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ENERGY LABORATORIES, INC. - CASPER, WYOMING

STANDARD OPERATING PROCEDURES

LARGE AREA ACTIVATED CHARCOAL COLLECTORS (LAACC)

Approved By:

Originator	*Date*
Technical Reviewer (if applicable)	*Date*
ELI Quality Assurance Officer	*Date*
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1.0 MEASURING RADON FLUX USING LARGE AREA ACTIVATED CHARCOAL COLLECTORS (LAACC)

The method used to measure radon flux involves absorption of radon on activated charcoal in a large area collector. The collector is placed onto the surface of the material to be measured and is allowed to collect radon for a time period of 24 hours. The radon collected on the charcoal is then measured by gamma spectroscopy.

Per 40 Code of Federal Regulations (CFR), *Part 61, Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration*, December 15, 1989, it is imperative that the temperature and moisture conditions are met for the measurement activity. Notification to the appropriate agencies should be made accordingly.

The collector consists of a PVC end cap with handle, screened spacer pads, charcoal distribution grid, screened retainer pad, and a steel retaining rod. Approximately 180 grams of activated charcoal is spread in the distribution grid. The retainer pad is placed over the charcoal and held in place by the retaining rod.

The collector is loaded with the charcoal by removing the retaining rod and pad, and placing the preweighed charcoal into the collector. The charcoal is then transported to the field in a sealed prenumbered can. The LAACC and charcoal canister numbers are recorded. The loading process should be done in an enclosed area so adverse wind conditions do not disturb the charcoal (blow it away). To allow for a quick transfer of charcoal into the LAACCs prior to deployment, LAACC units should be loaded by two or more personnel. Another team of two or more personnel should begin deployment immediately upon the charcoal transfer of a group of 10 to 20 LAACCs. Minimize the time a loaded LAACC is allowed to sit ambient atmosphere. Care must be taken to minimize confusion and order of LAACCs and charcoal cans. An organized method of transfer and a large working area assist in minimizing any errors in LAACC/canister mismatching. A large vehicle could provide for the necessary enclosed area (such as a Suburban or equivalent).

The prenumbered collectors are deployed by carefully positioning the end cap on a flat surface of the material to be measured with soils or tailings used to seal the edge, at the predetermined location. It is imperative that a complete seal is obtained between the collector and the material to be measured. A shovel or a hand trowel may be used to scoop the material around the edge of the collector, being careful not to scoop material into the vent hole. The location identification, LAACC number, and the set time should be recorded.

After approximately 24 hours (minor time overruns are acceptable) of exposure, the collectors are picked up and the time retrieved is recorded. If any other conditions are observed (such as a broken seal, wind blown conditions, etc.), they should also be recorded. The transfer of the charcoal should begin immediately upon retrieval. The LAACCs are transported to the enclosed work area where a team of two or more personnel are responsible for transferring the charcoal carefully back into the appropriate prenumbered cans. The time between retrieval and transferring the exposed charcoal should be held to a minimum, however, site and field conditions contribute to the timeliness of the transfer.

The activated charcoal is removed from the collector by removing the retaining rod and pad from the collector and dumping the charcoal into a large funnel which leads into the prenumbered steel alloy can. The can's lid is placed and a wrap of electrical tape is applied to the can seam to eliminate any leakage or introduction of air into the can. The tape also assists in creating a closed (sealed) system to allow for the radon collected to equilibrate for four (4) hours before counting to allow the ingrowth of the radon daughters.

The sealed cans are transported to the laboratory where they are counted and recorded. The following information pertains to the calculation that will be made to ascertain the radon flux for each specific LAACC location.

2.0 U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) REQUIREMENTS FOR FIELD MEASUREMENT OF RADON FLUX

Radon-222 Emissions from Uranium Mill Tailings Piles - Per 40 CFR, *Part 61, Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants; Radionuclides, Final Rule and Notice of Reconsideration*, December 15, 1989, the following has been reprinted:

Method 115 - Monitoring for Radon-222 (^{222}Rn) Emissions

> This Appendix describes the monitoring methods which must be used in determining the ^{222}Rn emissions from underground uranium mines, uranium mill tailings piles, phosphogypsum stacks, and other piles of waste material emitting radon.

