiation dose as well as inhalation of particulates. The dose to a member of the public with unrestricted access to and use of the impacted area could include a variety of pathways.

LC ISR, LLC will conduct operations, to include spill cleanup, in agreement with the ALARA principle and the "member of the public" and worker dose requirements of 10 CFR 20 and the "member of the public" requirements of 40 CFR 190.10. However, since access to spill locations will be restricted during the years of operation, only those exposure pathways consistent with the site access restrictions and existing land use will be used to meet these regulatory requirements.

LC ISR, LLC's direct radiation surveys and correlations to measured soil Ra-226 ($R^2$=0.88; **Figure 2.9-7**) and soil Ra-226 correlations to measured soil uranium ($R^2$=0.73; **Figure 2.9-8**) provide the basis for uranium and radium soil background concentrations characterized over the Lost Creek Permit Area. However, should spills occur, LC ISR, LLC will collect additional soil samples outside the spill margins to further characterize the soil radionuclide concentrations so that when combined with the radionuclide analysis of the spill content, accurate cleanup levels can be established to meet the decommissioning "Radium Benchmark Dose" of 10 CFR 40, Appendix A, Criterion 6. This will assure there will be no appreciable radionuclide migration off the spill location, and final decommissioning will be facilitated.

The following discussion illustrates how LC ISR, LLC will use RESRAD analysis to establish soil cleanup criteria, and presents proposed initial cleanup criteria.

**Activity Concentration Cleanup Criteria for a Spill at the Lost Creek Permit Area**

NUREG/CR-6733 (NRC, 2001) describes spill scenarios involving solid or liquid materials, including thickener failure and spill, pregnant lixiviant spill, and loaded resin spill.

NUREG/CR-6733 assumes no initial cleanup in its risk assessments for the spill scenarios and assumes the spill would be allowed to dry. LC ISR, LLC is committed to taking all necessary precautions to ensure that such spills do not occur. However, in the unlikely event of a spill of solids or liquids containing radioactive material, appropriate actions will be taken initially to remove spilled material and clean up the impacted areas to levels such that residual radiation doses to workers from the spill following initial cleanup would be less than 100 mrem per year (LC ISR, LLC perceives this as an initial

ALARA target for workers) and doses to members of the public, no greater than 25 mrem per year. Spill-impacted areas will be cleaned up to reduce doses to ALARA below these levels. Further cleanup of impacted areas, if necessary to meet criteria for unrestricted use, would be included in the final decontamination and decommissioning of the facility. LC ISR, LLC will use RESRAD as appropriate, using analysis results from cleanup samples to verify that the above goals have been met.

The following analyses assume that a spill inside the restricted area would impact workers during operations, and that a spill outside the restricted area could impact members of the public with unrestricted access to, and use of, the impacted area. Since the intent of these analyses is to develop criteria for residual contamination after spill cleanup, it does not need to address dose from the spill itself or resulting cleanup operations to workers (whose dose will be controlled under the in place, approved radiation protection and ALARA programs) or members of the public (who cannot have unrestricted access during licensed operations or who would not have access to affected unrestricted areas during cleanup). The initial LC ISR, LLC cleanup criteria discussed in the following paragraphs are summarized in **Table 4.2-2**.

**Thickener Failure and Spill**

NUREG/CR-6733 postulates a spill of 73,500 gallons of slurry containing 24,200 kg of $U_3O_8$. If such an incident were to occur, the cleanup criteria would be dependent on the potential dose from natural uranium. According to NUREG/CR-6733, the sole substantial radiological hazard would be inhalation of airborne particulate matter. However, based on a RESRAD analysis, the primary contributor to dose from natural uranium would be external exposure (ground) presumably from beta and gamma radiation from the immediate decay products of U-238 (Th-234 and Pa-234m).

Any portion of the spill inside a building or containment would be cleaned up immediately and would not have the opportunity to dry out and become airborne. Therefore, doses to workers would be limited to the initial cleanup phase. The criterion for immediate cleanup within a building or containment would be based on the presence of visible residues, i.e., any visible loose spill material would be removed. Liquids that are absorbed into surface material such as concrete would not present a significant inhalation hazard as the uranium would not become airborne. A spill outside the building with the potential to contaminate soils would also be cleaned up immediately before the material could dry sufficiently to become an airborne dust hazard.

