TECHNICAL EVALUATION REPORT
CHRISTENSEN RANCH MINE UNITS 2 THROUGH 6 RESTORATION REPORT URANIUM ONE USA, INC., WILLOW CREEK IN SITU RECOVERY FACILITY

DATE:

DOCKET NO.: 040-08502

LICENSEE: Uranium One USA, Inc.

SITE: Willow Creek Christensen Ranch, Wyoming

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SUMMARY AND CONCLUSIONS:

By letter dated September 11, 2015, Uranium One USA, Inc. (UO or the licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) a report documenting its groundwater restoration efforts at the Willow Creek Project Christensen Ranch Mine Units (MUs) 2 through 6 (restoration report) (UO, 2015). The restoration report was prepared by ARCADIS U.S., Inc. and provided UO's response to NRC's comments on groundwater restoration activities at MUs 2-6, which were previously provided to UO within a technical evaluation report (TER) dated NRC's October 23, 2012 (NRC, 2012).

NRC staff's evaluation in this TER centered on UO's responses to NRC comments for groundwater restoration at MU-2, MU-3, MU-4, and MU-6 (UO, 2015). The licensee stated it did not address NRC comments for MU-5 since uranium production activities were recently conducted in MU-5. UO's restoration report included a review of groundwater quality, hydrogeologic, and geochemical data collected from UO's Christensen Ranch. The further evaluations as reported by the licensee in their restoration report consisted of: (1) a review of target restoration values (TRVs) that involved recalculating TRVs using ProUCL and comparing the resulting TRVs values to restoration data to assess restoration completeness, (2) a review of water quality, geochemical, and hydrogeologic data such as the quality of the restoration data, groundwater geochemistry, historical excursions, and trends in stabilization data, and (3) hydrogeologic and geochemical analyses/modeling, which included the creation of groundwater geochemical models to better understand constituent fate and transport.

The NRC staff reviewed the licensee's restoration report and provides an independent review and analysis in this TER. The NRC staff concurs with many of the assessments in the restoration report; however, the NRC staff found deficiencies in the licensee's response to the NRC staff's comments provided in the 2012 TER (NRC, 2012). Consequently, the NRC staff cannot recommend approval of the restoration of the above-referenced mine units at this time. The NRC staff recommends that the licensee perform additional evaluation, restoration, and

decommissioning at these mine units, as needed, consistent with requirements of 10 CFR 40.42. The NRC staff's evaluation findings for each specific mine unit are included in this TER.

INTRODUCTION

By letter dated September 11, 2015, Uranium One USA, Inc., submitted a report entitled "Willow Creek ISR Project - Christensen Ranch, Mine Units (MUs) 2 – 6, Response to Comments from U.S. Nuclear Regulatory Commission Staff Technical Evaluation Report" to the NRC for review and approval (UO, 2015). The licensee's restoration report was prepared by ARCADIS U.S. Inc. and provided a response to NRC comments contained within NRC's October 23, 2012, TER concerning restoration efforts at UO's Christensen Ranch MU-2 through MU-6 (NRC, 2012). This TER is the NRC staff's evaluation of the UO's response to NRC comments for MU-2, MU-3, MU-4, and MU-6 within the above-referenced restoration report. The licensee did not address the NRC staff comments for MU-5 since uranium production has recently occurred in portions of MU-5.

BACKGROUND

Between 1993 and 2010, Cogema operated a uranium in-situ recovery (ISR) facility at the Irigaray and Christensen Ranch Projects, Johnson and Campbell Counties, Wyoming, under NRC source materials license SUA-1341. Uranium recovery operations for MU-2 through MU-6 at the Christensen Ranch Project were completed by 2005. In 2009, the license was transferred from Cogema to Uranium One USA, Inc. (NRC, 2009a).

Operations at the Christensen Ranch Project were conducted within five discrete areas designated as MU 2 through MU-6. Each mine unit is subdivided into three-to-six modules. In the Restoration Report, the licensee described a module as an individual wellfield. Uranium recovery at an individual module may have been sequentially added to a mine unit during operations. Restoration activities may also have been sequentially performed on a module-by-module basis. Production activities at the Christensen Ranch Project occurred at each mine unit generally within a 2- to 3-year period. MU-3 was the first mine unit to be brought into production at the Christensen Ranch Project with initial operations dating back to 1989 (prior to Cogema being the licensee). MU-5 and MU-6 were the last to be brought into production.

