ENERGY LABORATORIES, INC. - CASPER, WYOMING

STANDARD OPERATING PROCEDURES

RADON FLUX MEASUREMENT
EPA METHOD 115
LARGE AREA ACTIVATED CHARCOAL COLLECTORS (LAACC)

Approved By:

Originator _____ 6/10/97 ***Date***

Technical Reviewer (if applicable) _____ 6/4/97 ***Date***

ELI Quality Assurance Officer _____ 6-10-97 ***Date***

ELI Laboratory Manager _____ 6-11-97 ***Date***

Distribution of Official Copies:

ELI Laboratory Manager
All ELI Staff

1.0 SCOPE AND APPLICATION

The purpose of this SOP is to provide a general description of the placement, handling, subsequent analytical measurement, and calculation of radon flux measured from Large Area Activated Charcoal Canister (LAACC), also known as EPA Method 115, 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. In addition to the published EPA Method 115 technical information was also taken from EPA's publication 520/5-85-029, *Radon Flux Measurements on Cardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida*.

Radon flux measurements are performed on uranium mill tailings, phosphogypsum stacks, or on any solids (soil, waste, etc.) in which radon flux measurements are required. The majority of radon flux measurements have been for conventional uranium milling operations.

2.0 SUMMARY

The method used to measure radon flux involves adsorption of radon on activated charcoal in a large area collector (LAACC), diagram located in Section 7.0 Attachments. 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 charcoal is transferred into steel pre-numbered cans then transported to the laboratory for analysis and calculating radon flux. The radon collected on the charcoal is measured by gamma spectroscopy or equivalent equipment (multi or single channel analyzers). In addition to EPA's Method 115 document, publication EPA 520/5-85-029, *Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida, January 1986*, and EPA 520/1-89-009, *Indoor Radon and Radon Decay Product Measurement Protocols*, provides the basic information on design, measurement, and theory related to radon flux measurement and analysis. Partial copies of the publications have been attached in Section 6.0 References.

3.0 NOTES AND PRECAUTIONS

The following areas should be addressed before sampling:

- timing of collection (24 hours sampling or quarterly annual collection),
- 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 in the field prior to collector placement, and
- location of any background samples such as up wind of the impoundment (undisturbed areas) as a point of comparison or field duplicate samples.

Safety precautions that should be observed while performing radon flux measurement, in the field, and analysis, in the laboratory are as follows:

In the field
Observe all site specific hazard conditions
Make sure all paperwork is secured from environmental conditions
Do not open or compromise trip blank charcoal canisters

In the laboratory
Observe all laboratory safety procedures as specified in the Chemical Hygiene Plan and/or by the Standard Operating Procedure for the equipment or method.

4.0 DEFINITIONS

5.0 MATERIALS AND PROCEDURES

5.1 Materials

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. Refer to the diagram of construction located in Section 6.0 References.

5.2 ***Procedure for Measurement and Calculation of Radon Flux from Uranium Mill Tailings Piles***

The following 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.

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 collectors, prior to deployment, LAACC units should be loaded by two or more people. The collectors are loaded with the charcoal by removing the retaining rod and pad, placing the pre-weighed (pre-measured) charcoal into the charcoal support grid, and replacing the pad and rod. The collectors are transported to the field by vehicle and deployed. The LAACC unit, charcoal canister, and tailings grid location should be recorded. Teams of two or more people should begin deployment immediately upon the charcoal transfer. Minimize the time a loaded collector is allowed to sit in ambient atmosphere. Care must be taken to minimize confusion and order of LAACC units and charcoal cans. An organized method of transfer and a large working area assist in minimizing any errors in LAACC/canister mismatching.

The pre-numbered 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 pre-numbered 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 empties into the pre-numbered steel alloy can. The can's lid is placed and a wrap of electrical tape is applied to the can seam to eliminate any charcoal loss due to lid removal or introduction of air and/or radon into the can. The tape also assists in creating a closed system to allow for the radon collected to equilibrate for four (4) hours before counting to allow the ingrowth of the radon daughters.

The 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. Due to the near 100% efficiency of the activated charcoal to adsorb and retain radon and its associated particulate daughters, from the atmosphere in the LAACC units, no can sealing or seal testing is required. This method of collection and transportation is endorsed by EPA via EPA 402-R-92-004, EPA 402-R-92-004, *Indoor Radon and Radon Decay Products Measurement Device Protocols*, July 1992, and EPA 520/5-87-005, *EERF Standard Operating Procedure for Rn-222 Measurement Using Charcoal Canisters*, June 1987.

