



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

November 19, 2015

Mr. Michael Griffin  
Vice President of Permitting, Regulatory  
and Environmental Compliance  
Strata Energy, Inc.  
PO Box 2318  
Gillette, WY 82717-2318

**SUBJECT:** U.S. NUCLEAR REGULATORY COMMISSION VERIFICATION OF STRATA'S  
RESPONSE TO LICENSE CONDITION 12.7, ROSS IN-SITU RECOVERY (ISR)  
PROJECT, CROOK COUNTY, WY, SOURCE MATERIAL LICENSE SUA-1601,  
DOCKET NO. 040-09091, TAC J00735

Dear Mr. Griffin:

By submittals dated March 1, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15076A014), July 30, 2015 (ADAMS Accession No. ML15224B400), October 23, 2015 (ADAMS Accession No. ML15296A240), November 5, 2015 (ADAMS Accession No. ML15313A274), and November 10, 2015 (ADAMS Accession No. ML15314A439), Strata Energy, Inc. (Strata) submitted responses to preoperational license condition (LC) 12.7 of its Materials License SUA-1601. LC 12.7 states:

- 12.7 No later than 30 days before the preoperational inspection, the licensee shall provide to the NRC staff, for review and written verification, written procedures for its airborne effluent and environmental monitoring program that:
- A) Discuss how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.
  - B) Discuss and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.
  - C) Discuss how, in accordance with 10 CFR 20.1501, the occupational dose (gaseous and particulate) received throughout the entire License Area from licensed operations will be accounted for, and verified by, surveys and/or monitoring.

As described in the enclosed evaluation, the NRC staff previously verified that Strata met the requirement in LC 12.7 C) (ADAMS Accession No. ML15278A110). This letter documents the NRC staff's verification that Strata meets the requirements in LCs 12.7 A) and 12.7 B).

M. Griffin

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

If you have any questions regarding this action, please contact me at 301-415-0697 or by e-mail at [John.Saxton@nrc.gov](mailto:John.Saxton@nrc.gov).

Sincerely,

**/RA/**

John Saxton, Hydrogeologist  
Uranium Recovery Licensing Branch  
Division of Decommissioning, Uranium Recovery  
and Waste Programs  
Office of Nuclear Material Safety  
and Safeguards

Docket No.: 040-09091  
License No.: SUA-1601

Enclosure:  
Verification of Strata's  
Responses to LC 12.7 A) & 12.7 B)

cc: D. Schellinger, WDEQ

M. Griffin

2

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If you have any questions regarding this action, please contact me at 301-415-0697 or by e-mail at [John.Saxton@nrc.gov](mailto:John.Saxton@nrc.gov).

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Docket No.: 040-09091

License No.: SUA-1601

Enclosure:

Verification of Strata's

Responses to LC 12.7 A) & 12.7 B)

cc: D. Schellinger, WDEQ

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**NRC Staff Verification of Strata Energy, Inc., Submittals dated March 1, 2015, July 30, 2015, October 23, 2015, November 5, 2015, and November 10, 2015 Regarding Preoperational License Condition 12.7, Materials License SUA-1601; Docket No. 040-09091**