Restoration activities at the mine units were performed between 1997 and 2000 after the production activities ceased and continued on a sporadic schedule until 2005. Cogema reported that a 2-year hiatus occurred between the operation and restoration activities only at MU-3, whereas the restoration was conducted immediately following cessation of production activities at all other mine units. Restoration activities consisted of a groundwater sweep phase, groundwater treatment phase, and a groundwater recirculation phase. Injection of a reductant (hydrogen sulfide) was included for a short period of time either during groundwater treatment or groundwater recirculation phases for MU-2 through MU-4, and for a short period at selected spots in MU-6. Stability monitoring was conducted for four (4) contiguous quarterly events for each mine unit immediately following completion of the restoration activities.

REGULATORY FRAMEWORK

The NRC staff's evaluation of groundwater restoration is based on the uranium mill regulations in 10 CFR Part 40, Appendix A, which were written primarily for conventional uranium mills and later applied to ISRs. In 2009, Regulatory Issue Summary 2009-05 stated that 10 CFR Part 40, Appendix A, Criterion 5B standards, are the applicable restoration standards for groundwater at ISR facilities (NRC, 2009b). Prior to 2009, a groundwater "class-of-use" restoration standard, based on the State of Wyoming's groundwater classification system, was considered acceptable. This class-of-use standard was documented in license SUA-1341 for the Christensen Ranch Project. Therefore, the NRC staff's evaluation of the Christensen Ranch Restoration report applied the "class-of-use" groundwater restoration standard as it was applicable at the time that this report was submitted. A more detailed explanation of the regulatory framework can be found in the NRC October 23, 2012, TER (NRC, 2012).

SAFETY EVALUATION

Details of the safety evaluation are discussed below for each mine unit. However, several comments that are common to the mine units will be discussed first. Those comments are as follows:

Target Restoration Values

In response to the NRC staff's comments concerning the existing TRVs, UO used ProUCL, Version 5.0, (EPA, 2013) to recalculate TRVs using upper confidence limits[1] (UCLs) (UO, 2015), which is recommended for relatively large data sets (EPA, 2013). The UCLs were calculated using particular statistical distributions for each parameter for each wellfield. ProUCL uses normal, lognormal, and gamma distributions. UO recalculated TRVs using a 95% UCL for normal distributions and nonparametric methods for UCL development if normal, lognormal, and gamma distributions did fit a data set.

The TRVs used by the licensee are derived, in part, from tables referenced in License Condition 10.3 of the license (NRC, 2007), which also specifies that the baseline groundwater quality shall be the mean values of data listed in those tables. Recognizing the NRC staff's acknowledgement that the baseline values should reflect variability in the background concentrations (NRC, 2012), UO's calculated UCLs using ProUCL represent a "collective" measure of central tendency of a relatively large data set (EPA, 2013). Thus, the NRC staff finds UOs recalculation of TRVs in the restoration report (UO, 2015) to be satisfactory.

Statistically Significant Increasing Trends

UO provided results of Mann-Kendall (MK) trend analysis of Mine Unit well sample results on a wellfield basis (OU, 2015). The NRC staff observes that distribution or trend analysis used for demonstrating stabilization of the wellfield mean of a constituent is only appropriate if

[1] ProUCL uses the term upper confidence limits. The Willow Creek license SUA-1341 uses the term upper control limits. Both terms commonly use the acronym "UCL". The terms are interchangeable.

constituent values from each individual well in the wellfield grouping is stable with time. If the constituent values at individual wells are not stable over time, they cannot be combined with other data from stable wells to estimate a distribution or trend of the constituent for the wellfield grouping.

NUREG 1569, Section 6.1.3 (3) states, "Generally, the acceptance criteria for restoration success are based on the ability to meet the predetermined numerical standards of the restoration program and the absence of significant increasing trends of monitored indicator constituent concentrations during the stability monitoring period." (NRC, 2003). The licensee states, "Because the groundwater protection standards are calculated on a wellfield basis, trend analyses must be calculated on a wellfield basis. Otherwise, comparisons between individual well trends and groundwater protection standards are not statistically valid." However, the NRC staff observes that the purpose of stability monitoring is to demonstrate that a constituent concentration after restoration is stable (not increasing). A mean value of a restored constituent concentration may only be calculated on stable data to allow its comparison to the mean TRV (from stable pre-operational data). The mean of the constituent concentrations for each sampling time for all wells cannot be used for stability trending if any of the individual well data is not stable with time. Therefore, trend analysis of the mean can only be performed from wells that are themselves individually stable with time.

