April 15, 2014

Mike Thomas
Vice President Regulatory Affairs
Uranerz Energy Corporation
P.O. Box 50850
1701 East E Street
Casper WY, 82605-0850

SUBJECT: URANERZ ENERGY CORPORATION, NICHOLS RANCH ISR PROJECT, LICENSE AMENDMENT, LICENSE CONDITIONS 12.7 THROUGH 12.14, SOURCE MATERIALS LICENSE SUA-1597

Dear Mr. Thomas:

The U.S. Nuclear Regulatory Commission (NRC) is amending Materials License SUA-1597 by removing or modifying license conditions Uranerz Energy Corporation (Uranerz or the licensee) was required to address prior to the commencement of operations at the Nichols Ranch ISR Project. The original license issued on July 19, 2011, stated in Section 12.0, Preoperational Conditions, *Facility Specific Conditions*, that:

> Prior to the commencement of operations, the license shall be amended to address the following items in [license condition] LC 12.7 to LC 12.14.

Uranerz submitted information regarding these license conditions and requested they be removed from the license. Staff reviewed the submitted information and agrees to amend the license by removing and modifying some of the existing license conditions. The modified license conditions will be moved from the pre-operational to the operational section of the license. Staff is also amending license condition 9.2 by adding references to Uranerz's recently submitted information and commitments. License condition 9.2 is commonly referred to as the tie-down condition where the NRC binds the licensee to conduct operations in accordance with the commitments, representations, and statements contained in the license application and other submissions as noted. Please see the attached Safety Evaluation Report for the specifics of the amendments (Enclosure 1). By e-mail dated March 28, 2014, March 31, 2014, and April 11, 2014 Uranerz agreed to these changes in Material License SUA-1597 (see ADAMS Accession No. ML14092A320, ML14092A322, and ML14104A013, respectively). Enclosure 2 contains Amendment 2 to License SUA-1597. Enclosure 3 contains the NRC staff review of Uranerz's October 8, 2013 submittal.

With these amendments to the license, commencement of operations at the Nichols Ranch Unit of the Nichols Ranch ISR Project may begin once NRC Region IV verifies that the pre-operational inspection requirements have been met.

This licensing action meets the categorical exclusion provisions in 10 CFR Part 51.22(c)(11). Therefore, no further environmental review is required for this action. The Safety Evaluation Report for this licensing action contains further discussion of the categorical exclusion.

If you have any questions regarding this action, please contact Mr. Ron Linton, the Project Manager for Source Material License SUA-1597, 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 Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/
Andrew Persinko, Deputy Director
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 040-09067

Enclosures
1. Safety Evaluation Report
2. Amendment 2 to License SUA-1597
3. Staff Evaluation of October 8, 2013 Submittal for Pre-Operational License Condition 12.8.

cc: Mark Rogaczewski (WDEQ)

If you have any questions regarding this action, please contact Mr. Ron Linton, the Project Manager for Source Material License SUA-1597, at 301-415-7777, or by e-mail at Ron.Linton@nrc.gov.

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Sincerely,

/RA/
Andrew Persinko, Deputy Director
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

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cc: Mark Rogaczewski (WDEQ)

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SAFETY EVALUATION REPORT

Date: April 8, 2014

Docket No.: 040-09067

License No.: SUA-1597

Facility: Uranerz Energy Corporation, Nichols Ranch ISR Project

Project Manager: Ron C. Linton

Technical Reviewers: Ron Linton, Ron Burrows, James Webb, Elise Striz

Summary and Conclusions:

Uranerz Energy Corporation (Uranerz or the licensee), Nichols Ranch ISR Project, Materials License SUA-1597, Section 12.0, Facility Specific Conditions (NRC, 2014a) states:

> Prior to the commencement of operations, the license shall be amended to address the following items in [license condition] LC 12.7 to LC 12.14.

Uranerz submitted information or has provided information related to license conditions 12.7 to 12.14. The NRC Staff reviewed the submitted information and agrees to amend the license by removing some license conditions and modifying some of the existing license conditions. The modified license conditions will be are being moved from the pre-operational to the operational section of the license. The NRC staff reviewed the information provided and is amending Materials License SUA-1597 so that commencement of operations can begin upon completion of the preoperational inspection in accordance with the requirements in license condition (LC) 12.3. The basis for the amendment of each license condition is detailed below. The NRC staff also amended license condition 9.2 by adding references to Uranerz's recently submitted information and commitments. License condition 9.2 is commonly referred to as the tie-down condition where the NRC binds the licensee to conduct operations in accordance with the commitments, representations, and statements contained in the license application and other submissions as noted.

This licensing action meets the categorical exclusion provisions in 10 CFR Part 51.22(c)(11). Therefore, no further environmental review is required for this action. Page 22 contains further discussion of the categorical exclusion.

Safety Evaluation

License Condition 12.7

License Condition 12.7 states:

> The licensee shall install a meteorological station within the license area and collect meteorological data for a period of 1 year at a data recovery rate of 90 percent prior to commencement of operations. The collection of

meteorological data will continue until data are determined to be representative of long term conditions at the Nichols Ranch ISR Project. The data collected shall include, at a minimum, temperature, windspeed, and wind direction. Data submitted shall include an annual wind rose and a summary of the stability classification.

Staff Review and Analysis LC 12.7

Regulatory Guide 3.63 (NRC, 1988) states that the minimum amount of meteorological data needed for a siting evaluation is considered to be that amount of data collected on a continuous basis for a consecutive 12-month period that is representative of long-term (e.g., 30 years) meteorological conditions in the site vicinity. To verify if the period of record is characteristic of long-term meteorological conditions, the regulatory guide suggests comparing a concurrent period of meteorological data from a National Weather Service (NWS) station with the long-term meteorological data from that same NWS station. Twelve months is the minimum period of data collection. If the 12-month period is not representative of long-term conditions, then the licensee needs to collect additional data until it has the licensee has demonstrated that the sample collection period is representative of long-term conditions.

By letters dated November 1, 2013 (Uranerz, 2013g) and February 18, 2014 (Uranerz, 2014d), the licensee submitted information to address LC 12.7. This information included two years of meteorological data collected from an onsite meteorological station and an analysis of the long term representativeness of that data. The first analysis included a visual examination of the wind speed and wind direction frequency distribution for the data collected from the onsite meteorological station as well as for similar data obtained from nearby NWS stations located in Gillette and Casper, Wyoming. The timeframes chosen for the NWS data comparisons were the concurrent two year period coinciding with the data collection period at the Nichols Ranch ISR Project onsite meteorological station and the total available data collection period at each NWS station. The NRC staff finds these timeframe comparisons consistent with Regulatory Guide 3.63 (NRC, 1988) and therefore acceptable. The second analysis included a linear regression of wind speed, wind direction, and joint frequency distribution (i.e., combining wind speed and wind direction) for the NWS stations and timeframes discussed above.

The NRC staff determined that the licensee did not perform a proper statistical analysis to determine whether the data collected at the Nichols Ranch ISR Project is representative of long-term climate trends. Although acceptable statistical methods are not addressed in Regulatory Guide 3.63 (NRC, 1988), the NRC staff finds the following statistical approaches acceptable: 1) testing summary statistics, such as the mean from the short and long-term data, and 2) testing the statistics for similarity or validity of the data by using a statistical method such as the Student's T test, Chi square test for distribution, Kolmogorov-Smirnov test for distribution, etc., as appropriate (NRC, 2011a). Thus, based on the licensee's statistical analysis in its November 1, 2013 and February 18, 2014 submissions (Uranerz, 2013g, 2014d), the NRC staff cannot determine if the licensee collected the minimum amount of data or if the data collected is sufficient to represent long-term conditions.

The NRC staff provided its evaluation described above to the licensee during a March 11, 2014, public meeting (NRC, 2014d). Because the licensee did not provide the necessary statistical analyses, it did not meet NUREG-1569 (NRC, 2003) Section 2.5.3 acceptance criteria (1) and

(3), which require that the onsite program be designed in accordance with Regulatory Guide 3.63 (NRC, 1988), and that the meteorological data used for assessing impacts are substantiated as being representative of expected long-term conditions at and near the site. Therefore, the NRC staff determined that continued collection of meteorological data is required until the licensee has demonstrated that sufficient data has been collected to represent long-term conditions, which is needed to demonstrate compliance with 10 CFR Part 40, Appendix A, Criterion 7.

The NRC staff determined that, because of the quantity of meteorological data already collected, the fact that the projected maximum annual dose to a member of the public is a small fraction of the annual dose limit (refer to Attachment 3 of Uranerz, 2014i), the robustness of the operational effluent and environmental monitoring program (refer to the NRC staff's evaluation of LC 12.8 in this SER), and the requirement for the licensee to evaluate public dose on an annual basis (10 CFR 20.1301), the licensee may continue to collect the meteorological data during operations. The NRC staff has reasonable assurance that the licensee will meet the requirements of 10 CFR Part 40, Appendix A, Criterion 7 and 10 CFR 20.1301, provided it continues to assess the meteorological data during operations until the licensee has demonstrated that sufficient meteorological data has been collected to represent long-term conditions. Therefore, the NRC staff will delete current LC 12.7 from Section 12 "Preoperational Conditions" and add the amended requirements as LC 10.15 in Section 10 "Operations, Controls, Limits, and Restrictions" of NRC Materials License SUA-1597 to read:

LC 10.15 The licensee shall continue to collect meteorological data on a continuous basis at a data recovery rate of at least 90 percent until the NRC headquarters staff verifies in writing the data to be representative of long term conditions at the Nichols Ranch ISR Project. The data collected shall include, at a minimum, temperature, wind speed, and wind direction. Data submitted shall include an annual wind rose and a summary of the stability classification. Justification of the similarity or validity of the data shall include an analysis of the statistical data presented to illustrate confidence in the representativeness of the data.

Until the NRC headquarters staff verifies in writing that the meteorological data are representative of long term conditions at the Nichols Ranch ISR Project, the licensee shall continue to evaluate meteorological conditions to ensure that projected doses to members of the public and locations of environmental monitoring stations and radon detectors remain consistent with analyses submitted on February 28, 2014 (ML14063A214) and March 6, 2014 (ML14066A051). The licensee shall submit the results of this evaluation and discuss any proposed changes to its environmental monitoring program in the semi-annual operational effluent and environmental monitoring program report required by License Condition 11.1(D) to NRC headquarters for review.