5.2.1 Frequency 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 5.2.2 through 5.2.1.6 except that for measurements made over a one year period, the requirement of paragraph 5.2.4(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.

5.2.2 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 closure the pile shall be considered to consist of only one region.

5.2.3 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 closure which consists of only one regional minimum of 100 measurements are required.

5.2.3.1 Trip and Field Blanks

ELI prepares a minimum of 10% trip blanks to be sent to the field with the LAACC testing equipment and measurement charcoal containers. The trip blanks travel with the charcoal cans that will be used in the LAACC devices. The trip blanks stay with the unopened charcoal cans while in storage prior to transfer and deployment. The trip blanks stay in the work area upon deployment of the devices to the field for actual measurement. They are intended to provide information regarding the integrity of the shipping and handling of the measuring equipment to and from the field from the laboratory.

5.2.3.2 Background and Field Duplicate Measurements

Due to the non-homogeneous nature of tailings piles, it is recommended that some duplicate measurements are made in the field. Set two LAACC devices in the field adjacent to each other. In addition to field duplicates, it is recommended that some LAACC devices are deployed in areas of known background conditions (undisturbed field conditions). This data will complement the radon flux measurements as determined on the tailings pile.

5.2.4 Restrictions to radon flux Measurements

The following restrictions are placed on making radon flux measurements:

a. measurements shall not be initiated within 24 hours of a rainfall;
b. 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
c. measurements shall not be performed if the ambient temperature is below 35°F or if the ground is frozen. A min/max thermometer may be used if no meteorological data is available.

5.2.5 Areas of pile regions

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

5.2.6 Radon Flux Measurements

Measuring radon flux involves the adsorption 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.***

5.2.7 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 radon 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_1 = mean flux measured in region i (pCi/m^2-s)
A_1 = area of region i (m^2)
A_t = total area of pile (m^2)

5.3 Quality Assurance

ELI is an EPA certified and listed laboratory through the Radon Measurement Proficiency (RMP) Program. Laboratory certification has been maintained in the areas for determination of radiochemical, inorganics, organics, and bacteriological constituents 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.

5.3.1 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.

5.3.2 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.

5.3.3 Calibration Procedures and Frequency

ELI has two multi-channel gamma spectrometers available at its Casper facility. The radioactivity of two standard charcoal sources, each containing a carefully determined quantity of Radium-226 (^{226}Ra) uniformly distributed through ~ 280 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 made, at a minimum, 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 a minimum, 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.

5.3.4 Internal Quality Control Checks and Frequency

The charcoal from every tenth exposed canister shall be recounted. Five percent of the samples analyzed shall be blanks (charcoal having no radioactivity added).

5.3.5 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

ELI has performed a method detection limit (MDL) study using EPA's standard MDL definition and procedure. In addition, the following precision calculation is utilized at the laboratory at a 90% (2 sigma) confidence level:

$$\frac{2 \times \sqrt{SampleCount + BackgroundCount}}{SampleCount - BackgroundCount}$$

5.4 Reporting

The results of the individual flux measurements, the approximate locations on the pile, and the mean radon flux for 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 measurements that could significantly affect the results should be reported.

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 impoundments,
- 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.

6.0 REFERENCES

6.1 EPA Method 115, 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

6.2 EPA's publication 520/5-85-029, *Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida.*

6.3 EPA publication 520/1-89-009, *Indoor Radon and Radon Decay Product Measurement Protocols*, updated and made into two documents;