Spills within the restricted area will be cleaned up to levels that are ALARA. At a minimum, the impacted areas will be cleaned up to levels that would limit the residual, post cleanup dose to a worker to less than 100 mrem per year. Based on a RESRAD analysis, a U-nat concentration in soil equal to100 pCi/g would result in an annual dose

of 2.5 mrem/year. Since the dose is proportional to the concentration of uranium in soil, a cleanup level of 4000 pCi/g would result in an annual dose to a worker spending all of his or her 2,000 hr working year in the spill area approximately equal to 100 mrem per year, 76% from direct external exposure, 14% from inhalation of particulate matter, and 10% from soil ingestion. The RESRAD default dust concentration (0.1 $mg/m^3$) was used in the analysis. However, an increase in the assumed dust concentration to 1 $mg/m^3$ (to allow for possible LC site wind and dust conditions) would decrease the estimated cleanup criterion to 1,700 pCi/g due to the increased dose from inhalation of airborne particulate matter. An appropriate cleanup standard for spills within the restricted area, based on protection of workers, including a reasonable safety factor, is 1,500 pCi/g U-nat. LC ISR, LLC proposes this as the initial cleanup criterion for a spill of this nature.

Based on a RESRAD analysis, the dose to a member of the public at 100 pCi/g U-nat would be approximately 8 mrem per year, approximately 60% from direct external exposure, 10% from inhalation of particulate matter, and 30% from ingestion of locally grown plants, meat, and milk, as well as ingestion of soil. The estimated U-nat concentration in soil resulting in a dose of 25 mrem per year would be approximately 240 pCi/g above soil background concentration. This analysis is very conservative because it includes food chain pathways even though it is unlikely that food would be raised in the impacted area. LC ISR, LLC proposes this as the initial cleanup criterion for a spill of this nature in an unrestricted area.

**Pregnant Lixiviant and Loaded Resin Spills**

In its risk analysis, NUREG/CR-6733 assumes the pregnant lixiviant and loaded resin contains Ra-226 at a concentration of 3.4E3 pCi/L and U-nat at a concentration of 1.7E5 pCi/L. The short-lived decay products of Rn-222 were assumed to be in equilibrium with the Ra-226. As with the thickener spill scenario, the impacted area would be cleaned up immediately. The criteria for cleanup were calculated assuming a maximum annual dose to a worker of 100 mrem per year and 25 mrem per year for a member of the public. The RESRAD analysis was performed assuming a nominal U-nat concentration of 100 pCi/g in soil and a Ra-226 concentration of 2 pCi/g in soil, the ratio of the nuclides specified in NUREG/CR-6733. The appropriate clean up criterion was determined by scaling the nominal concentration.

Based on the most conservative RESRAD analysis, assuming an air particulate concentration of 1 $mg/m^3$, (again allowing for possible LC site wind and dust conditions) the estimated annual dose to a worker at a U-nat concentration in soil of 100 pCi/g and a Ra-226 concentration of 2 pCi/g, was approximately 10 mrem/year. Therefore, the cleanup criterion for U-nat would be 900 pCi/g with 18 pCi/g Ra-226 above soil background levels. LC ISR, LLC proposes this as the initial cleanup criterion for a spill of this nature.

The RESRAD-estimated dose to a member of the public from residual contamination after a spill of pregnant lixiviant (loaded resin spills will only occur in restricted areas since LC ISR, LLC does not intend to ship loaded resin at this time. If, in the future, resin is shipped from or to the site, additional analysis will be performed), assuming a U-nat concentration of 100 pCi/g and a Ra-226 concentration of 2 pCi/g, was 20 mrem/year. Therefore, based on a dose limit of 25 mrem per year, the cleanup criterion for members of the public would be 90 pCi/g U-nat, 1.8 pCi/g Ra-226. LC ISR, LLC proposes this as the initial ALARA target cleanup criterion for a spill of this nature; however, following a spill of this nature, LC ISR, LLC will use RESRAD with appropriate current land use and actual spill concentrations of Ra-226 and U-nat to re-determine the appropriate and justifiable cleanup criterion. Regardless, the cleanup criterion will meet the decommissioning "Radium Benchmark" of 10 CFR 40, Appendix A, Criterion 6.

**Yellowcake Spill**

LC ISR, LLC will apply the same cleanup criterion for a yellowcake spill, as for the thickener spill since in both cases the only nuclide of concern is uranium (NUREG/CR-6733).

In all cases, LC ISR, LLC will clean spills up as soon as practicable and will restrict access to the impacted area until the cleanup criteria are met. The above calculations are based on the assumed concentration ratio of U-nat to Ra-226 in the plant radioactive materials. The criteria will be adjusted if site specific data show a different assumption should be used.

