

**TECHNICAL EVALUATION REPORT - LICENSE AMENDMENT REQUEST
TO REVISE THE GROUND WATER MONITORING PROGRAM AT
THE UMETCO MINERALS CORPORATION'S GAS HILLS EAST, WYOMING SITE**

DATE: May 17, 2016

DOCKET NO.: 040-0299

LICENSE NO.: SUA-648

LICENSEE: Umetco Minerals Corporation

FACILITY: Gas Hills East, Wyoming

TECHNICAL REVIEWER: Matthew Meyer

PROJECT MANAGER: Dominick Orlando

1.0 SUMMARY AND CONCLUSIONS

In a letter dated January 22, 2015, Umetco Minerals Corporation (Umetco) requested that the U.S. Nuclear Regulatory Commission (NRC) amend Umetco's radioactive materials license number SUA-648 to modify the ground water monitoring program at Umetco's Gas Hills East site in Fremont and Natrona counties, Wyoming (Umetco, 2015a) (Agencywide Documents Access and Management System (ADAMS) Accession Number ML15027A095). On April 8, 2015, Umetco revised its request to address several questions raised by the NRC staff on November 6, 2014 (NRC, 2014b) (ML14301A282) regarding the ground water at the Gas Hills site (Umetco, 2015b) (ML15103A024). Specifically, Umetco requested changing the Ground Water Monitoring Plan to a standalone document; changing the sampling period from June to May through July; changing the sampling parameters to the Alternate Concentration Limits (ACL) constituents, plus chloride and sulfate in all wells; removing the discussion of model validation wells and target concentrations; adding an annual Ground Water Conditions report to be submitted to the NRC; and, adding four proposed new monitoring wells.

The NRC staff has reviewed the information provided by Umetco in their January 22, 2015, and April 8, 2015, requests, and has concluded that the requested revisions to the ground water monitoring program are appropriate and should provide information that will allow the NRC staff to evaluate the ground water quality and the fate and transport of contaminants, specifically radium-226+228, at the site. This information is important, as the possibility exists that the radium-226+228 in the ground water could move beyond the site long-term care boundary in the future and, if actions are necessary to address this potential issue, they will need to be concluded before the site license can be terminated. Although the radium plume has moved beyond the restricted area at the site, it is still within the area controlled by Umetco or the Bureau of Land Management (BLM) and there is not an immediate threat to the public health and safety or the environment.

2.0 BACKGROUND

Uranium milling was conducted at the Umetco site from 1960 to 1984 and the mill has been decommissioned. In 2001, Umetco submitted an application for ACLs to address ground water constituents-of-concern derived from historical milling operations at the site (Umetco 2001a) (ML011440258). The ACL application was supported by ground water flow, solute transport, and geochemical models. To help validate these models and provide an indication of ACL constituent attenuation, Umetco prepared and implemented a ground water monitoring plan that required comparison of ground water chloride and sulfate sampling results to corresponding model-predicted concentrations at four model validation wells. This approach suggested that, if chloride and/or sulfate concentrations exceeded the model-predicted concentrations at any model validation well, response actions would be needed, including, but not limited to, reassessment of the model simulations and assumptions. Therefore, in accordance with the Ground Water Monitoring Plan dated March 4, 2002 (Umetco 2002a) (ML020670552), the model validation wells were sampled annually for chloride and sulfate, and the sample results were compared to the model-predicted concentrations.

Between 2010 and 2012, measured concentrations of chloride and sulfate exceeded model predictions in monitoring well MW28, located along the ground water flow path between the Western Flow Regime (WFR) Point of Compliance (POC) and the Point of Exposure (POE). In addition, sampling results raised concerns that radium-226+228 was not being attenuated as predicted in the model. Based on the sampling results, Umetco agreed to perform a ground water evaluation of the WFR (Umetco 2014b) (ML14106A615). This Technical Evaluation Report (TER) summarizes the NRC staff's evaluation of Umetco's license amendment request to amend the ground water monitoring program to perform the evaluation of the WFR.

3.0 DESCRIPTION OF AMENDMENT REQUEST

License Condition (LC) 35 of radioactive materials license SUA-648 requires Umetco to conduct monitoring as described in the Ground Water Monitoring Plan. Umetco is requesting a license amendment for the installation four additional monitoring wells and modification of the Ground Water Monitoring Plan referenced in LC 35. Revisions to the Ground Water Monitoring Plan include:

- Changing the Ground Water Monitoring Plan to a stand-alone document;
- Changing the sampling period from June to May through July;
- Changing the sampling parameters to the ACL constituents, plus chloride and sulfate in all wells;
- Removing the discussion of model validation wells and target concentrations;
- Adding an annual Ground Water Conditions report to be submitted to the NRC; and
- Adding the four proposed new monitoring wells.