6.4 EPA 402-R-92-004, *Indoor Radon and Radon Decay Products Measurement Device Protocols*, July 1992, and

6.5 EPA 402-R-92-003, *Protocols For Radon and Radon Decay Product Measurements In Homes*, June 1993.

6.6 EPA 520/5-87-005, *EERF Standard Operating Procedure for Rn-222 Measurement Using Charcoal Canisters*, June 1987.

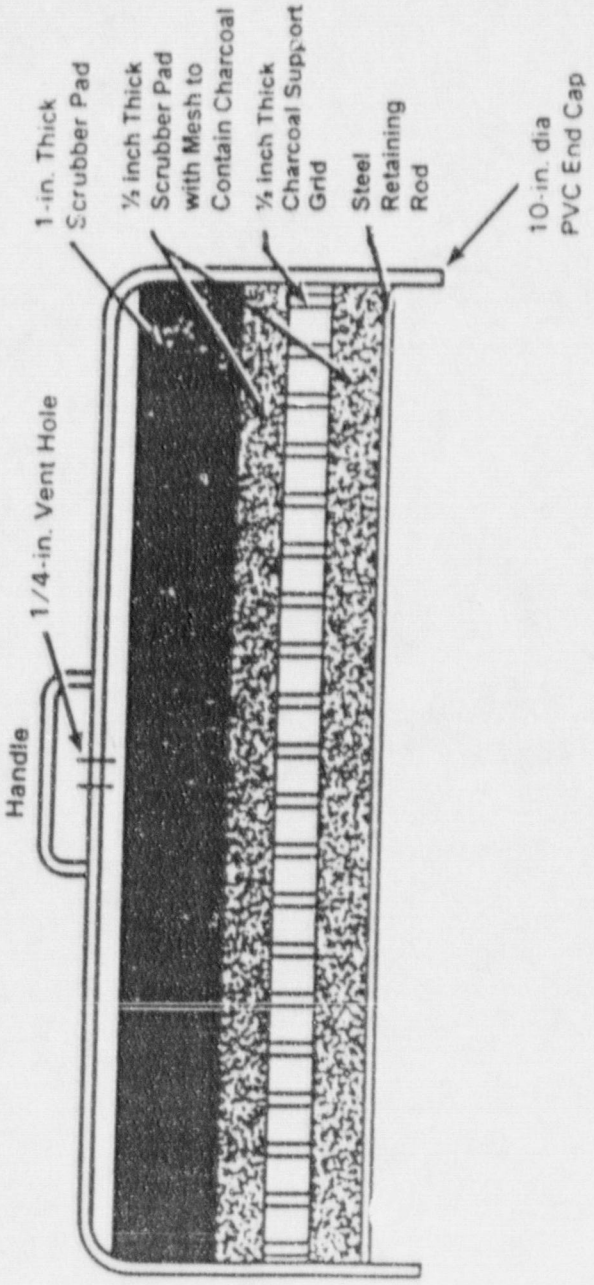
6.7. Copies of ELI's Quality Assurance and certifications are available upon request.

7.0 ATTACHMENTS

7.1 Diagram of LAACC device
7.2 Chain of Custody
7.3 Field Notes Form
7.4 Example of Report
7.5 Memo to File regarding EPA's informal field and laboratory audit of ELI's LAACC program.
7.6 Record of Acknowledgment/Signature Page

7.1 DIAGRAM OF LARGE AREA COLLECTOR

SOP ELI-C-50-907-01



Large Area Radon Collector

7.2 CHAIN OF CUSTODY

SOP ELI-C-50-907-01

M E M O R A N D U M

To: *LAACC Users*

From: *Sheryl Garling with Energy Laboratories, Inc.*

Subject: *Chain-of-Custody For Large Area Activated Charcoal Canister (LAACC) Units*

ELI has designed this memorandum to serve as (1) *Chain-of-Custody* for shipping and receiving the LAACC Units and supplies that accompany the equipment, (2) directions on transfer of activated carbon to and from: LAACC Units, and (3) placement information.

Packed by: _____, ELI-Casper Branch, Casper, Wyoming.

The LAACC Units have been shipped or delivered to:

Company Name: _____

Street Address: _____

City, State, Zip: _____

Phone & Fax: _____

Contact Person: _____

LAACC Units Shipped & No=s: _____ LAACC Units Rec=d & No=s: _____

Charcoal Cans Shipped & No=s: _____ Charcoal Cans Rec=d & No=s: _____

The attached *Large Area Activated Charcoal Canister (LAACC) Field Notes* table should be used when placing the LAACC Unit onto the tailings impoundments or stacks. The data necessary to generate proper radon flux is transcribed from your notes. Please write clearly. Field notes should be copied and one set returned to the laboratory along with LAACC Units, canisters, and any other equipment.

The following materials would be helpful for LAACC Unit set up and transfer of charcoal:

- funnel and holder,
- silicon grease,
- pliers,
- extra electrical tape, and
- a table within a building.

When transferring activated carbon (charcoal) into the LAACC Unit (preferably inside a building), care should be taken that:

- charcoal is leveled into the units,
- charcoal canister number has been identified to the corresponding LAACC unit number on the field notes, and
- the retaining rod is securely placed back into position.