# 4.3 Solid Wastes

Solid wastes, some of which will be classified as NRC 11(e)(2) byproduct materials, will be produced during construction, operation, and reclamation activities of the Project. Appropriate storage, treatment, and disposal methods for these wastes differ, as outlined below.

## 4.3.1 Solid Non-11(e)(2) Byproduct Materials

The solid non-11(e)(2) byproduct materials will include: non-hazardous materials typical of office facilities, such as paper, wood products, plastic, steel, biodegradable items, and sewage sludge; and hazardous materials also typical of office and ISR facilities, such as waste petroleum products and used batteries. None of these materials are closely associated with ISR and ore processing.

**Table 4.2-2 Summary of Initial Soil Cleanup Criteria**

| Exposure Scenario | Worker (above background) | Public (above background) |
|---|---|---|
| Thickener and Yellowcake | U-nat = 1,500 pCi/g | U-nat = 240 pCi/g |
| Pregnant Lixiviant and Loaded Resin | U-nat = 900 pCi/g<br>Ra-226 = 18 pCi/g | U-nat = 90 pCi/g<br>Ra-226 = 1.8 pCi/g |

## 5.3.1 Radiation Safety Inspections

### *5.3.1.1 Daily Inspections*

The RSO, HPT, or an individual designated by the RSO (hereafter referred to as the Designee) will conduct a daily inspection of all Plant areas where radioactive materials are present and/or where direct radiation levels may be elevated. The areas inspected will include, but shall not be limited to, the Plant, byproduct storage area, and Storage Ponds. The inspector will look for and report to the Operations Manager, Site Supervisor EHS/RSO and Mine Manager all non-conformances with regulations, SOPs, and ALARA principle. The inspector shall record date, name, areas inspected, and findings for each item on the inspection checklist (Attachment 5.7-5). If corrective actions are necessary, they shall be implemented as soon as is practicable. Corrective actions taken shall be documented. Documentation shall be maintained until license termination. At a minimum, the inspector will specifically check the ventilation systems, signage, security features, and the status of the Continuous Working Level (CWL) monitoring device.

The RSO may only designate an individual to perform daily inspections if that individual meets the training and experience qualifications outlined in Sections 5.4.3.2 and 5.5. A Designee may only be appointed to perform daily inspections that occur on weekends, holidays, and times when both the RSO and HPT(s) must both be gone at the same time (for example, illness or offsite training). In no case shall a Designee perform daily inspections for more than three consecutive days. The Designee has no authority to perform health physics duties outside the scope of his/her regularly assigned duties. For example, the Designee will not have authority to release materials for unrestricted release or to approve a RWP. On the first day the RSO or HPT return to work, the daily inspection checklist used by the Designee must be reviewed by the RSO or HPT. During periods when a Designee is used to complete daily inspections, either the RSO or HPT must be reachable by telephone to provide assistance.

### *5.3.1.2 Weekly Operations Inspections*

The RSO and Operations Manager, or their designees in their absence, shall perform a weekly inspection of all areas of the facility where radioactive materials and/or radiation levels above background may be present. The inspectors shall ensure that all regulations, SOPs and ALARA principles are being followed. The inspectors shall also look for ways to improve the operation in order to minimize exposure to radionuclides. The RSO or their designee shall perform the weekly inspection by listing the date, areas visited, names of inspectors, and inspection findings. Inspection findings shall be reported to the

# Daily Radiation Safety Inspection Checklist

**Date:** **Name of Inspector:**

| | OK | Corrective Action |
|---|---|---|
| **Control Room** | | |
| Housekeeping | | |
| Operator log reviewed | | |
| Operator inspections complete | | |
| **Chemical Storage Area** | | |
| Leaking pipes | | |
| Signage at entry door | | |
| Housekeeping | | |
| **RO Area** | | |
| Leaking Pipes | | |
| Signage on entry doors | | |
| Housekeeping | | |
| Radiation area boundaries | | |
| **IX/Elution Area** | | |
| Leaking pipes | | |
| Wall ventilation | | |
| Radiation area boundaries | | |
| Signage on entry doors | | |
| Housekeeping | | |
| Continuous radon meter | | |
| IX ventillation | | |
| Elution ventillation | | |
| Shaker deck ventillation | | |
| **Precipitation Area** | | |
| Leaking pipes | | |
| Tank ventillation issues | | |
| Housekeeping | | |
| **Dryer Area** | | |
| Leaking Pipes | | |
| Signage on entry doors | | |
| Housekeeping | | |
| **Byproduct Storage** | | |
| Proper waste packaging | | |
| Housekeeping | | |

