THE STATE OF WYOM

JIM GERINGER
GOVERNOR

Department of Environmental Quality

250 Lincoln Street • Lander, Wyoming 82520-2848 • Fax (307) 332-7726

ABANDONED MINES (307) 332-5085	AIR QUALITY (307) 332-6755	LAND QUALITY (307) 332-3047	SOLID & HAZARDOUS WASTE (307) 332-6924	WATER QUALITY (307) 332-3144

August 20, 1997

CERTIFIED MAIL RETURN RECEIPT REQUESTED NO. P 557 587 221

40-4492

US EPA - Region Eight
ATTN: Mr. Milton Lammering, 8P2-TX
Branch Chief, Toxics Program
999 18th Street, Suite 500
Denver, CO 80202-2466

RE: **American Nuclear (ANC) Tailings Reclamation Project**
Report of Results From 6/21-22/97 Radon Flux Test

Dear Sir,

In accordance with the requirement of 40 CFR Subpart T § 61.23(b), I am transmitting a report of the results of a radon flux test conducted on ANC Tailings Pond No. 2 on June 21 and 22, 1997. The test was conducted in accordance with the procedures specified in Method 115 of Appendix B of 40 CFR part 61. The test was conducted by Ms. Sheryl Garling of Energy Labs in Casper.

If you have any questions, please contact me or Ms. Garling.

Sincerely,

Mark Moxley
LQD District Supervisor

Enclosure

170120

NMS051

cc: Rick Chancellor DEQ-LQD, w/enclosure
Ken Hooks - NRC, w/enclosure
Sheryl Garling - ELI Casper, w/o enclosure

Drawer - Jim Cantrell

THE STATE OF WYOMING

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Department of Environmental Quality

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September 8, 1997

Mr. Kenneth Hooks, Project Manager
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

RE: American Nuclear Gas Hills Project
Additional Copies of Report of Results from 6/21-22/97 Radon Flux Test

Dear Mr. Hooks,

As requested, enclosed are two additional copies of the report on radon flux test results which was previously sent under cover of my letter dated August 20, 1997.

If you or any of the staff have any questions, please contact me.

Sincerely,

Mark Moxley,
LQD District 2 Supervisor

Enclosure

cc w/o enclosure: R. Chancellor, DEQ-LQD, Cheyenne
J. Voeller, AVI p.c., Cheyenne

40-4492 AMERICAN NUCLEAR CORP

ANC RECLAMATION REPORT LARGE AREA ACTIVATED CHARCOAL CANISTER RADON FLUX REPORT AND GRID LAYOUT

REC'D W/LTR 8/20/97...9709170378

engineering
planning
surveying
a.v.i, pc.

2035 westland rd., cheyenne, wyoming 82001 (307) 637-6017
Fax (307) 632-9326

ANC RECLAMATION PROJECT

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) RADON FLUX REPORT AND GRID LAYOUT

JULY 30, 1997

ANC RECLAMATION REPORT

LARGE AREA ACTIVATED CHARCOAL CANISTER
(LAACC)
RADON FLUX REPORT
AND
GRID LAYOUT

JULY 30, 1997

PREPARED FOR:

State of Wyoming
Department of Environmental Quality
Land Quality Division
250 Lincoln Street
Lander, Wyoming 82520

PREPARED BY:

A.V.I. Professional Corporation
2035 Westland Road
Cheyenne, Wyoming 82001
(307) 637-6017

REPORT OF RADON FLUX TEST

SITE: American Nuclear Corporation (ANC), Gas Hills Uranium Mill Tailings

LOCATION: Section 28, Township 33 North, Range 90 West, Fremont County, Wyoming

PROJECT MANAGEMENT: Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD)

TAILINGS FACILITIES STATUS:

- Tailings Pond No. 1 - Interim cover last placed in January, 1996. Presently awaiting pond settlement and consolidation prior to placement of final cover and erosion protection, which is currently projected to occur in 2000.

- Tailings Pond No.2 - Final cover placed June, 1997, immediately prior to this LAAC test. Presently, the final erosion protection (rip-rap) is being placed.