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Page ____ Of ____

Client: Location:

Weather Condition: Precip: Min Temp:

Inst.: _____ Eff: _____ Tech: _____
Inst. Back: _____
Charcoal Back: _____ Lot: _____
Standard: _____ Count: _____

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments

ENERGY LABORATORIES, INC.
SHIPPING: 2393 SALT CREEK HIGHWAY • CASPER, WY 82601
MAILING: P.O. BOX 3258 • CASPER, WY 82602
E-mail: energy@trib.com • FAX: (307) 234-1639 • PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

7.4 EXAMPLE OF REPORT

SOP ELI-C-50-907-01

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report

Project: COMPANY NAME
Location: Project Name
Report Date: September 10, 1996

Date Set: August 13, 1996
Date Remove: August 14, 1996
Weather: *Fair/Clear/min. temp 50 degrees F.
Date Counted: August 15, 1996

Method: Comapany's employees placed and retrieved LAACC units. EPA Method 115 per 40 CFR Part 61 (NESHAPs). Radon Flux results have been corrected for instrument & charcoal counts.

Lab I.D.	LAACC #	Canister #	Location	08-13-96 Time Set	08-14-96 Time Remove	Radon Flux pCi/m2s
96- 45644	1	1	1	09:14	09:15	10.4
96- 45645	2	2	2	09:14	09:15	3.5
96- 45646	3	3	3	09:15	09:15	6.7
96- 45647	4	4	4	09:16	09:16	0.6
96- 45648	5	5	5	09:16	09:17	<0.5
96- 45649	6	6	6	09:17	09:18	15.5
96- 45650	7	7	7	09:18	09:18	2.6
96- 45651	8	8	8	09:20	09:20	1.1
96- 45652	9	9	9	09:21	09:21	1.5
96- 45653	10	10	10	09:22	09:22	4.3
96- 45654	11	11	11	09:25	09:25	<0.5
96- 45655	12	12	12	09:26	09:26	8.1
96- 45656	13	13	13	09:27	09:27	11.1
96- 45657	14	14	14	09:27	09:27	1.0
96- 45658	15	15	15	09:29	09:29	16.8
96- 45659	16	16	16	09:30	09:32	24.6
96- 45660	17	17	17	09:31	09:32	14.0
96- 45661	18	18	18	09:32	09:33	5.3
96- 45662	19	19	19	09:32	09:33	8.9
96- 45663	20	20	20	09:35	09:35	33.5
96- 45664	21	21	21	09:38	09:38	6.5
96- 45565	22	22	22	09:41	09:41	2.2
96- 45666	23	23	23	09:41	09:41	1.3
96- 45667	24	24	24	09:41	09:42	1.6
96- 45668	25	25	25	09:43	09:43	0.9
96- 45669	26	26	26	09:44	09:44	3.1
96- 45670	27	27	27	09:45	09:45	3.6
96- 45671	28	28	28	09:47	09:47	3.0
96- 45672	29	29	29	09:47	09:47	2.1
96- 45673	30	30	30	09:48	09:48	5.0
96- 45674	31	31	31	09:49	09:49	6.8

wish f:\ww\dfdata\laacc\report.xls

Large Area Activated Charcoal Canister (LAACC) Radon Flux Quality Assurance Report

Project: COMPANY NAME

Location: Project Name

Report Date: September 10, 1996

Date Set: August 13, 1996

Date Remove: August 14, 1996

Weather: *Fair/Clear/min. temp 50 degrees F.

Date Counted: August 15, 1996

Date Counted	Blank Charcoal cpm	Standard No. 1 cpm	Standard No 2 cpm
08-15-96	98	1701	3384
08-15-96	94	1618	3421
08-15-96	90	1698	3358
Average	94	1672	3388

