August 18, 2015

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

SUBJECT: COMMENTS ON RESPONSE TO LICENSE CONDITION 11.11 REQUEST FOR ADDITIONAL INFORMATION, AIRBORNE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAM, AND RESULTS OF STAFF REVIEW OF RESPONSE TO LICENSE CONDITION 11.14, VENTILATION REPORT, CROW BUTTE RESOURCES, INC., CRAWFORD, NEBRASKA, LICENSE SUA-1534 (TACs L00762 AND L00763)

Dear Mr. Teahon:

By letter dated June 30, 2015 (Agencywide Documents Access and Management System (ADAMS) ML15217A332), Cameco Resources Crow Butte Operation (Cameco) submitted to the U.S. Nuclear Regulatory Commission (NRC) staff a response to an April 2, 2015 request for additional information (RAI) (ML15090A526) addressing license condition (LC) 11.11 of SUA-1534 providing information on its airborne effluent and environmental monitoring program. During our technical review of this response, NRC staff identified certain areas for which we are requesting additional clarification. The staff's comments are enclosed herein. These comments are organized according to the sections in the RAI response. Please either respond to these comments or provide a schedule for submitting your responses within 30 days of receipt of this letter.

In addition, the NRC staff previously accepted Cameco's response to LC 11.14 (ML14247A155), which provides detailed information on the ventilation system at the Crow Butte facility, for a detailed technical review by memorandum dated December 16, 2014 (ML14345A348). The NRC staff has completed its technical review of Cameco's response to LC 11.14 and has no further questions. This action is completed and the NRC staff will close TAC L00763.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," 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 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 me at 301-415-6443 or, by email, at Ronald.Burrows@nrc.gov.

Sincerely,

/RA/

Ronald A. Burrows, 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:
Comments on Response to LC 11.11
Request for Additional Information

cc: D. Miesbach, NDEQ
D. Pavlick, CBR

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U.S. Nuclear Regulatory Commission
Comments on Response to Request for Additional Information
License Condition 11.11
Cameco Resources Crow Butte Operation
For Source Material License SUA-1534

The purpose of the following comments are to provide the additional clarification and data that are necessary for the U.S. Nuclear Regulatory Commission (NRC) to review Cameco Resources Crow Butte Operation's (Cameco's, or the licensee) response to License Condition (LC) 11.11 Request for Additional Information (RAI) (Cameco, 2015a).

Comments on RAI 1 response:

Comment 1

The licensee responded to the following request:

> Please describe how radon daughter activity will be addressed for all radon sources originating from the main plant.

In its response the licensee stated:

> "Radon daughter measurements will be performed concurrently with the radon gas measurements from the tank vents listed in response 11.11 (A) and converted to an equivalent radon gas concentration using the conversion 0.33 WL is equivalent to 3E-8 µCi/mi. As with the results of the Lucas cell measurements, the emissions from the vent can be calculated assuming the manufacturer's flowrate (cf/min) for the ventilation fan associated with the tank vent. The radon progeny releases from tanks will be added to the total radon emission from the plant.
>
> Radon daughter concentrations are taken at routine sampling locations throughout the main plant on a schedule approved within the license. On a semi-annual basis these samples will be averaged and converted to an equivalent radon gas concentration as described above. The rate of radon released from the process facility will be based on the manufactures flowrate for each of the exhaust fans. It will be assumed that the fans are operational 100% of the time which will represent the worst case scenario. These emissions will be added to the total plant emissions."

NRC staff comment:

It is not clear to the NRC staff why radon daughter measurements are first converted to radon gas measurements, then the resulting calculated radon concentrations added to the actual radon gas measurements. This proposed method appears to overestimate the radon gas emissions without providing information on the radon daughter activity. It is not clear how this methodology would be used in the compliance with the reporting of effluent monitoring (e.g., 10 CFR 40.65) or for dose estimates (e.g., 10 CFR 20.1302).

In addition, this methodology does not appear to be conservative in its estimate of radon gas. For example, the formula for the radon equilibrium factor, F (refer to Section 4.9.3.2 of NRC, 2014a), is given as:

$$F = \left(\frac{radon\ progeny\ concentration\ (\mathrm{WL})}{radon\ concentration\ (\mathrm{pCi/L})}\right) \times \left(\frac{100\ \mathrm{pCi/L}}{\mathrm{WL}}\right) \qquad (1)$$

Where working level, WL, is a measurement of radon progeny in air.

While assuming 100 percent equilibrium (i.e., F = 1) is generally conservative for dose calculations when the concentration of radon gas is known, this is not true for calculating the radon gas from radon daughter working level measurements. For example, if the value of the radon equilibrium factor in Equation (1) is 50 percent (i.e., F = 0.5), the calculated radon concentration will be twice the measured radon progeny concentration.

