August 8, 2023

Mr. James Smith
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Ms. Rachel Miller
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

Re: Docket No. 07000925; License No. SNM-928
Cimarron Environmental Response Trust
Determination of Distribution Coefficients for Use in the Cimarron Decommissioning Plan

Dear Recipients:

During a July 24, 2023, presentation on the groundwater flow models and estimated durations of remediation, the U. S. Nuclear Regulatory Commission (NRC) asked questions related to the development of distribution coefficient (K_d) values used in performing the groundwater remediation duration estimates. Environmental Properties Management LLC (EPM) asserts that the NRC and the Oklahoma Department of Environmental Quality (DEQ) previously accepted the K_d values that were used in preparing these estimates and the last two revisions of the decommissioning plan for the Cimarron Site. Neither of the NRC's current hydrogeologists were aware of the development and previous acceptance of the K_d values.

EPM submits herein a summary of the communications between EPM and the NRC regarding the development of K_d values in an effort to resolve NRC concerns prior to the issuance of requests for additional information (RAIs) pertaining to *Facility Decommissioning Plan – Rev 3*.

- EPM submitted *Facility Decommissioning Plan – Rev 1* (ML16032A285) on December 31, 2015.
- Meetings with EPM, NRC, and DEQ personnel were conducted June 15-16, 2016, during which the D-Plan was presented, and issues of interest to the NRC and the DEQ were identified and discussed.
- An email submitted to the NRC and the DEQ on June 27, 2016, contained notes from the June 15-16 meetings (Attachment 1). The meeting notes state, "Estimates of duration are highly dependent upon the desorption of uranium from solids into groundwater, and the distribution coefficient (K*d*) is the most sensitive parameter upon which this is determined. Discussions were held concerning how K*d* had been calculated in the past. EPM committed to drafting a paper describing how K*d* had been determined, and providing the reports from the consultants who had performed the testing and the calculations. The paper will include EPM's recommendations for either performing

additional sampling and analysis during construction or revising duration estimates based on in-process monitoring data once groundwater remediation begins."

- On July 12, 2016, EPM submitted *Distribution Coefficient Determination for the Cimarron Site* (the 6-page letter was assigned the accession number ML16203A251). The entire submittal included the following attachments, each given a separate accession number:
  - *Determination of Distribution Coefficients (Kd) for Uranium in Soils* (ML20198M678)
  - *Dynamic Column (Elution) and Adsorption Studies on Soil and Water Samples from the Cimarron Corporation Site in Crescent, Oklahoma* (ML20199M357)
  - *Conceptual Site Model (Revision – 01)* (ML20213C536)
  - *2016 Kd Evaluation Using 2002 Data* (ML16203A254 through ML16203A259)

  The letter concluded, "The primary application of K_d is the calculation of groundwater remediation duration estimates, upon which remediation schedule and cost are heavily dependent. Once groundwater remediation begins, the rate of decline in uranium and nitrate groundwater concentrations, based on laboratory analytical groundwater results provided by periodic in-process remediation sampling events, will provide more definitive duration estimates than any K_d calculation could provide. Consequently, EPM does not believe the collection and analysis of additional soil and groundwater samples for the purpose of re-evaluating K_d provides a benefit commensurate with the cost that would be incurred. Further, the information provided by this effort would be far less useful than data that will be generated during in-process remediation monitoring."

- In a December 2, 2016, email, the NRC hydrogeologist stated, "I don't have issues with the Kd measurements; I do have one RAI in part involving Kd." This email is presumably not in ADAMS and is provided as Attachment 2 to this letter.

- The NRC issued RAIs in a letter dated February 9, 2017 (ML16336A198). The Deficiency SER #4 description read, "As part of a pump and treat system design consideration, estimates of clean-up time for the contaminated aquifers are provided in Figure 9.1. The assumptions involved with aquifer cleanup time estimates are not included in the DP. These assumptions may include such parameters as uranium distribution coefficient (K_d), dissolved uranium distribution and transport in aquifers within different sub-areas, and groundwater flow. For example, the distribution coefficients, K_d are often assumed to be reversible and linear. The difference and uncertainty in aquifer clean-up times for various sub-areas may have major impacts on the pump and treat design, operation and post-remedial groundwater monitoring."

  The Deficiency SER #4 RAI formulation read, "Provide a list of assumptions used for the aquifer cleanup time estimates. Explain how each of these assumptions is valid and reasonable given that the geological materials in the impacted aquifers at the site vary

considerably, ranging from mudstone, sandstone, to unconsolidated alluvial sediments. Provide an assessment and discussion of the impacts of uncertainties of the input parameters and assumptions on the clean-up time estimates for aquifers in various sub-areas."