**Background**

By letter dated March 1, 2015, Strata Energy, Inc. (Strata) provided its responses to preoperational license conditions (LCs) 12.7 and 12.8 of Materials License SUA-1601 (Strata 2015a). By letter dated July 23, 2015, NRC staff provided its comments on Strata's response to LC 12.7, and a request for additional information on Strata's response to LC 12.8 (NRC 2015a). By letter dated July 30, 2015, Strata responded to NRC staff's comments on LC 12.7 (Strata 2015c). Since July 30, 2015, Strata's responses to LC 12.8 were handled in separate correspondence (Strata 2015b). By letter dated October 15, 2015, NRC staff provided additional comments to Strata on its plan to meet LCs 12.7 A) and 12.7 B) and notified Strata that it had verified that Strata had described how it would account for occupational dose throughout the license area in accordance with LC 12.7 C) (NRC 2015b). By letter dated October 21, 2015, Strata provided additional clarification of its plans and commitments to meet LCs 12.7 A) and 12.7 B) (Strata 2015d). During its acceptance review, NRC staff identified areas in which Strata's response did not address staff's comments. On a subsequent project manager to project manager call, staff asked Strata for clarification of its response. As a result of that clarification, by letter dated October 23, 2015, Strata revised its October 21, 2015, submittal (Strata 2015e). By letter dated November 5, 2015 (Strata 2015f), and e-mail dated November 10, 2015 (Strata 2015g), Strata provided additional clarifications of its previous commitments regarding LC 12.7. Therefore, the scope of this verification review is Strata's description of how it will meet the requirements in LCs 12.7 A) and 12.7 B) as described in Strata's submittals dated March 1, 2015 (Strata 2015a); July 30, 2015 (Strata 2015c); October 23, 2015 (Strata 2015e); November 5, 2015 (Strata 2015f); and November 10, 2015 (Strata 2015g).

LCs 12.7 A) and 12.7 B) state:

- 12.7 No later than 30 days before the preoperational inspection, the licensee shall provide to the NRC staff, for review and written verification, written procedures for its airborne effluent and environmental monitoring program that:
  - A) Discuss how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.
  - B) Discuss and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.

**Evaluation – License Condition 12.7 A)**

In Attachment 2 to its March 1, 2015, letter, Strata provided its response to LC 12.7 A). Strata included extensive background information relevant to LC 12.7 A) in the following sections of Attachment 2, "Response to Pre-Operational License Conditions":

- 1.1 "Scope of the Response"
- 1.2 "Pertinent Regulations and Applicability"
- 1.3 "Technological Infeasibility"

Enclosure

The information in Sections 1.1 through 1.3 of Attachment 2 is primarily background information that did not directly address the technical requirements of LC 12.7 A). Therefore, NRC staff did not evaluate this information.

In Section 1.4, "Quantifying Principal Radionuclides," Strata described: how it will assess the radionuclide composition of its in-plant air samples and yellowcake (Section 1.4.1); the technological infeasibility of stack sampling (Section 1.4.2.1); its proposed alternative to stack sampling for determining radon effluent quantities in accordance with Title 10, Code of Federal Regulations (10 CFR) 40.65 (Section 1.4.2.2); and its justification for not quantifying principal radionuclides in air effluents from well fields. The staff's evaluation of this information is provided below.

#### *Effluent Quantities of Particulate Matter Radionuclides from the CPP*

In Section 1.4.1 of Attachment 2 to its March 1, 2015, letter, Strata committed to supplement its radiological characterization program described in Section 5.7.3.1.1 of its Technical Report (TR) by characterizing the radionuclide composition of its dryer product (yellowcake) within the first 3 months of dryer operations, including both (1) isotopic composition; and (2) total alpha and beta activity. Strata also described its current requirement to have a contamination control program in accordance with LC 9.7, which requires Strata to conform to Regulatory Guide 8.30, Regulatory Position 2.5. Strata also committed to perform isotopic analysis of in-plant air samples if the gross alpha concentration exceeds 25% of the derived air concentration (DAC) for Class D natural U. Section 5.7.3.1.1 of the TR (Strata 2011) already describes commitments to analyze composite air samples from various points in the CPP for natural U, thorium-230 and radium-226 and to characterize yellowcake product to verify its radiological composition.

Also, as stated in license condition 10.16, Strata is already required to characterize airborne samples for natural U, Th-230, Ra-226, Po-210, and Pb-210 as follows:

- 10.16 The licensee shall conduct radiological characterization of airborne samples for natural U, Th-230, Ra-226, Po-210, and Pb-210 for each restricted area air particulate sampling location at a frequency of once every 6 months for the first two years, and annually thereafter to ensure compliance with 10 CFR 20.1204(g). The licensee shall also evaluate changes to plant operations to determine if more frequent radionuclide analyses are required for compliance with 10 CFR 20.1204(g).

