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

June 13, 2017

Mr. Scott Schierman, Manager
Health, Safety, and Environment
Uranium One USA, Inc.
907 N. Poplar Street, Suite 260
Casper, WY 82601-1310

SUBJECT: URANIUM ONE, USA, INC., WILLOW CREEK PROJECT, U.S. NUCLEAR REGULATORY COMMISSION STAFF VERIFICATION OF LICENSE CONDITION 11.3 ITEMS, MATERIALS LICENSE SUA-1341 (TAC NO. J00711)

Dear Mr. Schierman:

By letters dated September 25, 2013, July 3, 2014, January 20, 2015, June 5, 2015, and April 17, 2017, Uranium One USA, Inc. (Uranium One) submitted its responses to License Condition (LC) 11.3 (NRC's Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML13273A017, ML14195A361, ML15040A077, ML15181A357, ML17111A981) for the NRC staff review and verification.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the submittals and verified that the required items are complete, with the exception of the alternative procedures to show compliance with 10 CFR 20.1204, as described in the second paragraph of license condition 11.3. Because the NRC staff was unable to verify alternative procedures to show compliance with 10 CFR 20.1204, Uranium One should continue to collect in-plant air samples for natural uranium, Ra-226, Po-210, Th-230, and Pb-210 to ensure compliance with 10 CFR 20.1204.

The NRC staff's verification of Uranium One's responses to LC 11.3 is enclosed.

If you have any questions regarding this action, please contact me at 301-415-7777, or by e-mail at ron.linton@nrc.gov.

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 ADAMS and is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/

Ron Linton, Project Manager/Hydrogeologist
Uranium Recovery Licensing Branch
Division of Decommissioning, Uranium Recovery,
and Waste Programs
Office of Nuclear Material Safety
and Safeguards

Docket No.: 040-08502
License No.: SUA-1341

Enclosure:
NRC Staff Verification of SUA-1341, LC 11.3

cc: Luke McMahan, PG. (WDEQ)
Ryan Schierman (WDEQ)

SUBJECT: URANIUM ONE, USA, INC., WILLOW CREEK PROJECT, U.S. NUCLEAR REGULATORY COMMISSION STAFF VERIFICATION OF LICENSE CONDITION 11.3 ITEMS, MATERIALS LICENSE SUA-1341 (TAC NO. J00711)
DATE June 13, 2017

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NRC Staff Verification of Uranium One USA, Inc. Submittals dated September 25, 2013, July 3, 2014, January 20, 2015, June 5, 2015, and April 17, 2017, Regarding License Condition 11.3, Materials License SUA-1341; Docket No. 040-08502

Background

In the NRC staff's Safety Evaluation Report for License Renewal of the Willow Creek Uranium In Situ Recovery Project (LR SER) (NRC 2013), the NRC staff found that Uranium One USA, Inc. (Uranium One) had not demonstrated that in-plant concentrations of gross alpha activity used in determining occupational dose was entirely attributable to natural uranium. For this reason, the NRC staff proposed a license condition, described below, which required Uranium One to determine whether radium-226 or other alpha-emitting radionuclides are present in plant air samples.

The NRC staff also found the following deficiencies with regard to Uranium One's airborne effluent and environmental monitoring program:

1. Uranium One had not provided sufficient justification for not performing environmental sampling for airborne particulate matter in the vicinity of the Christensen Ranch satellite building;

2. Uranium One had not provided a description of how quantities of radionuclides in air effluent would be determined in accordance with 10 CFR 40.65, "Effluent monitoring reporting requirements";

3. Uranium One had not provided an acceptable methodology by which it would annually evaluate the highest public doses in accordance with 10 CFR 20.1302;

4. Uranium One had not explained how radon progeny would be considered in annual assessments of public dose; and

5. Uranium One had not explained how it will account for occupational dose received outside the Irigaray central processing facility and Christensen Ranch satellite building and throughout the licensed area.

As a result of the issues described above, license condition 11.3 of Uranium One's renewed Byproduct and Materials License SUA-1341, Amendment 4, stated (NRC 2015b):

11.3 The licensee shall conduct effluent, personnel, and environmental monitoring programs in accordance with Sections 5.7 and 5.8 of the approved license application.

