UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 6, 2016

Mr. Larry Teahon
Manager, SHEQ
Cameco Resources, Crow Butte Operation
86 Crow Butte Road
P.O. Box 169
Crawford, NE 69339-0169

SUBJECT: OPEN ISSUES, MARSLAND EXPANSION AREA LICENSE AMENDMENT REQUEST, CROW BUTTE RESOURCES, INC., CRAWFORD, NEBRASKA, LICENSE SUA-1534 (CAC J00683)

Dear Mr. Teahon:

By letter dated November 12, 2015, Crow Butte Resources, Inc. (CBR) submitted to the U.S. Nuclear Regulatory Commission (NRC) staff a revised technical report for its request to amend its source material license SUA-1534 for the proposed Marsland Expansion Area uranium in situ recovery (ISR) facility located in Dawes County, Nebraska. By an e-mail dated April 26, 2016, NRC staff informed CBR that its revised application was accepted for further detailed technical review.

NRC staff has identified open issues associated with the preparation of an internal draft of the Safety Evaluation Report (SER). These open issues, enclosed herein, are gaps in the SER that need to be addressed before the SER can be finalized. Within 30 days of receipt of this letter, please either provide the information identified in the enclosure or inform us of the date you expect to provide the information.

In accordance with 10 CFR 2.390 of the NRC's "Agency Rules of Practice and Procedure," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

If you have any questions, please contact Mr. Tom Lancaster at 301-415-6563 or, by email, at Thomas.Lancaster@nrc.gov.

Sincerely,

/RA/

Tom Lancaster, Project Manager
Uranium Recovery Licensing Branch
Division of Decommissioning, Uranium Recovery,
and Waste Programs
Office of Nuclear Material Safety
and Safeguards

Docket No.: 40-8943
License No.: SUA-1534

Enclosure: Open Issues

cc: D. Miesbach, NDEQ
N. Harris, NDEQ

If you have any questions, please contact Mr. Tom Lancaster at 301-415-6563 or, by email, at Thomas.Lancaster@nrc.gov.

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CROW BUTTE RESOURCES, INC.
MARSLAND EXPANSION AREA
OPEN ISSUES

Vegetation, Food, and Fish Sampling

Issue 1: Quality of Sample Results

The laboratory results for several environmental media do not appear to be consistent with the data quality objectives of Regulatory Guide (RG) 4.14 (NRC, 1980), Section 5 through Section 7.

Discussion

RG 4.14 (NRC, 1980) provides recommendations on the collection of samples and the reporting of results, including the lower limit of detection, precision and accuracy of results, and how to report results.

RG 4.14 (NRC, 1980) recommends that if the recommended lower limit of detection (LLD) is not used, then the standard deviation estimated for random error should be no greater than 10 percent of the measured value. In addition, RG 4.14 (NRC, 1980) recommends that the magnitude of the systematic error should be reported if it is significant relative to the random error. Lastly, RG 4.14 (NRC, 1980) recommends that the term "not detected," "less than the lower limit of detection (LLD)," or similar terms should never be used. Each reported result should be a value and its associated error estimate, including values less than the lower limit of detection or less than zero.

The applicant's results for preoperational sampling of forage, livestock, fish, and sediment were reported with an associated precision. It is not clear to the Nuclear Regulatory Commission (NRC) staff how this precision was calculated and how much of the precision was due to random error and how much was due to systematic error. For example, several samples for meat and sediment were reported with a precision of ± 100 percent of the measured value. Some fish samples were reported with a precision of ± 200 percent of the measured value. In addition, several meat, fish and sediment samples were reported as less than the reporting limit.

Lastly, the NRC staff observes that the sample results for MED-7 are not included in Appendix W-2 as indicated in Section 2.9.7.2 of the application (CBR, 2015).

NRC Staff Comment

Please provide a description of how the precision for the environmental media samples was calculated, including a discussion of random and systematic errors. If available, please submit values for samples reported as less than the reporting limit.

