TECHNICAL EVALUATION REPORT

Review and Verification of Lost Creek's Mine Unit 2 Data Package
Lost Creek ISR Facility, Sweetwater County, Wyoming

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LICENSEE: Lost Creek ISR, LLC

SITE: Lost Creek Facility, Sweetwater County, Wyoming

PROJECT MANAGER: John L. Saxton

TECHNICAL REVIEWER: John L. Saxton

SUMMARY AND CONCLUSIONS

By letter dated July 12. 2016 (NRC's Agencywide Documents Access and Management System (ADAMS) Accession number ML16202A016), Lost Creek ISR, LLC (Lost Creek or LCI) submitted to the NRC a request to review its Mine Unit (MU) 2 Data Package. The data package was submitted pursuant to License Condition 10.12 of Source and Byproduct Materials License SUA-1598. By email dated September 20, 2016 (ML17094A397), the NRC staff issued Lost Creek a summary of verification issues. By letter dated March 15, 2017 (ML17087A007), Lost Creek provided responses to staff's verification issues.

The NRC staff has completed its review of Lost Creek's Mine Unit 2 Data Package and finds it acceptable because it is consistent with commitments in the approved Lost Creek License Application and applicable License Conditions (LCs). The NRC staff documents the justification for its actions in this Technical Evaluation Report (TER).

INTRODUCTION

Lost Creek operates its Lost Creek ISR facility under NRC Source and Byproduct Materials License SUA-1598 (ML111751649). License condition 10.12 requires Lost Creek to submit each wellfield data package (hydrologic test data package) for NRC review and verification. The specific language in LC 10.12 is as follows:

> Wellfield Packages. Prior to principal activities in a new wellfield, the licensee shall submit a hydrologic test data package to the NRC for review. The licensee shall submit a hydrologic test package at least 60 days prior to the planned start date of lixiviant injection. In each wellfield data package, the licensee will document that all perimeter monitoring wells are screened in the appropriate horizon in order to provide timely detection of an excursion. The licensee shall

Enclosure

not proceed with any lixiviant injection in the new wellfield before it receives written NRC verification of the submitted hydrologic test data package.

TECHNICAL EVALUATION

The wellfield package was reviewed using commitments in the approved license application, as amended, and the applicable license conditions. The commitments in the approved license application are:

(1) Submittal of an initial decommissioning plan;
(2) Installation of the required monitoring wells;
(3) Results and interpretation of hydrologic tests;
(4) Demonstration of connection of monitoring ring wells to the production zone (December 12, 2008 submittal); and,
(5) Baseline water quality to establish a Commission Approved Background concentration and the excursion parameter's Upper Control Limit (UCL).

By LC 10.10, LCI is required to submit a report to the NRC documenting its efforts to abandon historic drillholes prior to start of operations in a wellfield. By LC 10.12, LCI is required to submit the wellfield hydrologic test package prior to conducting principal activities (lixiviant injection). By LC's 11.3 and 11.4, LCI is required to establish the Commission Approved Background Concentrations and excursion parameter UCL's using its approved sampling program, respectively.

Staff reviewed LCI's MU2 Wellfield package using, as guidance, the review procedures and acceptance criteria listed in NUREG-1569, Standard Review Plan for In Situ Leach Uranium Extraction License Applications (Standard Review Plan) Section 5.7.8.2 (1), (2), (3) and (4), and Section 5.7.8.3 (1), (2), (3) and (4). These procedures assess whether the licensee has: (1) adequately sampled for and established the baseline water quality and restoration target values (RTVs) for the ore zone production area; (2) adequately sampled for and established excursion monitoring well upper control limits (UCLs); (3) established acceptable excursion monitoring well locations; and (4) verified horizontal continuity between the production zone and perimeter wells and vertical isolation between the production zone and vertical excursion monitor wells. In addition, the licensee is expected, in this wellfield package, to show compliance with all related LCs.