- On May 25, 2017, EPM submitted a response to RAIs (ML17150A495). The response to RAI SER-4 stated, "Remediation timeframe estimates were calculated for each area based on the following parameters:
  - Retardation – calculated using estimated bulk aquifer density, porosity, and Kd values;
  - Pore volume – calculated using estimated plume area, saturated thickness, and porosity values;
  - Initial aqueous-phase contaminant concentration – based on the maximum concentration at any location within a remediation area from 2011 through 2016;
  - Number of pore volumes required to reduce maximum contaminant concentration to remediation target concentration;
  - Time required to recover number of pore volumes required to reduce maximum contaminant concentration to remediation target concentration – based on groundwater extraction rates."

  The response went on to state that "The method for estimating remediation duration will be generally described in Sections 9.3, 'Western Area Remediation' and 9.4, 'Burial Area #1 Remediation'" (of *Facility Decommissioning Plan – Rev 1* [DP Rev 1]). The response also stated that the assumptions, input parameters, and calculation methods used to develop remediation timeframe estimates for each remediation area will be included as an appendix to DP Rev 1.

  This information was included in the Basis of Design, Appendix L to *Facility Decommissioning Plan – Rev 1* (ML19352E486), which was submitted to the NRC on November 5, 2018.

- In a letter dated February 28, 2019, the NRC accepted DP Rev 1 for detailed technical review (ML19056A515). Requests for supplemental information were included in that letter. None of the requests for information pertained to distribution coefficients.
- During meetings conducted on April 4-5, 2019, the potential impact of Tc-99 on ion exchange resin and biomass generated during treatment for nitrate was identified as a key concern. On May 3, 2019, EPM submitted *Potential Technetium 99 Impact to Influent, Waste, and Effluent* (ML19126A052). This document concluded that it was likely that Tc-99 would be detectable in the biomass generated during treatment of groundwater for nitrate.
- Throughout 2019 and 2020, EPM responded to all of the requests for supplemental information contained in the February 28, 2019, letter accepting DP Rev 1 for detailed

technical review. Neither NRC nor DEQ personnel expressed any concerns related to the K_d values presented in DP Rev 1 throughout 2019 – 2020.

- By June 2020, the DEQ had agreed to remove treatment for nitrate from the decommissioning plan. Because the removal of groundwater extraction and treated water injection systems in areas where uranium concentrations are less than 180 pCi/L represented a significant change to the site remediation approach, revision of the decommissioning plan was required. Consequently, RAIs were never issued for DP Rev 1.
- On July 31, 2020, EPM met with the NRC and the DEQ to present a phased approach to decommissioning the site. The first phase would remediate only areas in which uranium concentration exceeds the DCGL. If sufficient funding were available when the uranium concentration achieved the DCGL in all wells, a second phase would consist of continuing groundwater remediation to further reduce uranium concentrations. This phased approach was presented in *Facility Decommissioning Plan – Rev 2* (ML21076A479), submitted to the NRC on February 26, 2021.
- *Facility Decommissioning Plan – Rev 2* (DP Rev 2) was not clear when treatment of groundwater for uranium would be terminated. If at the end of Phase I funding were not sufficient to justify a second phase, treatment would be terminated at that time. But if there was sufficient funding to continue, groundwater treatment and accumulation of uranium in ion exchange resin would continue. Because there was no single clear path to license termination, on August 11, 2021, the NRC issued a letter (ML21193A181) stating that DP Rev 2 would not be accepted for detailed technical review. That letter included requests for supplemental information (ML21193A179) and requests for clarification (ML21193A180).
- On November 10, 2021, EPM informally submitted a draft of *Facility Decommissioning Plan – Rev 3* to the NRC, requesting a pre-application audit. On January 31, 2022, the NRC issued comments related to the decommissioning plan itself (ML22031A175). Although the comments related to the decommissioning plan were generated by NRC's hydrogeological reviewer, concerns related to the K_d values presented in the plan were not addressed in any of the comments.

<u>Summary</u>

In December 2016, the NRC accepted the K_d values used to estimate remediation durations that were presented in the 2015 *Facility Decommissioning Plan*. At that time, the NRC indicated that there was "one RAI in part involving K_d". That RAI was addressed with the submission of the Basis of Design included in DP Rev 1, submitted in 2018. The NRC has not since then expressed any concern related to the use of the K_d values presented in the 2015 *Facility Decommissioning Plan* since the submittal of DP Rev 1.

The July 12, 2016, *Distribution Coefficient Determination for the Cimarron Site* stated, "The primary application of K_d is the calculation of groundwater remediation duration estimates, upon

which remediation schedule and cost are heavily dependent. Once groundwater remediation begins, the rate of decline in uranium and nitrate groundwater concentrations, based on laboratory analytical groundwater results provided by periodic in-process remediation sampling events, will provide more definitive duration estimates than any K_d calculation could provide."