In addition, please submit sample results for MED-7, or indicate where this data can be found.

Issue 2: Meat samples

The applicant stated that no preoperational samples of game animals were collected.

Discussion

According to the applicant, there are a limited number of game animals in the licensed area, hunting access is limited by landowners, and that due to the migratory nature of game animals it would be difficult to attribute any radionuclide concentration origins to the site (CBR, 2015).

However, this explanation is not consistent with the applicant's description of big game species in the vicinity of the Marsland Expansion Area (MEA) in Section 2.8.6.1 of the technical report (TR) (CBR, 2015). For example, the applicant stated that pronghorn were observed regularly throughout the project area in 2011 and they appear to be relatively common year-round. In addition, the applicant stated that the home ranges for pronghorn can vary between 162 and 2268 hectares (400 and 5,600 acres) (CBR, 2015). Compared to the size of the MEA license area (1872 hectares (4,622 acres)) (refer to Table 2.2-3 of CBR, 2015) and the size of the 3.6 kilometer (km) (2.25 mile (mi)) radius Area of Review (15,341 hectares (37,879 acres)) (refer to Table 2.2-2 and Figure 2.2-1 of CBR, 2015), this range does not appear to be significant. Lastly, the applicant reported only that some pronghorn make seasonal migrations but that the migrations are not triggered by local weather conditions (CBR, 2015). Regarding access to hunters by landowners, there is currently at least one Open Fields and Waters hunting area of approximately 457 hectares (1,128 acres) located within approximately 8 km (5 mi) of the MEA in Box Butte County (refer to Public Access Atlas Mapsheet #2 of NGPC, 2016a and Figure 2.2-2 of CBR, 2015). According to the applicant, the daily movement of pronghorn does not typically exceed 9.7 km (6 mi). This range exceeds the distance to the Box Butte County hunting area discussed above. In addition, according to the Nebraska Game and Parks Commission, private landowners may enroll their land for allowing public hunting access at any time (NGPC, 2016a). Since the majority of the land is privately owned in, and directly adjacent to, the MEA (refer to Figure 1.3-2 of CBR, 2015) open hunting access could be granted at any time in the future. In any case, hunters may still hunt on private land with the landowner's consent (NGPC, 2016a).

Another example is the applicant's description of elk. According to the applicant, the Marsland Project Area is located in the Pine Ridge area, within the Ash Creek Elk Unit game management area (CBR, 2015, NGPC, 2016b). In addition, most of Nebraska's elk population inhabits the Pine Ridge area (CBR, 2015). The applicant stated that relatively large numbers of elk are known to occur year-round within the project area (CBR, 2015). The NRC staff observes that this observation is consistent with the results of the study by Benkobi, et al. (2005) that showed a significant overlap between the summer and winter ranges for elk in the Black Hills area. In addition, it has been documented that elk compete more with cattle for forage than other big game species because they have similar diets to cattle (Fricke, et al., 2008). The NRC staff observes that approximately 80 percent of the MEA license area, and 73 percent of land within 3.6 km (2.25 mi), is rangeland (refer to Tables 2.2-3 and 2.2-2, respectively, of CBR, 2015). Since cattle account for more than 90 percent of livestock in Dawes County (refer to Section 2.2.2.1 of CBR, 2015), it seems reasonable that elk would use rangeland in and around the MEA site for grazing.

Because of the observations above on game animals, and the lack of information on the consumption of locally raised beef, there is insufficient clarity for the NRC staff to conclude that

the applicant has analyzed the consumption of game animals sufficiently and that it doesn't need to collect meat samples from game animals for analysis consistent with RG 4.14 (NRC, 1980).

NRC Staff Comment

Please provide preoperational meat samples from relevant game animals within 3 km (1.9 mi) of the MEA site.

Issue 3: Crop samples

Other than vegetable gardens, the applicant did not address preoperational sampling of crops in the area.