NRC staff has determined that the information submitted in the LCI's Mine Unit 2 wellfield package meets the LC 10.12 requirement. The submission provides background ground water quality data, restoration target values, upper control limits at each monitoring well, as well as the information outlined in Section 5.7.8.2 of the license application:

1. A description of the location, extent, etc., of the production area
2. Map(s) showing the proposed production area (production patterns) and location of all monitoring wells
3. Geologic cross section maps
4. Isopach maps of the or zone , underlying , and overlying confining units
5. Discussion on pumping test methods including well completion reports
6. Discussion of the results and conclusions of the pumping tests
7. Data showing monitor well ring and ore zone are in communication

Standard Review Plan Section 5.7.8.2 review procedure (1) and Section 5.7.8.3 acceptance criteria (1) address the establishment of baseline ground water quality for the production area. In addition, NRC License SUA-1598 contains a specific LC 11.3 that addresses background water quality. License condition 11.3 states:

11.3 *Establishment of Background Water Quality. Prior to injection of lixiviant in each production area, the licensee shall establish background ground-water quality data for the ore zone, and overlying and underlying aquifers. The background-water quality will be used to define the background ground-water protection standards in 10 CFR Part 40, Appendix A, Criterion 5B(5) for the ore zone aquifer and surrounding aquifers. Water quality sampling shall provide representative pre-operational ground-water quality data and restoration criteria as described in Section 5.7.8.1 of the approved license application.*

The data for each production area shall consist, at a minimum, of the following sampling and analyses:

A) Ore Zone. Samples shall be collected from production and injection wells at a minimum density of one production or injection well per 4 acres. A minimum of six wells will be required for the baseline data per mine unit. The data for subhorizons may be combined if the licensee demonstrates that the grouping of data is statistically valid. Wells selected for the baseline data will be the same ones used to determine when restored ground water meets the NRC's ground-water protection standards in 10 CFR Part 40, Appendix A, Criterion 5B(5).

B) Perimeter Monitoring Wells. Samples shall be collected from all perimeter monitoring wells that will be used for excursion monitoring in the HJ Horizon. Perimeter wells will be installed for a mine unit in accordance with information presented in Section 3.2.2.2 of the approved license application. In no case will the perimeter monitoring wells be installed outside of the exempted aquifer as defined by the UIC permit area issued by the Wyoming Department of Environmental Quality. If the production patterns include multiple subhorizons within the HJ Horizon, the above requirements will be applicable to all subhorizons.

C) Overlying and Underlying Aquifers. Samples shall be collected from all monitoring wells in the first overlying and first underlying aquifer at a minimum density of one well per 4 acres of production area.

D) Sampling and Analyses. Four samples shall be collected from each well to establish background levels. Consecutive sampling events shall be at least 14 days apart. The samples shall be analyzed for parameters listed in Table 6.2-1 of the approved license application. The licensee can reduce the list of parameters analyzed in the third and fourth sampling events. The parameters that can be deleted from analysis are those that measure below the minimum analytical detection limits (MDL) during the first and second sampling events, provided the MDLs meet the data quality objectives for the sampling.

E) <u>Background Water Quality.</u> For the perimeter monitoring wells (LC 11.3(B)) and monitoring wells in the overlying and underlying aquifers (LC 11.3(C)), the background levels shall be the mean values on a parameter-by-parameter per well-by-well basis in accordance with Section 6.2.2 of the approved license application. For the ore zone monitoring wells, the background levels shall be established on a parameter-by-parameter basis using either the wellfield or well-specific mean value. The restoration target value (RTV) for each parameter shall be established using the mean value plus a statistically valid factor to account for spatial variability in the data.

The licensee provided the baseline ground water quality for overlying, perimeter, underlying and the production ore zone aquifers in the wellfield package in Attachment MU2 4-1 and the addendum attached to the cover letter as required by LC 11.3 Subparts A, B, and D. For each aquifer, four samples were taken at least 14 days apart and analyzed for the parameters listed in Table 2.7-12 of the approved license application. The data was provided in both electronic form and hard copy form. The licensee established the wellfield ore zone aquifer background ground water quality using approved statistical approaches on a production area basis. As required in LC 11.3 Subpart E, the RTVs for the ore zone production aquifer, also provided in Attachment MU2 4-1, were established on a parameter-by parameter basis as the baseline mean plus three standard deviations.

The licensee provided well completion data and geophysical logs for all wells in Attachment MU2 1-1. The licensee also provided quality control/quality assurance information for the baseline water quality sampling in tables MU2 4-6 (Field Blanks), MU2 4-7 (Duplicate Samples) and MU2 4-8 (Outlier analyses). No discrepancies were detected among the figures, tables or sampling data sheets in the wellfield package. For these reasons, NRC staff finds the measurement of wellfield baseline water quality and the proposed RTVs to be acceptable.