For wells with increasing trends for hazardous constituents, the NRC staff notes the licensee may consider the use of alternative approaches to model or predict trends in these wells in the future to demonstrate compliance with a standard or that the constituent concentrations will become stable and pose no threat to surrounding groundwater at a down gradient point of exposure (POE). In the case of Christensen Ranch MUs 2-6, the POE is considered the aquifer exemption boundary, as determined by the Wyoming Department of Environmental Quality (WDEQ), which is equivalent to the wellfield perimeter monitoring well ring at this site.

Geochemical Model

The NRC staff reviewed the geochemical modeling in the restoration report (OU, 2015). The NRC staff observes output files from PHREEQC[2] (pH-REdox-EQuilibrium-C Programming Language) were not provided; only the input files. As a result, the NRC staff was not able to complete their technical review with a full assessment regarding model behavior relative to groundwater observations. However, Table 4-2 and Figures 4-3 and 4-4 did provide some useful insights. While the tables and figures are helpful, they do not replace the need for the output files to be provided.

The NRC staff finds UO's modeling assumptions in the report are speculative. For example, the use of a surface complexation model (SCM) requires an estimate of the number of reaction sites per gram of sediment, which in turn, requires a measurement of specific surface area. Lacking this measurement, the licensee used a reaction site value of 3 m^2/g using mineralogy taken from

[2] PHREEQC is a computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations (Parkhurst and Appelo, 2013)

the Hanford site, while acknowledging that these values are arbitrary. These values taken from the Hanford site are not necessarily appropriate; site-specific values should be used. The licensee's comparison of the resulting effective distribution coefficients (K_d's) from the SCM to those assumed by NRC (typically higher than SCM results) does not provide much support. The use of an SCM can be a meaningful analytical tool, but requires substantial site-specific data (see NUREG/CR-6708 (NRC, 2001)) and volumes from the NEA Sorption Project (OECD/NEA, 2012, Davis et al., 2005).

The NRC staff observes that some of the modeling was done using results of the SCM and constant K_d values. In either case, using SCM or constant K_d values, the resulting concentration at the perimeter well was not acceptable, as noted by UO on pages 27 and 28 of the report. As a result, abiotic reduction of uranium (U) and selenium must be invoked by the licensee to obtain concentrations that are below the maximum contaminate level (MCL) at the wellfield perimeter monitoring well ring, which is also the POE. This is problematic; while studies have shown reduction of U on pyrite (usually well cleaned surfaces) in the laboratory, field studies have been less clear (see NUREG/CR-7167, page 2-6 (Yabusaki et al., 2014)). For example, at the Old Rifle site, there was little evidence found for abiotic reduction of U even when reduced iron and sulfur were present in solution (Yabusaki et al., 2011). Yabusaki et al., found this is likely due to inaccessibility of reduced phases to groundwater flow and to surface coatings inhibiting reactivity of pyrite. The licensee states on page 30 in the restoration report that abiotic reduction will increase reaction rates. However, the modeling is not based on site specific observations of U reduction in contact with the local aquifer material, and therefore the NRC staff concludes that this statement is unsupported and abiotic reduction should not be relied on. Staff agrees with the statement in the licensee's report (page 30) that "the importance and extent of these processes are highly aquifer-specific, and direct solids characterization or field testing is required to define these processes".

The NRC staff notes that justification for the length of time for the model runs was not provided. The timeframe should include the "break-through" curve of the constituent at the point of exposure. Also, comparing the U concentrations on the map (UO, 2015, Fig. 4-3) to the measured oxidation reduction potential (ORP) (UO 2015, Fig. 4-4); U = 2.69 milligrams per liter (mg/l) at well 2S88-1 while its ORP is -282.7 millivolts (mV). Well 3U45-1 has U = 3.26 mg/l and ORP of -198 mV. Well 6S29-1 has U = 0.531 mg/l and ORP of -147 mV. Well 4O66-1 has U = 4.16 mg/l and an ORP of -175 mV. While the redox values are as ORP (correction to Eh is not given), it appears using these data from the restoration report that reducing conditions do not necessarily mean that U will precipitate. The very strong complexes that U forms in solution can require strongly reducing conditions to precipitate (Langmuir, 1997) (Casas et al, 1998). As a result, modeling alone may not demonstrate that movement of water from the production zone (containing high concentrations of U) will be accompanied by reductive precipitation of U. As stated in the restoration report by the licensee, "Ultimately, the importance and extent of these processes are highly aquifer-specific, and direct solids characterization or field testing is required to define these processes."