In light of Strata's previous commitment to characterize yellowcake, the commitment in Attachment 2 of its March 1, 2015, letter appeared to clarify: when the yellowcake would be characterized (i.e., within first 3 months of operation); and what characterization would be performed (i.e., isotopic composition and total alpha and beta activity). However, Strata did not explain why it was committing to additional detail in its requirement to characterize yellowcake, and how this information would be relevant to the requirement in LC 12.7 A) to discuss how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.

By letter dated July 23, 2015, NRC staff provided a comment on Strata's March 1, 2015, letter, stating that Strata should explain how the additional detail it provided regarding yellowcake characterization relates to the requirement in LC 12.7 A) (NRC 2015a). By letter dated July 30, 2015, Strata replied that the purpose of the additional detail it provided was to commit to

a specific timeframe for yellowcake sampling and provide a more comprehensive evaluation of the radionuclides present in the Ross ISR product (Strata 2015c). Strata stated that the more thorough isotopic analysis would allow for a greater understanding of the quantity of the principal radionuclides present in the yellowcake product. However, Strata did not explain how this information would be used to ensure the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.

By letter dated October 15, 2015, NRC staff again asked Strata to explain how either the yellowcake analysis or the air sample isotopic analysis would be used to estimate effluent quantities from the central processing plant (CPP) (NRC 2015b). NRC staff requested that Strata explicitly describe how it will combine the results of air samples with CPP ventilation rates (or other information) to estimate the quantities of principal radionuclides released during each semi-annual reporting period. NRC staff also asked Strata to address periods during which CPP bay doors are open and/or active ventilation is not used.

By letter dated October 23, 2015 (Strata 2015e), Strata replied that it would determine average air concentrations of natural uranium, thorium-230, radium-226, and lead-210 in the CPP using quarterly composites of air samples taken in accordance with its plan outlined in its TR (Strata 2011). Strata's plan for air samples in the CPP is described in Section 5.7.3 of its TR. Strata stated that the average air concentrations will be multiplied by the average active air ventilation rate of the CPP to yield an estimate of the release rate per unit time. Strata stated that two fans in the active ventilation system maintain a combined flow rate of 40,000 cubic feet per minute (CFM), which will maintain six air exchanges per hour. Strata also explained that it will use active ventilation in the CPP at all times, except during maintenance on the ventilation system and power outages. Strata will also assume that the ventilation system runs continuously for purposes of calculating effluent quantities, which will account for periods when the ventilation system does not operate and the building is only passively ventilated. Strata also stated, "Due to the high ventilation rate of the CPP, Strata has reasonable assurance that any particulate matter effluent will be emitted through the ventilation system and not through any passive ventilation."

NRC staff finds that Strata's approach will result in a reasonable estimate of effluent quantities; however, NRC staff does not agree with Strata's statement in the October 23<sup>rd</sup> letter that the proposed active ventilation rate will ensure particulate matter effluent will be emitted through the active ventilation system exhaust and not through any passive ventilation. At issue is whether or not under high winds discharges through passive ventilation (i.e., through an open door) provides a significant component relative to the active ventilation rate. Based on the plant design, direct flow through the plant as part of the passive ventilation would be hindered in part from the location of the doors and plant equipment. By submittals dated November 5<sup>th</sup> and November 10<sup>th</sup> (Strata, 2015f; 2015g), Strata committed to verifying the contributions to effluent releases attributed to the passive ventilation as part of the larger study to quantify the effluent releases. Therefore, NRC staff finds acceptable Strata's approach to measuring effluent quantities of particulate matter from the CPP using average concentrations from quarterly composites of periodic plant air samples and an estimate of a constant active ventilation flow rate through the CPP of 40,000 CFM while measuring and quantifying the effluent rates attributed to the passive ventilation and adjusting the total effluent releases accordingly.