TRIP BLANKS		
Date Counted	Canister No.	Radon Flux** pCi/m2s
8-15-96	Trip Blank - 1	<0.5
8-15-96	Trip Blank - 2	<0.5
8-15-96	Trip Blank - 3	<0.5
8-15-96	Trip Blank - 4	<0.5
8-15-96	Trip Blank - 5	<0.5
8-15-96	Trip Blank - 6	<0.5
8-15-96	Trip Blank - 7	<0.5
8-15-96	Trip Blank - 8	<0.5
8-15-96	Trip Blank - 9	<0.5
8-15-96	Trip Blank -10	<0.5
8-15-96	Trip Blank -11	<0.5
8-15-96	Trip Blank -12	<0.5
8-15-96	Trip Blank -13	<0.5
8-15-96	Trip Blank - 14	<0.5
8-15-96	Trip Blank - 15	<0.5
8-15-96	Trip Blank - 16	<0.5
8-15-96	Trip Blank - 17	<0.5
8-15-96	Trip Blank - 18	<0.5
8-15-96	Trip Blank - 19	<0.5
8-15-96	Trip Blank - 20	<0.5
8-15-96	Trip Blank - 21	<0.5
8-15-96	Trip Blank - 22	<0.5
8-15-96	Trip Blank - 23	<0.5
8-15-96	Trip Blank - 24	<0.5
8-15-96	Trip Blank - 25	<0.5

Large Area Activated Charcoal Canister (LAACC) Radon Flux Quality Assurance Report

Project: COMPANY NAME

Location: Project Name

Report Date: September 10, 1996

Date Set: August 13, 1996

Date Remove: August 14, 1996

Weather: *Fair/Clear/min. temp 50 degrees F.

Date Counted: August 15, 1996

DUPLICATES			
Date Counted	Cannister No.	Radon Flux** pCi/m2s	Recovery Decimal
8-15-96	Duplicate - 45653	4.1	0.9
8-15-96	Duplicate - 45663	23.4	0.7
8-15-96	Duplicate - 45673	5.1	1.0
8-15-96	Duplicate - 45683	0.3	0.8
8-15-96	Duplicate - 45693	19.8	1.0
8-15-96	Duplicate - 45703	2.0	1.1
8-15-96	Duplicate - 45713	5.6	1.1
8-15-96	Duplicate - 45723	3.0	1.1
8-15-96	Duplicate - 45733	56.6	1.0
8-15-96	Duplicate - 45743	6.3	1.0
8-15-96	Duplicate - 45753	1.9	0.9
		Average of Replicates:	1.0

REPORT SUMMARY	
Minimum Measurement	< 0.5 pCi/m2s
Maximum Measurement	55.2 pCi/m2s
Average Radon Flux for #1-100	8.85 pCi/m2s

*Minimum temperature under 35 degrees Fahrenheit not acceptable.

**Note: ELI's Radon Flux Practical Quantitative Limit (POL) is 0.5 pCi/m2s.

Report Approved By:

lmh tyw\d\data\laacc\report.xls

Reviewed By:

MEMORANDUM

Date: *June 10, 1997*

To: *Energy Laboratories, Inc. File*

From: *Sheryl Garling with Energy Laboratories, Inc. - Casper, Wyoming*

Subject: *Summer of 1990 Unofficial Audit of ELI's Large Area Activated Charcoal Canister (LAACC) Program - From the Field to the Laboratory*

To date Energy Laboratories, Inc. (ELI) has not been officially audited by any regulatory agency regarding its Large Area Activated Charcoal Canister (LAACC -radon flux) program. On June 9, 1997 Milt Lammering with U.S. Environmental Protection Agency (EPA) in Denver was contacted to verify if there was any unofficial documentation made to file regarding ELI's radon flux program. **His response was that during an unofficial audit no documentation is made if all aspects of the audit are acceptable to the agency.**

To clarify the unofficial audit the following background information has been recorded:

Pathfinder Mines Corporation's Shirley Basin Operation scheduled to perform radon flux measurements for their tailings impoundment. They contacted the EPA's representative, Milt Lammering, and requested that he provide an on site audit of the program that ELI proposed. Milt Lammering and Bob Tower, EPA's Certification Officer for radiochemistry from Las Vegas, Nevada, visited the site during the time the collectors were deployed. They observed all aspects of the program from deployment to retrieval, charcoal transfer to and from collectors, and laboratory procedures for accepting samples, logging into laboratory, laboratory equipment, and analysis.

At no time, during the unofficial audit was there any comments or concerns regarding ELI's protocol. ELI designed the radon flux program from all the EPA documentation that was published at the time. The radon flux program has been maintained, since its inception, to the rigorous guidelines published by EPA.

To date, all ELI data submitted by clients, has not been questioned by the regulatory agencies overseeing the program.

For additional information please see SOP Section 6.0, *References*.

7.6 Record of Acknowledgment/Signature

SOP ELI-C-50-907-01

My signature below constitutes my acknowledgment that I have read and understand this SOP.