In its January 22, 2015, letter, Umetco requested the following modifications (underlined/strike through) to License Condition 35 to accommodate the license amendment request (Umetco, 2015a) (ML15027A095):

35. The Alternate Concentration Limits (ACL) for ground water contained in Umetco 's application dated May 11 and May 18, 2001, as revised by submittals of July 30, 2001, December 3, 2001, ~~and~~ March 4 and October 2, 2002, June 17, 2005, ~~and~~ October 31, 2011, and January 22, 2014 have been approved for this site. The licensee shall implement a ground water compliance monitoring program that includes the following:
- A. Conduct monitoring as described in the Groundwater Monitoring Plan ~~(ACL application, Appendix M) in the January 5, 2004 submittal, as revised by letter dated October 31, 2011 submitted by letter dated January 22, 2015. The validation of ACL exceedance will be in accordance with Section 4 of Appendix M.~~ The licensee shall submit this monitoring data to the NRC by September 30th of each year and include ground water contour maps, contamination iso-concentration maps, and trend graphs.
 - B. Comply with the following ACL in the western flow regime at Point of Compliance (POC) wells MWI and MAW21A: arsenic = 1.8 mg/L, beryllium - 1.64 mg/L, lead-210 = 35.4 pCi/L, nickel = 13. 0 mg/L, combined radium-226 and 228 = 250 pCi/L, selenium = 0.161 mg/L, thorium-230 = 57.4 pCi/L, and uranium-natural = 11.9 mg/L.
 - C. Comply with the following ACL in the southwestern flow regime at POC wells GW7 and GW8: arsenic = 1.36 mg/L, beryllium = 1.70 mg/L, lead-210 = 189 pCi/L, nickel = 9.34 mg/L, combined radium-226 and 228 = 353 pCi/L, selenium = 0.53 mg/L, thorium-230 = 44.8 pCi/L, and uranium-natural = 34.1 mg/L.
 - D. Laboratory reported lower limits of detection for radiological constituents shall be in accordance with Regulatory Guide 4.14, Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1 April 1980. Laboratory reported lower limits of detection for non-radiological constituents shall be no greater than 10% of the Alternate Concentration Limit for the constituents.

These proposed revisions were updated on April 8, 2015, as follows (Umetco, 2015b) (ML15103A024):

35. The Alternate Concentration Limits (ACL) for ground water contained in Umetco 's application dated May 11 and May 18, 2001, as revised by submittals of July 30, 2001, December 3, 2001, ~~and~~ March 4 and October 2, 2002, June 17, 2005, ~~and~~ October 31, 2011, and January 22, 2015 and April 8, 2015 have been approved for this site. The licensee shall implement a ground water compliance monitoring program that includes the following:
- A. Conduct monitoring as described in the Groundwater Monitoring Plan ~~(ACL application, Appendix M) in the January 5, 2004 submittal, as revised by letter dated October 31, 2011 submitted by letter dated January 22, 2015. The validation of ACL exceedance will be in accordance with Section 4 of Appendix M.~~ The licensee shall submit this monitoring data to the NRC by September 30th of each year and include ground water contour maps, contamination iso-concentration maps, and trend graphs.

- B. Comply with the following ACL in the western flow regime at Point of Compliance (POC) wells MWI and MAW21A: arsenic = 1.8 mg/L, beryllium = 1.64 mg/L, lead-210 = 35.4 pCi/L, nickel = 13.0 mg/L, combined radium-226 and 228 = 250 pCi/L, selenium = 0.161 mg/L, thorium-230 = 57.4 pCi/L, and uranium-natural = 11.9 mg/L.
- C. Comply with the following ACL in the southwestern flow regime at POC wells GW7 and GW8: arsenic = 1.36 mg/L, beryllium = 1.70 mg/L, lead-210 = 189 pCi/L, nickel = 9.34 mg/L, combined radium-226 and 228 = 353 pCi/L, selenium = 0.53 mg/L, thorium-230 = 44.8 pCi/L, and uranium-natural = 34.1 mg/L.
- D. Laboratory reported lower limits of detection for radiological constituents shall be in accordance with Regulatory Guide 4.14, Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1 April 1980. Laboratory reported lower limits of detection for non-radiological constituents shall be no greater than 10% of the Alternate Concentration Limit for the constituents.

4.0 TECHNICAL EVALUATION

Background

On January 22, 2015, Umetco submitted a license amendment request to modify the ground water monitoring program at its Gas Hills East, Wyoming, site (Umetco, 2015a) ([ML15027A095](#)). The request was amended and supplemented with additional information on April 8, 2015 (Umetco, 2015b) ([ML15103A024](#)). The license amendment request is the result of concerns first identified during an NRC site inspection on September 20, 2011, and documented in the inspection report dated October 17, 2011 (NRC, 2011) ([ML11290A292](#)). The inspection identified concentrations of chloride and sulfate that exceeded model-predicted target levels at monitoring well MW28, located along the ground water flow path for the WFR between the POC and POE. On June 25, 2012, Umetco submitted a technical memorandum to the NRC proposing to evaluate the model-predicted target levels to ensure that constituents with an ACL accurately represent current conditions (Umetco, 2012) ([ML12179A388](#)).

In 2013, Umetco expanded ground water sampling at the Gas Hills site to include all ACL constituents at the model validation wells as recommended by NRC staff on September 24, 2012 (NRC, 2012) ([ML12250A629](#)). Umetco provided the June 2013 sampling results for the ACL constituents at the model validation wells and an evaluation of ground water conditions on September 18, 2013 (Umetco, 2013) ([ML13263A017](#)). As a result of the June 2013 results and ground water evaluation, on March 11, 2014, the NRC staff expanded the ACL sampling recommendation to include all active monitoring wells (NRC, 2014a) ([ML14037A428](#)). The expanded sampling for all ACL constituents revealed elevated radium-226+228 concentrations at monitoring well MW28, which, in turn, raised concerns that the radium plume was not attenuating as predicted by the geochemical modeling used to support the ACL approval. On November 6, 2014, the NRC staff informed Umetco of their concerns (NRC, 2014b) ([ML14301A282](#)). Umetco responded to the NRC staff's concerns on April 15, 2014 (Umetco, 2014b) ([ML14106A615](#)) and agreed to perform a ground water evaluation of the WFR and various additional activities, as detailed in the letter, necessary to evaluate the NRC staff's concerns.