#### *Technological infeasibility of stack sampling*

In Section 1.4.2.1 of Attachment 2 to its March 1, 2015, letter, Strata, citing ANSI/HPS N13.1-1999, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities," (ANSI 1999) stated why it believes, among other

things, that isokinetic sampling of radon in vents is technologically infeasible and unreasonable. Strata stated that ANSI/HPS N13.1-1999 has been approved by the staff in Regulatory Guide 4.16, "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants" (NRC 2010). The staff evaluated ANSI/HPS N13.1-1999 and found that Section 6.3.1, "Basic considerations," specifically states that "ANSI N13.1-1969 recommendation for isokinetic sampling is no longer required. Studies have shown that isokinetic operation is not a prerequisite for obtaining representative samples (McFarland and Rodgers 1993)." Furthermore, with respect to radon (a non-reactive noble gas), Section 6.5 of ANSI/HPS N13.1-1999 states,

When non-reactive gases and vapors are the only species being sampled, the sampling requirements are considerably simpler than those for aerosol particles. The requirements for minimizing particle line-loss are irrelevant....If the flow can contain only gaseous contaminants, the nozzle design is not critical, but the sampling shall take place at a location where the flow is well mixed and meets the criteria of clause 5.2.2.2. The nozzle design can be simply an open ended or perforated tube.

With regard to clause 5.2.2.2 of ANSI/HPS N13.1-1999, the staff finds that radon will generally be sufficiently well mixed in the types of vent piping used at most ISRs such that the conditions of clause 5.2.2.2 will be met, and radon sampling can be straightforward and simple.

Aside from a review of ANSI/HPS N13.1-1999, as stated above, the NRC staff did not perform a detailed evaluation of the licensee's reasons for not performing stack sampling for radon or other radionuclides. This is because Strata's proposed method, which is addressed in the following section of this evaluation below, is an acceptable method described in the staff's draft guidance on surveys of radon and radon progeny in air and the licensee need not justify its reasons for not using other methods (NRC 2014a).

#### *Strata's Proposed Alternative to Stack Sampling for Radon and Radon Progeny*

In Section 1.4.2.2 of Attachment 2 to its March 1, 2015, letter, Strata described its method to estimate air effluent quantities of radon from the CPP (Strata 2015a). Strata stated that in the first six months of steady state operations, it will sample lixiviant and measure radon in water to establish both the quantity per unit time of radon entering the CPP in the pregnant lixiviant (i.e., radon in water) and the quantity per unit time of radon exiting the CPP in barren lixiviant. Strata proposed to attribute any positive difference in radon in the pregnant lixiviant minus barren lixiviant to loss through air effluent from the CPP (a "loss term"). The licensee provided two papers in support of the "loss term" approach (i.e., Brown and Smith 1981; Marple and Dziuk 1982). Strata stated that it would compare the results thus obtained to: (1) source term estimates calculated using Regulatory Guide 3.59 (NRC 1987); (2) source term estimates calculated using the method described in Appendix D to NUREG-1569 (NRC 2003); and (3) the results of routine operational environmental monitoring program. Strata also explained its view that quantifying principal radionuclides released in effluents from the well fields and other areas by direct measurements is technologically infeasible and unreasonable.

In its March 1, 2015, letter, Strata did not explain its method for determining concentrations of radon in water. By letter dated July 23, 2015 (NRC 2015a), NRC staff stated that one method for measuring radon in water is ASTM D5072-09, "Standard Test Method for Radon in Drinking Water" (ASTM 2009). NRC staff also stated that when describing this method or any other, Strata

should describe how it will control the pressure of lixiviant sampling to obtain a representative sample and also provide either a detailed description of the sampling locations and/or a piping diagram and sketch of the sampling station in detail sufficient to demonstrate that sample results will be representative of lixiviant conditions. By letter dated July 30, 2015, Strata stated that it would install valves at the existing daily grab or composite/injection solution sample stations that will allow persons taking samples to regulate the pressure and flow rate of sampled fluids (Strata 2015c). Strata also described the sampling method, which NRC staff determined are acceptable because they are substantially similar to published methods for sampling radon in water (EPA 2015).