EPM believes that the use of representative uranium concentrations at the 95% upper confidence level (at locations for which sufficient data was available to calculate the 95% UCL), the application of conservative K_d values (determined as described in the July 2016 letter), and the extension of remediation areas far beyond the extent of groundwater exceeding the 180 pCi/L license criterion, have resulted in a very conservative (long duration) estimate of the duration of remediation.

It will be far more beneficial (and cost effective) to re-estimate the duration of remediation after several calendar quarters of in-process groundwater monitoring data have been obtained than to attempt to refine the estimated duration of remediation in each area by evaluating the sensitivity or the uncertainty associated with distribution coefficient values. As Trustee for its beneficiaries (NRC and DEQ) EPM believes that it is in the best interest of both the regulatory agencies and the public to focus on the implementation of the D-Plan and the evaluation of in-process groundwater monitoring data.

If you have any questions or desire clarification on the information presented herein, please call me at (405) 641-5152.

Sincerely,

Jeff Lux

Project Manager

cc: (electronic copies only)
Stephanie Anderson and Linda Gersey, NRC Region IV
Paul Davis, Keisha Cornelius, Pam Dizikes, David Cates, and Jonathan Reid, DEQ
NRC Public Document Room
vcpsubmittals@deq.ok.gov

Attachments:

Attachment 1: Notes from June 15-16, 2016 Meetings

Attachment 2: Email – re: Paper on Distribution Coefficient

Attachment 1: Notes from June 15-16, 2016 Meetings

From:	Lux, Jeff J
To:	Ken L. Kalman (Kenneth.Kalman@nrc.gov); Paul Davis (j.paul.davis@deq.ok.gov); gerald.schlapper@nrc.gov; Halliburton, Bill; Ja-Kael Luey (jluey@kurion.com); Gerry Williams
Bcc:	Brad Brittain (bbrittain@enercon.com); Chuck Beatty (cbeatty@enercon.com); Jay Maisler (jmaisler@enercon.com); Joe Nardi (ajnardi@enercon.com); Hesemann, John
Subject:	Notes from June 5-16 Meetings
Date:	Friday, September 16, 2016 9:40:00 AM
Attachments:	2016-09-16 EPM - Notes from June Meeting.pdf

I spoke with Ken Kalman earlier this week about the draft notes from the June 15-16 meetings I had sent for his review. Ken told me to go ahead and finalize the notes. An electronic copy of the submittal is attached. I'm sending hard copies to NRC, NRC Region IV, and DEQ today. Feel free to call if you have questions regarding the notes on the meetings.

Jeff Lux, P.E.
Project Manager
Environmental Properties Management LLC
A subsidiary of Burns & McDonnell Engineering Company
405-642-5152

environmental
properties management, LLC

September 16, 2016

Mr. Ken Kalman
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Paul Davis
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

Dr. Gerald Schlapper
U.S. Nuclear Regulatory Commission
1600 East Lamar Blvd; Suite 400
Arlington, TX 76011-4511

Re: Docket No. 70-925; License No. SNM-928
Notes from June 15-16 Meetings re: Facility Decommissioning Plan

Dear Mr. Kalman:

Environmental Properties Management LLC (EPM) submits herein the final notes from meetings conducted at the Cimarron site on June 15th and in Oklahoma City on June 16th. The meetings were conducted to present a detailed overview of *Facility Decommissioning Plan*, submitted December 31, 2015.

An electronic copy is being sent to the NRC document control desk.

Sincerely,

Jeff Lux

Jeff Lux, P.E.
Project Manager

Attachment

cc: NRC Document Control Desk (electronic copy only)

9400 Ward Parkway • Kansas City, MO 64114
Tel: 405-642-5152 • jlux@envpm.com

Cimarron Environmental Response Trust
Meeting Notes
June 15-16, 2016

Meeting Attendees

NRC:
Ken Kalman
Lifeng Guo
Bob Nelson

DEQ:
Paul Davis
Torrie Jo Wale
Jordan Caldwell
Carl Parrott (15th only)
David Cates (15th only)

Kurion Inc.:
Ja-Kael Luey

Enercon Services:
Gerald Williams
Jay Maisler
Chuck Beatty
A. Joseph Nardi
Brad Brittain

Burns & McDonnell:
John Hesemann
Eric Dulle

Environmental Properties Management:
Bill Halliburton
Jeff Lux

Introduction

Mr. Kalman announced that notice of these meetings was published in the Federal Register. The public notice stated that members of the public who wished to attend could attend via teleconference, and if they desire to attend, they should contact either Mr. Kalman or Mr. Lux to obtain bridgeline information. No members of the public had contacted either Mr. Kalman or Mr. Lux; consequently, no members of the public attended.

Mr. Lux stated that the purpose of the meetings is to present the Decommissioning Plan (D-Plan) and provide descriptions of the groundwater remediation infrastructure and water treatment facilities, as well as the work that will be performed, to achieve license termination.