Date	*Print Name*	*Signature*

CALCULATIONS

1, 2 & 3

ANSWER TO REQUEST 2 & 3

Calculation 1

Accuracy Calculation for Standards as identified by the USNRC:

$$\frac{\text{Measured - Actual}}{\text{Actual}}$$

Calculation 2

Precision Calculation as identified by the USNRC:
Known as Percent difference:

$$\frac{\text{Duplicate Count \#1 - Duplicate Count \#2}}{\text{Average (Duplicate \#1, Duplicate \#2)}}$$

Calculation 3

Data Counting error 2-sigma as defined by USEPA Standard Operating Procedure for Radon-222 Measurement Using Charcoal Canisters EPA 520/5-87-005is calculated as follows:

@ 95% confidence,
Expressed in decimal percent, or multiply by 100 for %

$$2 \times \frac{\text{square root (Gross Counts + Background Counts)}}{\text{Gross Counts - Background Counts}}$$

Supplement to Large Area Activated Charcoal Canisters October 7, 1996 Report
Quality Assurance Calculations

Calculation 1 - Standard Accuracy	
Description	**Data**
Equipment Efficiency - cpm/dpm	0.00896
dpm/pCi	2.22
Count Time - minutes	5
Background - gross counts	125
Background - cpm	25
Standard 1 - pCi/can, actual	18210
Standard 2 - pCi/can, actual	36420
Standard 1 - average gross counts, measured	1810
Standard 2 - average gross counts, measured	3591.7
Standard 1 - average gross cpm, measured	362
Standard 2 - average gross cpm, measured	718.34
Standard 1 - average net cpm, measured	337
Standard 2 - average net cpm, measured	693.34
Standard 1 - average pCi/can, measured	16952
Standard 2 - average pCi/can, measured	34876
Standard 1 - (Measure-Actual)/Actual, %	-6.91
Standard 2 - (Measured-Actual)/Actual, %	-4.24

Calculation 2 - Precision			
Description	**Count Gross Counts**	**Duplicate Gross Counts**	**(Dup1-Dup2)/ Avg(Dup1&Dup2)**
Duplicate 1 - 54353 - 4.5/4.4 pCi/m2s	7109	6967	2.02
Duplicate 2 - 54363 - <0.5/<0.5 pCi/m2s	457	459	-0.44
Duplicate 3 - 54373 - <0.5/<0.5 pCi/m2s	218	217	0.46
Duplicate 4 - 54383 - <0.5/<0.5 pCi/m2s	363	362	0.28
Duplicate 5 - 54393 - 2.9/2.9 pCi/m2s	4666	4641	0.54
Duplicate 6 - 54403 - 09./0.8 pCi/m2s	1390	1321	5.09
Duplicate 7 - 54413 - <0.5/<0.5 pCi/m2s	542	510	6.08
Duplicate 8 - 54423 - <0.5/<0.5 pCi/m2s	530	528	0.38
Duplicate 9 - 54433 - <0.5/<0.5 pCi/m2s	298	289	3.07
Duplicate 10 - 54443 - <0.5/<0.5 pCi/m2s	710	668	6.10
Duplicate 11 - 54453 - 6.4/6.5 pCi/m2s	4881	4962	-1.65
Duplicate 12 - 54463 - 0.7/0.7 pCi/m2s	528	508	3.86
Average - % Difference			2.16

Supplement to Large Area Activated Charcoal Canisters October 7, 1996 Report
Quality Assurance Calculations

Calculation 3 - Data Counting Error		
Data Precision	**Data**	**Precision, %**
Background gross counts	125	
Count Time - minute	5	
54368 Data - 0.7 pCi/m2s, gross counts	1076	7.29
gross counts + background	1201	
gross counts - background	951	
54362 Data - 1.2 pCi/m2s, gross counts	1875	5.11
gross counts + background	2000	
gross counts - background	1750	
54388 Data - 5.0 pCi/m2s, gross counts	7975	2.29
gross counts + background	8100	
gross counts - background	7850	
54414 Data - 11.6 pCi/m2s, gross counts	16672	1.57
gross counts + background	16797	
gross counts - background	16547	
54416 Data - 16.4 pCi/m2s, gross counts	23614	1.41
gross counts + background	24815	
gross counts - background	22413	
54395 Data - 20.8 pCi/m2s, gross counts	33226	1.20
gross counts + background	35226	
gross counts - background	31226	
54415 Data - 47.1 pCi/m2s, gross counts	67719	0.92
gross counts + background	75819	
gross counts - background	59619	
54357 Data - 86.8 pCi/m2s, gross counts	137581	0.65
gross counts + background	154378	
gross counts - background	120784	