Discussion

The NRC staff observes that cultivated fields make up approximately 6.3 percent of the project area (approximately 118 hectares (291 acres)) and include crops such as alfalfa, wheats, oats, corn, barley, and rye (refer to Section 2.8.5.3 of CBR, 2015). Additional cropland can be found in the vicinity of the MEA (refer to Figure 2.2-1 of CBR, 2015). Consistent with RG 4.14 (NRC, 1980), the applicant should consider food crops raised within 3 km (1.9 mi) of the MEA or provide justification for an alternate program.

NRC Staff Comment

Consistent with RG 4.14 (NRC, 1980), please provide preoperational crop samples from within 3 km (1.9 mi) of the MEA site or provide justification for an alternate program.

Issue 4: Vegetable Gardens

The applicant did not provide sufficient justification for its alternative sampling methodology for vegetable gardens.

Discussion

As an alternative to sampling the garden crops directly, the applicant proposed sampling the soil in the gardens and relating the radioactivity concentration in the soil to an estimate of the radioactivity concentration in the garden crops by calculating a concentration factor. This concentration factor is based on crop type and is radionuclide specific. The applicant used the methodology discussed in NUREG/CR-5512 (NRC, 1992a) to develop the concentration factors for seven private gardens. The variables used to calculate the concentration factors are listed in Table 2.9-36 and the resulting soil analyses and estimated radioactivity concentration in the garden crops are presented in Appendix CC of the TR. The applicant evaluated three generic crop types: root vegetables, leafy vegetables, and fruits.

The NRC staff evaluated the applicant's alternative sampling program for its ability to reasonably estimate the radioactivity concentration in various crops. The NRC staff observes that the methodology presented in NUREG/CR-5512 (NRC, 1992a) is intended for estimating doses due to residual radioactivity as a result of decommissioning. It does not address ongoing effluents from an operating facility, nor does it address ongoing gardening activities during operations that could affect the results of the soil sample analyses (refer to SER Section 5.7.8).

For example, the addition of fertilizer and soil conditioners worked into the top layer of soil could dilute the resulting radiological analysis of the soil and thus the estimated crop radioactivity.

As a result, the agricultural pathway analysis (i.e., dose from consuming crops) utilized in NUREG/CR-5512 (NRC, 1992a) includes the direct root uptake of radioactivity from soil and the deposition of resuspended soil on plant surfaces. As discussed in RG 3.51 (NRC, 1982a), and elsewhere (Persson and Holm, 2011), the concentration of released particulate radionuclides can be transferred to edible portions of plants by root uptake and foliar (i.e., leaves) retention. For polonium-210 and lead-210, it has been reported that atmospheric deposition is the main source of these radionuclides in above-ground parts of plants (Vandenhove, 2009; Watters, et al., 1969). One study indicated that actual root uptake and translocation into edible portions of plants used as human food were observed to equal less than 1 percent for polonium-210 and lead-210 (Watson, 1983).

The applicant did not propose deriving a total crop radioactivity concentration, which includes foliar deposition, based on the radioactivity concentration it calculated using measured soil radioactivity concentrations and the methodology presented in NUREG/CR-5512 (NRC, 1992). Therefore, the NRC staff does not have reasonable assurance that the applicant can reasonably estimate the radioactivity concentration in various crops using the proposed methodology.

As part of the applicant's alternative sampling program, it proposed a lower limit of detection (LLD) for polonium-210 in soil equal to 2 picoCuries/gram (pCi/g) [2 x 10^{-6} microCuries (µCi)/g] (refer to Appendix CC of CBR, 2015). This was necessary as there is no LLD listed for polonium-210 in soil in RG 4.14 (NRC, 1980).