License Condition 12.8

License Condition 12.8 states:

> Prior to the preoperational inspection, the licensee shall provide the following information for the airborne effluent and environmental monitoring program in which it shall develop written procedures to:
>
> 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. Evaluate the member(s) of the public likely to receive the highest exposures from licensed operations consistent with 10 CFR 20.1302.
>
> C. 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.
>
> D. 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.

Staff Review and Analysis LC 12.8

The NRC staff observes that several sources of radiological effluents exist that are associated with ISR uranium recovery operations. Generally, these sources can be classified as point sources, area or diffuse sources, and fugitive sources. Point sources include those operations that have exhaust confined in a stack, duct, pipe, or similar release point prior to atmospheric release. Area or diffuse sources such as well fields are not confined before being released to the atmosphere. Fugitive sources can include, among other things, pump seal leaks, losses from container loading not captured in ventilation systems, airborne contamination from dried spills, and releases resulting from pressure relief devices.

The NRC staff observes that reporting quantities of radioactive materials released to unrestricted areas is only one part of the requirements of 10 CFR 40.65(a)(1), “Effluent Monitoring Reporting Requirements.” A licensee is also required to address in its 10 CFR 40.65(a)(1) report any instances where quantities of radioactive materials released during the reporting period are significantly above its design objectives previously reviewed as part of the licensing action.

Aside from demonstrating compliance with the effluent monitoring reporting requirements in 10 CFR 40.65, a licensee must perform surveys in accordance with 10 CFR 20.1501 that are sufficient to demonstrate compliance with 10 CFR 20.1301 public dose limits. Surveys, defined in 10 CFR 20.1003, “Definitions,” may include calculations or physical measurements to evaluate radiation hazards. The 10 CFR 20.1302 addresses ways to demonstrate compliance with dose limits for individual members of the public. An applicant must also demonstrate compliance with 10 CFR 20.1501 which requires surveys that are reasonable under the circumstances to evaluate the magnitude and extent of radiation levels, concentrations or

quantities of radioactive materials and the potential radiological hazards of the radiation levels and residual radioactivity detected.

Regarding the use of calculations to demonstrate compliance with 10 CFR Part 20, the use of predictive models, such as those presented in Regulatory Guide 3.59 (NRC, 1987) and the MILDOS-AREA computer code (Yuan, et al., 1989), has never been explicitly approved for demonstrating compliance with radiation protection standards during operations (see, for example, the discussion on predictive evaluations of 10 CFR Part 20 compliance in NRC, 1981). The NRC developed Regulatory Guide 3.59 (NRC, 1987) for use when environmental monitoring data is not yet available and it directs applicants and licensees where to look for separate guidance on compliance with radiation protection standards. This separate guidance is provided in NUREG-0859 (NRC, 1982). The NRC staff recognizes that NUREG-0859 (NRC, 1982) was written to specifically address compliance issues with 40 CFR Part 190. However, Regulatory Guide 3.59 (NRC, 1987) also addresses compliance issues with 10 CFR Part 20, 10 CFR Part 40, 40 CFR Part 190 and 40 CFR Part 192 and refers to the guidance in NUREG-0859 (NRC, 1982). Since the technical shortcomings related to predictive modeling discussed in NUREG-0859 are generic in nature, the NRC staff determined that the guidance comments regarding the use of predictive modeling are relevant to ISR facilities demonstrating compliance with 10 CFR Part 20 and 10 CFR Part 40 requirements.

NUREG-0859 (NRC, 1982) provides guidance to NRC's Uranium Recovery Licensing Branch (URLB) and addresses the use of NRC approved predictive modeling and environmental monitoring programs. The specific guidance in NUREG-0859 (NRC, 1982) to URLB staff relevant to this review regarding the assessment of radioactivity concentrations to which individuals may be exposed is "...the primary means of compliance must be by measurements made at the point of an actual individual receptor..." and that "...actual compliance determination during operation will be based on environmental monitoring data." The NRC staff observes that Regulatory Guide 3.59 (NRC, 1987) and NUREG-0859 (NRC, 1982) is Commission-approved guidance and, as discussed above, is relevant to this review for the licensee to meet the requirements of 10 CFR Part 20 and 10 CFR Part 40.

The guidance discussed above from NUREG-0859 (NRC, 1982) is also relevant to how a licensee should demonstrate compliance with 10 CFR 20.1501(a). The guidance emphasizes using measurements made at the point of an actual individual receptor as the primary means of compliance, and also identifies surveys (i.e., monitoring) that are generally acceptable methods for demonstrating compliance with 10 CFR 20.1501(a)(1), as well as surveys that are reasonable (i.e., monitoring) under the circumstances experienced at ISR facilities (refer to 10 CFR 20.1501(a)(2)). Ultimately, to determine compliance with the regulations, NRC staff requires monitoring data to such an extent that the licensee's design basis can be verified and reasonably accurate maximum potential annual radiation doses to the public can be estimated. The NRC staff also observes that 10 CFR 40, Appendix A, Criterion 7, requires that an operational monitoring program measure or evaluate compliance with applicable standards and regulations and assess the performance of control systems and procedures.

After reviewing the licensee's application for a Source Material License Application to construct and operate the Nichols Ranch ISR Project (Uranerz, 2007), NRC staff found the licensee's proposed airborne effluent and environmental monitoring program inadequate (refer to Sections 4.1 and 5.7.7 of NRC, 2011b). As a result of NRC staff's review, LC 12.8 (NRC, 2011b) was

required in Materials License SUA-1597 in order to obtain information on the licensee's program for monitoring airborne effluents and for determining dose to workers and members of the public as a result of these effluents.

By letter dated October 8, 2013 (Uranerz, 2013f), the licensee submitted its initial response to LC 12.8 of its Materials License SUA-1597. The NRC staff evaluated the licensee's initial response to LC 12.8 for compliance with applicable regulations and consistency with Commission guidance and found this initial response inadequate for several reasons. This evaluation is contained in Enclosure 3.

Subsequent to NRC staff issuing its draft evaluation (NRC, 2014c) of the licensee's proposed airborne effluent and environmental monitoring program, the licensee withdrew its initial response to LC 12.8 (Uranerz, 2013f) and replaced the initial response with additional information (Uranerz, 2014e, 2014f, 2014i, 2014j) to address this condition. Therefore, NRC staff's review herein only considers these replacement submittals (Uranerz, 2014e, 2014f, 2014i, 2014j) in its evaluation of the licensee's response to LC 12.8.

LC 12.8(A)

In its response to LC 12.8(A) (Uranerz, 2014e, 2014f, 2014i, 2014j), the licensee described its program for measuring and accounting for airborne particulate and gaseous emissions from three main sources: the Central Processing Plant (CPP), the header houses, and the wellfield. For effluents from the CPP, the licensee will account for effluents from the building itself utilizing information on the building exhaust fans (flow rate) and applying measured values for radon (Rn-222) and particulate concentrations. The licensee will account for times when the building exhaust fans are running and when they are not operating. In addition, the release of radon from vented tanks will be measured with scintillation cells by sampling the exhaust vent. The measured radon concentrations from the exhaust will be combined with the exhaust flow rate with the system assumed to be running continuously. Particulate emissions will be based on isotopic analyses of filters used for monthly gross alpha measurements (Uranerz, 2014e, 2014f, 2014i, 2014j).

NRC staff observes that measuring Rn-222 in the exhaust vent using the scintillation cells is consistent with Test Method A-6 of Method 114 in 40 CFR 61, Appendix B, and therefore acceptable.

For effluents from the header houses, the licensee will use the flow rate from the exhaust fan which is 36,100 liters per minute (1,275 cubic feet per minute) and are operated on a continual basis (Uranerz, 2014j). Radon effluent will be based on radon measurements using the modified Kusnetz method. Particulate emissions will be based on semi-annual isotopic analyses of filters used for monthly gross alpha measurements (refer to Attachment 1 of Uranerz, 2014f). The licensee stated that as new header houses are installed, the releases from these header houses will be added to the total release from all header houses. (Uranerz, 2014j)

For radon effluents from the wellfield, the licensee proposed sampling ten percent of the recovery wells and measuring radon using the modified Kusnetz method (Uranerz, 2014j). The licensee excluded injection wells from sampling as they have sealed well heads and the

licensee concluded that the potential for radon release is minimal from these wells. An average concentration from all well heads sampled will be converted to a quantity of activity from each recovery well (Uranerz, 2014j).

Lastly, the licensee committed to analyzing radon emissions from unplanned releases of production fluids in the wellfield using the modified Kusnetz method (Uranerz, 2014j). The activity of radon resulting from these unplanned releases will be included in the total emissions from the wellfield (Uranerz, 2014j).

The NRC staff reviewed the licensee's proposed methods for quantifying the principal radionuclides from all point and diffuse sources released to unrestricted areas in gaseous effluents from licensed operations at the Nichols Ranch Unit and how these releases will be accounted for, and verified by, surveys and monitoring. The NRC staff determined that the proposed methods are consistent with NUREG-1569 (NRC, 2003), Acceptance Criterion 4.1.3(2), meet the requirements of 10 CFR 40.65 and are therefore acceptable.

However, Uranerz' submittal only addressed the Nichols Ranch Unit. The NRC staff requires the same information to address operations in the Hank Unit. Therefore, the NRC staff is imposing a license condition requiring the licensee to submit the same information prior to injection of lixiviant at the Hank Unit. This license condition is as follows:

LC 10.17 Prior to the injection of lixiviant at the Hank Unit, the licensee shall provide to the NRC headquarters staff for review and written verification the following information for the airborne effluent and environmental monitoring program for the Hank Unit. The licensee shall develop written procedures to incorporate this information.

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. Evaluate the member(s) of the public likely to receive the highest exposures from licensed operations consistent with 10 CFR 20.1302.

C. 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.

D. 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.

LC 12.8(B)

In its response to LC 12.8(B) (Uranerz, 2014e, 2014f, 2014i, 2014j), the licensee presented the process that it used to identify the dose to the member of the public likely to receive the highest

dose from its operations. The licensee evaluated categories of members of the public that were likely to spend at least 50 hours per year in the vicinity of the site. In addition, the licensee evaluated input parameters for its MILDOS-AREA (Yuan, et al., 1989) calculations used to provide an initial estimate of potential doses to members of the public (Uranerz, 2014e, 2014f, 2014i, 2014j).