SUMMARY OF RADON EMINATION TESTING

ANSWER TO REQUEST #4

3.0 Summary of Radon Emanation Testing

The first radon sampling containers were set out at 0947 and the last one at 1331 on September 25, 1996. The first sampling containers were removed at 0914 and the last one at 1340 on September 26. Because of the threat of rain on the morning of the 26th, twenty-six of the first samples removed were short of the 24 hour exposure time, nineteen at 33 to 52 minutes short, and seven at 63 to 71 minutes short. The rest of the eighty-nine samples were exposed from 24 hours to 24 hours and 15 minutes.

During the sampling, the minimum temperature was 44°F, cloudy with mild wind. We did receive about a five-minute sprinkle of rain on each day. The rain was not enough to really wet the ground so no puddling occurred. The regulations require that no puddling of rain occurs during the sampling period.

The charcoal containers and canisters were obtained from Energy Laboratories, Inc., in Casper, Wyoming. The charcoal used was received pre-weighed in the shipping containers sealed with tape. Immediately prior to setting the sample canisters in the field, the charcoal was transferred from the shipping container tot he sampling canisters at UNC's administration office. At the end of the exposure time, the canisters were picked up brought back to the administration office, transferred back into the corresponding shipping container, sealed with tape and shipped UPS overnight back to Energy Laboratories, Inc., for the samples to be analyzed.

4.0 Summary of Radon Results

Total number of samples set out on tailings	115
Total number of usable samples	112
Total number of trip blanks	25
Total number of laboratory duplicates	12
Average radon flux for tailings	5.71 pci/m²s
Minimum radon flux for tailings	0.5 pci/m²s
Maximum radon flux for tailings	86.81 pci/m²s

Copy of laboratory report, chain of custody, and site map showing sampling locations is enclosed in Appendix A

SAMPLE NARRATIVE

ANSWER TO REQUEST #5

ENERGY LABORATORIES, INC.
SHIPPING: 2393 SALT CREEK HIGHWAY • CASPER, WY 82601
MAILING: P.O. BOX 3258 • CASPER, WY 82602
E-mail: energy@trib.com • FAX: (307) 234-1639 • PHONE: (307) 235-0515 • TOLL FREE: (888) 235-0515

SAMPLE NARRATIVE

Date:	November 5, 1997
Client:	United Nuclear Corporation
Location:	Gallup, NM
Laboratory Method:	EPA Method 115
Method Name:	Large Area Activated Charcoal Canister (LAACC) Radon Flux Measurement
Sample Numbers:	96-54354 through 96-54468
Prepared By:	Sheryl A. Garling

On September 25, 1996, United Nuclear Corporation's employees placed 115-LAACC units on their tailings. All 115-LAACC units were deployed on the tailings; no field duplicates or background location measurements were made. UNC established the survey grid. The units were removed September 26,1 996, after 24 hours of exposure.

The Standard Operating Procedure provided to UNC in the previous years and the method described therein is the same SOP supplied to the USNRC (Ken Hooks and Bob Evans) on June 11, 1997. The only change was the SOP format. To date there has not been any request to change EPA Method 115 in ELI SOPs.

In 1996 there was no request for leak testing the cans for the LAACC projects, by the clients, in 1996. Only recently (1997) have clients been requesting leak testing of canisters upon completion of analyses. As suspected the canisters ***do not*** leak in ambient water (submerged for a minimum of one minute). The protocol for measuring radon (radon flux) and measurement methodology has been research and developed by EPA during their investigation for home radon and environmental health issues. All the data generated has been published and listed in the bibliography section of ELI's SOP.

Prepared By: Sheryl Garling Date: 11/6/97

NEW RADON SAMPLE SITE MAP
SHOWING THE SAMPLING POINTS AND
ACTUAL LIMITS OF TAILING

ANSWER TO REQUEST #6

MEMO FROM RADIATION TECH, MAX CHISCHILLY, JR.