Please provide the NRC staff with a rationale for converting radon daughter measurements to radon gas concentrations and reporting only radon gas concentrations and how this methodology will be used for compliance purposes. In your response, please justify the use of 100 percent equilibrium (i.e., F = 1) for converting the measurement of radon progeny in air to a radon gas concentration that is not conservative.

Comment 2

The licensee also responded to the following request:

> Please provide a drawing that details current tank vent connections so that staff can verify the tank vent locations shown in the drawing "Tank Vent Locations" attached to Cameco's January 2, 2015, submittal.

In its response the licensee stated:

> "Included is a drawing showing the tank vent connections; based on this drawing, CBO has added an additional sampling point to account for resin cleaning."

NRC staff comment:

The NRC staff observes that the licensee's response to this request included a drawing titled "Tank Vent Locations" that included the configuration of various tank vent intakes and ductwork as well as floor exhaust vent fans. As a separate action, the licensee also submitted a detailed study of the ventilation system at the Crow Butte facility in accordance with LC 11.14 (Cameco, 2014).

The NRC staff reviewed the licensee's responses to NRC staff's Request for Additional Information (Cameco, 2015a) and LC 11.14 (Cameco, 2014), the "Ventilation Report", together in order to understand the proposed methodology for measuring effluents at the Crow Butte facility. There appear to be inconsistencies between the RAI response (Cameco, 2015a) and

the Ventilation Report (Cameco, 2014). For example, on the RAI response Figure Tank Vent Locations (Cameco, 2015a), there appear to be nine tank vent sample locations and three floor exhaust fans that discharge to the outside of the facility. On the other hand, Tables 4 and 5 of the Ventilation Report (Cameco, 2014) indicate a total of 10 tank vents, 3 box fans, 2 pipes, 1 room, and 1 unidentified duct that discharge to the outside of the facility.

Please clarify the relationship between the identified discharge points in RAI response Figure Tank Vent Locations (Cameco, 2015a) and the discharge points specified in Tables 4 and 5 of the Ventilation Report (Cameco, 2014). The purpose of this clarification request is to understand locations where effluents are being directed from the Crow Butte facility in order to evaluate the licensee's effluent monitoring plan.

Comments on RAI 3 response:

The licensee responded to the following request:

> Please describe how radon daughter activity will be addressed for radon sources originating from the wellhouses.

In its response the licensee stated:

> "Radon daughters measurements will be collected semi-annually within the wellhouses in which radon gas samples are collected and converted to an equivalent radon gas concentration using the conversion factor 0.33 WL equals 3E-8 µCi/ml. These average semi-annual radon concentrations will be used along with the manufacture's rating on the wellhouse exhaust fan to determine the total radon released from the wellhouses."

NRC staff comment:

This is a similar issue as accounting for radon from the main plant.

Please see Comment 1 for RAI 1 response for a detailed discussion of the NRC staff's comment.

Please provide the NRC staff with a rationale for converting radon daughter measurements to radon gas concentrations and reporting only radon gas concentrations and how this methodology will be used for compliance purposes. In your response, please justify the use of 100 percent equilibrium (i.e., F = 1) for converting the measurement of radon progeny in air to a radon gas concentration that is not conservative.

Comments on RAI 5 response:

The licensee responded to the following request:

> Please provide detail on what current meteorological data will be used for the annual updates.

In its response the licensee stated:

> "The current met data (data from the year that is represented by the annual report) that is required for the MILDOS calculation will be used."

NRC staff comment:

Please clarify the source of the meteorological data (i.e., location of the meteorological station used to collect the data) that will be used for the input to MILDOS for the annual public exposure updates.

Comments on RAI 7 response:

The licensee responded to the following request:

> Please provide a description of measurements of radon or radon progeny in air to ensure the dose to members of the public do not exceed regulatory limits for this alternate approach.

In its response the licensee stated:

> "As mentioned in the submission, generally measurements at or near the maximally exposed member of the public will be used to estimate annual dose. However, if modeling is performed for calculation of dose to the maximally exposed member of the public; measured emissions will be used as an input to the MILDOS-Area model and the outputs compared statistically to the measurements made at the environmental monitoring stations to confirm the reasonableness of the model results.
>
> In response to 11.11 (A), Crow Butte indicated that measurements of the radon from tank vents will be performed at a minimum of once a quarter. Samples will be taken during highest predicted concentrations and will be used to determine the effluent of radon from vented tanks. To evaluate the conditions that would represent the highest concentration of radon in the vents, samples will be collected during different stages of the tank's operation. However, measurement of the maximum emission rate is not indicative of actual annual emissions and by definition will overestimate annual emissions; potentially by a significance amount. As such measurements of the maximum emissions rate are not generally useful for modelling purposes. Field measurements made with a track etch cup are integrated measurements that average the radon concentration over the entire monitoring period. There is a reasonable probability that use of a maximum emission rate as a model input will produce model outputs that are overestimated and cannot be confirmed though measurement because the input will be overestimated.
>
> Crow Butte operation will investigate the impact of using maximum emissions rates in modelling and, prior to use of calculations to determine public dose, will provide NRC with a proposal regarding how the inputs to the model will be determined using actual measurements."