The results of the evaluation of categories of members of the public are presented in Table 1 in Attachment 3 of the licensee's response (Uranerz, 2014i). Time spent during a year in the vicinity of the site by members of the public ranged from an estimated 90 hours (courier) to 2400 hours (workforce housing residents). Other postulated members of the public included a hunter (240 hours), oil field worker (175 hours), vendor (260 hours), and coal bed methane (CBM) worker (660 hours).

Adjusting for projected occupancy times in their respective areas, the licensee calculated maximum predicted doses of less than one millirem per year for all members of the public evaluated (refer to Table 5 of Uranerz, 2014i). In calculating these projected doses, the licensee assumed negligible dose from particulates due to the fact that it will be using vacuum driers and the exhaust from these driers will be vented to the dryer room (Uranerz, 2014i). The licensee reasoned that for purposes of identifying the maximally exposed member of the public, ignoring the dose from particulates will not alter the results (Uranerz, 2014c). In addition, the licensee will validate this assumption by assessing the results of its particulate monitoring stations (Uranerz, 2014i). The NRC staff agrees with this reasoning and observes that the airborne effluent monitoring program proposed in its response to LC 12.8(A) (Uranerz, 2014j) will provide additional information that can be used by NRC staff to validate this assumption.

The NRC staff observes that the calculations presented by the licensee (refer to Table 5 in Attachment 3 of Uranerz, 2014i) represent only an initial identification of a potential maximally exposed member of the public as a result of the licensee's operations. As required by 10 CFR 20.1302, the licensee must demonstrate compliance with the annual public dose limit. To satisfy LC 12.8(B), the licensee committed to evaluate the maximally exposed individuals annually considering factors such as changes to operating conditions, changes to surrounding land use, and data collected over the year (Uranerz, 2014i).

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 Nichols Ranch Unit and determined that it meets the requirements of 10 CFR 20.1302 and is therefore acceptable.

LC 12.8(C)

In its response to LC 12.8(C), the licensee described its method for incorporating the progeny from radon (Rn-222) into its estimates of public dose resulting from licensed operations at the Nichols Ranch Unit (Uranerz, 2014e, 2014f, 2014i, 2014j). The licensee will measure radon at the boundaries of its unrestricted areas (Uranerz, 2014e, 2014f, 2014i, 2014j).

The NRC staff observes that the licensee has provided its designations of restricted, controlled, and unrestricted areas for the Nichols Ranch facility in Attachment 5 of its March 6, 2014 submittal (Uranerz, 2014i). NRC staff reviewed the proposed designated controlled areas along

with the licensee's March 5, 2014 submittal (Uranerz, 2014h) transmitting the surface landowner's consent. The NRC staff determined that the licensee's designation of controlled areas (Uranerz, 2014i) meets the regulatory definition of a controlled area, including demonstrating that it can limit access to that area (refer to definition of controlled area in 10 CFR 20.1003). This includes the ability to require a member of the public to exit the controlled area at any time (refer to questions 29 and 417, and NRC's responses, from NRC, 1994).

The licensee will measure radon around the CPP using an array of eight RADTRAK radon detectors (refer to Attachment 2 of Uranerz, 2014f) (Uranerz, 2014i). The licensee will also monitor radon outside the Nichols Ranch Production Area #1 (refer to Attachment 2 of Uranerz, 2014f) using the same type of detectors. Radon for both of these locations will be assumed to be in 100 percent equilibrium with its progeny. Average annual concentrations from these measurements will be compared to 10 CFR 20, Appendix B, Table 2 effluent concentration value for radon with daughters present. (Uranerz, 2014i)

In the event the measured average annual radon concentrations exceed the 10 CFR 20, Appendix B, Table 2 effluent concentration value for radon with daughters present, the licensee presented its methods for demonstrating compliance with the public dose limits of 10 CFR 20.1301 (Uranerz, 2014i). The licensee stated that it may use measured radon source terms coupled with a model such as MILDOS-AREA (Yuan, et al., 1989) or it would perform a dose assessment using measured radon concentrations at receptor locations. For example, there will be a RADTRAK radon detector installed in the workforce housing and at CBM wells. For dose assessment purposes, the licensee will assume that radon is in 100 percent equilibrium with its progeny.

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

LC 12.8(D)

In its response to LC 12.8(D) (Uranerz, 2014f), the licensee described how it would account for occupational dose received throughout the Nichols Ranch Unit from radon and its progeny and particulates. The types and locations of monitoring to support the calculation of occupational dose are summarized in Attachment 1 of the licensee's February 28, 2014 submittal (Uranerz, 2014f).

For calculating the dose from radon and its progeny, the licensee proposed using a combination of measurements and calculations using the modified Kusnetz method in the CPP, header houses and deep disposal well buildings (Uranerz, 2014f). In addition, the licensee will place RADTRAK radon detectors around its facility to determine average radon concentrations. Measured concentrations will be compared to the 10 CFR 20, Appendix B, Table 2, occupational values for radon with daughters present to derive an occupational dose (Uranerz, 2014f).

For calculating dose from airborne particulates, the licensee will perform air sampling in the CPP and header houses and perform isotopic analyses on these samples on a semiannual

basis (Uranerz, 2014f). Measured concentrations will be compared to the 10 CFR 20, Appendix B, Table 2 occupational values for the corresponding radionuclide to derive an occupational dose (Uranerz, 2014f).

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

The NRC staff will remove LC 12.8 from Materials License SUA-1597 and revise LC 9.2 to include the commitments, representations, and statements made by Uranerz in submissions dated February 19, 2014 (Uranerz, 2014e), February 28, 2014 (Uranerz, 2014f), March 6, 2014 (Uranerz, 2014i), and March 11, 2014 (Uranerz, 2014j).

License Condition 12.9

License Condition 12.9 states:

> Prior to the preoperational inspection, the licensee shall develop a survey program for beta/gamma contamination for personnel contamination from restricted areas, and beta/gamma contamination in unrestricted and restricted areas that will meet the requirements of 10 CFR Part 20, Subpart F.

Staff Review and Analysis LC 12.9 - Contamination Controls

In terms of release levels for uranium recovery facilities, natural uranium is considered to be composed of U-238, U-235, U-234, and the short half-life daughters of U-238 (i.e., Th-234, protactinium [Pa]-234 and Pa-234m) in secular equilibrium with the U-238. Since these short half-life daughters are beta-gamma emitters, separate beta-gamma release limits apply to them.

By letters dated March 4, 2014 (Uranerz, 2014g) and March 5, 2014 (Uranerz, 2014h), the licensee submitted information to address LC 12.9. The purpose of LC 12.9 was to obtain information on the licensee's program for evaluating equipment released for unrestricted use and personnel monitoring when beta-gamma-emitting radionuclides may be present (refer to Section 5.7.6 of NRC, 2011b). These submittals were reviewed for compliance with the applicable requirements of 10 CFR Part 20 using the acceptance criteria outlined in NUREG-1569 (NRC, 2003), Section 5.7.6.3.

Contamination Surveys of Skin and Personal Clothing

The licensee described its program for monitoring personnel exiting the CPP (Uranerz, 2014g). Scan stations are equipped with a bench top rate meter with an attached beta-gamma probe. As a minimum, personnel will survey the hands and soles of shoes. An audible alarm will be triggered if beta-gamma contamination exceeds 1000 disintegrations per minute (dpm) per 100 cm^2. The alarm set point is based on background levels expected during normal operations. (Uranerz, 2014g)

In addition, the licensee stated that individuals working in an operating wellfield will be required to survey for beta-gamma contamination prior to entering a designated clean area or leaving the facility after a shift (Uranerz, 2014g). A beta-gamma survey instrument will be available in a centrally located header house for this purpose (Uranerz, 2014g).

The NRC staff evaluated the licensee's proposed program described above for controlling personnel contamination and determined that it meets the requirements of 10 CFR 20.1501(a) and can show compliance with requirements in Part 20. Therefore, the NRC staff finds the proposed program acceptable.

Contamination Surveys for Equipment and Material Released to Unrestricted Areas

The NRC staff observes that the licensee has provided its designations of restricted, controlled, and unrestricted areas for the Nichols Ranch facility in Attachment 5 of its March 6, 2014, submittal (Uranerz, 2014i). The NRC staff reviewed the proposed designated controlled areas along with the licensee's March 5, 2014 submittal (Uranerz, 2014h) transmitting the surface landowner's consent. The NRC staff determined that the licensee's designation of controlled areas (Uranerz, 2014i) meets the regulatory definition of a controlled area, including demonstrating that it can limit access to that area (refer to definition of controlled area in 10 CFR 20.1003). This includes the ability to require a member of the public to exit the controlled area at any time (refer to questions 29 and 417, and NRC's responses, from NRC, 1994).

The licensee described its program for releasing equipment and material for unrestricted release (Uranerz, 2014g). This included a description of proposed monitoring equipment and methodologies for determining minimum detectable concentrations of beta-gamma contamination. The licensee's radiation staff will perform and document the survey prior to releasing equipment or materials for unrestricted release. In addition, potentially contaminated equipment or materials moved from one controlled area to another (e.g., a wellfield area that is fenced and designated as a controlled area) will be released using the unrestricted release program. Contaminated equipment and material that can't be released for unrestricted release will be disposed of as 11e.(2) waste. (Uranerz, 2014g)

The NRC staff evaluated the licensee's proposed program described above for controlling equipment and material contamination and determined that it is consistent with NUREG-1569, Acceptance Criterion 8, and is therefore acceptable.

In addition to the licensee's program described above, NRC staff observes that the licensee is bound by specific license conditions that govern the release of equipment and material for unrestricted release. Specifically, LC 9.6 (NRC, 2014a) discusses release criteria (NRC, 1993), and LC 9.7 (NRC, 2014a) discusses survey requirements (NRC, 2002a, 2002b).

The NRC staff will remove LC 12.9 from Materials License SUA-1597 and amend LC 9.2 to include the commitments, representations, and statements made by Uranerz in submissions dated March 4, 2014 (Uranerz, 2014g) and March 5, 2014 (Uranerz, 2014h).