The NRC staff also evaluated the applicant's proposed LLD for polonium-210 in soil samples. Using the proposed LLD value of 2 pCi/g (2 x 10^{-6} µCi/g, or 2 x 10^{-3} µCi/kg) for polonium-210 in soil, the applicant reported "Not Detectable" for plant radioactivity concentration of polonium-210 for all seven private gardens for all crop types (root vegetables, leafy vegetables, and fruits). The NRC staff observes that while this LLD value is only one order of magnitude higher than the LLD recommended in RG 4.14 (NRC, 1980) for the other radionuclides (Natural uranium, thorium-230, radium-226, and lead-210) in soil, it is three orders of magnitude higher than the LLD recommended for polonium-210 in vegetation (1 x 10^{-6} µCi/kg).

Since the calculated plant radioactivity concentration of polonium-210 is directly related to the measured polonium-210 concentration in soil samples by the concentration factor, the LLD for polonium-210 in soil should be a value that will enable the applicant to reasonably estimate plant radioactivity concentrations of polonium-210 that it would be able to determine by direct analysis (i.e., by collecting crop samples as recommended by RG 4.14 (NRC, 1980). The NRC staff observes that, as discussed above, the applicant collected forage vegetation samples three times from three different locations. The LLD values for these samples ranged from 1.2 x 10^{-6} µCi/kg to 4.6 x 10^{-6} µCi/kg, all samples having measured values of polonium-210 concentrations of 2.1 x 10^{-6} µCi/kg to 5.9 x 10^{-5} µCi/kg. Referring to Figure 2.7-4 of the applicant's TR, several of the private gardens (Troester1, Troester2, and Furman) are near at least one of the forage sampling sites. The forage sampling sites were chosen based on wind data indicating maximum predicted airborne radionuclide concentrations during operations. For a baseline analysis, it seems reasonable to expect similar polonium-210 concentrations in above-ground portions of plants. Therefore, the NRC staff does not have reasonable assurance that the applicant's proposed soil concentration LLD for polonium-210 will yield useful results for estimates of polonium-210 concentration in crops.

NRC Staff Comment

For the proposed alternate methodology for determining radionuclide concentrations in vegetable crops, please provide the following information:

1. Please describe how total plant radionuclide concentration, including that deposited by foliar deposition, will be determined using the proposed methodology.
2. Please provide a justification for using an LLD for polonium-210 concentration in soil that is not sufficient to relate calculated polonium-210 concentration in vegetation to actual polonium-210 concentration in vegetation at levels that were measured at the MEA site.
3. Discuss how ongoing gardening activities, such as the addition of fertilizers and soil conditioners to the top layer of garden soil, could affect the results of the radiological analyses of the garden soil.
4. Provide the depth of soil collected for use in the preoperational garden soil radioactivity analyses.

Issue 5: Soil Sampling Field Investigation

Data missing from the applicant's preoperational soil sampling program.

Discussion

As part of an applicant's description of its site characteristics, RG 3.46 (NRC, 1982b) recommends that an applicant report site-specific radiological data, including results of measurements of concentrations of radioactive materials occurring in soil that could be affected by the proposed activities. RG 4.14 (NRC 1980) recommends that up to 40 surface soil samples be collected at 300 meter (984.25 ft) intervals to a distance of 1500 meters (4921.26 ft) in eight meteorological sectors, as well as 5 or more surface soil samples collected at air particulate stations. In addition to the soil samples collected at a depth of 5 cm (2 in.) as recommended in RG 4.14 (NRC, 1980), soil sampling is recommended in NUREG-1569 (NRC, 2003), Acceptance Criteria 2.9.3(2) at depths of 15 cm (6 in.) for background decommissioning.

The NRC staff observes that 10 CFR Part 40, Appendix A, Criterion 6(6) specifies decommissioning criteria in terms of soils analyzed for Ra-226 at a depth averaged over the first 15 cm below the surface and subsequent 15-cm thick layers below the first 15 cm thereafter for subsurface soils. While the applicant recognized the additional sampling recommendations in NUREG-1569 (NRC, 2003), Acceptance Criteria 2.9.3(2) (i.e., collecting soil samples at depths of 15 cm (6 in.) for background decommissioning) (refer to Appendix BB, Section 2.1.1), it did not appear to incorporate these recommendations into its sampling strategy for the soil samples collected in accordance with the recommendations of RG 4.14 (NRC, 1980).