By letter dated October 15, 2015, NRC staff commented that Strata had not explained how it would estimate air effluent quantities of radon progeny (NRC 2015b). By letter dated October 23, 2015, Strata explained that it would assume equilibrium between radon and radon progeny (Strata 2015e). This is a conservative approach to estimating effluent quantities of radon progeny and is, therefore, acceptable to NRC staff.

#### *Other Point and Diffuse Sources*

In its March 1, 2015, letter, Strata did not explain how it would account for radionuclides in effluents from well fields or deep disposal well houses (Strata 2015a). Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities," Regulatory Position 3.3, "Unmonitored Effluents," states, "If a licensee has release points for which monitoring is not practicable, the licensee should estimate the magnitude of the unmonitored effluents ... Unmonitored releases may be estimated based on the quantity of material used in these areas or the number of procedures performed or other appropriate methods. When practicable, unmonitored effluents should not exceed 30% of the total estimated effluent releases." (NRC 1993). By letter dated July 23, 2015, NRC staff commented that Strata did not explain how it would account for radionuclides in effluents from well fields or deep disposal well houses (NRC 2015a). By letter dated July 30, 2015, Strata committed to additional effluent monitoring (Strata 2015c). Strata stated that it would collect monthly working level samples using the modified Kusnetz method in header houses, deep disposal well buildings, and at specified wells in the wellfield. Strata stated that it would assume a conservative equilibrium factor of 1, "as it is the most conservative value." By letter dated October 15, 2015, NRC staff commented that an equilibrium factor of 1 is not conservative, because the equilibrium factor appears in the denominator in the equation converting working levels (radon progeny) to radon concentrations (NRC 2015b). By letter dated October 23, 2015, Strata revised its plan to state that it would measure radon using track-etch detectors in header houses, the deep disposal well building, and 10 percent of production well covers and assume equilibrium between radon and radon progeny to arrive at an estimate of effluent quantities of radon progeny (Strata 2015e). This is a conservative approach to estimating effluent quantities of radon progeny and is, therefore, acceptable to NRC staff.

By letters dated July 30, 2015 and October 23, 2015, Strata stated that it will multiply monthly average radon and radon progeny concentrations in all header houses by design flow rates for fans in those structures to determine an average monthly effluent quantity for these structures (Strata 2015c, e). Strata will multiply the average monthly effluent quantity by the number of header houses in operation to determine the monthly effluent quantity for all header houses. Strata will use the same approach for its deep disposal well building. Strata also stated that it will also survey 10% of the production wells on a quarterly basis. For wellheads, Strata committed to obtain radon samples from 10% of production wells using track-etch devices. As with estimates of radon effluent quantities from header houses, Strata planned to assume equilibrium between measured radon progeny and radon to estimate quantities of radon progeny effluent. Given that



there is no motive force to induce air flow from production wells except changes in water level, Strata stated it would use the rate at which air samples are normally taken using the modified Kusnetz method of measuring radon progeny (2 liters per minute) as the effluent flow rate. Strata also stated it will calculate an average effluent quantity for wellheads in a manner similar to that for header houses. This is a conservative approach to estimating effluent quantities of radon and radon progeny and is, therefore, acceptable to NRC staff.

With regard to particulate radionuclides, Strata stated in its letters dated July 30, 2015 and October 23, 2015, that it would perform monthly surveys in header houses and deep disposal well building for gross alpha concentration (Strata 2015c, e). These samples will be composited semi-annually for measurements of natural uranium, thorium-230, radium-226, polonium-210, and lead-210. Effluent quantities will be calculated in a manner similar to that for radon, in which Strata will determine site-wide average radionuclide concentrations in air inside headers houses and the deep disposal well building and multiply these averages by the design flow rates of ventilation systems in those structures.