License Condition 12.10

License Condition 12.10 states:

> Prior to the preoperational inspection, the licensee will submit monitoring results to the NRC for review that include sampling of domestic and livestock wells that are located within 2 kilometers of the proposed production area monitoring ring wells (MR-wells) of the Nichols Ranch and Hank Units. Samples shall be collected, at a minimum, semiannually. Samples shall be analyzed for the UCL parameters in Section 5.7.8.9 of the approved license application and for natural uranium and radium-226.

Staff Review and Analysis LC 12.10

Uranerz submitted information related to LC 12.10 in the following reports:

- Semi-Annual Report, July - December 2012, dated January 25, 2013 (Uranerz, 2013a)
- Semi-Annual Report, January - June 2013, dated July 17, 2013 (Uranerz, 2013b)
- Semi-Annual Report, July - December 2013, dated February 13, 2014 (Uranerz, 2014a)

Appendix A of each of the referenced Semi-Annual Reports contains a table showing the domestic and livestock wells sampled surrounding the Hank Unit and the Nichols Unit that are located within 2 kilometers of the proposed production area monitoring ring wells (MR-wells). Each well has been sampled for the UCL parameters in Section 5.7.8.9 of the approved license application, chloride, conductivity, and alkalinity, and for natural uranium and radium-226. There were several instances were a well was reported dry or inoperable and was not sampled. Staff reviewed the information provided and finds that the information is adequate and meets the requirement of the license condition as stated.

The NRC staff will remove LC 12.10 from Materials License SUA-1597.

License Condition 12.11

License Condition 12.11 states:

> Lists of Instruments. At least 30 days prior to the preoperational inspection, the licensee shall provide the following:
>
> A. A list of radiation measurement instrumentation that will be used to measure or quantify the radioactivity on air sampling media. The list will provide the manufacturer, model number and/or a description of the instrument, range, instrument sensitivity (LLD), and its planned use to measure radioactivity.
>
> B. A list of radiation survey instrumentation available for radiation contamination surveys. The licensee will also provide adequate information to show the capability of each instrument such as the type of instrument, range, sensitivity (lowest range limits), and planned use.

Staff Review and Analysis LC 12.11

By letter dated October 3, 2013, Uranerz submitted information related to the requirements of LC 12.11 (Uranerz, 2013e) and requested that LC 12.11 be removed from the license. On February 13, 2014, the NRC staff requested additional information related to the October 3, 2013 submission (NRC, 2014b). On February 18, 2014, Uranerz responded to the NRC request for additional information (Uranerz, 2014c). The October 3, 2013 submission contained three tables containing the lists of instrumentation that will be used at the Nichols Ranch Project (Uranerz, 2013e).

Table 1 is the air sampling instrument. The licensee identified 10 air sampling units that included the manufacturer, model number, range, accuracy, planned use, and instrument description (Uranerz, 2013e). The licensee identified two counting instruments and directed the reader to Table 2 for the MDC calculations (Uranerz, 2013e). These instruments will be used to count and measure the activity on the air filters. The NRC staff determined that the licensee has purchased (or leased) the proper air sampling instrument to collect, measure, and calibrate the radon and air particulate in air for the planned use in the plant during operations.

In Table 2, the licensee identified the air sample counting instruments (Uranerz, 2013e). This included the type of air sampling method, scaler, equation (for MDA or MDC), background count rate and count time, gross count time, efficiency, expected volume, Kusnetz factor and conversion factor for radon and air particulate, respectively, and the calculated MDA for each instrument. The licensee demonstrated that the minimal detectable activity (MDA) is ten percent of the regulatory limit for radon and air particulate (total uranium). The NRC staff determined that the licensee can count and measure activity on air samples to detect and measure concentrations below the regulatory limit during plant operations with these instruments.

In Table 3, the licensee identified radiation survey instrumentation for contamination control (Uranerz, 2013e). This includes the manufacturer, model number, range, instrument sensitivity, planned use, and instrument description. Uranerz provided additional information in a letter dated February 18, 2014 that describes the use of the Ludlum 43-92 and Ludlum 43-93 (Uranerz, 2014c). The licensee plans to use the Ludlum 43-93 for both surveying of material for release from the plant also for personnel monitoring stations. Uranerz further indicated that the Ludlum 43-92 coupled with the Ludlum Model 3 will not be used to meet any regulatory requirements. The purpose of the Ludlum 43-92 is solely for use as an informational tool for the radiation safety staff. Uranerz calculated a minimal detectable count rate (MDC) of 1,271 cpm at a removable contamination level of 900 dpm/100 cm^2. The NRC staff determined that the instrument cannot determine if the activity is removable or fixed. Thus, the use of a removable limit (1000 dpm/100 cm^2), is considered a conservative value and well below the total activity of 5000 dpm/100 cm^2 for removable and fixed. Uranerz estimated the dose rates at the scanning stations to be between 20-30 uR/hr. The manufacturer specifications state the sensitivity of the Ludlum 43-93 instrumentation to gamma radiation to be 15-20 cpm per uR/hr. A 30 uR/hr field would yield an instrument reading of 600 cpm. This is below the calculated value of 1,271 cpm at a removable contamination level of 900 dpm/100 cm^2. An instrument reading of 600 cpm in a 30 uR/hr gamma field would equate to below the 500 dpm/100 cm^2 for total activity (removable and fixed activity). The licensee indicated that in situations where the MDC are not being met

because of high dose rates, the instruments will be moved to a lower background area to perform the surveys.

Uranerz had indicated in the February 18, 2014 letter to the NRC that the planned use of the Ludlum 42-93 will be used for release of personnel and equipment in areas with gamma radiation and in scanning (or frisking) stations (Uranerz, 2014c). Frisking stations include both scanning and stationary (static) sampling. The user scans personnel or equipment until an elevated reading is observed and then the user then holds the detector over the area in question for a stationary (static) sampling to determine compliance. The Minimum Detectable Activity calculated by Uranerz is the stationary or static measurement. Uranerz has demonstrated that they can detect the total activity below 500 dpm/100 cm^2 (10% of the 5000 dpm/100 cm^2 limit for total activity). This method is consistent with the detection sensitivity discussed by E.W. Abelquist, Decommissioning Health Physics: A Handbook for MARSSIM Users (Abelquist, 2001). The decision to determine if the frisk is within compliance with contamination limits rest with the static measurement and not the scan.

The scanning minimal detectable activity (or count) include not only the counting parameters for static measurements, but also the speed or rate of movement of the detector over the surface of the person or equipment, surface roughness, as well as the size of the hot spots. These factors should be incorporated into the scan MDA to ensure that the scan MDA is close to the static MDA as possible. Scanning parameters, such as speed of the detector used by the individual, should be discussed in standard operation procedures and available for inspection by NRC inspectors.

The Ludlum 19 and Thermo Eberline meters will used to measure gamma exposure rates in uR/hr and R/hr, respectively. The sensitivity of exposure rate readings is designed to be within 10% and 2% percent of the true reading, respectively. The NRC staff determined that the instruments described in Table 3 are acceptable for conducting contamination and exposure rate surveys.

The NRC staff determined that the licensee has provided an adequate list and capability of the instrumentation, including an a priori minimal detectable activity (count) for each air sampling counting and contamination counting instrument. The minimal detectable activity (count) is below regulatory limits for static measurements. Therefore, NRC staff has reasonable assurance that Uranerz has adequate radiation protection instrumentation to conduct a proper radiation safety program.

The NRC staff will remove LC 12.11 from Materials License SUA-1597 and amend LC 9.2 to include the commitments, representations, and statements made by Uranerz in submissions dated October 3, 2013 (Uranerz, 2013e) and February 18, 2014 (Uranerz, 2014c) to LC 9.2.

License Condition 12.12

License Condition 12.12 states:

> Prior to the preoperational inspection, the applicant will provide a survey plan for postreclamation and decommissioning verification surveys that

> demonstrates that residual radioactivity in soil meets the criteria in 10 CFR Part 40, Appendix A, Criterion 6(6). The applicable cleanup criteria will be identified for radium-226 and soil cleanup criteria will be developed for natural uranium using the radium benchmark dose approach. Applicable criteria for thorium-230 will also be addressed in the plan.

Staff Review and Analysis LC 12.12

By letter dated October 3, 2013, Uranerz submitted information related to the requirements of LC 12.12 (Uranerz, 2013d) and requested that LC 12.12 be removed from the license.

The NRC rule "Timeliness in Decommissioning of Material Facilities" (59 *Federal Register* 36026-36040, July 15, 1994), and NRC Administrative Letter 96-05; Compliance with the Rule "Timeliness in Decommissioning of Material Facilities" (NRC, 1998) states that the effect of the final rule is to require the uranium recovery licensees to notify the NRC within 60 days when they have permanently ceased operations or have not conducted operations for 24 months (Section 10 CFR 40.42(d)) and to submit a decommissioning plan within 12 months of the notification or license expiration. The decommissioning process is to be completed within two years, unless an alternative schedule is approved. NUREG-1757, "Consolidated Decommissioning Guidance: Decommissioning Process for Materials Licensees", Final Report, (NRC, 2006) provides guidance regarding decommissioning that leads to termination of a license (or partial decommissioning). The guidance includes provisions for the facility radiation surveys that also include the following: 1) the release criteria, 2) characterization surveys, 3) in-process surveys, 4) the final status survey design, and 5) the final status survey report.

The NRC staff determined that the decommissioning plan shall include a discussion of the survey plan, and a detailed (final status) survey plan can be submitted after the submittal of the decommissioning plan but before commencing decommissioning. Therefore, LC 12.12 will be deleted and the provision for a survey plan will be added to LC 10.12.

LC 10.12 currently reads:

> At least 12 months prior to initiation of any planned final site decommissioning, the licensee shall submit a detailed decommissioning plan for NRC review and approval. The plan shall represent as-built conditions at the Nichols Ranch ISR Project.

LC 10.12 will be modified to read:

> At least 12 months prior to initiation of any planned final site decommissioning, the licensee shall submit a detailed decommissioning plan for NRC review and approval. The plan shall represent as-built conditions at the Nichols Ranch ISR Project.
>
> The licensee will provide a final status survey plan for postreclamation and decommissioning that demonstrates that residual radioactivity in soil and building structures meets the criteria in 10 CFR Part 40, Appendix A, Criterion 6(6). The applicable cleanup criteria will be identified for radium-

> 226 and soil cleanup criteria will be developed for natural uranium using the radium benchmark dose approach. Applicable criteria for thorium-230 will also be addressed in the plan.