To address the first part of its soil sampling field investigation, the applicant established a radial grid pattern centered on the location of the proposed MEA satellite building (CBR, 2015). In addition, the applicant sampled soil at air monitoring stations MAR-1 through MAR-5 (CBR, 2015). A summary description of these sampling locations and analyses performed is found in Table 1 and illustrated in Figures 3 and 4 (refer to Appendix BB of CBR, 2015). The sampling results are presented in Section 4 of Appendix BB in CBR, 2015.

The purpose of the secondary soil sampling investigation was to collect a sufficient number of soil samples to show that the results of the background natural uranium and Ra-226 soil concentrations were representative of the MEA site (CBR, 2015). The first set of soil samples performed under this investigation constituted 10 locations (labeled as SOILCORR1 through SOILCORR10) chosen based on the range of gamma radiation observed at the site. These locations are illustrated in Figure 8 (refer to Appendix BB). The sampling results are presented in Section 4 of Appendix BB. CBR, 2015.

To determine the total number of background samples needed, the applicant followed guidance presented in draft NUREG/CR-5849 (NRC, 1992) (CBR, 2015). Using the results of the initial 10 soil samples described above, the applicant calculated that 14 additional Ra-226 samples, and one additional natural uranium soil sample, were required to satisfy the statistical objectives described in draft NUREG/CR-5849 (refer to Section 8.6 of NRC, 1992). To ensure that the sampled areas represented the extent of the disturbed area of the MEA, the applicant collected 23 supplemental background soil samples (labeled as MARSS-01 through MARSS-23). These supplemental soil sampling locations are illustrated in Figure 5 (refer to Appendix BB). The sampling results are presented in Section 4 of Appendix BB. CBR, 2015.

As described above, the applicant did not sample at 15 cm (6 in.) depths for the RG 4.14 radial soil samples. This is not consistent with Acceptance Criterion 2.9.3(2) of NUREG-1569 (NRC, 2003). As discussed above, 10 CFR Part 40, Appendix A, Criterion 6(6) decommissioning criteria for land (i.e., soil) is prescribed in terms of 15 cm (6 in.)-thick layers of soil. Therefore, the 5 cm (2 in.) depth radial soil samples collected by the applicant can't be used for decommissioning purposes.

The NRC staff observes that the applicant incorporated 13 of the 5 cm (2 in.) depth radial soil samples into its background soil investigation (refer to Table 4, Table 5, footnote 3 of Table 8, and Appendix F of Appendix BB in CBR, 2015).

Because the applicant is lacking 15 cm (6 in.) depth soil samples in and around the proposed location of the MEA satellite building, and because the applicant incorporated 5 cm (2 in.) depth radial soil samples into its background soil investigation (e.g., calculation of required number of samples in Appendix F of Appendix BB, soil samples collected in various soil types in Table 4 of Appendix BB), there is insufficient clarity for the NRC staff to determine that the applicant's soil sampling field investigation results comply with 10 CFR Part 40, Appendix A, Criterion 7. The NRC staff requires additional analysis by the applicant to address these information gaps.

NRC Staff Comment

Please provide 15 cm (6 in.) depth soil sample results for the area around the proposed location of the MEA satellite building and a revised analysis of the secondary soil investigation to include only 15 cm (6 in.) depth soil sample results.

Issue 6: License Condition (LC) 11.10

The NRC staff has not received a response to its comments on the applicant's contamination survey program, including a demonstration of minimum detectable concentrations (MDC) for survey instruments.

Discussion

By letter dated February 24, 2016, the NRC staff transmitted comments on the applicant's proposed contamination survey program (NRC, 2016a). The NRC staff has not received a response to these comments.

NRC Staff Comment

Since the contamination survey program for the MEA facility is contingent on the NRC staff's verification of the applicant's response to LC 11.10, the NRC staff can't begin its review of Section 5.7.6 of the applicant's TR until this verification is complete.