Response to Specific NRC Staff Comments for Each Mine Unit

Mine Unit 2 (MU-2) North

As previously stated in the October 2012 TER (OU, 2012), the NRC concurs that the restoration of MU-2 North is protective of human health and safety and the environment provided that:

(1) Statistically significant increasing (SSI) trends noted for uranium and radium-226 at well 2T92-2 are shown to be reversed and stabilization is demonstrated.

(2) The licensee provides a confirmatory analysis of the groundwater quality at well 2MW108 subsequent to corrective actions for the 2011 excursion that demonstrates impacts to the aquifer following the 2011 excursion event meet regulatory requirements.

Results of the NRC staff's review of Uranium One's response to the two above-referenced NRC comments (UO, 2015) is as follows:

1) The NRC staff finds that the restoration report is deficient in showing the SSI trends noted for uranium and radium-226 at well 2T92-2 to be reversed and stable.

   Basis: UO provided results of MK trend analysis of MU 2 North well sample results for U and radium on a wellfield basis (OU, 2015). As discussed above under the heading "SSI Trends," use of well field basis for demonstrating stabilization of mean or median concentrations is only appropriate if levels from each individual well in the wellfield grouping is stable with time (EPA, 2009). Additionally, the NRC staff notes that the UO report incorrectly states, "MU-2 North is stable without any SSI trends." The MK analysis provided in Appendix C of UO's restoration report appears to show an increasing tread for U and radium-226 with the available data.

2) The NRC staff finds the licensee's confirmatory analysis of the groundwater quality at well 2MW108 subsequent to corrective actions for the 2011 excursion sufficiently demonstrates that a potential excursion no longer exists. UO's response to the NRC's comment on this matter is sufficient; the NRC is not requesting further information on this issue.

   Basis: The licensee provided a confirmatory analysis of the groundwater quality subsequent to corrective actions for the 2011 excursion at well 2MW108 (OU, 2015). Monitoring data provided UO consists of the weekly analysis of excursion parameters from October 24, 2011, to December 5, 2011, and thereafter, quarterly to May 7, 2013. This monitoring data does not show the presence of an excursion as specified by license condition (LC) 11.2 (NRC, 1998, 2007). The NRC staff finds UO's monitoring data obtained after corrective actions for the 2011 excursion at well 2MW108 provides reasonable assurance that an excursion no longer exists.

Mine Unit 2 (MU-2) South

As previously stated in the October 2012 TER (NRC, 2012), the NRC staff cannot recommend approval of the MU-2 South restoration until:

(1) The licensee demonstrates the overlying and production aquifers between MU-2 South and MU-3 are not impacted; and

(2) The licensee demonstrates the SSI trend noted in the uranium concentrations at well 2AF34-1 is reversed and stable.

The NRC staff evaluation of Uranium One's response to the two above-referenced comments is as follows:

1) The NRC staff finds the licensee's ore-zone and overlying excursion monitoring data from 2009 to 2013 for the area between MU-2 and MU-3 sufficiently demonstrates that an excursion no longer exists. No further response to the NRC staff's previous comment concerning this matter is requested at this time.

   Basis: The licensee provided ore-zone excursion monitoring data from 2009 to 2013 for perimeter monitoring wells between MU-2 and MU-3 (OU, 2015). The monitoring data indicates that none of these ore-zone monitoring wells exhibited excursions, except well 2MW-89, which has not exhibited excursions since March 2012 as specified by LC 11.2 (NRC, 1998, 2007). Thus, the NRC staff finds UO's monitoring data obtained between 2009 and 2013 provides reasonable assurance that the ore zone aquifer monitoring wells between MU-2 South and MU-3 no longer exhibit an excursion.