License Condition 12.13

License Condition 12.13 states:

> At least 30 days prior to the preoperational inspection, the licensee will submit a Quality Assurance Program (QAP) to the NRC for review to verify the license application statement that the QAP will be consistent with Regulatory Guide 4.15.

Staff Review and Analysis LC 12.13 – Quality Assurance Program

By letter dated October 3, 2013, Uranerz submitted draft information related to the requirements of LC 12.13 (Uranerz, 2013c) and requested that LC 12.13 be removed from the license. Uranerz submitted an updated QAP in correspondence dated February 13, 2014 (Uranerz, 2014b).

Regulatory Guide 4.15, Section C, Regulatory Position, states, “The following presents the QA program elements that should be developed and implemented to ensure the quality of data/results for radiological effluent and environmental monitoring programs” (NRC, 2007), which include the following:

1. Organizational Structure and Responsibilities of Managerial and Operational Personnel
2. Specification of Qualifications of Personnel
3. Operating Procedures and Instructions
4. Records
5. Quality Control in Environmental Sampling
6. Quality Control in the Radioanalytical Laboratory
7. Quality Control for Radioactive Effluent Monitoring Systems
8. Verification and Validation
9. Assessments and Audits
10. Preventive and Corrective Actions

The NRC staff reviewed the QAP submitted by Uranerz (Uranerz, 2014b). The Uranerz QAP contains the organizational structure and responsibilities of managerial and operational personnel as well as the specifications for qualifications of personnel. Initial training, on the job training, and refresher training of personnel is addressed in the QAP and in referenced site operating procedures (SOPs). Uranerz has developed a comprehensive set of operating SOPs and instructions. The SOPs have been reviewed by the NRC staff during preoperational inspection of the Nichols Ranch ISR Project. Uranerz SOPs contain instructions, procedures, and schedules that should be prepared for the functions associated with the QAP program as suggested in Regulatory Guide 4.15, Section C(3). Uranerz has committed to maintaining records as required by NRC license SUA-1597 and has developed a SOP for record retention.

The individual(s) responsible for record retention is identified in the QAP. Uranerz has developed multiple SOPs to implement and ensure quality control for environmental sampling including radiological and effluent sampling, surface and groundwater sampling, soil and sediment sampling, and air particulate sampling and monitoring programs. The environmental sampling quality control program includes a discussion of quality control samples, sample documentation, sample handling, storage, and shipping. The QAP contains a discussion of the laboratory management and quality control program as well as the calibration and quality control of instruments, measuring devices, and test equipment for the radiological effluent and environmental monitoring program. The radiation safety officer is principally responsible for the validation and verification of activities. The verification and validation section of the QAP contains discussions of anomalous data, data screening, technical review, corrective action, laboratory variance and nonconformance, and quality control sampling. Uranerz has committed in its QAP to perform an annual review of the radiation protection and ALARA program and the QAP program. The QAP contains a list of areas that will be audited during the annual review of the programs. The preventive and corrective action program is discussed in the QAP. The NRC staff had determined that the QAP is adequate and consistent with Regulatory Guide 4.15 and provides reasonable assurance that the QAP will be implemented consistent with Regulatory Guide 4.15.

The NRC staff observes that the licensee committed in its license application (Uranerz, 2007) to implementing a QAP consistent with NRC Regulatory Guide 4.15 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment," Revision 1, 1979. Regulatory Guide 4.15 has been revised, and Revision 2 is the most current version. Therefore, based on the determination above, staff will remove the pre-operational license condition and add a LC to SUA-1597, Section 10, requiring the licensee to maintain a QAP consistent with the latest revision of Regulatory Guide 4.15. Maintaining a license condition requiring a QAP consistent with Regulatory Guide 4.15 will ensure the licensees QAP will remain subject to review and inspection by NRC.

The NRC staff will remove LC 12.13 from Materials License SUA-1597 and amend LC 9.2 to include the commitments, representations, and statements made by Uranerz in submissions dated February 13, 2014 (Uranerz, 2014b) to LC 9.2.

LC 10.16 will be added to SUA-1597 to read:

LC 10.16 The licensee will maintain and implement a Quality Assurance Program consistent with Regulatory Guide 4.15 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment," as revised.

License Condition 12.14

License Condition 12.14 states:

> Prior to the preoperational inspection, the licensee shall develop written procedures to control production fluids and maintain inward hydraulic

> gradient as required in LC 10.9 if a disposal well becomes inoperable as discussed in LC 10.11.

Staff Review and Analysis LC 12.14

Uranerz provided information to the NRC staff related to LC 12.14 in the form of SOPs during the preoperational inspection. The NRC staff reviewed SOP PRD-SOP-24 and SOP PRD-SOP-19 and determined that the licensee has developed written SOPs to control production fluids and maintain and inward hydraulic gradient as required in LC 10.9 if a disposal well becomes inoperable as discussed in LC 10.11. The SOP contains steps and procedures the licensee will take if one or more disposal wells become inoperable. Staff reviewed the information provided in the SOPs and finds that the information is adequate and provides reasonable assurance that the licensee will control production fluids and maintain an inward hydraulic if one or more disposal wells become inoperable.

The NRC staff will remove LC 12.14 from Materials License SUA-1597.

Section 12.0, Preoperational Conditions, *Standard Conditions*

Staff Review and Analysis Section 12.0, Preoperational Conditions, Standard Conditions

The NRC staff is not amending the license conditions 12.1 through 12.6 of SUA-1597. These conditions will be reviewed during the NRC preoperational inspection as required by LC 12.3. These conditions may be removed or amended at a later date pending the outcome of the NRC preoperational inspection.

Section 12.0, Preoperational Conditions, *Facility Specific Conditions*

Uranerz Energy Corporation (Uranerz), Nichols Ranch ISR Project, Materials License SUA 1597, Section 12.0, *Facility Specific Conditions*, states:

> Prior to the commencement of operations, the license shall be amended to address the following items in LC 12.7 to LC 12.14.

Staff Review and Analysis Section 12.0, Facility Specific Conditions

The NRC staff is amending LCs 12.7 through 12.14 by removing some license conditions and modifying others as stated in this Safety Evaluation Report. Therefore, the above license condition is no longer required.

The NRC staff will remove the requirement from Materials License SUA-1597.

License Condition 9.2

License Condition 9.2 states:

LC 9.2 The licensee shall conduct operations in accordance with the commitments, representations, and statements contained in the license application dated November 30, 2007, as amended by submissions dated August 21, 2008, March 11, 2009, February 24, 2010, September 15, 2010, and September 22, 2010, which are hereby incorporated by reference, except where superseded by specific conditions in this license. The licensee's approved license application must be maintained on site.

Whenever the word "will" or "shall" is used in the above referenced documents, it shall denote a requirement.

Staff Review and Analysis LC 9.2

License Condition 9.2 is commonly referred to by the NRC Staff as the tie down condition. By this license condition, NRC is binding the licensee to conduct operations in accordance with the commitments, representations, and statements contained in the license application and other submissions as noted. Since the licensee has made additional commitments, representations, and statements in submissions to the NRC as discussed above in the body of this Safety Evaluation Report, the NRC staff will reference these commitments in this license condition.

License Condition 9.2 will be modified to read:

LC 9.2 The licensee shall conduct operations in accordance with the commitments, representations, and statements contained in the license application dated November 30, 2007, as amended by submissions dated August 21, 2008, March 11, 2009, February 24, 2010, September 15, 2010, September 22, 2010, October 3, 2013 (ML13282A301), February 13, 2014 (ML14050A023), February 18, 2014 (ML14063A068), February 19, 2014 (ML14051A113), February 28, 2014 (ML14063A214), March 4, 2014 (ML14064A128), March 5, 2014 (ML14065A018), March 6, 2014 (ML14066A051) and March 11, 2014 (ML14071A092) which are hereby incorporated by reference, except where superseded by specific conditions in this license. The licensee's approved license application must be maintained on site.

Whenever the word "will" or "shall" is used in the above referenced documents, it shall denote a requirement.

Environmental Review

The NRC staff determined that the amendment of LC 12.7 to 12.14 meets the regulatory actions that are eligible for categorical exclusion or otherwise not requiring environmental review under the criterion listed in 10 CFR, Part 51.22(c)(11) that states:

> (11) Issuance of amendments to licenses for fuel cycle plants and radioactive waste disposal sites and amendments to materials licenses identified in § 51.60(b)(1) which are administrative, organizational, or procedural in nature, or which result in a change in process operations or equipment, provided that: (i) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite, (ii) there is no significant increase in individual or cumulative occupational radiation exposure, (iii) there is no significant construction impact, and (iv) there is no significant increase in the potential for or consequences from radiological accidents.

The staff finds the amendments to Materials License SUA-1597 to be procedural in nature. The information provided by Uranerz, as required by license conditions 12.7 through 12.14, and the commitments to the programs Uranerz has developed and submitted to NRC for review and verification by the NRC staff will not result in any change in the types or significant increase in the amounts of any effluents that may be released offsite.

References

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Uranerz, 2013c. Uranerz Energy Corporation, Nichols Ranch Project, Source Materials License SUA-1597, Docket No. 40-9067, License Condition 12.13, Submittal of Draft Quality Assurance Program, Radiological Effluent and Environmental Monitoring Program, October 3, 2013, ADAMS accession No. ML13288A146.

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Yuan, et al, 1989. Yuan, Y.C., J.H.C. Wang, and A.J. Zielen, 1989. ANL/ES-161, "MILDOS-AREA: an Enhanced Version of MILDOS for Large-Area Sources," Argonne National Laboratory, Argonne, IL, June 1989.

Uranerz Energy Corporation, Nichols Ranch Project, Materials License SUA-1597, Final Evaluation of October 8, 2013 submittal for Pre-operational License Condition 12.8
April 8, 2014

By letter dated October 8, 2013 (UEC, 2013a), Uranerz Energy Corporation (UEC, or the licensee) submitted a response to Condition 12.8 of its Materials License SUA-1597 (NRC, 2011a). License Condition (LC) 12.8 states the following:

> Prior to the preoperational inspection, the licensee shall provide the following information for the airborne effluent and environmental monitoring program in which it shall develop written procedures to:
>
> 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. Evaluate the member(s) of the public likely to receive the highest exposures from licensed operations consistent with 10 CFR 20.1302.
>
> C. 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.
>
> D. 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.