License Amendment Request

The license amendment request includes an evaluation of the ground water contaminant migration and attenuation in the WFR, addresses the NRC staff's concerns presented by the NRC on November 6, 2014 (NRC, 2014b) (ML14301A282), and requests the following six revisions to the Ground Water Monitoring Plan: (1) Changing the Ground Water Monitoring Plan to a standalone document; (2) Changing the sampling period from June to May through July; (3) Changing the sampling parameters to the ACL constituents in addition to chloride and sulfate in all wells; (4) Removing the discussion of model validation wells and target concentrations from the Ground Water Monitoring Plan; (5) Adding an annual Ground Water Conditions report to be submitted to the NRC; and, (6) Adding the four proposed ground water monitoring wells to the Ground Water Monitoring Plan.

Introduction

Umetco's license amendment request presents Umetco's current assessment of radium-226+228 sources, migration, and attenuation in the WFR. This assessment is based on an assessment of geochemical modeling at MW28, major ion geochemical signatures, factors controlling radium-226+228 mobility, and historic and current concentration isopleths for radium-226+228 and indicator constituents.

While the license amendment request presents six proposed changes to the Ground Water Monitoring Plan, the NRC staff's technical evaluation below focuses on the four additional proposed ground water monitoring wells essential to evaluating the migration and attenuation of radium-226+228 downgradient of MW28, the ground water conditions downgradient of MW1 near MW70A, and the ground water conditions in the vicinity of MW71B. The five additional requests are addressed in the Evaluation Findings section.

In addition, Umetco's April 8, 2015 (Umetco, 2015b) (ML15103A024) supplement to the January 22, 2015 (Umetco, 2015a) (ML15027A095), license amendment request provides responses to comments and concerns raised by the NRC staff on November 6, 2014 (NRC, 2014b) (ML14301A282). Umetco's responses to the NRC staff's concerns are addressed throughout this TER, as appropriate.

Ground water Evaluation

Original Geochemical Model

The original geochemical model (PHREEQC) approved by the NRC on March 29, 2002 (NRC, 2002) (ML021070805), simulated ACL constituent concentrations at the POE as a function of time over the 1,000-year compliance period and spatially only at the POC and POE at year 1,000 of the compliance period. The modeling effort did not provide predicted concentrations for the ACL constituents at any intermediate monitoring wells (between the POC and POE) as a function of time along the modeled flow path, which began at the edge of the Above Grade Tailings Impoundment (AGTI) and traveled through POC well MW21A and Monitoring well MW28 to the POE in the WFR.

Modified Geochemical Model

To overcome this issue, Umetco modified the original PHREEQC input files to generate output at a distance that approximately corresponds to monitoring well MW28. The modified geochemical model uses an updated version of PHREEQC (3.0.6) in conjunction with the original GasHills.dat database.

The results of the modified geochemical model predicted a peak radium-226+228 concentration at MW28 below the maximum background value of 79 picocuries per liter (pCi/L) and well below the 199 pCi/L and 163 pCi/L observed during ground water sampling events in June 2013 and June 2014, respectively. The discrepancy observed at MW28 between the concentrations predicted by PHREEQC and those observed (see Table 1) indicates that radium-226+228 is attenuating at a slower rate than predicted, based on the model assumptions. Alternatively, concentrations of radium-226+228 upgradient of MW28 were in excess of the statistically derived source term concentration of 250 pCi/L originally used in PHREEQC. The elevated upgradient radium-226+228 source may have influenced concentrations at MW28, resulting in concentrations greater than predicted by the original geochemical model.

Location	Maximum Predicted Radium-226+228 Concentration		Observed Radium-226+228 Concentration	
	Ground water Velocity			
	0.167 feet/day	0.33 feet/day	June 2013	June 2014
MW28	57.1 pCi/L	72.6 pCi/L	199 ± 2.3 pCi/L	163 ±pCi/L

Table 1. Maximum Predicted and Observed Radium-226+228 Concentrations at MW28 in 2013 and 2014

Revised Geochemical Model

The original geochemical model controlled radium-226+228 attenuation by both ion exchange with clay minerals and adsorption to hydrous ferric oxide (HFO). Concentrations of radium-226+228 at the site have been shown to increase with decreasing pH, with the greatest effect occurring at a pH of approximately 6.0, indicating that adsorption to HFO may be the primary process influencing radium transport. The original geochemical model also assumed an initial radium-226+228 source term concentration of 250 pCi/L that was predicted to decrease exponentially with time. The original geochemical model did not account for historic radium-226+228 concentrations in excess of 500 pCi/L at monitoring wells near the AGTI.

The geochemical model was revised to account for the known upgradient concentrations in excess of the statistically derived radium-226+228 concentration of 250 pCi/L and adsorption to HFO as the primary attenuation process. The radium-226+228 concentration in the revised geochemical model was increased to 300 pCi/L at an approximate distance of 1,000 feet from the AGTI and only adsorption to HFO was allowed to control attenuation. The pH of the existing ground water was also uniformly decreased to 5.5 for the entire modeled length of the WFR, but the initial and decreasing source terms for radium-226+228 and pH were not changed (i.e., tailings seepage water had an initial radium-226+228 source term concentration and pH value of 250 pCi/L and 5.50 respectively).