Facility Operating History

The Cimarron facility produced mixed oxide and uranium fuel. All decommissioning for mixed oxides was completed and License SNM-1174 was terminated by the Nuclear Regulatory Commission (NRC) in 1993. Buildings, equipment, waste, and soil have been decommissioned and released for unrestricted use, and only groundwater remediation is required to complete decommissioning for uranium and achieve license termination for License SNM-928.

All waste and soil exceeding unrestricted release criteria were removed from three burial areas: BA1, BA2, and BA3 as part of the decommissioning process. Approximately 500,000 cubic feet of soil meeting the criteria for on-site disposal in NRC's Branch Technical Position *Disposal or Onsite Storage of Residual Thorium or Uranium from Past Operations* was placed in three burial trenches in Burial Area #4 (BA4). A hydrogeological investigation was performed to identify impact to groundwater from burial trenches, impoundments, and pipeline leaks. Delineation of groundwater exceeding decommissioning criteria has been completed.

All but approximately 52 acres of the site (Subareas F, G, and N) has been released for unrestricted use.

Facility Description

The approximately 700-acre property consists of approximately 450 acres of rolling topography and 250 acres of Cimarron River floodplain. The geology of the site consists of three low-permeable silty sandstone units (Sandstones A, B, and C), each underlain by mudstone. Sandstones A and B discharge to the Cimarron River's floodplain alluvium. Sandstone C underlies the alluvial material. There is a slight vertical gradient due to Sandstone C discharging groundwater to the alluvium.

Two freshwater ponds are located in two intermittent stream channels. Both ponds discharge to the Cimarron river floodplain. Groundwater flow models have been developed for the Western Alluvial Area (WAA) and BA1, which is approximately ¼ mile east of the WAA.

Prior to and during licensed activities, the property has been used for farming. Currently, the property is used for harvesting grass for cattle feed. A dose assessment demonstrating no impact from consumption of meat from cattle consuming harvested grass was approved by NRC. Cimarron Holdings owns and operates a manufacturing and warehousing operation on a 24-acre portion of the site occupied by the former processing buildings. Oil and gas is produced from beneath the site via horizontal wells drilled from an offsite location.

Unrestricted Release Criteria

Unrestricted release criteria have already been established, and are stipulated in License Condition 27. For groundwater, the NRC criterion for unrestricted release is 180 pCi/L total uranium. The NRC criterion is referred to in the *Facility Decommissioning Plan* as the derived concentration goal level, or DCGL.

Although uranium is the only radiological chemical of concern (COC) which exceeds release criteria, DEQ has established unrestricted release criteria for uranium, nitrate and fluoride (DEQ Criteria).The DEQ Criteria are 30 micrograms per liter (µg/L) for uranium, 22.9 milligrams per liter (mg/L) for nitrate, and 4 mg/L for fluoride. The NRC Criterion for Tc-99 is 3,790 picoCuries per liter (pCi/L), and the EPA-calculated MCL for Tc-99 is 900 pCi/L.

Radiological Status of the Facility

All buildings and equipment have been released from the license. All environmental media except groundwater has been demonstrated to comply with unrestricted release criteria stipulated in License Condition 27 (the NRC Criterion). Tc-99 is also present in groundwater at concentrations below unrestricted release criteria, but above the Maximum Contaminant Level (MCL) promulgated in the primary drinking water standard.

The extent of groundwater impact exceeding NRC and/or DEQ Criteria has been delineated as follows:

- Uranium exceeds the NRC criterion in two areas, BA1 and a portion of the WAA.
- Uranium exceeds its DEQ Criterion in the WAA, the Uranium Pond #1 (UP1) and Uranium Pond #2 (UP2) Areas, BA2 and BA3, and near Monitor Well 1348.
- Nitrate exceeds its DEQ Criterion in the WAA, the UP1 and UP2 Areas, BA2 and BA3, the Process Building Area (PBA), and near Monitor Well 1348.
- Fluoride exceeds its DEQ Criterion in the WAA, the UP1 and UP2 Areas, and near Monitor Well 1348.

Planned Decommissioning Activities

The discussion of planned decommissioning activities was spread throughout the meetings. Topics that related to specific sections of the planned decommissioning activities were addressed after that section of the plan was described. The notes contained herein describe the discussion of each topic as they were presented during the meetings, after which discussion of the plan will continue. The following is a general description of planned decommissioning activities, and some of this may change as the plan is finalized and as the remediation process is monitored and evaluated.