Issue 7: Airborne Effluent Monitoring

The applicant's proposed airborne effluent and environmental monitoring program for the Marsland facility is not consistent with what has been approved for the main facility.

Discussion

By letter dated January 6, 2016 (NRC, 2016b), the NRC staff verified the adequacy of the applicant's response to LC 11.11 (NRC, 2014). This verification occurred after the submittal of the most recent revised application (CBR, 2015). As a result, the proposed airborne effluent and environmental monitoring program is insufficient to demonstrate compliance with 10 CFR 40.65, 10 CFR 20.1302, and 10 CFR 20.1501.

The NRC staff recognizes that certain "as built" drawings are not available to demonstrate compliance for items such as tank vents and general ventilation discharge points.

NRC Staff Comment

Please update the Marsland application to reflect commitments made to address LC 11.11 (NRC, 2014) for the main facility. Please also specifically address those aspects of the facility that will have to be submitted at a later date (e.g., tank vents and general ventilation discharge points). The NRC staff can't begin its review of Section 5.7.7 of the applicant's TR until these actions are completed.

Issue 8: Inconsistent Operational Surface Soil Analytes

It is unclear which analytical tests will be performed on annual surface soil samples.

Discussion

In Section 5.7.7.3 of the application, the applicant committed to sampling surface soils annually during operations and analyzing them for natural uranium, radium-226, thorium-230, and lead-210 (CBR, 2015). In Table 5.7-1 of the application, the applicant committed to sampling surface soils annually during operations, but only analyzing them for natural uranium, radium-226, and lead-210 (CBR, 2015).

NRC Staff Comment

Please clarify which isotopes will be analyzed for the annual surface soil samples.

Issue 9: Insufficient Justification for not Sampling Vegetation and Livestock during Operations

The applicant proposed evaluating surface soil and sediment samples during operations as a substitute for forage, crop, and livestock sampling.

Discussion

RG 4.14 (NRC, 1980) recommends vegetation, food and fish samples where a significant pathway to man is identified in individual licensing cases. A significant pathway is further clarified in Table 2, footnote "o" of RG 4.14 (NRC, 1980) to mean that the predicted dose to an individual would exceed 5 percent of the applicable radiation protection standard.

The applicant proposed an alternative to the RG 4.14 (NRC, 1980) methodology. However, the applicant provided no analysis to demonstrate that the soil and sediment samples would provide as good as, or better, indicator of licensed material potentially accumulating in the environment.

NRC Staff Comment

Please provide additional analyses regarding the relationship between radionuclides found in soils and sediments and their relationship to vegetation and livestock samples. In addition, please propose levels of radionuclides in the soils and sediments that would trigger vegetation and livestock sampling and a basis for those trigger levels.

An alternative would be to either perform vegetation and livestock sampling or demonstrate that no significant pathway to man exists.

Issue 10: Surface Soil Cleanup Verification and Sampling Plan

In Section 6.4.2 of its application, the applicant proposed the use of global positioning system (GPS)-based gamma surveys to evaluate potentially contaminated surface soils against the requirements of 10 CFR Part 40, Appendix A, Criterion 6(6) (CBR, 2015).

Discussion

The applicant described the results of its preoperational gamma exposure rate survey for the approximately 784 hectares (1,938 acre) of disturbed area of the MEA site in Appendix BB of its application (CBR, 2015). The applicant's survey included 122,795 data points with summary statistics as shown in Table 19 of Appendix BB in the application (CBR, 2015). The applicant identified the distribution of gamma exposure rate measurements in the MEA disturbed area as a normal distribution. Since the data are normally distributed, the mean, or average, value of the gamma measurements and the median are the same, as indicated in Table 19 (Appendix BB in CBR, 2015). As such, the frequency of gamma measurements above the average value is the same as the frequency of gamma measurements below the average. These individual measurements were then applied to the entire MEA disturbed area using a geospatial interpolation technique known as kriging. The result of the kriged data is shown on Figure 14 in Appendix BB of the application (CBR, 2015).