The revised modeling results showed that transport of an additional single radium-226+228 input of 300 pCi/L west of the AGTI under lower pH conditions produced a peak radium-226+228 activity of 200 pCi/L at MW28 when a flow rate of 0.33 feet/day was simulated. When the simulation was projected to the POE, the predicted radium-226+228 activity was approximately 175 pCi/L, which is above the maximum radium-226+228 background value of 79 pCi/L for the WFR. The revised geochemical model predictions are considered conservative due to the assumed low pH conditions used for the entire modeled length of the WFR, which allows radium-226+228 to transport similar to a conservative tracer. The future extent of radium-226+228 attenuation beyond MW28 should largely be controlled by the rate pH increases at the plume front as the ground water acidity is further neutralized.

Current Ground Water Conditions

Umetco's ground water evaluation provided on September 18, 2013, (Umetco, 2013) (ML13263A017) included a conceptual model of plume migration in the WFR based on the results of additional ACL constituent sampling in June 2013. To further refine the conceptual model, characterization of both historic and recent radium-226+228 activities and major ion chemistry was undertaken to characterize the source, extent, and fate of radium-226+228 in the ground water migrating west of the AGTI.

Major Ion Chemical Signatures

The composition of major cations and anions was analyzed to distinguish between geochemical signatures of the pore water released from the mill tailings and native background water to aid in the identification and monitoring of plume migration. The analysis determined that ground water impacted by mill tailings pore water had a magnesium-sulfate (Mg-SO_4) geochemical signature, while native ground water had a calcium-sulfate (Ca-SO_4) geochemical signature.

Since 2001 a significant shift in the major ion chemistry has been observed at MWI64, located upgradient of MW28, and in the downgradient monitoring wells. The ground water composition at MWI64 has shifted from an impacted Mg-SO_4 signature toward a Ca-SO_4 signature with higher proportions of bicarbonate (HCO_3) from 2001 to 2014. In parallel, monitoring wells located downgradient from MWI64 shifted toward increased proportions of magnesium relative to their historic Ca-SO_4 signatures. The downgradient shifts were most pronounced at MW25 and MW28, located west of MWI64.

Source and Mobility Evaluation

Before 2001, ground water trends showed that increases in radium-226+228 were most pronounced at MWI64, whereas recent increases in radium-226+228 are most prominent at MW28. Between 2001 and 2013, radium-226+228 at MW28 increased from 17.9 pCi/L to 199 pCi/L, while during the same period radium-226+228 decreased from 215 pCi/L to 15.6 pCi/L at MWI64. The maximum radium-226+228 activity at MW28 (199 pCi/L) is only slightly lower than that observed at upgradient well MWI64 (215 pCi/L), indicating that radium-226+228 is primarily migrating conservatively, i.e., at the same rate as ground water flow, similar to sulfate, as long as the pH generally remains below 6.0.

The elapsed travel time between the first radium-226+228 peak at MWI64 and the corresponding peak at MW28 provides a calculated ground water velocity of 0.33 feet/day, which is consistent with the upper ground water velocity used in the NRC-approved ACL application (NRC, 2002) (ML021070805). Concentrations of radium-226+228 at the site have been shown to increase with decreasing pH, with the greatest effect occurring at a pH of approximately 6.0, indicating that adsorption to iron oxide minerals may be the primary process influencing radium transport.

Proposed Monitoring Wells

The four new proposed monitoring wells will be installed in the Lower Wind River aquifer of the WFR, with the well screens set at approximately the same elevation in each well. To the extent practicable, the well screens will be designed to overlap the existing well screen intervals in monitoring wells MWI64, MW28, and MW77. This will likely require Umetco to install longer (i.e., 50- to 60-ft) well screens in the new wells. Based on these requirements and the ground surface elevation at each of the proposed locations, the well depths are expected to range from 230 to 270 feet below ground surface.

MW83 will be located approximately 300 feet downgradient (west) of MW28. This well is intended to intercept peak radium-226+228 activities from upgradient and evaluate radium attenuation along the ground water flow path. The downgradient location of MW83 from MW28 should begin to intercept the plume within 1 year after being installed.

MW84 was initially proposed to be located 600 feet northwest of MW28 to allow for further refinement of the ground water flow direction and to provide a second point for evaluating the attenuation of radium-226+228. Umetco provided supplemental information to the January 22, 2015 (Umetco, 2015a) (ML15104A202), license amendment by letter dated April 8, 2015 (Umetco, 2015b) (ML15104A222), to address comment #2 from NRC's November 6, 2014 letter (NRC, 2014b) (ML14301A282) regarding uranium concentrations observed at MW70A and the lack of downgradient monitoring wells in place to assess attenuation of uranium. Umetco evaluated historic trends in uranium, chloride, and sulfate at MW1 and MW70A, major ion signatures, and expected constituent travel times. Umetco's evaluation determined that evidence of migration of constituents at MW70A is inconclusive due to inconsistencies with major ion signatures at MW70A, and expected constituent travel times of indicator concentrations between MW1 and MW70A. Umetco contends that the conditions observed at MW70A are likely representative of a stagnant ground water condition, limited in both lateral and vertical extent and is not representative of local ground water conditions or of ground water migrating from upgradient sources to the POE.