Overview

To facilitate planning and communication, the Site has been broadly divided into three areas: Burial Area #1 (BA1), the Western Alluvial Area (WAA), and the Western Uplands Area (WUA). The two western areas have been further subdivided into the following remediation areas:

Alluvial Areas	**Upland Areas**
BA1 "U > DCGL"	UP1
BA1 "U < DCGL"	UP2
WAA "U > DCGL"	WU-BA2
WAA "U > DCGL WEST"	WU-BA3
WAA "U < DCGL EAST"	WU-1206
WAA "BLUFF"	PBA

The D-Plan identifies the 1206 drainage and the area immediately surrounding it as "WU-1206". However, there is a northern component that utilizes only injection at WU-BA3, and a southern component that utilizes only extraction near Well 1348. To facilitate communication, these areas will be referred to in this document as WU-BA3 and WU-1206.

Groundwater Extraction

Groundwater will be extracted from extraction wells installed in all the alluvial areas and the PBA, and from sumps installed in extraction trenches constructed in BA1 "U > DCGL", WAA "U > DCGL", and WU-1206 areas. Based on current modeling and calculations, groundwater will be delivered to one of five treatment trains as follows:

Treatment Train / Flow Rate	**Area(s) Treated**
1 – Uranium treatment only: 100 – 125 gpm	WAA "U > DCGL", PBA, WU-1206 SOUTH
2 – Uranium & Nitrate treatment: 100 – 125 gpm	WAA "U < DCGL WEST"
3 – Uranium & Nitrate treatment: 100 – 125 gpm	WAA "U < DCGL EAST"
4 – Nitrate treatment only: 100 – 125 gpm	WAA "BLUFF"
5 – Uranium treatment only: 70 – 100 gpm	BA1 "U > DCGL", BA1 "U < DCGL"

Groundwater Treatment

The Western Area Treatment Facility, constructed in the UP1 Area, will treat water via Treatment Trains 1 through 4. A separate treatment facility will be located in BA1 (Treatment Train 5) to treat groundwater from this area. Groundwater pumping and extraction, water treatment, and treated water

injection and discharge in Burial Area #1 will all be performed as a separate effort, except for the processing and disposal of waste generated during water treatment.

Treatment for uranium will be by ion exchange in Treatment Trains 1, 2, 3, and 5. In each train, groundwater will flow through lead, lag, and polishing vessels, yielding treated water that contains uranium concentrations below its MCL. Data generated by laboratory analysis of influent and effluent from each resin vessel in each train will be evaluated to determine when the lead vessel should be exchanged. Each time a lead vessel is removed, valves will re-route the groundwater such that the lag vessel becomes the lead vessel, the polishing vessel becomes the lag vessel, and the former lead vessel, now filled with fresh resin, becomes the polishing vessel.

Treatment for nitrate will be by biodenitrification in Treatment Trains 2, 3, and 4. During the treatment process, nitrate will be reduced to nitrogen (N_2) gas in bioreactors inoculated with denitrifying bacteria. The bioreactors will be supplied with a food source for the bacteria; nitrogen gas generated by the process will be released to the atmosphere. Anticipated bioreactor quantities and heating requirements for each treatment train, based on anticipated influent nitrate concentrations, are as follows:

Treatment Train / Influent Concentration	**# of Bioreactors / Heat or No Heat**
2 – Uranium & Nitrate treatment: 18 mg/L	Single Bioreactor / No Heat
3 – Uranium & Nitrate treatment: 43 mg/L	Single Bioreactor / Heated
4 – Nitrate treatment only: 76 mg/L	Dual Bioreactors / Heated

Treated water from Treatment Trains 1, 2, 3, and 4 will be combined into single effluent tank prior to injection or discharge. Treated water from Treatment Train 5 will be sent to an effluent tank located in BA1 prior to injection or discharge.

Operation of individual uranium and nitrate treatment units will be discontinued when the influent concentration for a COC (i.e., uranium or nitrate) falls below the corresponding MCL. If a treatment train includes both uranium and nitrate treatment units and the MCL has been achieved for only one COC, the unneeded unit will be bypassed and operation of the other unit will continue.

Treated Water Injection

A portion of the treated water will be injected into Sandstone A via sumps installed in injection trenches in the UP1, UP2, WU-BA2, and WU-BA3 Areas. Treated water will be injected into Sandstone B via sumps installed in two injection trenches in BA1 "U > DCGL", and two injection wells in the UP2 Area. Injection will be by gravity flow, controlled by manifold systems equipped with automated valves. Injection systems will maintain targeted water levels monitored by pressure transducers installed within each sump or well. This will induce sustained heads in the fractured sandstone units to drive impacted groundwater toward extraction trenches and/or wells. Injection will be performed in accordance with the requirements of the DEQ Underground Injection Control program.

Treated Water Discharge

All treated water not injected into injection trenches and/or wells will be discharged to the Cimarron River in accordance with an Oklahoma Pollution Discharge Eliminations System (OPDES) permit. EPM submitted an application for an OPDES permit in May 2016. Treated water from the Western Area Treatment Facility will be discharged via Outfall 001, and Treated water from the BA1 Treatment Facility will be discharged via Outfall 002. All the treated water than cannot be injected into the sandstones under gravity flow will be discharged through one of the permitted outfalls.