Standard Review Plan Section 5.7.8.2 review procedure (2) and Section 5.7.8.3 acceptance criteria (2) address the establishment of UCLs for a production area. In addition, NRC License SUA-1598 contains a specific LC 11.4 that addresses UCLs for excursion monitoring wells:

11.4 <u>Establishment of Upper Control Limits (UCLs)</u>. Prior to injection of lixiviant into a production area, the licensee shall establish excursion control parameters and their respective upper control limits (UCLs) in the designated overlying aquifer, underlying aquifer, and perimeter monitoring wells in accordance with Section 5.7.8.2 of the approved license application. Unless otherwise determined, the default excursion parameters are chloride, conductivity, and total alkalinity. The UCLs shall be established for each excursion control parameter and for each well based on the mean plus five standard deviations of the data collected for LC 11.3. The UCL for chloride can be set at the sum of the background mean concentration and either (a) five standard deviations or (b) 15 mg/L, whichever sum provides the higher limit.

The licensee measured the UCL indicator parameters in the overlying perimeter ring and underlying excursion monitoring wells in the wellfield package and provided the sample results in Attachment MU2 4-1. For each set of excursion monitoring wells, six samples were taken at least 14 days apart and analyzed for the UCL indicator parameters of chloride, conductivity, and total alkalinity. The data were provided in both electronic form and hard copy form. The licensee established the UCLs using approved statistical approaches. The final UCLs, also

listed in Attachment MU2 4-1 and the Addendum to the Cover Letter, for overlying perimeter ring and underlying excursion monitoring wells, respectively, were set as the mean plus five standard deviations.

The licensee conducted mechanical integrity testing (MIT) tests on all excursion monitoring wells. Results of the MIT were provided for all wells in Table MU2 2-1b. The licensee only used wells which passed MIT to sample for the excursion indicators. No discrepancies were detected among the figures, tables or sampling data sheets in the wellfield package. For these reasons, NRC staff finds the measurement of excursion monitoring well UCL indicators and the UCLs provided to be acceptable.

Standard Review Plan Section 5.7.8.2 review procedures (3) and Section 5.7.8.3 acceptance criteria (3) address the establishment of acceptable excursion monitoring well locations. In Section 2.0 of the wellfield package report, the licensee evaluated and confirmed the geological characterization of MU2 by providing detailed cross sections and isopachs derived from the well boring logs. The licensee determined that the FG, HJ and KM horizons within MU2 were the upper, ore and underlying aquifers consistent with the conceptual model in the approved license application. In addition, the Lost Creek Fault and system of faulting identified in MU1 extends into MU2. The displacement and conceptual model of the faulting in MU2 is consistent with that for Mine Unit 1. The NRC staff reviewed the number, location, and screened interval of the excursion monitoring wells in the overlying and underlying aquifers, and on the perimeter ring. NRC staff finds the information meets the commitments in the approved license application and is therefore acceptable.

In Section 5.3, the licensee stated re-abandoned 137 of the 144 historic drillholes within the MU2 boundary. The licensee stated if any such wells were located in the future they would be abandoned according to Wyoming Department of Environmental Quality rules.

Standard Review Plan Section 5.7.8.2 review procedures (4) and Section 5.7.8.3 acceptance criteria (4) address the need for the licensee to verify horizontal continuity between the production zone and perimeter wells and vertical isolation between the production zone and vertical excursion monitor wells. In Section 2.0, the licensee presented the design, analysis, and results of two separate pumping tests it conducted to establish the hydrogeological characteristics and isolation of the ore zone production aquifer in MU2. The first pumping test was performed north of the major faulting and the second pumping test was performed south of the faulting zone. The two pumping tests confirmed a hydrologic connection between ore zone wells and the perimeter ring excursion monitoring wells on the respective side of the faulting. The test also confirmed that there was limited to no response in the overlying and underlying aquifers or across the fault zone. This limited response supported the finding that the overlying and underlying aquitards have sufficient thickness and integrity to provide adequate confinement ore zone production aquifer. In addition, the licensee confirmed the hydrologic characteristics of transmissivity (36 to 160 ft^2/day) and storativity ($4.1x10^{-5}$ to $1.0x10^{-4}$) for the production zone aquifer north of the Fault, and transmissivity (108 to 373 ft^2/day) and storativity ($5.3x10^{-5}$ to $2.4x10^{-4}$) for the production zone aquifer south of the Fault. The NRC staff finds these values to be in agreement with the values provided in the license application. NRC staff finds the design, time period, analysis, and results of the two pumping tests to be acceptable.