To further evaluate ground water conditions near MW70A, a modified location was proposed for MW84. The modified location is approximately 400 feet downgradient of MW70A and approximately 1,300 feet downgradient (northwest) of MW21A. The modified location provides a better distribution of wells across the downgradient portion of the site. This well will be used to refine the ground water flow direction, provide a point on the north side of the plume for evaluating plume migration, and for delineating the northern extent of the plume.

MW85 is located approximately 1,400 feet northwest of MW28. This well is intended to intercept the leading edge of sulfate-impacted ground water from the AGTI, and will provide an early indication of downgradient contaminant movement. MW85 would be about the same

distance from MW28 as MW77, and would serve as an additional sentinel well to detect plume migration before the plume reached the POE.

MW86 is an additional well proposed by Umetco on April 8, 2015 (Umetco, 2015b) (ML15104A222) to address comment #3 from NRC's November 6, 2014 letter (NRC, 2014b) (ML14301A282), which questioned the suitability of MW71B as a long-term monitoring well and for use in model validation, since the screened interval of the well is contained in the lower portion of the WFR. Ground water concentrations of milling-related constituents were historically restricted to the upper 50 feet (ft.) of the WFR and concentrations were shown to decline rapidly with depth from 50 to 100 ft., which is the approximate depth of MW71B. MW86 will be located approximately 500 feet northwest of MW71B and is screened in the upper portion of the aquifer. The location of the proposed well will be slightly north of MW71B so that it is directly downgradient of former extraction wells MWC33 and MWC34 where high radium concentrations were observed in the early 1990s. This well is intended to provide an early indication of downgradient contaminant movement and provide a shallower monitoring point to complement the deeper MW71B.

Umetco stated in the January 22, 2015, (ML15027A095) request that they will also collect samples of the aquifer solids from the unsaturated and saturated zones as the proposed new wells are drilled. The samples will be characterized with respect to bulk mineralogy, clay and organic carbon content, cation exchange capacity, and amorphous iron oxide content.

Background Ground Water Quality

To address the NRC staff's concerns regarding concentrations of nickel and beryllium in excess of the POE concentrations reported at the furthest downgradient monitoring well (MW77) near the proposed long-term care boundary (NRC, 2014b) (ML14301A282), Umetco provided a response to the concern on April 8, 2015 (Umetco, 2015b) (ML15104A222). The NRC staff compared observed nickel and beryllium concentrations at MW77 to the POE concentrations found in Tables 2.9 and 2.10 of the ACL application. Umetco contends that the values listed in Table 2.9 and 2.10 only represent the maximum model-predicted values at the POE for the 1,000-year time frame and not the background values approved for use at the POE in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 40, Appendix A, Criterion 5B(5). Umetco believes that the background concentrations consist of a range of background values determined for each constituent and believes that the highest background value for each constituent is the appropriate POE value.

The NRC staff reviewed the January 22, 2015, and April 8, 2015, requests (Umetco, 2015a and Umetco, 2015b) (ML15027A095 and ML15104A222) and agrees with Umetco's conclusion that an additional monitoring well at the site boundary to verify the actual concentration of ACL constituents is not necessary with respect to nickel and beryllium in the WFR. The NRC staff also agrees that the maximum constituent concentration in the range of background represents the appropriate POE constituent concentrations. The following are clarifications regarding Umetco's response and the NRC staff's concern:

1. Umetco's response cited 10 CFR 40, Appendix A, Criterion 5B(5) as the regulation used to establish "POE values." However, 10 CFR 40, Appendix A, Criterion 5B(5) does not directly address standards at the POE as Umetco's response states. Rather, Criterion 5B(5) requires that the ground water protection standards must be met at the POC. In

order for an ACL to be approved, it must be protective. To accomplish this, an ACL for a hazardous constituent must attenuate to, or not exceed, a protective value within the 1,000 year performance period established by Criterion 6 at a potential exposure location. In this case, the protective concentrations for the approved ACLs are the maximum constituent concentrations observed in the samples from background wells provided in Appendix A to the ACL application.

2. The ACL application included a detailed evaluation of ambient ground water quality as stated in Umetco's response. The background evaluation was provided in Appendix A to the ACL application (Umetco, 2001b) (ML011450325). The statistical evaluation of ambient ground water conditions at the Gas Hill site was prepared in support of the ACL application to address the NRC staff's Request for Additional Information (RAI) number 22 (NRC, 2000b) (ML003696238) included with the April 17, 2000 NRC letter (NRC, 2000a) (ML003699821). RAI number 22 stated that, by only using one time maximum values that represented the worst water concentrations measured, the application did not adequately characterize the ambient water quality. A single background value was statistically derived from the range of background measurements to represent background conditions at the site rather than a "range of background" for each constituent. The statistically derived background constituent concentrations reported in Appendix A were provided for comparison with the ground water modeled concentrations at the POE in Table 2.10 of the revised draft ACL application dated May 31, 2001 (Umetco 2001b) (ML011450325) and the application states that the "model also shows that concentrations at the POE will be below background values established for the area, as described in Appendix A." Appendix A describes background relative to the statistically derived constituent concentrations for the WFR and the Southwest Flow Regime (SFR). On December 3, 2001 (Umetco 2001c) (ML020020133 and ML020020229), the NRC received the final revision to the ACL application, which revised the statistically derived background concentration with a "range of background" concentrations for each ACL constituent. This final December 3, 2001 version of the ACL application (Umetco, 2001c) (ML020020133 and ML020020229) with the range of background concentrations was subsequently approved by NRC staff by letter dated March 29, 2002 (NRC, 2002) (ML021090A292). While the main report of the ACL application was revised, Appendix A was not revised to reflect the change from the statistically derived background concentration to the maximum background concentration within the range of background values. This conflicting information led to the NRC staff's concern regarding observed nickel and beryllium concentrations at MW77. Therefore, the approved background values applicable at the POE are the Maximum Values provided in Table 2 below.