The licensee shall conduct airborne samples for natural uranium, Ra-226, Po-210, Th-230 and Pb-210 at each in-plant air particulate sampling location at a frequency of once every 6 months for 2 years, and annually thereafter, to ensure compliance with 10 CFR 20.1204. The licensee shall also evaluate changes to plant operations to determine if more frequent radionuclide analyses are required to demonstrate compliance with 10 CFR 20.1204. The licensee may demonstrate compliance or provide alternative procedures specific to in-plant air particulate

sampling to show compliance with 10 CFR 20.1204 to the NRC for review and verification within 6 months of license renewal.

The licensee shall conduct airborne samples for natural uranium, Ra-226, Po-210, and Pb-210 at each Christensen Ranch environmental monitoring location at a frequency of once every 6 months for 2 years, and annually thereafter, to ensure compliance with 10 CFR 20.1301. The licensee shall also evaluate changes to plant operations to determine if more frequent radionuclide analyses are required to demonstrate compliance with 10 CFR Part 20.1301. The licensee may demonstrate compliance or provide alternative procedures specific to environmental monitoring for natural uranium, Ra-226, Po-210, and Pb-210 to show compliance with 10 CFR 20.1301 to the NRC for review and verification within 6 months of license renewal.

The licensee shall describe how the environmental monitoring program demonstrates that 10 CFR Part 20 public dose limits in controlled and unrestricted areas are met. The documentation of the areas designated as restricted, controlled and unrestricted areas and the environmental monitoring station locations shall be updated periodically, as needed.

The licensee shall provide the following information for the airborne effluent and environmental monitoring program in which it shall develop written procedures, that shall be submitted to NRC for verification prior to implementation, to:

a. Discuss, in accordance with 10 CFR 40.65, how the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.

b. Evaluate, consistent with 10 CFR 20.1301 and 10 CFR 20.1302, the highest exposures likely for member(s) of the public from licensee operations.

c. Discuss how radon progeny (radon-222) will be factored into the determination of potential public dose from the licensee's operations consistent with 10 CFR Part 20, Appendix B, Table 2.

d. Discuss, in accordance with 10 CFR Part 20.1501, how the occupational dose (gaseous and particulate) received throughout the entire license area from licensee operations will be accounted for, and verified by surveys and/or monitoring.

By letter dated September 25, 2013, Uranium One responded to the requirements in LC 11.3 by providing a description of its in-plant air particulate sampling program and its proposed alternative to collecting airborne samples for natural uranium, Ra-226, Po-210, and Pb-210, at each Christensen Ranch environmental monitoring location (Uranium One 2013). By letter dated May 6, 2014, the NRC staff informed Uranium One that its September 25, 2013, letter was incomplete because it did not address the latter parts of LC 11.3, including the requirements in LC 11.3, parts a. through d. (NRC 2014a). The NRC staff and Uranium One met on May 27, 2014, to discuss licensing issues, including the issues addressed in LC 11.3 (NRC 2014b). By letter dated July 3, 2014, Uranium One provided additional information in response to LC 11.3, parts a. through d. (Uranium One 2014).

By letter dated November 12, 2014, the NRC staff informed Uranium One that information provided by Uranium One in its letters dated September 25, 2013, and July 3, 2014, had not been accepted for detailed technical review because the submittals did not contain sufficient information (NRC 2014c). The NRC staff provided an 11-page enclosure to its November 12, 2014, letter, which provided examples of information that Uranium One had not provided. By letter dated December 15, 2014, the NRC staff requested a response to the NRC staff's November 12, 2014, letter within 30 days of receipt of its December 15, 2014, letter (NRC 2014d).

By letter dated January 20, 2015, Uranium One provided a revision to its July 3, 2014, submittal that addressed LC 11.3, parts a. through d. (Uranium One 2015a). By letter dated May 4, 2015, the NRC staff informed Uranium One that its January 20, 2015, submittal had been accepted for detailed technical review (NRC 2015a). In its May 4, 2015, letter, the NRC staff also enclosed requests for additional information required for the NRC staff to complete its review. By letter dated June 5, 2015, Uranium One responded to the NRC staff's requests for additional information (Uranium One 2015b).