NRC staff has verified that Strata has developed a written plan which discusses how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring. A summary of Strata's monitoring plan is shown in Table 1 of this evaluation.

#### *Triggers for Vegetation and Cattle Sampling*

Though it was not part of license condition 12.7 A), the staff's Safety Evaluation Report (NRC 2014b) stated in Section 5.7.7.3.2.4 that "...the applicant specify, in its airborne effluent and environmental monitoring program, particular conditions that will trigger the need for the applicant to conduct operational livestock and vegetation sampling." This request was not contained in any preoperational license condition. In Section 1.5 of Attachment 2 to its March 1, 2015, letter, Strata stated that it would start vegetation and cattle sampling, as described in Regulatory Guide 4.14 (NRC 1980), if air sampling results for particulate radionuclides (natural U, Th-232, Ra-226, and/or Pb-210) at any air sampling station in unrestricted areas was greater than 25% of the applicable effluent concentrations in 10 CFR 20, Appendix B, Table 2, for at least two quarters in any year.

The staff evaluated Strata's proposed trigger. In Section 5.7.7.1.3 of its TR, Strata stated that it would monitor vegetation, food, and fish based on the results of the MILDOS-AREA model and final approval of the operational monitoring program (Strata 2011). Strata also stated in TR Section 5.7.7.1.3, "In the event monitoring is required, sample collection will be conducted similar to the pre-operational baseline monitoring described in Section 2.9 and will meet the recommendations of Regulatory Guide 4.14." In Table 5.7-1 of Strata's application, which summarizes Strata's operational environmental monitoring program, Strata committed to vegetation sampling for Ra-226 and Pb-210 three times during the grazing season in 3 different sectors that have the highest predicted concentrations of radionuclides. Strata also committed to animal tissue sampling (3 beef samples and 1 fish sample) for Ra-226 and Pb-210 once during site decommissioning and prior to license termination. However, as stated in footnote (o) of Table 2 of Regulatory Guide 4.14:

**Table 1. Ross ISR Project Summary of Methods to Estimate Effluent Quantities in Accordance with 10 CFR 40.65**

Type of Effluent	Effluent Location				
	CPP Occupied Spaces	Process Vents	Header Houses & DDW Houses	Wellfields	Spills
Particulate matter <sup>1</sup>	[Quarterly isotopic analysis of periodic plant air samples] x [design exhaust volume]	Not measured <sup>2</sup>	[Monthly gross alpha ] x [design exhaust volume]  [Semiannual isotopic analysis of monthly filters] x [design exhaust volume]	Not measured <sup>3</sup>	[Recent process fluid assay] x [volume of spill]
Radon	Monthly <sup>4</sup> radon-in-water loss term. <sup>5</sup>		[Average quarterly track-etch] x [design exhaust volume]	[Average quarterly track-etch in 10% of production wells] x [2 liters per minute]	[Radon-in-water at time of spill] x [volume of spill]
Radon progeny	Equilibrium with radon assumed.				

<sup>1</sup> Isotopic analysis includes natural uranium, thorium-230, radium-226, and lead-210.

<sup>2</sup> Process vents for wet processes at this ISR would not contain significant particulate matter.

<sup>3</sup> Operating wellfields are not sources of significant diffuse emissions of particulate matter.

<sup>4</sup> First samples upon startup (wellfield conditioning) and monthly thereafter. Strata may reduce frequency after trending data.

<sup>5</sup> Confirmed by quarterly track-etch air samples at the CPP security perimeter in each of eight cardinal and ordinal directions.

Vegetation or forage sampling need be carried out only if dose calculations indicate that the ingestion pathway from grazing animals is a potentially significant exposure pathway (an exposure pathway should be considered important if the predicted dose to an individual would exceed 5% of the applicable radiation protection standard).