NRC staff comment:

As the NRC staff presented in RAI 7, it previously determined (NRC, 2014b, 2014c) that using calculations and models with no monitoring results to support either is not sufficient to demonstrate compliance with public dose limits as well as using measurements made at the point of an actual individual receptor as the primary means of compliance. Therefore, it is unclear to the NRC staff why the licensee is proposing the use of modeling for the calculation of dose to the maximally exposed member of the public. Specifically, the conditions under which the licensee would use the alternate approach of modeling as a primary means of compliance are vague and the NRC staff does not know when "generally measurements at or near the maximally exposed member of the public" will not be used by the licensee.

In addition, the licensee proposed comparing the results of MILDOS calculations with measurements made at the environmental monitoring stations to confirm the reasonableness of the model results. Although the NRC staff presented this methodology as an option to the uranium recovery industry (NRC, 2011), the licensee neither provided sufficient information for the NRC staff to enable it to make a determination that MILDOS is "calibrated" for the Crow Butte site nor did it request the NRC staff to make this determination.

Please provide the NRC staff with a more definitive description of it program for performing measurements of radon or radon progeny in air to ensure the dose to members of the public do not exceed regulatory limits, or provide the NRC staff with a specific request to review an alternate program with sufficient information for it to make a regulatory decision.

Comments on RAI 8 response:

The licensee responded to the following request:

> Please provide measurements of concentrations for radon and its daughters in th wellfield and outside the Main Plant or an analysis to justify disregarding this potential occupational exposure pathway.

In its response the licensee stated:

> All wellfield operations personnel participate in the monitoring program, which include monitoring for internal and external exposure. The external exposure is monitored wit OSL badges provided by Landauer and exchanged on a quarterly frequency. The badge are worn for an employee's entire shift. Since it is difficult to sample all areas of th wellfield accurately, the internal exposures for the wellfield operations personnel ar based on the same plant concentrations at a 100% occupancy factor. Wellfiel concentrations of both radon daughters and airborne uranium will be much lower tha plant concentrations so this is a very conservative way to assign internal intake.

NRC staff comment:

The licensee's approach appears reasonable. However, the NRC staff requires pertinent monitoring information on which to base an evaluation.

The licensee previously submitted historical data on in-plant radon daughter monitoring results for the years 1994 -2006 (refer to Table 5.8-1 of Cameco, 2009). Please provide the NRC staff with updated in-plant radon daughter monitoring results (i.e., from 2007 to the present).

In addition, the licensee previously submitted a monitoring plan for the Crow Butte facility that included radon and radon daughter monitors placed on all sides of the Crow Butte central processing plant (refer to the Crow Butte Sampling Plan and associated figures in the attachments to Cameco, 2011). Please provide the NRC staff with available data from these monitoring efforts.

Comments on RAI 9 response:

The licensee responded to the following request:

> Please provide an analysis and justification for disregarding other potential airborne particulate radionuclides that may contribute to occupational dose to demonstrate compliance with 10 CFR 20.1204.

In its response the licensee stated, in part (some text omitted):

> Semi-annually, since 2013 Cameco has been collecting samples from seven locations throughout the main plant for isotopic analysis. This data is analyzed currently for U-nat, Th^{230}, Ra^{226} and Pb^{210}. In 10 CFR 20.1204 (g), it states that when a mixture of radionuclides in air exists, licensees may disregard certain radionuclides within the mixture if:
>
> a) the licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in 10 CFR 20.1201 and in complying with the monitoring requirements in 10 CFR 20.1502(b), and
>
> b) the concentration of any radionuclide disregarded is less than 10% of its DAC, and
>
> c) the sum of these percentages for all the radionuclides disregarded in the mixture does not exceed 30%.
>
> The NRC staff also raised the question of addressing dose from the decay products of U^{238}, specifically Th^{234} and Po^{210}. Because of the very short half-life of Th^{234}, the need to factor in ingrowth and high LLDs, a lab analysis is not a reasonable option; therefore, a theoretical calculation has been performed assuming equilibrium with its parent U^{238}. U^{238} contributes 49% of the specific activity of U-nat and Th^{234} will be assumed to be in equilibrium at the time of inhalation with U^{238}. The following table shows the calculated U^{238} activity based on the measured average U-nat activity for 2013 through 2015, and a comparison of the Th^{234} activity to the DAC from 10 CFR 20.