By letter dated July 27, 2016, the NRC staff requested additional information regarding Uranium One's proposed methods to estimate effluent quantities (NRC 2016). By letter dated April 17, 2017, Uranium One provided a response to the NRC staff's July 27, 2016, letter, and a revised effluent monitoring plan (Uranium One 2017).

From the discussion above, the scope of the NRC staff's ongoing verification review includes the following Uranium One submittals:

1. Letter dated September 25, 2013, addressing the first three paragraphs of LC 11.3 (Uranium One 2013);

2. Letter dated July 3, 2014, addressing the last two paragraphs of LC 11.3 (Uranium One 2014);

3. Letter dated January 20, 2015, revising the July 3, 2014, submittal addressing the last two paragraphs of LC 11.3 (Uranium One 2015a);

4. Letter dated June 5, 2015, responding to the NRC staff requests for additional information (Uranium One 2015b); and

5. Letter dated April 17, 2017, responding to the NRC staff requests for additional information (Uranium One 2017).

In its comments below, the NRC staff organized its verification review into the following LC 11.3 topics:

1. In-plant air sample compliance with 10 CFR 20.1204

2. Environmental particulate air samples at Christensen Ranch

3. Accounting for air effluent quantities in accordance with 10 CFR 40.65

4. Evaluating the highest public dose in accordance with 10 CFR 20.1302

5. Accounting for radon progeny in public dose assessments

6. Accounting for occupational dose in all licensed areas

Evaluation

1. In-plant air sample compliance with 10 CFR 20.1204

As stated in Section 5.7.3.3.1, "Airborne Particulate Uranium Monitoring," of the NRC staff's LR SER (NRC 2013), the NRC staff did not agree with Uranium One's approach to in-plant air sampling as described in Section 5.7.3.1 of its License Renewal Application (LRA). Specifically, the NRC staff stated that Uranium One should not assume that all gross alpha activity collected on air samples is attributable to natural uranium. Rather, Uranium One should conduct surveys in accordance with 10 CFR 20.1501 to assess whether other radionuclides, including radium-226 and thorium-230, are also present. Uranium One may then apply the requirements in 10 CFR 20.1204 for mixtures of radionuclides in order to determine occupational internal exposures. This is why the second paragraph of LC 11.3 of the renewed license requires Uranium One to periodically assess mixtures of radionuclides and then provide to the NRC for review and verification within 6 months of license renewal either: (1) a demonstration that 10 CFR 20.1204 is met, or (2) provide procedures to show compliance with 10 CFR 20.1204.

By letter dated September 25, 2013, Uranium One responded to LC 11.3 and described its procedures for compliance with 10 CFR 20.1204 (Uranium 2013). Uranium One described different approaches for the Christensen Ranch satellite building and the Irigaray central processing facility. For the Christensen Ranch satellite building, Uranium One explained that it would measure radionuclide concentrations in incoming pregnant lixiviant to determine the mixture of radionuclides present in process solutions. Uranium One proposed to perform this sampling semi-annually. Using this information, Uranium One would assume that alpha-emitting radionuclides detected in plant air samples are present in the same proportions as detected in samples of process solutions. Airborne concentrations of each alpha-emitting radionuclide would then be compared to its respective derived air concentration (DAC) from Appendix B to Part 20. Uranium One stated that if the sum of the fractions is less than 10 percent, or the total concentration is less than 10 percent of the most restrictive DAC, then it would not be required, under 10 CFR 20.1502(b), to monitor occupational intake, and compliance with 10 CFR 20.1204 is not required.

For areas inside the Irigaray central processing facility that are outside the yellowcake drypack area, Uranium One proposed the same approach as described above for the Christensen Ranch satellite building. Inside the yellowcake drypack area at the Irigaray facility, Uranium One will measure only gross alpha concentrations in air and compare these results to the appropriate uranium DAC. As noted in Section 5.7.3.3.1 of the NRC staff's LR SER for Willow Creek (NRC 2013), the NRC staff agrees that radioactivity in air samples in the dryer/packaging area is natural uranium.