Treatment Media Management

Spent resin will be sluiced out of a lead resin vessel, run through a scrolling centrifuge to dewater it, and transferred by conveyor to a ribbon blender, where it will be mixed with sufficient inert material to comply with the waste acceptance criteria (WAC) of the licensed low level radioactive waste (LLRW) disposal facility. A sample of the spent resin will be analyzed for isotopic uranium to determine the U-235 content of the waste. Initially, conservatively high values of 4% enrichment (by mass) will be used for resin from Treatment Train 1 and 2% enrichment (by mass) for resin from Treatment Trains 2, 3, and 5. After blending, the waste will be packaged in 55-gallon drums (or other approved containers) and stored in a secure storage area until it is shipped for disposal.

Biomass will periodically be removed from the bioreactors. Because the groundwater in Treatment Trains 2 and 3 will have been treated for uranium, biomass from Treatment Trains 2 and 3 will be disposed of as solid waste. Because the groundwater in Treatment Train 4 will not have been treated for uranium, biomass from Treatment Train 4 will be disposed of as LLRW. Biomass removed from bioreactors will be dewatered by a centrifuge and loaded into a sludge cart. The biomass will be mixed with sufficient inert material to comply with the WAC for the LLRW disposal facility or municipal landfill. After blending, the waste will be packaged in 55-gallon drums (or other approved containers) and stored until it is shipped for disposal in accordance with applicable DOT and NRC requirements.

Samples of influent to each treatment train, in-process samples of effluent from each resin vessel, and effluent from each treatment train will be collected and analyzed on a weekly basis. Influent will be analyzed for both uranium and nitrate. In-process samples will be analyzed for uranium. Effluent will be analyzed for uranium, nitrate, and fluoride. Evaluation of uranium data for influent, in-process, and effluent samples will provide the information needed to maintain compliance with the 1,200 gram U-235 possession limit.

Radioactive Waste Management

Solid radwaste generated by groundwater remediation activities will fall into one of several categories:

- Spent anion resin,
- Biomass,
- Protective clothing, materials and equipment used for maintaining the systems and processing the groundwater, and
- Contaminated piping and equipment of the treatment systems.

Solid radwaste will be transported to a licensed LLRW disposal facility.

No liquid radioactive waste or mixed waste will be generated during decommissioning operations.

Planned Decommissioning Activities (continued)

In-Process Groundwater Monitoring

Depth to water (DTW) will be continuously measured in all extraction and injection wells and sumps. DTW will be measured in all in-process monitoring wells daily for the first week, then weekly for a month, then monthly. Groundwater samples will be collected for laboratory analysis from all in-process monitoring wells on a monthly basis.

The data obtained will be used to optimize the extraction of uranium by adjusting flows as needed, to monitor the progress of groundwater remediation, and to determine when groundwater treatment can be discontinued in discrete areas.

Post-Remediation Groundwater Monitoring

When at least two consecutive months of in-process groundwater monitoring indicates that all wells in an area comply with the NRC Criterion, extraction and treatment will cease. Groundwater samples will be collected from post-remediation monitoring wells until it is determined that extraction and treatment must resume, or until 12 consecutive quarters of data yields uranium concentrations that are less than the NRC Criterion in all post-remediation monitoring wells.

Environmental Monitoring and Control

Environmental monitoring requirements will be fulfilled by the in-process monitoring program. Effluents will be discharged to the Cimarron River via DEQ-permitted Outfalls 001 and 002. The permit will limit the concentrations of COCs to less than their MCLs, and these concentrations will be reported on a monthly basis.

Releases of radioactive material to the environment can occur during groundwater through leaks in piping, a release of contaminated water from influent tanks, or failure of an ion exchange vessel that has processed impacted groundwater.

Except for short distances where piping carries water from contaminated areas to the treatment facilities, piping generally conveys impacted groundwater from less impacted areas through more highly impacted areas. A release from a leaking pipe would simply return the impacted water to its upgradient source.

NRC asked about leaks from piping in unimpacted or less impacted areas. EPM explained why the low concentrations of groundwater in the piping is of such low concentration that it cannot contaminate soil to levels above the NRC Criterion.

Influent tanks will be double-walled tanks with leak detection sensors that will shut off flow to the tank if water is detected in the annulus between the tanks. Ion exchange vessels will be installed in containments with leak detection sensors that will shut off flow to the ion exchange system in the event of a leak.