ANSWER TO REQUEST #7

UNITED NUCLEAR CORPORATION

P.O. Box 3077
Gallup, New Mexico 87305-3077

Telephone: (505) 722-6651
Fax: (505) 722-6654

To: Edward M. Morales Date: 10/10/97

From: Max Chischilly Jr.
Max Chischilly, Jr. - Radiation Technican

Subject: Weather Events during United Nuclear's 1996 Radon Emanation Sampling

I personally certify that the following field procedure or condition occurred.

1. Temperature and precipitation readings enclosed in Table attached.

2. LAACC placement was postponed on 9/24/96 due to overcast and chance of rainfall. There was no rainfall that day.

3. LAACC Placement was performed on 9/25/96. On that day we did get about a 5 minute sprinkle rain event.

4. At 0900 on 9/26/96 another 5 minute sprinkle rain event occurred. We thought the five minute event was going to be longer, so 26 of the LAACC unites were removed short of 24 hours exposure period. (i.e. 19 at 33 to 52 minutes short, 7 at 63 to 71 minutes short).

5. No LAACC unit seal was broken nor was the seal around the units surrounded by water the ground was not even damp. Upon transferring the charcoal from LAACC unit #18 it seemed to have some moisture in it. During the rain sprinkle some moisture could have gone in the vent hole of the LAACC unit.

6. The ambient minimum temperature was above 35° F and precipitation recorded at our tailing site weather station was less than 0.025 inches.

TEMPERATURE AND PRECIPITATION READINGS PRIOR, DURING AND AFTER RADON EMANATION SAMPLING

Date	Time	Present Temperture	Previous Day Temperature (°F)	Previous Day Precipitation (IN.)
9/23/97	0900	60	35 (Low) 74 (HI.)	0
9/24/97	0840	53	38 (Low) 77 (HI.)	0
9/25/97	0831		41 (Low) 69 (HI.)	0
9/26/97	0800	49	44 (Low) 71 (HI.)	Trace (≤.025") at Tailings Weather Station
9/27/97	0900	39	36 (Low) 36 (HI.)	0

NEW QUALITY ASSURANCE REPORT FROM ELI

ELI

Large Area Activated Charcoal Canister (LAACC) Radon Flux Quality Assurance Report

Project:	**UNC MINING & MILLING**	**Date Set:**	**09-25-96**
Location:	**Churchrock Mill Site Tailings Cell**	**Date Remove:**	**09-26-96**
Report Date:	**October 7, 1996, revised 01/15/97**	**Date Counted:**	**09-27-96**
Weather:	**Cloudy, mild wind, slight short shower on 9-25 (p.m.) & 9-26 at 09:00. Min. temp 44°.**		

Trip Blank - Lab I.D.	Cannister #	Radon Flux - pCi/m²s*
96- 54469	9	<0.5
96- 54470	10	<0.5
96- 54471	11	<0.5
96- 54472	12	<0.5
96- 54473	13	<0.5
96- 54474	14	<0.5
96- 54475	15	<0.5
96- 54476	16	<0.5
96- 54477	17	<0.5
96 54478	18	<0.5
96- 54479	19	<0.5
96- 54480	20	<0.5
96- 54481	21	<0.5
96 54482	22	<0.5
96- 54483	23	<0.5
96- 54484	24	<0.5
96- 54485	25	<0.5

Blank Charcoal cpm	Standard Number 1 cpm	Standard Number 2 cpm
125	1810	3592

Total Number of Laboratory Duplicates:	12
Total Number of Field Duplicates:	NA
Total Number of Trip Blank Cannisters:	17
Total Number of Measurements On Tailings Cell:	112

Average Radon Flux for Tailings Cell, revised: 5.67 pCi/m²s

Removed -1A, -3C,-5G from average due to samples outside limits of tailings disposal area

Minimum Radon Flux for Tailings Cell: <0.5 pCi/m²s

Maximum Radon Flux for Tailings Cell: 86.81 pCi/m²s

* Note: ELI's Radon Flux Practical Quantitative Limit (PQL) is 0.5 pCi/m²s.

Report Approved By: Sheryl Hanberg

lmh f:\reports\client96\unc\9654354

OVERSIZE
DOCUMENT
PAGE(S) PULLED

SEE APERTURE CARD FILES

APERTURE CARD/PAPER COPY AVAILABLE THROUGH NRC FILE CENTER

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARD(S) 1

ACCESSION NUMBERS OF OVERSIZE PAGES:

[redacted]

9802170028-01

DRP-08