By letter dated July 23, 2015, NRC staff commented that Strata should clarify its description of operational livestock and vegetation sampling in light of commitments already made and staff guidance in Regulatory Guide 4.14, Table 2, regarding acceptable trigger levels. By letter dated July 30, 2015, Strata stated that it will follow the commitments outlined in TR Section 5.7.7.1.3, and not those commitments made in TR Table 5.7-1 or Section 1.5 of Attachment 2 to Strata's March 1, 2015, letter. Strata stated that it would update TR Table 5.7-1 to reflect the change after receiving NRC verification of LC 12.7 (Strata 2015c).

NRC staff is not verifying or approving these changes, as they were not the subject of any preoperational license condition. However, NRC staff agrees that Strata should revise its TR to reconcile differences in the descriptions of the environmental monitoring program as regards vegetation and forage sampling. The NRC staff notes that any revision could include specific mention of the 5% trigger value contained in footnote (o) of Table 2 of Regulatory Guide 4.14.

### *Spills*

By its July 30<sup>th</sup> submittal (Strata 2015c), Strata proposed to estimate the effluent release due to an unplanned release (i.e., spill to the surface) of process fluid in a wellfield by multiplying the total volume of solution released by the radon concentrations most recently measured in the relevant process solution. Staff interprets this commitment to mean the relevant process fluid is either the pregnant or barren lixiviant and the most recent is relative to the occurrence of the unplanned release. Based on Strata's commitments, NRC staff finds Strata's proposed plan to account for effluent releases due to unplanned releases acceptable.

### **Evaluation - License Condition 12.7(B)**

In Attachment 2 to its March 1, 2015, letter, Strata provided information in response to license condition 12.7(B), which states:

Discuss and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.

Strata included extensive background information relevant to license condition 12.7(B) in the following sections of Attachment 2 of its letter:

- 2.1 "Scope of the Response"
- 2.2 "Pertinent Regulations"

The staff finds that the information in Sections 2.1 and 2.2 of Attachment 2 is primarily background information that did not directly address the technical requirements of license condition 12.7(B). Therefore, NRC staff did not evaluate this information.

In Section 2.3, "Proposed Monitoring and Analysis Method," Strata described how it will factor radon progeny into analyzing public dose from operations. Strata proposed to compare background-subtracted downwind concentrations of lead-210 in air to effluent concentrations for lead-210 in 10 CFR 20, Appendix B, Table 2. Strata proposed to measure lead-210 in quarterly composites of weekly air samples collected at Strata's established pre-operational air sampling stations. Figure 2.9-24 of Strata's TR indicates there are six air monitoring stations located at the site boundary between 0.4 and 1.8 miles from the CPP (Strata 2011). Strata also proposed using the MILDOS-AREA code to: (1) calculate public dose, including dose from radon progeny; (2) and calculate downwind concentrations of lead-210 for comparison with measured concentrations of lead-210 at the site boundary.

By letter dated July 23, 2015 (NRC 2015a), the NRC staff identified the following concerns with Strata's proposed approach:

1. Measurements of lead-210 at the air sampling stations at the site boundary are not annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area, as described in 10 CFR 20.1302(b)(2)(i). Therefore, the comparison to effluent concentrations of measured lead-210 concentrations at site boundary locations beyond the boundary of the unrestricted area does not demonstrate that public dose limits are met.
2. Even if lead-210 concentrations were measured at the boundary of the unrestricted area, lead-210 is not "...at the end of the short-lived radon progeny decay train," as stated by Strata. lead-210 is a long-lived progeny of radon-222 with a half-life of 22 years and is not present in the environment in either secular equilibrium or transient equilibrium with relatively short-lived radon-222 from nearby licensed sources. In fact, assuming radon-222 were present at constant concentrations, lead-210, with its half-life of 22 years, would take about 100 years to reach equilibrium (Eisenbud 1997). Furthermore, as a result of both its long half-life and various mechanisms for removal of dust from the atmosphere (e.g., dry and wet deposition), it is generally not possible to reliably attribute measured lead-210 in air to any nearby source of radon-222. Therefore, lead-210 is not an appropriate "proxy" for short-lived radon progeny emitted from nearby sources.
3. For the reason stated above (item 2), the use of MILDOS-AREA to calculate downwind concentrations of lead-210 for comparison to measured values for the first four quarters of plant operation is not valid. Also, the staff has not approved the use of MILDOS-AREA during the period of plant operation to calculate annual public dose for purposes of annual demonstrations of compliance with 10 CFR 20.1301 and 20.1302. As stated in Section 4.2.2 of the Draft Interim Staff Guidance (NRC 2014a), one acceptable approach involves measurements of radon-222 in lixiviant water, as proposed by Strata, and use of MILDOS-AREA to estimate downwind concentrations of radon and radon progeny, provided that the licensee also commits to measuring radon or radon progeny in air to verify that predicted concentrations are not exceeded. As described in Section 4.7 of the draft ISG, when feasible, measurements should be performed close enough to the facility that releases from the facility are statistically distinguishable from background.