2.1 Measurement and Calculation of Radon Flux from Uranium Mill Tailings Piles

2.1.1 ncy of flux measurement

A single set of radon flux measurements may be made, or if the owner or operator chooses, more frequent measurements may be made over a one year period. These measurements may involve quarterly, monthly, or weekly intervals. All radon measurements shall be made as described in paragraphs 2.1.2 through 2.1.6 except that for measurements made over a one year period, the requirement of paragraph 2.1.4(c) shall not apply. The mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each measurement period. The weather conditions, moisture content of the tailings and area of the pile covered by water existing at the time of the measurement shall be chosen so as to provide measurements representative of the long term radon flux from the pile and shall be subject to EPA review and approval.

2.1.2 Distribution of flux measurements

The distribution and number of radon flux measurements required on a pile will depend on the clearly defined areas of the pile (called regions) that can have significantly different radon fluxes due to surface conditions. The mean radon flux shall be determined for each individual region of the pile. Regions that shall be considered for operating mill tailings piles are:

- water covered areas,
- water saturated areas (beaches),
- dry top surface areas, and
- sides, except where earthen material is used in dam construction.

For mill tailings after disposal the pile shall be considered to consist of only one region.

2.1.3 Number of radon flux measurements

Radon flux measurements shall be made within each region of the pile, except for those areas covered with water. Measurements shall be made at regularly spaced locations across the surface of the region, realizing that surface roughness will prohibit measurements in some areas of a region. The minimum number of flux measurements considered necessary to determine a representative mean radon flux value for each type of region on an operating pile is:

- water saturated area - no measurements required as radon flux is assumed to be zero,
- water saturated beaches - 100 radon flux measurements,
- loose and dry top surface - 100 radon flux measurements, and
- sides - 100 radon flux measurements, except where earthen materials is used in dam construction.

For mill tailings pile after disposal which consists of only one regional minimum of 100 measurements are required.

2.1.4 Restrictions to radon flux

Measurements - the following restrictions are placed on making radon flux measurements:

- measurements shall not be initiated within 24 hours of a rainfall;
- if a rainfall occurs during the 24 hour measurements period, the measurement is invalid if the seal around the lip of the collector is surrounded by water; and
- measurements shall not be performed if the ambient temperature is below 35°F or if the ground is frozen.

2.1.5 Areas of pile regions

The approximate area of each region of the pile shall be determined in units of square meters.

2.1.6 Radon Flux Measurements

Measuring radon flux involves the absorption of radon on activated charcoal in a large-area collector. The radon collector is placed on the surface of the pile area to be measured and allowed to collect for a period of 24 hours. The radon collected on the charcoal is measured by gamma-ray spectroscopy. The detailed measurement procedure provided in Appendix A of EPA 520/5-85-0029(1) shall be used to measure the radon flux on uranium mill tailings, except the surface of the tailings shall not be penetrated by the lip of the radon collector as directed in the procedure, rather the collector shall be carefully positioned on a flat surface with soil or tailings used to seal the edge.

2.1.7 *Calculations*

The mean radon flux for reach region on the pile and for the total pile shall be calculated and reported as follows.

a. The individual radon flux calculations shall be made as provided in Appendix A EPA 86 (1). The mean rad⁻⁻ flux for each region of the pile shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

b. The mean radon flux for the total uranium mill tailings pile shall be calculated as follows:

$$J_s = \frac{J_1 A_1 + \ldots J_2 A_2 \ldots J_i A_i}{A_t}$$

Where:

J_S	=	mean flux for the total pile (pCi/m^2-s)
J_i	=	mean flux measured in region i (pCi/m^2-s)
A_i	=	area of region i (m^2)
A_t	=	total area of pile (m^2)

2.1.8 *Reporting*

The results of the individual flux measurements, the approximate locations on the pile, and the mean radon flux foe each region and the mean radon flux for the total stack shall be included in the emission test report. Any conditions or unusual event that occurred during the measu⁻ements that could significantly affect the results should be reported.