U.S. Nuclear Regulatory Commission (NRC, or the Commission) staff evaluated the licensee's response to LC 12.8 for compliance with applicable regulations and consistency with Commission guidance. The results of the NRC staff's evaluation are as follows.

LC 12.8(A)

In its response to LC 12.8(A) (UEC, 2013a), the licensee proposed relying on the use of predictive models such as those presented in Regulatory Guide 3.59 (NRC, 1987) and the MILDOS-AREA (Yuan, et al., 1989) computer code to estimate the quantity of principal radionuclides released to unrestricted areas during operations. The licensee stated (UEC, 2013a) that it will report these estimated releases during operations in accordance with 10 CFR 40.65(a)(1).

The NRC staff observes that the licensee previously provided the same approach using the MILDOS-AREA predictive model and rationale for estimating these releases during operations in its February 24, 2010 letter (UEC, 2010a) responding to the NRC staff open issues and subsequently incorporated in the licensee's revised Technical Report (UEC, 2010b). The NRC staff previously evaluated (refer to Safety Evaluation Report (SER) Sections 4.1 and 5.7.7 of NRC, 2011a) the licensee's proposed approach for complying with 10 CFR 40.65(a)(1) and found it to be inadequate. The NRC staff has found nothing in the licensee's current submittal

(UEC, 2013a) to invalidate these previous findings; therefore, the original findings stand and previous the NRC staff conclusions remain valid.

The NRC staff observes that the licensee's main argument for relying solely on predictive models to satisfy the reporting requirements of 10 CFR 40.65(a)(1) is the wording of the regulation itself. As observed by the licensee, 10 CFR 40.65(a)(1) does not explicitly require measurements for the information to be reported. The NRC staff agrees with this observation. However, reporting quantities of radioactive materials released to unrestricted areas is only one part of the requirements of 10 CFR 40.65(a)(1). A licensee is also required to address in its 10 CFR 40.65(a)(1) report any instances where quantities of radioactive materials released during the reporting period are significantly above its design objectives previously reviewed as part of the licensing action.

The NRC staff reviewed (refer to SER Section 5.7.7 of NRC, 2011a) the licensee's use of the predictive model MILDOS-AREA (Yuan, et al., 1989) computer code to evaluate potential doses to receptors as a result of the licensee's proposed operations and found it to be acceptable, thus forming the safety basis for compliance with public exposure limits and enabling the NRC staff to issue the license. In other words, the result of the licensee's use of the predictive model MILDOS-AREA (Yuan, et al., 1989) computer code is the design objective that the NRC staff relied upon for its licensing action to which the licensee should compare quantities of radioactive materials released as a result of operations during future reporting periods. The NRC staff determined that comparing the results of multiple future calculations using the same, or similar, predictive models as used in the original design objective fails to provide meaningful data for evaluation of quantities of radioactive materials released in the licensee's effluents as a result of its licensed operations. Specifically, the licensee has not demonstrated that its proposed approach is sufficient to determine when quantities of radioactive materials released during the reporting period are significantly above its design objectives previously reviewed as part of the licensing action. Therefore, the licensee's proposed method does not provide the NRC staff with reasonable assurance that it can fully comply with the reporting requirements of 10 CFR 40.65(a)(1).

The NRC staff also observes that 10 CFR 40, Appendix A, Criterion 7, requires that an operational monitoring program be conducted to, among other things, measure or evaluate compliance with applicable standards and regulations and to evaluate the performance of control systems and procedures. The NRC staff determined that the alternative proposed by the licensee, relying solely on the use of predictive models such as Regulatory Guide 3.59 (NRC, 1987) and the MILDOS-AREA (Yuan, et al., 1989) computer code to estimate the quantity of principal radionuclides released to unrestricted areas during operations, is not equivalent to, nor more stringent than, the requirements of 10 CFR 40, Appendix A, Criterion 7. Specifically, the licensee has not demonstrated that its current operational monitoring program provides sufficient monitoring results that can be used to measure or evaluate compliance with the public dose limits specified in 10 CFR 20.1301 . In addition, the licensee has not demonstrated that its current operational monitoring program provides sufficient information to evaluate the performance of its radon control systems and procedures. Therefore, the requirements as specified in 10 CFR 40, Appendix A, Criterion 7 are relevant to the licensee and the licensee's proposed alternative program is not approved as a result of this submittal (UEC, 2013a).

In any case, 10 CFR 40.65(a)(1) also requires the licensee to include in its effluent report other information that the Commission may require to estimate maximum potential annual radiation doses to the public resulting from effluent releases. As described above, the NRC staff determined that the licensee's proposed method for accounting for effluent releases from operations, and subsequent reporting in accordance with 10 CFR 40.65(a)(1), is insufficient for the NRC staff to perform these estimates. The NRC staff requires monitoring data to such an extent that the licensee's design basis can be verified and reasonably accurate maximum potential annual radiation doses to the public can be estimated.

Lastly, the licensee asserts (UEC, 2013a) that historical use of the MILDOS code and the results of the environmental monitoring program to verify compliance with 10 CFR 20, Appendix B, Table 2 values by two current operating in situ recovery (ISR) facilities indicates that this method can be used to satisfy the reporting requirements of 10 CFR 40.65. The NRC staff disagrees with that statement. The NRC staff completed its review of the license renewal application of one of these facilities and determined that this practice does not provide the information required by 10 CFR 40.65 (refer to Section 5.7.8 of NRC, 2012). The other facility referenced by the licensee is currently under review by the NRC staff for a license renewal.

LC 12.8(B)

In its response to LC 12.8(B) (UEC, 2013a), the licensee presented the process that it used to identify the dose to the member of the public likely to receive the highest dose from its operations. The licensee evaluated categories of members of the public that were likely to spend at least 50 hours per year in the vicinity of the site. In addition, the licensee evaluated input parameters for its MILDOS-AREA (Yuan, et al., 1989) calculations used to provide an initial estimate of potential doses to members of the public.

The results of the evaluation of categories of members of the public are presented in Table 1 of the licensee's response (UEC, 2013a). Time spent during a year in the vicinity of the site by members of the public ranged from an estimated 90 hours (courier) to 260 hours (equipment delivery/maintenance). Other postulated members of the public included a hunter (240 hours) and oil field workers (175 hours). The NRC staff requires additional information on how the total projected number of hours for an oil field worker is derived. In addition, the NRC staff requires clarification as to whether or not the projected hours for coal bed methane workers is represented by the hours projected for oil field workers and how these hours were derived.

In order to bound the highest predicted public dose, the licensee chose to run the MILDOS model using a generic worker with access across all areas of the licensed area. It is a bounding calculation because the generic worker is postulated to spend 2000 hours per year at any location in the vicinity of the licensed area. This time is significantly more than that projected for members of the public presented in Table 1 (UEC, 2013a). Figure 1 of the licensee's submittal (UEC, 2013a) presents the results of these calculations.

The licensee presented its analysis of the potential source terms at the Nichols Ranch Project (UEC, 2013a). After rejecting uranium particulates as a potential source of exposure, the licensee modeled the radon source term in MILDOS. Table 2 of the licensee's response (UEC, 2013a) presents the MILDOS input values for the Nichols Ranch and Hank Units.

In rejecting uranium particulates as a potential dose contributor, the licensee cited (UEC, 2013a) measurement data demonstrating that the emissions at the dryer exhaust are "essentially zero". The NRC staff is unaware of these measurements and will require the licensee to supply this data for the NRC staff to be able to verify the licensee's technical basis.

In any case, the NRC staff observes that the licensee previously provided the same approach and rationale for rejecting uranium particulates as a potential dose contributor in its March 11, 2009 letter (refer to Section 4.1 of UEC, 2009) responding to the NRC staff's request for additional information and subsequently incorporated in the licensee's revised Technical Report (UEC, 2010b). The NRC staff previously evaluated (refer to SER Sections 4.1 and 5.7.7 of NRC, 2011a) the licensee's proposed approach for rejecting uranium particulates and found it to be inadequate. The NRC staff has found nothing in the licensee's current submittal (UEC, 2013a) to invalidate these previous findings; therefore, the original findings stand and previous the NRC staff conclusions remain valid.

The licensee reported (UEC, 2013a) that the results of the MILDOS evaluation predict a maximum dose to the generic worker (i.e., 2000 hrs/yr) from radon is 2.02 mrem/yr. However, the NRC staff observes that a dose of 119.54 mrem/yr is calculated for the location with the following coordinates (in units of kilometers (km)): X = 7, Y = 4.5. See the last entry on Table 1 below, reproduced, in part, from Attachment 1 of the licensee's response (UEC, 2013a). This calculated dose is above the public dose limit of 100 mrem/yr and is not addressed by the licensee.

Table 1 – Doses from the Time Step of Highest Predicted Exposures (Step 5) (Adapted from Attachment 1 of UEC, 2013a)

Location			
X (km) (East of CPP)	Y (km) (North of CPP)	Maximum Dose (mrem) (Time Step 5)	Corrected for 40 Hour Work Week
6.75	2.5	0.282	0.064578
6.75	2.75	0.394	0.090226
6.75	3	0.622	0.142438
6.75	3.25	1.16	0.26564
6.75	3.5	1.67	0.38243
6.75	3.75	1.3	0.2977
6.75	4	0.87	0.19923
6.75	4.25	0.662	0.151598
6.75	4.5	0.531	0.121599
6.75	4.75	0.403	0.092287
6.75	5	0.321	0.073509
6.75	5.25	0.292	0.066868
6.75	5.5	0.263	0.060227
6.75	5.75	0.236	0.054044
6.75	6	0.212	0.048548
7	2	0.145	0.033205
7	2.25	0.155	0.035495
7	2.5	0.244	0.055876
7	2.75	0.398	0.091142
7	3	0.589	0.134881
7	3.25	1.33	0.30457
7	3.5	2.12	0.48548
7	3.75	1.53	0.35037
7	4	0.938	0.214802
7	4.25	0.716	0.163964
7	4.5	522	119.538

The NRC staff observes that the calculations presented by the licensee (UEC, 2013a) represent only an initial identification of a potential maximally exposed member of the public as a result of the licensee's operations. 10 CFR 20.1302 requires the licensee to demonstrate compliance with the annual public dose limit. To satisfy LC 12.8(B) (NRC, 2011a), the licensee must address how it will evaluate the member(s) of the public likely to receive the highest exposures from licensed operations on an ongoing basis throughout its operational lifetime.