Table 2. Selected Background Values for the Western Flow Regime and Background Minimum, Median, and Maximum values							
Radionuclide Constituent	Radium-226 (pCi/L)	Radium-228 (pCi/L)	Radium-226+228 (pCi/L)	Uranium (mg/L)	Thorium-230 (pCi/L)	Lead-210 (pCi/L)	Gross Alpha (pCi/L)
Minimum Value	0.2	0.4	0.7	0.0009	-2.90	-2.8	1.0
Median Value	9.2	4.0	14.4	0.010	0.00	1.4	30.0
Maximum Value	72.0	12.0	79.0	0.26	0.50	6.1	380

Non-Radionuclide Constituent	Arsenic (mg/L)	Beryllium (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Minimum Value	0.001	0.01	0.01	0.01	1.0	125.0	366.0
Median Value	0.009		0.05		5.6	442.0	780.0
Maximum Value	0.17	0.16*	2.22	0.01	14.0	1,920.0	3,097.0

*Detection limit per NRC license = 0.16 mg/L, Appendix A concentration was 0.01

Eleven (11) wells were identified as being representative of background ground water quality for the Western Flow Regime: A8, Adobe 4, DOMW1, MW27, MW28, MW30, MW76, MW77, and Rim Wells 1, 2 and 3. Background data was obtained from Appendix A, Tables A.6 through A.8 (ML011450325)

Evaluation Findings

Based on the NRC staff's review of Umetco's interpretation of the analysis, the NRC staff concludes that:

- (1) the elevated radium activity currently present at MW28 was derived from tailings-impacted ground water from the vicinity of monitoring well MWI64 or potentially higher radium-226+228 concentrations that were undetected by MWI64;
- (2) the factors controlling radium fate and transport at the site appear to be different than the conceptual model for radium migration presented in the ACL application; and
- (3) despite these conceptual model differences, it is still possible that radium-226+228 activities will naturally attenuate to within background levels before reaching the WFR POE.

The NRC staff reviewed the proposed Ground Water Monitoring Plan, which includes the following six changes: (1) Changing the Ground Water Monitoring Plan to a standalone document; (2) Changing the sampling period from June to May through July; (3) Changing the sampling parameters to the ACL constituents in addition to chloride and sulfate in all wells; (4) Removing the discussion of model validation wells and target concentrations from the Ground Water Monitoring Plan; (5) Adding an annual Ground Water Conditions report to be submitted to the NRC; and (6) Adding the four proposed ground water monitoring wells to the Ground Water Monitoring Plan.

Changing the Ground Water Monitoring Plan to a standalone document

The NRC staff has determined that the proposed change to make the Ground Water Monitoring Plan a standalone document is acceptable and will not impact current or future ground water monitoring requirements. The change is administrative in nature and will alleviate confusion, as references to "Appendix M of the ACL Application" in the license have caused confusion in the past.

Changing the sampling period from June to May through July

The NRC staff has determined that the proposed change to the annual sampling period from the month of June to a timeframe that spans from May 1st through July 31st is acceptable. The

expanded ground water sampling timeframe will provide the licensee additional time for ground water sampling to account for weather related delays or other unforeseen circumstances. The extended sampling timeframe should not be influenced by temporal (seasonal) variations since the samples will be obtained during the same seasonal period as the previous sampling event.

Changing the sampling parameters to the ACL constituents, plus chloride and sulfate in all wells

The NRC staff has determined that the proposed change to annually sample the ACL constituents (i.e., arsenic, beryllium, lead-210, nickel, combined radium-226 and -228, selenium, thorium-230 and uranium-natural), sulfate and chloride at the POC wells and non-POC wells for the WFR and SFR listed in Table 1 of the Ground Water Monitoring Plan, dated January 2015 is acceptable. The change is commensurate with past staff requests and monitoring of the ACL constituents in addition to chloride and sulfate will provide a direct comparison of ground water quality conditions rather than depending on indicator constituents alone. The additional ground water sampling of all ACL constituents at all active ground water wells will provide an accurate understanding of the ground water conditions with respect to constituent transport and attenuation prior to reaching the established POE.

Removing the discussion of model validation wells and target concentrations

The NRC staff has determined that the proposed change to remove the discussion pertaining to model validation wells and target concentrations in the Ground Water Monitoring Plan is acceptable. The model validation wells and the chloride and sulfate target concentrations are not providing a reliable indication of contaminate plume migration or attenuation. The former model validation wells will still be utilized for ground water sampling and will remain non-POC Wells in the Ground Water Monitoring Plan dated January 2015.

Adding an annual Ground Water Conditions report to be submitted to the NRC

The NRC staff has determined that the additional reporting requirement for the proposed annual Ground Water Conditions report is appropriate and shall include, but not be limited to, information as detailed herein. The report will inform the NRC staff about current and future conditions using observed ground water monitoring data and predicted concentrations downgradient of the POC using the revised geochemical model as discussed in the January 22, 2015 (Umetco, 2015a) (ML15027A095) license amendment request.