   The licensee provided 2000 through 2013 excursion monitoring data for overlying monitoring wells in the area of MU-2 South and near MU-3 (OU, 2015). This data exhibited concentrations below the upper control limits, except specific conductance in MW-48S and MW-46S. Since both chloride and alkalinity concentrations have remained below upper control limits in MW-48S and MW-46S since 2000, the NRC staff finds that the data does not show the existence of an excursion as specified by LC 11.2 (NRC, 1998, 2007).

2) The NRC staff finds that the restoration report is deficient in showing the SSI trends noted for uranium at well 2AF34-1 to be reversed and stable.

   Basis: UO reassessed the stability data using MK trend analysis for the entire MU-2 South wellfield (UO, 2015). As discussed above under the heading "SSI Trends," use of well field basis for demonstrating stabilization of mean or median concentrations is only appropriate if levels from each individual well in the wellfield grouping is stable with time (EPA, 2009). UO also presented geochemical modeling (using PHREEQC version 2.17) to show that concentrations of uranium in MU-2 will not result in an exceedance of the EPA's MCL at the monitoring well ring. However, as discussed above under the heading

entitled “Geochemical Model,” the NRC staff found significant deficiencies in UO’s geochemical model, which significantly affect modelling results.

Mine Unit 3 (MU-3) without (w/o) Expansion

As previously stated in the October 2012 TER (NRC, 2012), the NRC staff cannot recommend approval of the MU-3 w/o expansion (exclusive of Module 4A) restoration until:

(1) The licensee confirms that well 3D12-2 used in the restoration, but not in the baseline, was needed to replace a well that has been abandoned.
(2) The elevated conductivity noted in the 2009 sampling and levels of all constituents of concern in wells 3T37-2 and 3T27-2 are adequately demonstrated to be below Class IV standards.
(3) The licensee demonstrates the SSI trend noted in the uranium concentrations at well 3V58-2 is reversed and stable.

The NRC staff evaluation of Uranium One’s response to the three (3) above-referenced comments is as follows:

(1) UO clarified that well 3D12-2 is designated for both baseline and restoration. No further response to NRC comment concerning this matter is requested at this time.
(2) The NRC staff finds UO response is deficient in addressing the above-referenced 2012 TER comment, “the elevated conductivity noted in the 2009 sampling and levels of all constituents of concern in wells 3T37-2 and 3T27-2 are adequately demonstrated to be below Class IV standards.”

    Basis: As pointed out by UO, well 3T37-2 in NRC summary comments for MU-3 w/o expansion (exclusive of Module 4a) within the 2012 TER (NRC, 2012) is a typo. NRC meant to type well 3T37-1 instead of well 3T37-2. UO provided well 3T37-1 post-stability monitoring data from December 19, 2012, to November 6, 2013, and 3T27-2 post monitoring data from December 19, 2012, to February 26, 2014 (UO, 2015). This data provided concentrations for chloride, specific conductance, alkalinity, uranium, and radium-226. The well 3T37-1 data indicates 6.98 milligrams/liter (mg/L) uranium and 207.0 picocuries/liter (pCi/L) Radium-226 on November 6, 2013. The well 3T27-1 data indicates February 26, 2014, 13.90 mg/L uranium on February 26, 2014 and 207.0 pCi/L Radium-226 on August 28, 2013. As noted by UO (UO, 2015), the NRC staff observes that these uranium and radium-226 concentrations for wells 3T37-1 and 3T27-2 are above regulatory standards.

    UO states, “the effect of these increased concentrations on long-term stability in this wellfield and water quality at the aquifer exemption boundary is negligible as demonstrated by the geochemical modeling. Residual concentrations of constituents are not expected to exceed drinking water standards at the aquifer exemption boundary” (UO, 2015). However, as discussed above under the heading entitled “Geochemical

Model," the NRC staff found significant deficiencies in UO's geochemical model, which may significantly affect modelling results.

3) The NRC staff finds that the restoration report is deficient in showing the SSI trends noted for uranium at well 3V58-2 to be reversed and stable.

   Basis: UO reassessed the stability data using MK trend analysis for the entire MU-3 wellfield (UO, 2015). As discussed above under the heading "SSI Trends," use of well field basis for demonstrating stabilization of mean or median concentrations is only appropriate if levels from each individual well in the wellfield grouping is stable with time.