The NRC staff observes that the results of MILDOS are dependent on site-specific meteorological conditions at the Nichols Ranch and Hank Units. LC 12.7 of Materials License SUA-1597 (NRC, 2011a) requires the collection of this information. The licensee has submitted data (UEC, 2013b) in accordance with LC 12.7 (NRC, 2011a). However, this information has not yet been evaluated by the NRC staff. Any changes to the meteorological

data resulting from this evaluation could impact the licensee's exposure and dose calculations required under LC 12.8(B) (NRC, 2011a).

LC 12.8(C)

In its response to LC 12.8(C) (UEC, 2013a), the licensee presented a variety of methods that could potentially be used to assess public dose from radon progeny but did not specifically address how radon progeny are incorporated into public dose assessment at its facility. For example, the licensee did not discuss specific types of measurements for radon daughters that will be used at its facility, how these measurements will be used for assessing public dose, or which value in 10 CFR Part 20, Appendix B, Table 2 will be used for comparison with measured radon concentrations. Regarding the use of measurements for analyzing potential public dose from operations due to radon progeny, the licensee previously stated (UEC, 2010a, 2010b) that it would manage the area between the process area and the site boundary as a controlled area pursuant to 10 CFR 20.1003. In addition, the licensee did not propose (UEC, 2013a) any additional monitoring locations for assessing public dose than what was previously proposed (refer to Section 5.7.7 of UEC, 2010b) for its airborne effluent and environmental monitoring program. These environmental monitoring locations are generally at or near the Nichols Ranch site boundary. As required by 10 CFR 20.1301(b), the dose limits for members of the public continue to apply to those members of the public that have access to controlled areas. As discussed below, members of the public will be permitted access to the licensee's proposed controlled area. Therefore, the licensee did not propose monitoring locations relevant to determining the exposure of potentially maximally exposed members of the public.

The NRC staff observes that in order to be classified as a controlled area, the licensee must be able to demonstrate that it can limit access to that area (refer to definition of controlled area in 10 CFR 20.1003). This includes the ability to require a member of the public to exit the controlled area at any time (refer to questions 29 and 417, and NRC's responses, from NRC, 1994). This requirement is the same for all licensees subject to 10 CFR Part 20 (see, for example, Silverman, 2003). The licensee's Nichols Ranch and Hank Units include a total of approximately 3,370.53 acres (refer to Appendix D2 of UEC, 2007). Surface ownership is mostly private, with the exception of approximately 280 acres of Bureau of Land Management (BLM) land in the Hank Unit (refer to Appendix D2 of UEC, 2007). Land use within these units includes oil and gas wells (Hank Unit) and coal bed methane wells (both units) (refer to Section 2.2.5 of UEC, 2007). These wells are operated by numerous corporations (refer to Addendum 2A of UEC, 2007) whose workers are members of the public for the licensee's dose assessment purposes. In addition, the NRC staff observes that the licensee stated that it "...does not anticipate that in situ recovery operations will interfere with ongoing coal bed methane operations." (refer to Appendix D1 of UEC, 2007). Given the expanse of UEC's licensed area, the amount of identified commercial activity, and potential BLM activity (also members of the public for the licensee's dose assessment purposes), on the Hank and Nichols Ranch Units, the NRC staff does not have reasonable assurance that the licensee can limit access to its proposed controlled area, including the ability to require all corporate entities and BLM personnel to exit these areas at any time.

Because of the lack of any specificity related to the licensee's dose assessment of radon progeny during operations, and the lack of detail regarding how the licensee can restrict access to the proposed controlled area, the NRC staff does not have reasonable assurance

that the licensee will correctly factor in radon progeny to assess public dose and therefore finds this response unacceptable. In addition, until such time as the licensee can demonstrate with reasonable assurance (e.g., written agreements from all necessary parties, etc.) that it can limit access to its proposed controlled area, the areas outside of restricted areas should be treated as unrestricted areas for public dose assessment purposes.

The NRC staff observes that the licensee proposed (UEC, 2013a) that calculations with no supporting monitoring results can be used to demonstrate that the plant design will comply with the public dose limits specified in 10 CFR 20.1301 during actual operations. The licensee refers to Regulatory Guide 3.59 (NRC, 1987) and the MILDOS-AREA computer code (Yuan, et al., 1989) as methods approved by NRC for use at in ISR facilities (UEC, 2013a). The NRC staff agrees with the licensee insofar as these two documents are approved for use by the NRC. The value of the predictive nature of the MILDOS code is discussed in several places (NRC, 1981, Chen, et al., 1998). As discussed in the NRC staff's response to LC 12.8(A) in this document, the NRC staff reviewed the licensee's use of the predictive model MILDOS-AREA (Yuan, et al., 1989) computer code to evaluate potential doses to receptors as a result of the licensee's proposed operations and found it to be acceptable, thus forming the safety basis for compliance with public exposure limits.

Regarding the use of calculations to demonstrate compliance with 10 CFR Part 20, the use of predictive models, such as those presented in Regulatory Guide 3.59 (NRC, 1987) and the MILDOS-AREA computer code (Yuan, et al., 1989), has never been explicitly approved for demonstrating compliance with radiation protection standards during operations (see, for example, the discussion on predictive evaluations of 10 CFR Part 20 compliance in NRC, 1981). The NRC developed Regulatory Guide 3.59 (NRC, 1987) for use when environmental monitoring data is not yet available and it directs applicants and licensees where to look for separate guidance on compliance with radiation protection standards. This separate guidance is provided in NUREG-0859 (NRC, 1982). The NRC staff recognizes that NUREG-0859 (NRC, 1982) was written to specifically address compliance issues with 40 CFR Part 190. However, Regulatory Guide 3.59 (NRC, 1987) also addresses compliance issues with 10 CFR Part 20, 10 CFR Part 40, 40 CFR Part 190 and 40 CFR Part 192 and refers to the guidance in NUREG-0859 (NRC, 1982). Since the technical shortcomings related to predictive modeling discussed in NUREG-0859 are generic in nature, the NRC staff determined that the guidance comments regarding the use of predictive modeling are relevant to ISR facilities demonstrating compliance with 10 CFR Part 20 and 10 CFR Part 40 requirements.

NUREG-0859 (NRC, 1982) provides guidance to NRC's Uranium Recovery Licensing Branch (URLB) and addresses the use of NRC approved predictive modeling and environmental monitoring programs in general. The specific guidance in NUREG-0859 (NRC, 1982) to URLB staff relevant to this review regarding the assessment of radioactivity concentrations to which individuals may be exposed is "...the primary means of compliance must be by measurements made at the point of an actual individual receptor..." and that "...actual compliance determination during operation will be based on environmental monitoring data." The NRC staff observes that Regulatory Guide 3.59 (NRC, 1987) and NUREG-0859 (NRC, 1982) is Commission-approved guidance and, as discussed above, is relevant to this review. Consistent with a request by the National Mining Association (refer to the first discussion point of NMA, 2010), the NRC staff is not modifying this Commission-approved guidance. The NRC staff presented this approach to the ISR industry during the 2011 Uranium Recovery Workshop (NRC, 2011b).

The NRC staff recognizes that NUREG-0859 (NRC, 1982) was issued prior to the current 10 CFR Part 20 becoming effective. However, the NRC staff determined that the guidance discussed above from NUREG-0859 (NRC, 1982) is also relevant to how the licensee should demonstrate compliance with 10 CFR 20.1501(a). The guidance emphasizes measurements made at the point of an actual individual receptor as the primary means of compliance with public dose limits, and identifies surveys (i.e., monitoring) that are generally acceptable methods for demonstrating compliance with 10 CFR 20.1501(a)(1), as well as surveys that are reasonable (i.e., monitoring) under the circumstances experienced at ISR facilities (refer to 10 CFR 20.1501(a)(2)). Ultimately, as discussed in the NRC staff's evaluation of the licensee's response to LC 12.8(A) above, to determine compliance with the regulations, the NRC staff requires monitoring data to such an extent that the licensee's design basis can be verified and reasonably accurate maximum potential annual radiation doses to the public can be estimated.

The NRC staff observes that the guidance in NUREG-0859 (NRC, 1982) is consistent with other Commission-approved guidance as well as the requirements in 10 CFR 20.1302(b)(1). For example, Regulatory Guide 8.37 (NRC, 1993) provides guidance on a licensee's as low as reasonably achievable (ALARA) program for demonstrating compliance with 10 CFR 20.1101(b). Regulatory Position C.3 of Regulatory Guide 8.37 (NRC, 1993) states that "Licensees must perform surveys and monitoring sufficient to demonstrate compliance with the requirements of 10 CFR 20.1302." In addition, NUREG-1736 (NRC, 2001) provides similar guidance for demonstrating compliance with 10 CFR 20.1101(b). NUREG-1736 (NRC, 2001) states that "...the licensee should be able to demonstrate that periodic reviews of performance have been made and that efforts have been made to achieve ALARA." The NRC staff observes that performance, as generally defined (Urdang and Flexner, 1973) by "the manner of performing or functioning", cannot be determined solely with predictive modeling. Similar to the NRC staff's evaluation of the licensee's response to LC 12.8(A) above for demonstrating compliance with 10 CFR 40.65(a)(1), the licensee's current environmental monitoring program and proposed use of predictive modeling fails to provide the NRC staff with reasonable assurance that the licensee can demonstrate that doses to members of the public are ALARA.