Environmental Information

NUREG-1757, *Consolidated Decommissioning* Guidance, identifies numerous ways in which decommissioning activities may impact land use, natural resources, and the public. The decommissioning activities described in *Facility Decommissioning Plan are* designed to achieve release of the Site for unrestricted release and license termination, and are not anticipated to present adverse impacts to land use, natural resources, or the public. This includes impact to transportation near the Site, air quality, noise levels, historical and cultural resources, visual/scenic resources, members of the public, or workers at the Site. Implementation of the decommissioning work will have a positive impact on the geology and soils, water resources, and the socioeconomic environment, and will result in the beneficial use of a site that has been essentially unused for over four decades.

Project Management

Organization charts were provided for the following stages of the project:

- Construction and startup
- Groundwater remediation operations
- License termination
- Ongoing remediation post license termination

Radiation Protection Program

The existing radiation protection plan has been modified to provide for additional radiological monitoring and licensed material control related to water treatment operations. The radiation protection program will include a material control and accountability program. A section on criticality safety was included to describe the process and process controls that prevent a nuclear criticality situation from developing. It also justifies the exclusion of the U-235 in fissile exempt packaged waste from the 1,200-gram possession limit.

Quality Assurance

The existing quality assurance plan has been modified to address issues specifically relevant to the decommissioning activities. The quality assurance program is established to provide:

- Compliance of products and services (including sample collection and analysis services) with license and regulatory requirements.
- Establishment and effective implementation of quality management systems and procedures.
- Opportunities for improving the organization, quality, compliance and cost performance are identified and implemented.
- Timely evaluation of personnel resources, needs, skills and performance to stress the importance of, and identify opportunities for, continual quality improvement.
- Data for decision making that are of the quality needed to support Cimarron Site goals and assure compliance with nuclear and environmental compliance requirements.

Facility Radiation Surveys

Decommissioning criteria for facilities and equipment, soil and soil-like material, and groundwater are stipulated in License Condition 27. No further characterization surveys are needed. The following five types of in-process surveys will be performed at the Site:

- In-process groundwater monitoring
- Influent and effluent monitoring
- Shipping package surveys (primarily for LLRW waste packaging and transportation)
- Release surveys
- Routine surveys

At the completion of decommissioning activities, final status survey plans will be submitted to NRC. Upon approval of the plans, final status surveys will be conducted, and final status survey reports will be submitted that demonstrate (in conjunction with post-remediation groundwater monitoring results) that the site is releasable for unrestricted use.

Schedule

The schedule assumes that approval of the D-Plan enables construction to be completed by the end of June 2018.

Reduction of uranium concentrations to the NRC Criterion in the western areas is estimated to require less than three years. Post-remediation monitoring would then be performed for a minimum of three years after that. Demobilization of treatment systems may be completed by the end of 2024.

Remediation of BA1 is estimated to require over 8 years. Post-remediation monitoring would then be performed for a minimum of three years after that. Demobilization of treatment systems may be

completed by the end of 2029. Final status surveys would require a minimum of 6 months, potentially ending in 2030.

After license termination, remediation of uranium and nitrate to achieve DEQ Criteria is likely to require additional decades.

Estimates of duration are highly dependent upon the desorption of uranium from solids into groundwater, and the distribution coefficient (K_d) is the most sensitive parameter upon which this is determined. Discussions were held concerning how K_d had been calculated in the past. EPM committed to drafting a paper describing how K_d had been determined, and providing the reports from the consultants who had performed the testing and the calculations. The paper will include EPM's recommendations for either performing additional sampling and analysis during construction or revising duration estimates based on in-process monitoring data once groundwater remediation begins.

License termination should be achieved by the end of 2030.

Planned Decommissioning Activities (continued)

Demobilization

The general sequence of groundwater remediation and treatment system shutdown, demobilization, and NRC license compliance is as follows:

When post-remediation monitoring in WAA "U > DCGL" confirms that uranium concentrations are below the DCGL, the uranium and nitrate treatment systems will be demobilized from the WA Treatment Facility. Resin processing equipment, WAA and WUA groundwater extraction and injection equipment and controls, and influent and effluent tanks will remain in place and functional.

When post-remediation monitoring in BA1 confirms that uranium concentrations are below the DCGL, the BA1 Treatment Facility and the resin processing equipment in the Western Area Treatment Facility will be demobilized. No final status survey is anticipated for BA1, unless there is reason to believe that impacted groundwater may have been released into the treatment facility area. BA1 groundwater extraction and injection equipment and controls, and influent and effluent tanks, will remain in place and functional.

Demobilization will consist of surveying equipment and material that can be practically surveyed for release. Material that is not releasable or that cannot be practically surveyed will be packaged and shipped to a licensed LLRW disposal facility. Material that is releasable will be salvaged, recycled, or shipped to a municipal waste facility for disposal.

Financial Assurance

A cost estimate was generated based on the projected schedule for decommissioning activities. After addition of a 25% contingency, the estimated cost to decommission the site and achieve license termination was less than $72 million (in 2015 dollars). Certification of financial assurance was provided, stating that the total funding available to the Trust is over $86 million (2015 dollars).