In addition, the applicant described its attempt to correlate gamma exposure rate measurements at the site with radium-226 (Ra-226) soil concentrations (refer to Section 1.1 of Appendix BB in

CBR, 2015). The applicant was not successful in demonstrating a relationship between these variables as the background exposure rate was too uniform across the MEA site.

The applicant proposed performing a final GPS-based gamma survey and sampling soil in areas that exceeded the average background gamma exposure rate (CBR, 2015). However, the NRC staff observes that half of the background data already exceed the average value due to the normal distribution of the data. In addition, the applicant has not demonstrated a minimum detectable concentration for radium or other radionuclides in soil for the methodology it proposed. As a result, the NRC staff doesn't have confidence that the applicant can detect contaminants (e.g., Ra-226, natural uranium) in the soil using gamma exposure rate measurements for the purpose of complying with 10 CFR Part 40, Appendix A, Criterion 6(6).

NRC Staff Comment

Please provide calculations for the minimum detectable concentrations of Ra-226 and natural uranium in soil using the methodology proposed for surface soil cleanup verification in Section 6.4.2 of the application.

Issue 11: Update Tornado Data and Analysis

The revised technical report (CBR, 2015) was not updated with tornado data and analysis for the period after 2012.

Discussion

The applicant reported five tornado events occurred in Dawes County, Nebraska from 2000 and 2012 (CBR, 2015). These five tornado events did not exceed a Fujita or Enhanced Fujita scale (F- or EF-scale, respectively) magnitude of F0 or EF0 and no injuries, deaths, property or crop damage occurred.

Prior to the Revised Technical Report (CBR 2015), staff observes that three additional tornado events occurred in Dawes County, Nebraska from 2013 to April 2016 (NOAA, 2016), one of which was reported to have a magnitude of EF1. This tornado occurred on June 11, 2013 and damaged to 16 buildings, with at least eight outbuildings destroyed (NOAA, 2016).

Staff observes that the updated analysis should include the effects to smaller MEA structures (e.g. buildings, wellhouses), chemical storage and the possible reaction of process chemicals. Staff also observes that the analysis should include an evaluation of the future probability of the occurrence of tornados at the MEA.

NRC Staff Comment

Please update tornado data and analysis to include tornados that occurred since 2012. The updated analysis should include an evaluation of environmental impacts from the tornadoes that occurred since 2012 and the future probability of the occurrence of tornados at the MEA. Additionally, the update should consider effects to MEA structures (e.g. buildings, wellhouses) and potential environmental impacts. Finally, the updated tornado data should be used to consider impacts from tornadoes on the chemical storage of materials and the possible reaction of process chemicals.

Issue 12: Update to corporate organization and associated administrative procedures

As indicated by an e-mail from Mike Thomas (Cameco Resources) to Doug Mandeville (NRC) on May 31, 2016, staff observes that updates to the corporate organization occurred since CBR's submittal of the revised technical report for the MEA (CBR, 2015).

Discussion

An e-mail received by NRC on May 31, 2016 provided a revised Cameco Resources regulator contact list. This email appears to reflect changes in the corporate organization that may have changed the corporate organization and associated administrative procedures for the MEA.

NRC Staff Comment

Please provide an update to the corporate organization and associated administrative procedures for the MEA.

Issue 13: Identification of the Orella Member of the Brule Formation

In Sections 2.7.2 of the Revised 2015 Technical Report (TR) (CBR, 2015), the Brown Siltstone Member of the Brule Formation is described as constituting the first overlying aquifer above the production zone. However, in a letter dated April 20, 2016, to the Nebraska Department of Environmental Quality (NDEQ) in support of its Aquifer Exemption Application (AEP) (CBR, 2016), CBR makes the following statements:

"Geophysical logs in Figure 6 of "Cenozoic Paleogeography of Western Nebraska", show several ash beds in relation to accepted formational boundaries of the Arikaree, Brule and Chadron Formations. A review of geophysical logs from the MEA show similar log traces for some of these air-fall tuff horizons; in particular, the Nonpareil, upper Whitney, and lower Whitney ash zones.... Therefore, in the revised AEP, the base of the Brule Formation has been moved downward, below the lower Whitney Ash."