Mine Unit 3 (MU-3) with (w/) Expansion (Module 4A)

As previously stated in the October 2012 TER (NRC, 2012), the NRC staff cannot concur that the restoration of MU-3 w/ expansion (module 4A) is protective of human health and safety and the environment until the licensee:

(1) Provides a statistical evaluation of the restoration data including rationale for outliers and stability analyses.
(2) Demonstrates the SSI trend in uranium and radium-226 in wells 3W75-1 and 3Z87-1 is reversed and stable.

The NRC staff evaluation of Uranium One's response to the two (2) above-referenced comments is as follows:

(1) The NRC staff finds UO's response is deficient in providing a statistical evaluation of the restoration data that includes rationale for outliers.

   Basis: UO provided performed statistical analysis and comparisons to TRVs and other groundwater protection standards for MU-3 on a wellfield basis (UO, 2015). However, UO's statistical analysis did not present an evaluation of the restoration data outliers. Results of UO's analysis indicate only radium-226 for the MU-3 exceeds the groundwater protection standard. UO claimed that their geochemical modeling effort will not result in an exceedance of the EPA's MCL at the monitoring well ring. However, as discussed above under the heading entitled "Geochemical Model," the NRC staff found significant deficiencies in UO's geochemical model, which may significantly affect modelling results.

(2) The NRC staff finds that the restoration report is deficient in showing the SSI trends noted for uranium at wells 3W75-1 and 3Z87-1 to be reversed and stable.

   Basis: UO reassessed the stability data using MK trend analysis for the entire MU-3 wellfield (UO, 2015). As discussed above under the heading "SSI Trends," use of well field basis for demonstrating stabilization of mean or median concentrations is only appropriate if levels from each individual well in the wellfield grouping is stable with time.

Mine Unit 4 (MU-4)

As previously stated in the October 2012 TER (NRC, 2012), the NRC staff cannot concur that the restoration of MU-4 is protective of human health and safety and the environment until the licensee:

(1) Demonstrates that its restoration effort results in parameter levels approaching asymptotic trends using best practicable technology (BPT).
(2) Provides confirmatory analyses on the uranium concentrations at monitoring well 4MW-15 that demonstrate the levels are within regulatory requirements (groundwater protection criteria).
(3) Adequately characterizes the impacts to the aquifer in the vicinity of 4MW-1 and those impacts are within regulatory requirements (groundwater protection criteria).
(4) Demonstrates stability of contaminant concentrations by showing no SSI trends during the stability monitoring period once the restoration goals are achieved.

The NRC staff evaluation of Uranium One's response to the four (4) above-referenced comments is as follows:

(1) The NRC staff finds that UO has not adequately demonstrated that its restoration effort at MU-4 is consistent with the application of BPT[3].

    Basis: UO's provided a table that summarizes restoration and stability data for hazardous constituents at MU-4. UO's response is inadequate in addressing the NRC staff's observations (UO, 2015, MU-4 Evaluation Step 2 – Asymptotic Trends and Application of BPT), which identify deficiencies in the demonstration of MU-4 restoration effort being consistent with the application of BPT. These observations included trends within graphs of uranium (U_3O_8) and conductivity versus pore volumes of groundwater treatment for modules in the MU-4 Report in the Restoration Report (Cogema, 2008) as well as other relevant observations.

[3] Limited guidance is available for the NRC staff's interpretation of "not achieving" the primary goal in the case of the class-of-use as a secondary goal. 10 CFR Part 40 Appendix A Criterion 5B(6) specifies that the licensees may request use of an ACL, Criterion 5B(5)(c), but only after demonstrating that Criterion 5B(5)(a) and Criterion 5B(5)(b) are not practicably achievable considering available corrective actions and that the limits are as low as reasonable achievable; however, the class-of-use standard as applied in this case is not an ACL and this regulatory requirement is not applicable. Guidance in NUREG-1569 (NRC, 2003) states that "secondary standards will not be applied so long as restoration continues to result in significant improvement in ground-water quality. The applicant must first attempt to return ground-water quality to primary restoration standards before falling back on secondary restoration standards." Wyoming Guideline No 4 states that the secondary goal of restoration within class of use is applicable if and only if BPT has been demonstrated. Wyoming guideline 4 defines BPT as "a technology based process determined by WDEQ as justifiable in terms of existing performance and achievability (in relation to health and safety) which minimizes, to the extent safe and practicable, disturbances and adverse impacts of the operation on human or animal life, fish, wildlife, plant life and related environmental values."