Lastly, in its response to LC 12.8(A) (UEC, 2013a), UEC quotes the requirements of 10 CFR 20.1302(b)(1): "A licensee shall show compliance with the annual dose limit in § 20.1301 by demonstrating by measurement **or calculation** (emphasis added) that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit.". As discussed in Commission guidance addressing 10 CFR 20.1302 (NUREG-1736 (NRC, 2001)), there is a distinction between the dose received by a member of the public and the exposure of that member of the public. These terms are separately defined in 10 CFR 20.1003. The NRC staff observes that the definition of "monitoring" also distinguishes between exposure and dose. Clearly, these terms have specific meanings and are not used interchangeably. Basically, exposure means being exposed to radioactive material and dose, or committed effective dose equivalent in the case of internal dose from radon and its progeny, is the dose received by each of the body organs or tissues that are irradiated (refer to definition of "exposure" and "dose" in 10 CFR 20.1003). NUREG-1736 (NRC, 2001) goes on to say that public dose may result from any combination of external and internal exposure. The NRC staff observes that when a member of the public is exposed to radon and its progeny, it is generally the exposure of that individual to the progeny of radon that contributes the majority of the dose to that member of the public. The other requirements (e.g., 10 CFR 40, Appendix A, Criterion 7) and guidance discussed above

relating to monitoring will provide the necessary information on the exposure of a member of the public to radon and its progeny. This exposure information can then be used by the licensee to calculate the dose to the member of the public receiving the highest exposure. The NRC staff concludes that relying solely on calculations to demonstrate compliance with public dose limits without supporting monitoring results, the licensee's proposed methodology does not provide the NRC staff with reasonable assurance that the licensee can derive relevant exposure information, and demonstrate compliance with dose limits for members of the public, as required by 10 CFR Part 20. After the licensee determines the exposure of a member of the public, it can then calculate or measure the dose to members of the public, consistent with the provisions of 10 CFR Part 20.

However, even if this were not the case, the licensee's proposed method of using only calculations appears to be inconsistent with LC 9.2 of Materials License SUA-1597 (NRC, 2011a). Specifically, LC 9.2 (NRC, 2011a) requires the licensee to conduct its operations in accordance with the commitments, etc., in the license application and subsequent amending submissions as specified in the condition. Two specific submissions for the license amendment include licensee documents dated February 24, 2010 (UEC, 2010a) and September 15, 2010 (UEC, 2010b). In these documents, the licensee committed itself "...to show compliance with the annual dose limit in 10 CFR 20.1301 by using results from routine monitoring supplemented by calculation pursuant to 10 CFR Part 20.1301(b)(1)." The NRC staff observes that there appears to be an error in the licensee's submittals as there is no 10 CFR 20.1301(b)(1) codified in the regulations. In any case, the licensee clearly committed to using monitoring as the primary means by which it will demonstrate compliance with the annual dose limit in 10 CFR 20.1301. Under 10 CFR 20.1003, "monitoring" is defined as measurements of radiation levels, concentrations, surface area concentrations or quantities of radioactive materials and the use of the results of these measurements to evaluate potential exposures and doses. Therefore, the licensee is not authorized to demonstrate compliance with public dose limits using calculations only, as proposed in this submittal (UEC, 2013a).

LC 12.8(D)

In its response to LC 12.8(D), the licensee described its approach for determining occupational dose received throughout the licensed area. In its license application (refer to Section 2.9.3 and Figures 2-25 and 2-26 of UEC, 2010b), the licensee established baseline environmental monitoring stations in the Nichols Ranch and Hank Units. The locations of these baseline environmental monitoring stations were based upon the wind data from regional meteorological stations (refer to Section 2.5 of UEC, 2010b). Based upon onsite meteorological data (refer to Figure 1 of UEC, 2013a), the licensee proposed adding three additional radon Track-etch detectors in the Nichols Ranch Unit (two in the downwind direction, one in the wellfield) and two additional radon Track-etch detectors (radon detectors) in the Hank Unit (two in the downwind direction) (refer to Figure 2 of UEC, 2013a). The licensee stated that it would use radon monitoring station HR-2, already established at the Hank Unit, to determine radon emanation from the wellheads there. (UEC, 2013a)

The location of the additional radon detectors was based on the licensee's reasoning that placing them in the downwind direction will result in measuring the highest radon concentrations (UEC, 2013a). However, the license did not explain why the radon detectors were placed in the specified locations within the downwind direction. If the purpose was to determine an average radon concentration within the licensed area outside of the plant, the

NRC staff does not have reasonable assurance that using the additional five radon detectors will provide a reasonable average radon concentration over an area of approximately 3,370.53 acres (Nichols Ranch and Hank Units combined, refer to Appendix D2 of UEC, 2007).

For the following reasons, the NRC staff also does not have reasonable assurance that the additional five radon detectors can be used to determine the maximum radon concentrations. Firstly, the licensee characterizes the source of radon as "nearly pure radon gas" (UEC, 2013a). In its response to LC 12.8(D) (UEC, 2013a), the licensee stated that radon and its progeny originate primarily from the central processing plant (CPP). The NRC staff observes that the licensee's characterization of radon gas does not take into account radon within the plant that has already undergone radioactive decay, thus having some fraction of radioactive progeny present prior to exposure. Occupational exposure from radon progeny is well documented during normal operations within the plant areas at ISR facilities (see, for example, Section 5.8.3.2 of CBR, 2007 and Section 5.8.2.2 of Cameco, 2012) and radon levels can increase during changes in a licensee's operations (See Section 3 of NRC, 2011c and Section 2 of NRC, 2013). In the licensee's application (refer to Section 4 of UEC, 2010b), it described its method for controlling radon buildup within buildings. This includes open doorways during favorable weather. The NRC staff does not find it reasonable to assume that occupational exposure (and public exposure) from radon progeny inside plant areas, such as that received at other operating ISR facilities, stops at the door or other exit point from the building. On the contrary, radon progeny will continue to build up over time (Evans, 1969). For these reasons, the radon exiting the buildings can't be characterized as "nearly pure radon gas". Therefore, although the licensee stated that..."closer to the source" does not necessarily mean "greater dose", proximity to the CPP does not rule out that this location could be the site of highest exposure.

Secondly, the licensee used results of its onsite baseline year wind data to determine placement of the five additional radon detectors (refer to Figure 1 of UEC, 2013a). The results of these radon detectors will then be used to calculate occupational dose, which is done on an annual basis (refer to 10 CFR 20.1201). The NRC staff observes that the licensee also submitted a second year wind rose from the Nichols Ranch meteorological station in response to another license condition (see UEC, 2013b). In this second year wind rose, two of the three primary wind directions (east and south-southwest) remained the same, while the north-northwest wind sector replaced the southwest wind sector. The NRC staff observes that the MILDOS code uses a Gaussian diffusion equation to estimate atmospheric concentrations of radionuclides and uses the joint wind speed and direction frequency distribution provide by the licensee to normalize the average atmospheric concentration of the radionuclides (Momeni, et al., 1979). Variations in dominant wind sectors are to be expected for any given year, especially for such short collection times as one year. However, assuming the wind rose was established in a year representative of the long term meteorological conditions, this does not present a problem for using the MILDOS code to evaluate placement of environmental monitoring stations. The reasons are that the major purposes of the environmental monitoring stations are to evaluate the performance of effluent controls and the environmental impact of milling operations over the operational life of the facility (NCRP, 1993; NRC, 1980). For these purposes, long term trending is more important than instantaneous values. However, for calculating annual occupational dose, short term variations (i.e., year to year, or within a year) can have a more profound impact if, for example, a dominant sector is missed in any given year. Without longer-term wind data, the NRC staff does not have reasonable assurance that placing the radon detectors in the baseline year downwind direction will be representative of

maximum radioactivity concentrations on a yearly basis for purposes of calculating annual occupational dose.

Thirdly, the licensee does not appear to take into account work inside the header houses where radon progeny could potentially build up to levels higher than found in the general outdoors.

Fourthly, the NRC staff observes that in its response to LC 12.8(B) the licensee provided isodose curves for the Nichols Ranch and Hank Units (refer to Figure 1 of UEC, 2013a). Comparing Figure 2 of the licensee's response to LC 12.8(D), describing the placement of the additional radon detectors, to these isodose curves, the NRC staff observes that they do not appear to correlate. In other words, it does not appear that additional radon detectors are placed within the licensed area where the maximum dose was calculated to occur.

Based on the NRC staff's evaluation above, additional information is necessary to justify the number and locations of the radon detectors used for calculating occupational dose in the license area.

While the licensee discussed its proposed methodology for monitoring radon and presented calculational aspects of deriving a dose from exposure to radon progeny, it did not commit to accounting for occupational exposure to employees throughout the licensed area, including header houses and wellfields. The NRC staff requires information on how the dose received by employees working throughout the entire license area, including header houses and wellfields, will be assigned to those employees. This information should include how exposure times and exposure concentrations will be assigned to individual employees working throughout the entire license area, including header houses and wellfields and entered into exposure records.

In rejecting uranium particulates as a potential dose contributor, the licensee cited (UEC, 2013a) measurement data demonstrating that the emissions at the dryer exhaust are "essentially zero". The NRC staff is unaware of these measurements and will require the licensee to supply this data for it to be able to verify the licensee's technical basis.

As discussed above in the NRC staff's evaluation of the licensee's response (UEC, 2013a) to LC 12.8(B), the licensee previously provided the same approach and rationale for rejecting uranium particulates as a potential dose contributor in its March 11, 2009 letter (refer to Section 4.1 of UEC, 2009) responding to the NRC staff's request for additional information and subsequently incorporated in the licensee's revised Technical Report (UEC, 2010b). The NRC staff previously evaluated (refer to SER Sections 4.1 and 5.7.7 of NRC, 2011a) the licensee's proposed approach for rejecting uranium particulates and found it to be inadequate. The NRC staff has found nothing in the licensee's current submittal (UEC, 2013a) to invalidate these previous findings; therefore, the original findings stand and previous staff conclusions remain valid.

Also discussed above in the NRC staff's evaluation of the licensee's response (UEC, 2013a) to LC 12.8(B), the results of MILDOS are dependent on site-specific meteorological conditions at the Nichols Ranch and Hank Units. LC 12.7 of Materials License SUA-1597 (NRC, 2011a)

requires the collection of this information. The NRC staff is aware that the licensee has submitted data (UEC, 2013b) in accordance with LC 12.7 (NRC, 2011a). However, this information has not yet been evaluated by the NRC staff. Any changes to the meteorological data resulting from this evaluation could impact the licensee's proposed methodology for addressing LC 12.8(D) (NRC, 2011a).

In addition, based on data submitted by the licensee (UEC, 2010b), the NRC staff concluded (refer to SER Section 2.6.3.1 of NRC, 2011a) that there was insufficient information to determine that the baseline environmental radon monitors were located in sectors with the highest predicted airborne radioactivity. LC 11.9 (NRC, 2011a) requires the licensee to establish radon air samplers in the three sectors with the highest predicted radioactivity concentrations resulting from operations. The NRC staff is not evaluating the adequacy of the location of the licensee's baseline environmental monitoring stations during this review. If the licensee submits revised locations for its baseline environmental monitoring stations, the NRC staff will review the information at that time.

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