Discussion

NRC staff notes that, although the Orella Member of the Brule Formation is identified in the TR as the lowermost Brule unit above the Chadron Formation, it is not mentioned in these representations to NDEQ, which appears to reflect that information sent to the NDEQ is inconsistent with information sent to NRC.

NRC Staff Comment

The applicant should revise the TR as necessary with respect to the identification of the Orella Member of the Brule Formation at the site.

Issue 14: Additional Characterization of the Lower Brule Formation

CBR notes in its letter to NDEQ (CBR, 2016) that:

"As the base of the Brule Formation has been revised downward, a corresponding decrease in the thickness of the upper Chadron Formation is observed....As these lower portions of the Brule Formation were not monitored for water quality and water levels, CBR proposes to install

additional monitoring wells to assess quarterly water quality and water levels for this portion of the Brule Formation for a period of one year to assess seasonal conditions....The original Marsland pump test did not assess potential impacts to this lower portion of the Brule Aquifer. Therefore, CBR proposes to· perform an additional pumping test, once the above monitoring wells are completed, to assess if any hydrologic connections exist between the mining zone and the lower portion of the Brule Formation."

Discussion

The proposed additional characterization of the lower Brule Formation described above to the State is new information that the NRC has not seen before and is not mentioned in the TR submitted to NRC.

Criterion 5G(3) of Appendix A requires that the applicant supply information about the: "Location, extent, quality, capacity and current uses of any ground water at and near the site." In reference to the ground-water resources adjacent to ISR facilities, Section 2.7.1(3ii) of NUREG-1569 calls for: "a description of aquifer properties, including material type, formation thickness, effective porosity, hydraulic conductivity, and hydraulic gradient." An aquifer is defined in 10 CFR 40, Appendix A, as "a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs." Section 2.7.2 of NUREG-1569 also calls for an evaluations of "the site hydrogeologic conceptual model for ground-water flow in potentially affected aquifers" as well as an examination of "pumping tests that are used to investigate vertical confinement or hydraulic isolation between the ore production zone and upper and lower aquifers."

If an aquifer deeper than the previously identified one in the Brown Siltstone Member is determined to represent the first overlying aquifer within the Brule Formation, additional pump test and chemical data to demonstrate the isolation of such an aquifer from the production zone would be required. Furthermore, the vertical and horizontal effects on the groundwater flow system of water withdrawals from a deeper Brule aquifer (if found) would have to be evaluated by the applicant. The vertical and horizontal effects on the groundwater flow system of water withdrawals from a deeper Brule aquifer (if found) would also have to be evaluated by the applicant.

NRC Staff Comment

The applicant should revise the TR to encompass the additional characterization of the Brule Formation and address the related NRC regulatory requirements.

Issue 15: Lack of Water Samples from Ephemeral Streams

In the Section 2.9.4 of the Revised 2015 TR, the applicant states, "Lack of water flow in ephemeral drainages in the MEA has prevented collection of surface water samples." This same statement was also contained in the original 2012 TR. However, in section 2.9.7.2 of the 2015 TR, although only sediment samples were collected, the applicant makes the statement that "the ephemeral drainages at the designated sampling points were sampled twice, once following spring runoff, and in late summer following period of extended low flow."

Discussion

Section 1.1.2 of Regulatory Guide 4.14 stipulates that: “Any stream beds that are dry part of the year should be sampled when water is flowing.”

NRC Staff Comment

The applicant should clarify how the “following spring runoff” and “following period of extended flow” statements reconcile with the “lack of water flow” statement in the TR. Given the lack of water samples from ephemeral drainages to date, the applicant should also commit to obtaining such samples during flow events that may occur at any time during the pre-operational period.

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