In its July 23, 2015, letter, the NRC staff recognized that operations at newer ISR facilities may result in annual effluent quantities of radon below that which would result in concentrations of radon near the facility that are statistically distinguishable from background. This may be because newer ISRs: (1) use pressurized down flow columns that are not open to the atmosphere, and; (2) have facility-wide leak rates of radon from all systems containing

pressurized lixiviant that are much less than 1% per day, which is the value assumed in the example in Appendix D of NUREG-1569 (NRC 2003), and which is the value used by many licensees in initial applications. In such cases, the NRC staff, citing one acceptable approach described by the staff in its draft Interim Staff Guidance (NRC 2014a), stated that a network of radon samplers at the security perimeter of the CPP, which includes at least one sample in each of the eight cardinal and ordinal directions (N, NE, E, SE, etc.), will provide staff the requisite assurance that calculated annual quantities of radon in air effluent are not exceeded.

In its July 30, 2015, response, Strata stated that it would place a network of radon samplers at the security perimeter of the CPP to verify that concentrations predicted by the MILDOS-AREA computer model are not exceeded. These samplers would be the same type used in the operational environmental monitoring program. This is acceptable because it meets the guidance in Section 4.2.2 of NRC's draft ISG (NRC 2014a). By letter dated October 15, 2015, NRC asked Strata to clarify how it plans to use the MILDOS-AREA model (NRC 2015b). Specifically, NRC staff asked whether Strata will (1) calculate source terms (e.g., using Regulatory Guide 3.59) or (2) use measured source terms from its effluent monitoring plan developed in accordance with LC 12.7 A). Staff stated that either measured source terms, or the larger of measured or calculated source terms for each point and diffuse source would be acceptable to NRC staff. By letter dated October 23, 2015, Strata clarified that it will use measured source terms, determined in accordance with the effluent monitoring plan, with MILDOS-AREA to estimate downwind concentrations at the boundary of the unrestricted area (Strata 2015e).

Strata also stated it would verify the accuracy of the MILDOS-AREA model results by comparing the results to operational environmental monitoring program results of samples collected at the perimeter boundary and nearest residences. Strata stated that it would also use background measurements from the same time period as the measurements around the facility to obtain net radon concentrations above background. Strata stated that if issues arise regarding the sensitivity of the devices used, it will follow the guidance provided in Section 4.5 of NRC's draft ISG (NRC 2014a), including use of a high sensitivity device with a lower MDC or multiple detectors in a single location to lower the uncertainty associated with that location.

NRC staff finds Strata's approach acceptable to factoring in radon progeny in its annual analysis of public dose because it is consistent with NRC's draft guidance (NRC 2014a).

## **Conclusion**

NRC staff has verified that Strata's written plans and procedures for its airborne effluent and environmental monitoring program described by letters dated March 1, 2015 (Strata 2015a); July 30, 2015 (Strata 2015c); and October 23, 2015 (Strata 2015e):

- A) Discuss how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.
- B) Discuss and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.

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