(2) The NRC staff finds UO's response is deficient in demonstrating the uranium levels of in 4MW- 15 are within regulatory requirements (ground water protection criteria).

Basis: UO indicated that the latest analytical data collected in September 2013 indicates a uranium concentration of 0.14 mg/L, whereas baseline (mean + 2 standard deviations) is 0.037 mg/L (UO, 2015). However, as expressed in the 2012 TER (NRC, 2012), because this well, under static conditions, is downgradient of MU-4 and the impacts to the groundwater at this well from the elevated uranium concentration, the NRC staff determined that additional analysis should be conducted on this well. The NRC staff notes that UO did not provide the analysis of the elevated uranium concentration other than to say that "a review of all the data and modeling results indicates that MU-4 is stable, and the NRC staff should approve this restoration." Regarding the model, as discussed above under the heading entitled "Geochemical Model," the NRC staff found significant deficiencies in UO's geochemical model, which may significantly affect modelling results.

(3) The NRC staff finds that UO adequately characterized the impacts to the aquifer in the vicinity of 4MW-1 with additional water quality information. No further response to the NRC staff's prior comment concerning this matter is requested at this time.

Basis: UO provided water quality data obtained from well 4MW-1 covering the period from March 11, 2009, to July 2, 2014 (UO, 2015). This water quality data included chloride, conductivity, alkalinity, and pH. A review of the analytical data indicates that this well continues to be off excursion status per LC 11.2 (NRC, 1998, 2007) since it was terminated from excursion status by letter dated July 1, 2011 (UO, 2011).

(4) The NRC staff finds UO's response is deficient in demonstrating of the stability of contaminant concentrations by showing no SSI trends during the stability monitoring period once the restoration goals are achieved.

Basis: UO provided results of MK trend analysis of MU-4 sample results for uranium, selenium, and radium-226 on a wellfield basis (OU, 2015). As discussed above under the heading "SSI Trends," use of well field basis for demonstrating stabilization of mean or median concentrations is only appropriate if levels from each individual well in the wellfield grouping is stable with time.

Mine Unit 5 (MU-5)

The NRC staff's comments regarding MU-5 were not addressed by the licensee because UO has recently produced uranium from a portion of this wellfield.

Mine Unit 6 (MU-6)

As previously stated in the October 2012 TER (NRC, 2012), the NRC staff cannot concur that the restoration of MU- 6 is protective of human health and safety and the environment until the licensee:

(1) Provides the NRC staff with data used to define baseline; and
(2) Demonstrates that its restoration effort is consistent with BPT and results in levels that exhibit an asymptotic trend.

The NRC staff evaluation of Uranium One's response to the two (2) above-referenced comments is as follows:

(1) The NRC staff finds UO's response is deficient in providing data used to define baseline for MU-6

Basis: UO provided the calculated TRVs for MU-6 wellfield basis (UO, 2015), but not the data used to define baseline as further discussed in the 2012 TER (NRC, 2012). This data is necessary for the NRC staff's independent evaluation of the restoration data.

(2) The NRC staff finds UO's response is deficient in demonstrating that its restoration effort is consistent with BPT and results in levels that exhibit an asymptotic trend.

Basis: UO's response does not include a demonstration that its restoration effort is consistent with BPT and results in levels that exhibit an asymptotic trend. UO reported that restoration results for uranium concentrations meet groundwater protection standards and show uranium exhibits an SSI trend for MU-6 on wellfield basis. As discussed above under the heading "SSI Trends," use of well field basis for demonstrating stabilization of mean or median concentrations is only appropriate if levels from each individual well in the wellfield grouping is stable with time. UO stated that geochemical modeling results indicated that much higher concentrations of uranium can exist in the production zone without impacting water quality at the monitoring well ring. However, as discussed above under the heading entitled "Geochemical Model," the NRC staff found significant deficiencies in UO's geochemical model, which significantly affect modelling results.

REFERENCES

10 CFR Part 40. *Code of Federal Regulations*, Title 10, Energy, Part 40, "Domestic Licensing of Source Material."

10 CFR Part 40, Appendix A. *Code of Federal Regulations*, Title 10, Energy, Part 40, Appendix A, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by The Extraction or Concentration of Source Material from Ores Processed Primarily for their Source Material Content."

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