In the NRC staff's letter dated November 12, 2014, the NRC staff denied acceptance of Uranium One's September 25, 2013, letter for review. In the November 12, 2014, letter, the NRC staff explained why Uranium One's proposed alternative air sampling procedures were not acceptable (NRC 2014c). In its subsequent submittals, Uranium One has not addressed the issues previously identified by the NRC staff. As a result, the NRC staff cannot verify Uranium One's proposed alternative procedures. Until such time as Uranium One provides alternative procedures which are acceptable, it should continue to: (1) monitor for internal exposure in

accordance with 10 CFR 20.1502(b)(1) and Section 5.7.3 of the approved license application, as stated in License Condition 11.7; and (2) in accordance with License Condition 11.3, paragraph 2, continue to collect air samples and perform isotopic analysis of air samples for natural uranium, Ra-226, Po-210, Th-230 and Pb-210 to ensure compliance with 10 CFR 20.1204.

2. Environmental particulate air samples at Christensen Ranch

As stated in Section 5.7.3.3.2, "Airborne Effluent and Environmental Air Particulate Monitoring," of the NRC staff's LR SER (NRC 2013), the NRC staff did not agree with Uranium One's approach to airborne effluent and environmental air particulate monitoring at the Christensen Ranch satellite building, as described in Section 5.8.1 of its LRA. This is why the third paragraph of LC 11.3 states that Uranium One should either: (1) collect airborne samples for natural uranium, Ra-226, Po-210, and Pb-210 at each Christensen Ranch environmental monitoring location at a frequency of once every 6 months for 2 years, and annually thereafter, to ensure compliance with 10 CFR 20.1301, or (2) provide to the NRC, for review and verification within 6 months of license renewal, alternative procedures specific to environmental monitoring for natural uranium, Ra-226, Po-210, and Pb-210 to show compliance with 10 CFR 20.1301.

By letter dated September 25, 2013, Uranium provided alternative procedures for environmental monitoring in which it repeated its previous position that environmental air particulate monitoring at Christensen Ranch should not be required and that the results of environmental air particulate monitoring around the Irigaray central processing facility should be considered bounding and representative of values that would be measured at Christensen Ranch. In its January 20, 2015, letter, Uranium One committed to comparing effluent quantities of particulate radionuclides from the Christensen Ranch satellite building (described further in Section 3. below) with effluent quantities from the Irigaray central processing plant stack. Uranium One explained that the effluent quantities from the dryer stack will be higher than those from the satellite building, which doesn't have a dryer or any other significant source of particulate matter emissions. This comparison will demonstrate environmental air sample concentrations downwind of the Irigaray stack are bounding and representative of environmental air concentrations that would be measured downwind of Christensen Ranch satellite building. As described below in Section 4, particulate radionuclide measurements from the Irigaray central processing plant environmental monitoring stations would be used to calculate public dose regardless of where individuals likely to receive the highest dose are located.

The NRC staff finds Uranium One's approach acceptable because Uranium One has described a method to demonstrate that radionuclides in air downwind of the Christensen Ranch satellite building would not be higher than concentrations of radionuclides in air around the Irigaray central processing facility.

3. Accounting for air effluent quantities in accordance with 10 CFR 40.65

As described above, Uranium One's revised response to LC 11.3.a. is provided in a letter dated April 17, 2017 (Uranium One 2017). The Uranium One April 17, 2017, submittal incorporates statements, commitments, and representations included in Uranium One's submittals dated January 20, 2015, and June 5, 2015 (Uranium One 2015a, b). The NRC staff has summarized Uranium One's revised proposal in Table 1 below.

Table 1. NRC staff summary of effluent monitoring proposal "Method 1" at Willow Creek Project (Uranium One 2017)