Ongoing Remediation

As the D-Plan is written, during the last post-closure remediation monitoring period, EPM will meet with DEQ and NRC to develop a path forward based on available remediation technologies that do not have the potential to accumulate uranium, and which may be implemented within available funding. Alternative approaches may include (but are not limited to):

- Pump and discharge groundwater without treatment
- Monitored natural attenuation
- Removal of remaining infrastructure and sell the site with restrictions on use in the deed.

During discussions on the projected schedule, it was stated that although the concentrations of uranium and thorium in the WAA "U < DCGL" WEST and the WAA "U < DCGL" EAST areas are much lower than in the areas in which uranium exceeds the NRC Criterion, these very large areas contain such a large volume of groundwater that the remediation efforts presented in the D-Plan will achieve only a small portion of the reduction in concentrations needed to obtain DEQ's unrestricted release of the site by the time NRC Criterion is achieved and the treatment facilities are demobilized.

The construction and installation of the groundwater extraction and injection infrastructure and treatment facilities represents approximately 43% of the estimated cost of remediation, of $38.2 million. Approximately $12.6 million of that is associated with construction in these two very large areas.

The design team is evaluating alternative approaches to achieve license termination in the same timeframe while yielding substantial cost savings, without significantly changing the design. One alternative involves the elimination of the remediation infrastructure and treatment systems associated with the two areas listed above. EPM will present to NRC and DEQ alternative approaches to groundwater remediation that will not require additional time or cost to address in the design documents, and which will achieve license termination in the same timeframe at lower cost than estimated in the D-Plan.

Revisions to the License

EPM requests that Condition 8 be amended to remove the possession limit for thorium and to provide for the exclusion of U-235 in fissile exempt material packaged for disposal from the 1,200 gram U-235 possession limit.

EPM requests that License Condition 9 be amended to redefine the licensed site. Most of the area within which groundwater exceeds the NRC Criterion has been released for unrestricted use, and most of the area remaining under license is releasable for unrestricted use.

EPM requests that License Condition 10, which addresses final surveys and on-site disposal of waste, be deleted from the license, and that two of the documents cited in the existing Condition 10, which relate to final status surveys, be transferred to License Condition 27(a).

EPM requests that License Condition 23, which authorizes the on-site disposal of waste, be deleted from the license.

EPM requests that License Condition 26, which addresses superseded radiation protection program documents, be amended to reference the current radiation protection plan, as amended in accordance with License Condition 27(e) (the change approval process).

EPM requests that License Condition 27, which addresses the decommissioning of the site, be amended to delete documents authorizing work that is now complete, and to incorporate the requirements of the current D-Plan.

ALARA Analysis

NRC regulations require an that an ALARA analysis be performed to determine if decommissioning work should be performed subsequent to compliance with NRC's dose-based decommissioning criterion, based on the cost of additional dose reduction. The purpose is to determine if additional work is justified to reduce residual dose to levels that are As Low As Reasonably Achievable (ALARA). The ALARA

analysis performed for this decommissioning project demonstrates that the proposed action far exceeds the cost per man-rem avoided established by NRC as an ALARA goal. The performance of additional remediation to further avoid future dose is unwarranted.

Attachment 2: Email – re: Paper on Distribution Coefficient

Lux, Jeff J

From: Guo, Lifeng <Lifeng.Guo@nrc.gov>
Sent: Friday, December 2, 2016 12:11 PM
To: Lux, Jeff J; Kalman, Kenneth
Cc: Halliburton, Bill
Subject: RE: Paper on Distribution Coefficient

Hi Jeff,

I don't have issues with the Kd measurements; I do have one RAI in part involving Kd. We can discuss it in the upcoming conference call.

Thanks

Lifeng

From: Lux, Jeff J [mailto:jlux@envpm.com]
Sent: Monday, November 28, 2016 5:57 PM
To: Kalman, Kenneth <Kenneth.Kalman@nrc.gov>; Guo, Lifeng <Lifeng.Guo@nrc.gov>
Cc: Halliburton, Bill <bhalli@burnsmcd.com>
Subject: [External_Sender] Paper on Distribution Coefficient

The last document for which EPM needs feedback from NRC is the paper on the determination of the distribution coefficient for uranium in groundwater at the Cimarron site. EPM concluded that further sampling and analysis is not warranted. DEQ agrees with EPM's assertion, but we need to hear from NRC, because if NRC does not accept the assignment of Kd values, we need to conduct whatever sampling is needed early in 2017 to re-evaluate those values.

Once again, your feedback as soon as you can get to this would sure be appreciated.

Jeff Lux, P.E.
Project Manager
Environmental Properties Management LLC
A subsidiary of Burns & McDonnell Engineering Company
405-642-5152