A similar calculation has been performed for Po^{210}, using Pb^{210} as the parent radionuclide. Full equilibrium between Pb^{210} and Po^{210} has been assumed and as mentioned, the Pb^{210} has not been background corrected, so it is a conservative value.

As with the other radionuclides discussed previously, Th^{234} and Po^{210} are below the criteria in 10 CFR 20.1204(g) and can be disregarded. The internal dose from airborne particulates, will continue to be assessed based on the total alpha activity present compared with the DAC and ALI values for natural uranium. Due to the fact Crow Butte is a long running operations and the particulate concentrations are substantially below the criteria in 10 CFR 20.1204(g), Crow Butte proposes that going forward in-plant isotopic analysis be performed only once per license term in order to confirm that no changes have occurred.

NRC staff comment:

The requirements that specify when a licensee may disregard certain radionuclides in a mixture when determining internal exposure are found in 10 CFR 20.1204(g). NRC guidance on 10 CFR 20.1204(g) can be found in NUREG-1736 (NRC, 2001). NUREG-1736 presents several examples of calculations using mixtures of radionuclides.

The following questions and answers on the NRC website may also be helpful in addressing mixtures of radionuclides and when certain radionuclides may be disregarded when assessing internal dose:

Q121: http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/qa121.html

Q403: http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/qa403.html

Q453: http://www.nrc.gov/about-nrc/radiation/protects-you/hppos/qa453.html

In particular, question Q403 addresses disregarding the contribution of a radionuclide for recording and reporting purposes if it is less than 10% of the CEDE.

The licensee's proposed method of assessing mixtures of radionuclides does not meet the requirement of 10 CFR 20.1204(g)(1) and is not consistent with the guidance provided above for this regulation. Specifically, while the licensee measured or calculated the activity of the radionuclides and compared the activity to their respective DACs as indicated in its statement above, the licensee did not account for the activity of those radionuclides it disregarded based on the DAC analysis. For example, the licensee calculated the following activities for Th^{234}, based on U^{238} activity:

Year	Average of Uranium (µCi/ml)	Th^{234} Activity (µCi/ml)	DAC (µCi/ml)	Percent of DAC
2013	2.57E-13	1.26E-13	6.00E-08	0.00021%
2014	2.48E-13	1.22E-13	6.00E-08	0.00020%
2015	7.14E-13	3.50E-13	6.00E-08	0.00058%

Based on the DAC analysis, the licensee disregarded Th^{234} altogether. However, the correct application of 10 CFR 20.1204(g)(1) is to add the activity of Th^{234} to the U^{238} activity. This methodology is also correct for any other radionuclides that are in equilibrium with its parent.

Please provide the NRC staff with a proposed method of assessing mixtures of radionuclides that meets the requirement of 10 CFR 20.1204(g)(1) and is consistent with the guidance provided above for this regulation.

Comments on Administrative Issue 3 response (Addendum)

The licensee responded to the following request:

> In Section 2.1, a comparison is made between the airborne particulate concentrations measured at environmental monitoring stations AM1, AM2, and AM3 with the effluent concentration values in 10 CFR 20, Appendix B, Table 2.
>
> Please provide a description of how these environmental monitoring station results, located at a distance from the source, are used to infer the vacuum dryer particulate source term.

In its response the licensee updated a table to include monitoring stations AM24 and AM25 and stated:

> "Environmental monitoring stations AM24 and AM25 are located near the central processing plant and show a uranium concentration that is <0.1% below the 10 CFR 20 Effluent Concentration for airborne uranium particulate."

NRC staff comment:

The NRC staff observes that the response to Administrative Issue 3 did not answer the original question. In its original response (Cameco, 2015b), the licensee compared the results of distant monitoring stations to the 10 CFR 20, Appendix B, Table 2, effluent concentration value for uranium in an attempt to demonstrate that the vacuum dryer used to dry yellowcake releases no particulates.

For example, the licensee indicated that AM1 is located approximately 900 meters (m) (0.56 miles (mi)) from the plant, AM2 is approximately 1,210 m (0.75 mi) from the plant, and AM3 is approximately 2,060 m (1.28 mi) from the plant (refer to Table 3.0-1 of Cameco, 2015b). At these distances, it is not clear to the NRC staff how measurements can be utilized to construct a

source term for the vacuum dryer or confirm the lack of particulate release. In any case, the licensee included two additional monitoring stations in its response to Administrative Issue 3, AM24 and AM25, which are closer to the yellowcake dryer source (61 m (200 feet) north and south of the plant, respectively) (Cameco, 2015a). The NRC staff observes that, although the monitoring results from these locations could potentially be used for other compliance purposes, these close-in measurements are not taken at the point of release and that, as the NRC has previously evaluated (NRC, 2014d), only a portion of the source term will be measured at these two locations.

Please clarify for the NRC staff if any measurements, other than general environmental monitoring, have been taken to specifically characterize the vacuum dryer effluent.

References

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