# Daily Radiation Safety Inspection Checklist

| | OK | Corrective Action |
|---|---|---|
| **Drum Storage** | | |
| Yellowcake spillage | | |
| Signage on entry doors | | |
| Housekeeping | | |
| Radiation area boundaries | | |
| **Shop** | | |
| Housekeeping | | |
| Signage on entry doors | | |
| **Lab** | | |
| Housekeeping | | |
| Proper container labeling | | |
| **Employees** | | |
| Proper eye PPE | | |
| Proper use, personal dosimetry | | |
| Proper foot PPE | | |
| Proper hand PPE | | |

**Signature** **Date**

Reviewed daily by RSO or HPT: _____

Reviewed daily by Plant Operator: _____

Reviewed weekly by Plant Foreman: _____

Plant Operator & RSO or HPT must review after inspection (or first workday after weekend or holiday)
Plant Foreman or more senior position must review within one week of the inspection

- a thorough knowledge of the proper application and use of all health physics equipment used during uranium recovery activities, the chemical and analytical procedures used for radiological sampling and monitoring, methodologies used to calculate exposure to uranium and its daughters, and a thorough understanding of the uranium recovery process and equipment used and how the hazards are generated and controlled during the uranium recovery process.

### 5.4.3.1 Health Physics Technician

The HPT will have one of the following combinations of education, training, and experience.

Option I:

- an associate degree or two or more years of study in the physical sciences, engineering, or health related field;
- at least a total of four weeks of generalized training (up to two weeks may be on-the-job training) in radiation health protection applicable to uranium recovery facilities; and
- one year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium recovery facility; or

Option II:

- a high school diploma;
- a total of at least three months of specialized training (up to one month may be on-the-job training) in radiation health protection relevant to uranium recovery facilities; and
- two years of relevant work experience in applied radiation protection.

### 5.4.3.2 Designee

The Designee's qualifications and training will be commensurate with their level of responsibility and significance of the hazards they are attempting to recognize and mitigate. Beyond normal radiation worker duties, the Designee's duties shall be limited to completing and documenting the daily radiation safety inspection during the absence of both the RSO and HPT. The Designee shall not perform more than three consecutive days of inspection. The Designee may not perform any other RSO or HPT specific radiation safety duties (For example, the Designee will not have authority to release materials for unrestricted use or to approve a RWP.). The Designee training shall consist of the following as a minimum:

- A high school diploma.
- A minimum of three months experience working at the Lost Creek Project as a radiation worker.

- Annual radiation worker training complying with Reg. Guide 8.31 Section 2.5.
- A line by line review of the Daily Inspection SOP with the RSO or HPT.
- On the job-training performing daily inspections under the direct supervision of the RSO or HPT. An individual shall complete a minimum of five (5) directly supervised inspections before becoming qualified to be a Designee. In order to remain qualified as a Designee, the individual must complete at least five (5) daily inspections under the direct supervision of the RSO or HPT annually. The on the job training will consist of the following:
  - ✓ How to complete the inspection check list;
  - ✓ A review of each inspection item in the field so the potential designee understands what they are inspecting and what upset situations require notification of the RSO or HPT;
  - ✓ A discussion of findings and corrective actions resulting from recent inspections;
  - ✓ How to contact the RSO or HPT if needed;
  - ✓ A discussion of how each item on the inspection checklist affects employee safety; and
  - ✓ The candidate must accompany the RSO or HPT on at least five complete inspections before being appointed a Designee.

  LC ISR does not believe it is appropriate to send a Designee candidate to RSO training since this position does not perform the technical duties of an RSO that are commonly taught during RSO training (such as dose calculation, instrument calibration, LLD calculation, unrestricted release surveys, employee training, etc.)

The RSO shall determine if an individual is qualified to be a Designee by:

- Documenting that the training requirements outlined above in 2a have been satisfactorily completed.
- Proffering a written test to determine if the individual is able to properly use the inspection sheet, recognize hazards, and report hazards to individuals responsible for implementing corrective action. The candidate must demonstrate an advanced profiency of each of these topics before being appointed Designee.

The RSO shall maintain a file for each designee containing their education, training and testing qualifications as described above. The designation of an individual will be documented in the file and the file shall be maintained in a manner that is easily inspectable by the NRC.

## 5.4.4 Department Heads

These positions require a bachelor's degree in engineering or associated science degree from an accredited college or university or an equivalent level of work experience, plus a minimum of two years of managerial experience in engineering, geology, or operational functions.