Effluent Location	Particulate Matter	Radon	Radon Progeny	Licensee Radon Source Term[1]
Christensen Ranch Satellite Plant	Semi-annual isotopic of monthly filters x building ventilation flow[2]	Semi-annual radon-in-water loss (i.e., "mass-balance" approach)	Licensee will assume equilibrium between radon and radon progeny	S_{in}-S_{out}
Christensen Ranch Bleed	Not measured[3]	Semi-annual radon-in-water loss (i.e., "mass-balance" approach)	Licensee will assume equilibrium between radon and radon progeny	S_{disp}
Irigaray Stack	Stack sampling[4]	Accounted for at Christensen Ranch Satellite Plant	Accounted for at Christensen Ranch Satellite Plant	
Irigaray Plant	Semi-annual isotopic of monthly filters x building ventilation flow[2]	Accounted for at Christensen Ranch Satellite Plant	Accounted for at Christensen Ranch Satellite Plant	
Modular Buildings and DDW Houses	Not measured[3]	Quarterly samples of radon concentrations in air[5] in all modular buildings using track-etch detectors x building ventilation flow	Licensee will assume equilibrium between radon and radon progeny	MB_{Rn}
Wellfields	Not measured[3]	Quarterly samples of radon concentrations in air[5] in five wellheads per operational wellfield using track-etch detectors x 2 liters per minute[6] x sample duration (minutes)	Licensee will assume equilibrium between radon and radon progeny	WH_{Rn}
Spills	Not measured[3]	Radon concentration in spilled fluid (e.g., pregnant lixiviant) x estimated volume of spill	Licensee will assume equilibrium between radon and radon progeny	SS_{Rn}
Ponds	Not measured[3]	Accounted for at Christensen Ranch Bleed	Accounted for at Christensen Ranch Bleed	

[1] The licensee will estimate total radon effluent quantities by adding all five terms
[2] Isotopic analysis includes natural uranium, thorium-230, radium-226, lead-210, and polonium-210.
[3] Process bleed, operating wellfields, modular buildings, deep disposal well (DDW) houses, lixiviant spills, and ponds are not sources of significant diffuse emissions of particulate matter.
[4] Already part of Uranium One's NRC-approved sampling program
[5] Sample results will be net concentrations after subtracting background results from air monitoring station AS-1.
[6] This is a non-mechanistic flow rate previously determined by the NRC staff to be reasonably bounding of air flow from a recovery well.

For this evaluation, the NRC staff examined how Uranium One addressed four deficiencies the NRC staff previously identified (NRC 2016) in Uranium One's earlier proposal (Uranium One 2015b). The first deficiency the NRC staff described in its July 27, 2016, letter, pertained to how Uranium One proposed to estimate effluent quantities of radon progeny from release points at which it proposed to measure only radon effluent quantities (and not radon progeny). In its April 17, 2017, revised proposal, Uranium One stated it would assume that radon and radon progeny are in secular equilibrium for purposes of estimating effluent quantities of radon progeny where it proposed to measure only radon. As explained in its July 27, 2016, letter, the NRC staff finds this approach acceptable because this is a conservative and bounding assumption (NRC 2016).

The second deficiency that the NRC staff identified in its July 27, 2016, letter was that Uranium One had not explained the frequency of radon-in-water samples it proposed to take at the de-gas column and deep disposal well house as part of its proposed "Method 2" (NRC 2016). As explained further below, Uranium One's revised proposal does not include Method 2 sampling of radon concentrations in water at the de-gas column and deep disposal well house. Therefore, this deficiency is resolved by using a single revised approached, referred to as "Method 1."

The third deficiency that the NRC staff identified in its July 27, 2016, letter was that Uranium One had proposed to sample some effluent streams for radon progeny concentrations using the modified Kusnetz method. As the NRC staff explained in its July 27, 2016, letter, it is not correct or conservative to measure short-lived radon progeny concentrations in air and assume equilibrium with radon gas concentrations in air (NRC 2016). As stated in its April 17, 2017, revised proposal, Uranium One will no longer measure radon progeny concentrations using the modified Kusnetz method for the purpose of estimating effluent quantities of radon and radon progeny from its operations.

The fourth deficiency that the NRC staff identified in its July 27, 2016, letter, pertained to specific methods of estimating effluent quantities from resin trucks and from spills. Both resin trucks and spills were part of what Uranium One previously referred to as "Method 2." In its revised proposal, Uranium One removed the sampling approaches described under Method 2 and replaced them with a single suite of measurements it referred to as "Method 1." Specifically, Uranium One assumes effluent quantities from resin trucks are accounted for in the mass balance approach at the Christensen Ranch Satellite Plant. With regard to spills, Uranium One adopted one acceptable approach that the NRC staff explained in its July 27, 2016, letter. Specifically, Uranium One will estimate air effluent quantities of radon from spills using radon measurements from of the spill fluid (e.g., pregnant lixiviant) and an estimate of the volume of the spill.