Umetco has committed to providing an assessment in the annual Ground Water Conditions report of the model predicted rate of migration and attenuation for radium-226+228 by calibration of the revised geochemical model, model simulations for pH's dependency on calcite, and additional geochemical modeling to evaluate current and predicted temporal and spatial ground water conditions from the source term to the POE as described in Umetco's January 22, 2015 (Umetco, 2015a) (ML15027A095) amendment request. The assessment will be based on monitoring data obtained from the proposed and existing monitoring wells and geochemical characterization of solid aquifer materials.

The NRC staff has concluded that a thorough description of all model simulations and further revisions to the geochemical model should be provided in the evaluation for inclusion in future annual reports and Umetco should provide electronic copies of all model input files used in the

evaluation. In addition, Umetco shall submit to the NRC a final Ground Water Conditions report for verification once Umetco validates the model predictions for a time period that has been approved by the NRC to determine if the revised modeling effort will reasonably predict concentrations of site constituents at the POE during the 1,000 year compliance period. Finally, the final, as built, completion reports for the new monitoring wells should be included in the first Ground Water Conditions report following completion of well installation.

While the supporting rationale and modifications to the geochemical model provided have been reviewed by staff, the staff would like to note that any future modeling performed should be driven by the field data obtained and should not be solely constrained to the model revisions described in the report. The effort should be dynamic in nature and details of any changes to the revised model should be detailed in the annual Ground Water Conditions report.

Adding the four proposed new monitoring wells

The NRC staff has determined that the four proposed monitoring wells, MW83-MW86, are appropriately located and will aid in the verification and understanding of ACL constituent transport between the POC and the POE and will help address NRC staff concerns regarding the lack of attenuation observed for radium-226+228. The staff agrees that the additional characterization of the aquifer solids through direct measurement of bulk mineralogy, clay and organic carbon content, cation exchange capacity, and amorphous iron oxide content will greatly enhance Umetco's conceptual and geochemical models.

The NRC staff recommends direct measurement of the neutralization capacity in the WFR to support Umetco's conclusion that the "acidity within the plume is being progressively neutralized" (Umetco 2015a) (ML151027A095). The model simulations proposed by Umetco to evaluate the amount of calcite (CaCO_3) required to account for pH increases between MWI64 and MW28 could potentially overestimate the neutralization capacity since the increase in pH values is partly influenced by the flushing of relatively clean ground water from upgradient as stated in Section 5.0 of the ground water evaluation provided in Umetco's January 22, 2015 license amendment request (Umetco 2015a) (ML15104A202). Neutralization reactions occur very rapidly between acids and carbonates, typically resulting in moderate advancement of the pH plume front depending on the amount of carbonate minerals present in the aquifer solids. This does not appear to be occurring based on the pH isopleths provided in Figures 3-10 through 3-12 for years 1993, 2001, and 2014, respectively. However, the NRC staff understands that the pH isopleths have been driven by pH values observed at MW70A, which is being evaluated due to uncharacteristic ground water conditions.

The proposed new monitoring wells will be installed with well screens set at approximately the same elevation in each well and will contain screened intervals of 50 to 60 feet to allow overlap between the existing screened intervals in monitoring wells MWI64, MW28, and MW77. The NRC staff agrees that the new monitoring wells should contain overlapping screened intervals with current monitoring wells. The overlapping screened intervals would allow for discrete sampling across the screened interval to characterize ground water quality with respect to depth and the ability to obtain samples from elevations consistent with existing monitoring wells, if field data or future ground water evaluations indicate additional characterization would be appropriate (e.g., downgradient radium-226+228 concentrations exceed upgradient concentrations, indicating a stratified zone of contamination exists in the upper portion of the WFR).

If conditions warrant (i.e., if Umetco determines that site derived constituents of concern are present during well installation or sampling at concentrations that could pose a threat to workers or the public), Umetco should inform the NRC and develop or revise procedures applicable to the planned sampling and field activities (e.g., core bore sampling and logging) in accordance with 10 CFR 20.1101 and/or applicable industry standards. A summary of the newly developed or revised procedures should be discussed in the Ground Water Conditions report and made available for review upon request during future site inspections.

5.0 ENVIRONMENTAL EVALUATION

On March 11, 2015, staff of the NRC, BLM and Umetco held a conference call to discuss the installation of the ground water monitoring wells. At the time of the call, Umetco proposed to install the wells on land under the authority of the BLM, and the BLM stated that they would address compliance with the National Environmental Policy Act for the surface activities at the site. However, subsequent to this call, Umetco revised the location and number of wells to include one well on property owned by Umetco, requiring that NRC determine if the proposed action will have an adverse impact on threatened or endangered species or habitats pursuant to the Endangered Species Act (ESA), or the proposed action could adversely impact historic or cultural properties pursuant to the National Historic Preservation Act (NHPA) (Umetco 2015b) (ML15103A024).

The NRC has concluded that, due to the limited ground disturbance anticipated to be associated with the construction of this well, Umetco's proposed action "may affect" listed species or their designated critical habitat. However, these effects are expected to be insignificant, and therefore, the NRC has concluded that the proposed action is "not likely to adversely affect" any endangered or threatened species or critical habitat within the area of influence for the proposed action. The proposed well will be located on a previously disturbed area (remediated pipeline trace) and no construction, other than drilling of the well and the installation of the well head will be done.