3.0 *SAMPLING AND LABORATORY PROCEDURES FOR ATTAINING RADON FLUX MEASUREMENTS*

Quality Assurance Procedures for Measuring ^{222}Rn Flux - Per 40 CFR, Part 61, *Environmental Protection Ag_ncy, National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration*, December 15, 1989, the following has been reprinted:

Method 115 - Monitoring for ^{222}Rn Emissions

This Appendix describes the monitoring methods which must be used in determining the ^{222}Rn emissions from underground uranium mines, uranium mill tailings piles, phosphogypsum stacks, and other piles of waste material emitting radon.

a. Sampling Procedures

Records of field activities and laboratory measurements shall be maintained. The following information shall be recorded for each charcoal canister measurement:

- site,
- name of pile,
- sample location,
- sample ID number,
- date and time on,
- date and time off, and
- observations of meteorological conditions and comments.

Records shall include all applicable information associated with determining the sample measurement, calculations, observations, and comments.

b. Sample Custody

Custodial control of all charcoal samples exposed in the field shall be maintained in accordance with EPA chain of custody field procedures. A control record shall document all custody changes that occur between the field and laboratory personnel.

c. Calibration Procedures and Frequency

The radioactivity of two standard charcoal sources, each containing a carefully determined quantity of Radium-226 (^{226}Ra) uniformly distributed through 180 grams of activated charcoal, shall be measured. An efficiency factor is computed by dividing the average measured radioactivity of the two standard charcoal sources, minus the background, in cpm by the known radioactivity of the sources in dpm. The same two standard charcoal sources shall be at the beginning and at the end of each day's counting as a check of the radioactivity counting equipment. A background count using unexposed charcoal should be made at the beginning and at the end of each counting day to check for inadvertent contamination of the detector or other changes affecting the background. The unexposed charcoal comprising the blank is changed with each new batch of charcoal used.

d. Internal Quality Control Checks and Frequency

The charcoal from every tenth exposed canister shall be recounted. Five percent of the samples analyzed shall be either blanks (charcoal having no radioactivity added) or samples spiked with known quantities of ^{226}Ra.

e. ***Data Precision, Accuracy, and Completeness***

The precision, accuracy, and completeness of measurements and analyses shall be within the following limits for samples measuring greater than 1.0 pCi/m^2-s.

- Precision: 10%
- Accuracy: 10%
- Completeness: At least 85% of the measurements must yield usable results

Energy Laboratories, Inc. (ELI) has two multi-channel gamma spectrometers available at its Casper facility.

ELI is an EPA certified and listed laboratory. Certification has been maintained in the areas for determination of radiochemical, inorganics, and organics in drinking waters. ELI has been actively participating in EPA's Radon Proficiency Program since its inception for determination of radon concentrations in homes and structures. ELI has two staff members presently accepted by the U. S. Nuclear Regulatory Commission (NRC) as Radiation Safety Officers and have performed radiation surveys for uranium operations since 1980. These surveys include alpha, beta, and gamma emitting radionuclides in air, soil/surface, and water for determination of employee occupational exposure awhile working at mine sites.

Copies of ELI's Quality Assurance and certifications are available upon request.

The professional personnel will be available for consultation prior to and during the sampling duration. The following areas should be addressed before sampling:

- timing of collection (24 hours sampling or annual),
- regions within the tailings impoundment (quantity and area),
- personnel responsible for placement of collectors,
- EPA notification of intent to proceed with collection,
- current topographical map of tailings impoundments to be sampled,
- sample point locations to be marked prior to collector placement, and
- location of any background samples such as up wind of the impoundment (undisturbed areas) as a point of comparison.

ELI will provide the company with a report that will include a minimum of the following:

- number and laboratory ID of collectors placed,
- date and time of collectors placed, retrieved, and charcoal counted;
- map of location of collectors (provided by company);
- radon flux calculations for each detector, region, and total tailings impoundment;
- spectrum print out for each detector, if requested; and
- quality assurance data will be provided upon request. This data will consists of duplicates, blanks, standards, and geometry verification.