The NRC staff evaluated Uranium One's revised proposal for estimating effluent quantities by: (1) summarizing Uranium One's proposal in Table 1 above and (2) evaluating Table 1 to determine whether Uranium One had reasonably considered all point and diffuse sources of radionuclide air effluents, and all principal radionuclides in air effluents. The NRC staff also evaluated the formulas proposed by Uranium One for calculating effluent quantities by entering the formulas and example parameter values in an Excel spreadsheet. The purpose of the NRC staff's spreadsheet evaluation was to assess whether all necessary parameter values are accounted for in the licensee's proposed effluent monitoring plan. On the basis on the completeness of Table 1, as regards sample location, principal radionuclides, sample type, and sample frequency, and because the effluent monitoring plan depicted in Table 1 provides all the

information needed to calculate effluent quantities of principal radionuclides, the NRC staff finds Uranium One's revised method "Method 1" acceptable.

4. Evaluating the highest public dose in accordance with 10 CFR 20.1302

As described above, Uranium One's revised response to LC 11.3.b. is provided in its letters dated January 20, 2015 (Uranium One 2015a) and June 5, 2015 (Uranium One 2015b). Uranium One stated that it used the MILDOS-AREA computer code to initially identify the individual likely to receive the highest dose from licensed operations, in accordance with 10 CFR 20.1302(b)(1). As described below, the methodology used by Uranium One will be used each year to reassess whether the individual likely to receive the highest dose should be updated as a result of changes in land use.

The use of the MILDOS-AREA code to assess the individual likely to receive the highest dose requires information about: (1) the radionuclide air effluent locations and annual quantities of radionuclides released to the atmosphere; (2) representative on-site meteorological data; (3) potential exposure pathways; and (4) locations of individuals likely to receive the highest dose.

In its initial assessment of the individual likely to receive the highest dose, which was included as Attachment 2 to its January 20, 2015, letter, Uranium One evaluated four individual sources of effluent release in its MILDOS-AREA model: the Irigaray central processing facility stack; the Christensen Ranch satellite building; Mine Unit 7 wellfield; and wellfields in Mine Units 10 and 12. Uranium One used the methodology in Regulatory Guide 3.59 to estimate effluent quantities of radon-222. It also used measured monthly effluent quantities of natural uranium, thorium-230, radium-226, and lead-210, from the Irigaray dryer. For meteorological data, Uranium One used its on-site meteorological data collected at Irigaray central processing facility in 1980 and 1981. The potential exposure pathways considered by Uranium One included inhalation and ingestion pathways. To evaluate individuals likely to receive the highest dose, Uranium One first evaluated the total effective dose equivalent rate (i.e., mrem/yr) that would be received assuming 100 percent occupancy at each of 1,050 locations on a square grid centered on the Christensen Ranch satellite building. Uranium One used a grid spacing of 500 meters in its assessment. Uranium One calculated that the highest overall total effective dose equivalent (TEDE) rate would be 12.1 mrem/yr at a distance of about 4,000 meters east of the Christensen Ranch satellite building. This location corresponds to the location of the Mine Unit 7 wellfield source. As described below, Uranium One applied the maximum calculated TEDE rate to hunters, coal bed methane (CBM) workers and oil company workers. Uranium One similarly calculated a maximum TEDE rate of 6.6 mrem/yr for members of the public likely to remain within 250 meters of the Christensen Ranch satellite building, which were assumed to be couriers, vendors, and Uranium One employees that stay overnight in on-site housing. The two maximum TEDE rates (i.e., 12.1 mrem/yr and 6.6 mrem/yr), which are based on 100 percent occupancy, were then reduced to account for expected occupancy for each type of public receptor. Using this methodology, Uranium One estimated that the individual likely to receive the highest dose from licensed operations is a CBM well worker receiving an annual TEDE of up to 3.75 mrem/yr. Uranium One also estimated that its employees in on-site workforce housing would receive a public dose of up to 1.39 mrem TEDE per year.

As a result of the assessment described above, Uranium One committed to initially place passive radon detectors and gamma radiation monitoring devices (e.g. optically-stimulated luminescent dosimeters) at each of the following locations shown on Figure 2 of Attachment 2 to its January 20, 2015 letter (Uranium One 2015a): (1) well number 4447-2-21 for Mine Unit 10;

(2) well number 34-4-4476 in Mine Unit 7; well numbers 4577-25-41 and 4577-25-32 in Mine Unit 8; each man camp; the electrical substation near Mine Unit 8; and the Anadarko compressor and water station located about 2.5 miles SE of the Irigaray central processing facility.