On April 28, 2015, the NRC staff contacted the U.S. Fish and Wildlife Service (FWS) regarding Umetco's proposed action and the NRC staff's conclusions that the project would not adversely impact threatened or endangered species or critical habitat (NRC, 2015a) (ML15104A202). By letter dated July 6, 2015, the FWS stated that the project, as proposed, was in compliance with the requirements of the ESA and that the consultation process under the ESA was concluded (FWS, 2015) (ML15205A097). In their letter, the FWS stated:

In accordance with the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703, measures should be taken to ensure that no take of migratory birds occurs during project related activities. Work that could lead to the take of a migratory bird or eagle, their young, eggs, or nests (e.g. drilling a water well or constructing new roads in the vicinity of a nest) should be coordinated with our office.

The requirement will be included as a license condition.

On May 4, 2015, the NRC staff contacted the Wyoming State Historic Preservation Office (SHPO) as part of the NHPA evaluation of Umetco's proposed action. The letter contained

NRC staff's conclusions that the proposed action would not affect historic or cultural properties (NRC, 2015b) (ML15104A222) because of the limited ground disturbance associated with the construction of this well, and the construction would occur on previously disturbed areas. By letter dated May 15, 2015, the Wyoming SHPO concurred with the NRC staff's conclusions that no historic properties would be affected by Umetco's proposed action (WYSHPO, 2015a) (ML15149A069). However, the Wyoming SHPO recommended that the following stipulation be included in the NRC's license amendment:

If any cultural materials are discovered during construction, work in the area should halt immediately, the federal agency and SHPO staff be contacted, and the materials be evaluated by an archeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards (48 FR 22716, September 1983).

The above requirement will be included as a license condition.

Finally, the NRC staff reviewed the proposed action in accordance with NUREG-1748 "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC, 2003) (ML032450279) and has concluded that the action is categorically excluded under 10 CFR 51.22(c)(11) and, as such, the NRC staff will not prepare an Environmental Assessment for the changes to the license conditions.

NUREG-1748 provides guidance to the NRC staff for evaluating proposed licensee actions to determine if they fall within the category of actions that are excluded pursuant to 10 CFR Part 51. Appendix B of NUREG-1748 provides a checklist that should be completed to determine if the proposed action is categorically excluded. The checklist and the staff's evaluation is included below.

A. Is the action consistent with the Statements of Consideration for the categorical exclusion?

Yes. The proposed action meets the criteria for an categorical exclusion under 10 CFR 51.22(c)(11)(i-iv) because the license amendment would only result in a change to process operations and:

- 1) Would not significantly change or increase the amounts of any effluents that may be released offsite. The only effluent that may be released is a small amount of ground water released during well purging. This ground water is already in the offsite aquifer and the concentrations of any constituents of concern is very low;
- 2) There will be no significant increase in individual or cumulative occupational radiation exposure. Any ground water removed from the well will contain very low concentrations of radioactive material that will not result in any occupational exposure;
- 3) There will be no significant construction impact. The proposed well will be located on a previously disturbed area and no construction, other than drilling of the well and the installation of the well head will be done; and
- 4) There is no significant increase in the potential for, or consequences from, radiological accidents. The only radioactive material will be the low concentrations in the ground water samples.

- B. Is the action likely to significantly affect any aspect of the natural environment?

No. Some visual and noise impacts will occur during the installation of the well but this will be short-lived and, after the well is installed, no further impacts will occur.

- C. Is the action likely to significantly impact any aspect of the cultural environment including those that might be related to environmental justice?

No. The well will be located on a previously evaluated and disturbed area (NRC, 2015c) (ML15119A358).

- D. Is the action likely to generate a great deal of public interest about any environmental issue?

No. The proposed action was noticed in the *Federal Register* on March 23, 2015 (FR 80 No.55, Monday March 23, 2015) and interested members of the public were offered the opportunity to request a hearing on the proposed action. No member of the public requested a hearing. In addition, no previously proposed licensing actions at this site have raised public interest.

- E. Is there a high level of uncertainty about the environmental effects?

No. The environmental effects of the action are well understood. Well drilling and ground water sampling are well established activities and the uncertainties regarding them are low (ML091480244 & ML091480188) (NRC, 2009).

License Conditions

The staff has determined that the following License Conditions should be included in the license amendment:

- A. Conduct monitoring as described in the Ground Water Monitoring Plan and as discussed in Umetco's January 22, 2015 and April 8, 2015 requests. The licensee shall submit this monitoring data, in the form of a Ground Water Conditions report, to the NRC by September 30th of each year and include ground water contour maps, contamination iso-concentration maps, and trend graphs. The licensee shall include a thorough description of all model simulations and any further revisions to the geochemical model in the evaluation in the Ground Water Conditions report. The licensee shall provide electronic copies of all model input files used in the evaluation. The licensee shall submit to the NRC a final Ground Water Conditions report for verification once the licensee validates the model predictions for a time period that has been approved by the NRC. The final, as built, completion reports for the new monitoring wells shall be included in the first Ground Water Conditions report following completion of well installation.
- F. If any cultural materials are discovered during the installation of the ground water monitoring wells or related construction activities, work in the area shall be halted immediately, the NRC and the State of Wyoming Historic Preservation Office shall be

contacted, and the materials shall be evaluated by an archeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards.

- G. Measures shall be taken to ensure that no take of migratory birds occurs during project related activities. Work that could lead to the take of a migratory bird or eagle, their young, eggs, or nests (e.g. drilling a water well or constructing new roads in the vicinity of a nest) shall be coordinated with the U.S. Fish and Wildlife Service, Cheyenne, Wyoming Office.

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