As stated above, Uranium One committed to re-evaluate its estimates of individuals likely to receive the highest dose from licensed operations each year as part of the land use survey.

To demonstrate compliance with the dose limits for individual members of the public, Uranium One committed to calculate dose in accordance with 10 CFR 20.1302(b)(1). The dose calculations will be based on concentrations of particulate radionuclides in air at the Irigaray central processing facility environmental air sample stations; environmental dosimeters; and radon-222 concentrations at each of the locations described above where individuals are likely to receive the highest dose. Uranium One will use occupancy times for each receptor based on site-specific estimates, which will be justified when the annual public dose is reported.

The NRC staff reviewed the licensee's proposed methods for evaluating the member(s) of the public likely to receive the highest exposures from radon and its progeny and particulates from licensed operations at the Willow Creek project and determined that it meets the requirements of 10 CFR 20.1302 and is therefore acceptable.

5. Accounting for radon progeny in public dose assessments

To account for radon progeny, Uranium One stated it would use a dose conversion factor derived from the effluent concentrations in Appendix B to 10 CFR Part 20 for radon-222 with daughters present.

The NRC staff reviewed the licensee's proposed methods for incorporating the progeny from radon-222 into its estimates of public dose resulting from licensed operations at the Willow Creek project and determined that it meets the requirements of 10 CFR 20.1302 and is therefore acceptable.

6. Accounting for occupational dose in all licensed areas

License condition 11.3.d. requires Uranium One to discuss how it will account for occupational dose received by monitored employees throughout the license area. In other words, Uranium One had explained in its LRA how it would conduct surveys in the Irigaray central processing facility and Christensen Ranch satellite building, but it had not discussed surveys in other license areas where occupational doses may be received. In its January 20, 2015, letter, Uranium One stated in addition to the measurements in the Irigaray central processing facility and Christensen Ranch satellite building, as specified in Sections 5.7 and 5.8 of the NRC–approved LRA, Uranium One will commit to making measurements of radon progeny in the wellfield modular buildings at the same frequencies as specified in Section 5.7 of the LRA. Uranium One will also assign occupational dose to workers in the wellfields by assuming 2,000 hours per year occupational exposures at the concentrations measured in the Irigaray central processing facility and Christensen Ranch satellite building.

Uranium One also explained that external dose is assigned to all monitored employees based on work groups. In this case, individuals not assigned dosimeters will be assigned a dose based on the dose received by a representative member of their group. The groups include plant operators, wellfield operators, maintenance workers, and laboratory workers.

The NRC staff reviewed the licensee's proposed methods for accounting for occupational dose received throughout the Willow Creek project from radon and its progeny and particulates and determined that it meets the requirements of 10 CFR 20.1501 and is therefore acceptable.

Conclusion

As described above, the NRC staff reviewed and verified the following Uranium One submittals meet the requirements of license condition 11.3 of Source Material License SUA-1341: September 25, 2013 (Uranium One 2013), January 20, 2015 (Uranium One 2015a), June 5, 2015 (Uranium One 2015b), and April 17, 2017 (Uranium One 2017). The licensee should track regulatory commitments contained in these letters and revise its licensing basis documents accordingly.

References

10 CFR Part 20. Code of Federal Regulations, Title 10, Energy, Part 20, "Standards for Protection against Radiation."

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

Cogema (Cogema Mining, Inc.) 2008. Letter from T. Hargrove, Cogema, to B. Von Till, NRC, dated May 30, 2008, Re: Docket 40-8502, License SUA-1341 (Renewal Application). ADAMS Accession No. ML081850689 (pkg). Updated October 31, 2008 (ML083110405), July 17, 2009 (ML092110700), November 19, 2010 (ML103280266), March 7, 2012 (ML120820095), and July 10, 2012 (ML12206A436).

NRC (U.S. Nuclear Regulatory Commission). 1987. Regulatory Guide 3.59, "Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations," Washington, DC: NRC, Office of Nuclear Regulatory Research. Accession No. ML003739503.

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