RADON CONTROL MEASURES:

The design of the radon cover is described in the site reclamation plan which was submitted to the Nuclear Regulatory Commission (NRC). Radon emanation was modeled using the NRC-prescribed methodology. The radon cover consists of an average of 2.7 feet of interim (mine spoil) cover, plus 3 feet of compacted mine spoil material, plus 3 feet of compacted clean borrow material.

TAILINGS POND NO. 2 LAAC TEST:

The LAAC test was conducted on June 21 and 22, 1997. This report contains all of the laboratory test results, a map of the canister locations and a description of standard operationg procedures that were followed. Persons participating in the test were: Sheryl Garling, Roger Garling, Don Juarez - Energy Laboratories; Bruce Perryman, Scott Cowley, Ray Robison - AVI p.c.; Mark Moxley - WDEQ-LQD. Weather conditions during the test were warm and sunny. The overnight low was 57 degrees F and the high was 86 degrees F.

CERTIFICATION:

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001.

8-18-97

Mark Moxley, Project Manager WDEQ-LQD

THE STATE OF WYOMING

M GERINGER
GOVERNOR

Department of Environmental Quality

250 Lincoln Street ● Lander, Wyoming 82520-2848 ● Fax (307) 332-7726

ABANDONED MINES (307) 332-5085	AIR QUALITY (307) 332-6755	LAND QUALITY (307) 332-3047	SOLID & HAZARDOUS WASTE (307) 332-6924	WATER QUALITY (307) 332-3144

May 21, 1997

CERTIFIED MAIL RETURN RECEIPT REQUESTED NO. P214 397 035

US EPA - Region Eight
ATTN: Mr. Milton Lammering, 8P2-TX
Branch Chief, Toxics Program
999 18th Street, Suite 500
Denver, CO 80202-2466

RE: American Nuclear Tailings Reclamation Project
Notification of Radon Flux Test

Dear Sir,

This letter is intended to satisfy the requirement of 40 CFR Subpart T § 61.23(b) that notice be given to EPA 30 days prior to a radon flux test. **It is our intent to conduct the required radon flux test on the ANC tailings pond no.2 on June 21, 1997,** or as soon as possible thereafter, dependent on weather conditions. The test will be conducted in accordance with the procedures specified in Method 115 of Appendix B of 40 CFR part 61. The test will be conducted by Ms. Sheryl Garling of Energy Labs in Casper.

If you have any questions, please contact me or Ms. Garling.

Sincerely,

Mark Moxley
LQD District Supervisor

cc: Rick Chancellor DEQ-LQD
fax: Ken Hooks - NRC
Robert Evans - NRC
Sheryl Garling - Energy Labs
Jim Voeller - AVI p.c.

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

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report - AVI

Project:	**AMERICAN NUCLEAR, INC.**	**Date Set:**	**06-21-97**
Location:	**Gas Hills - Tailings Pond #2**	**Date Remove:**	**06-22-97**
Report Date:	**June 24, 1997**	**Date Counted:**	**06-23-97**
Weather:	**Clear & sunny, slight breeze, min. temp 57°.**		

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

Lab ID		LAACC #	Canister #	Location	06-21-97 Time Set	06-22-97 Time Remove	Radon Flux pCi/m^2s
97-	34951	16	28	206	09:00	09:18	<0.5
97-	34952	68	99	207	09:02	09:18	<0.5
97-	34953	63	52	208	09:04	09:19	<0.5
97-	34954	87	87	209	09:05	09:19	<0.5
97-	34955	62	119	210	09:06	09:20	<0.5
97-	34956	81	110	211	09:08	09:20	<0.5
97-	34957	67	97	212	09:08	09:20	<0.5
97-	34958	59	86	232	09:11	09:37	<0.5
97-	34959	35	96	231	09:13	09:38	<0.5
97-	34960	114	115	230	09:15	09:38	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	34961	40	43	229	09:16	09:39	<0.5
97-	34962	54	88	228	09:17	09:39	<0.5
97-	34963	36	117	227	09:18	09:40	<0.5
97-	34964	37	92	226	09:20	09:40	<0.5
97-	34965	74	95	225	09:21	09:41	<0.5
97-	34966	23	118	224	09:23	09:41	<0.5
97-	34967	26	98	223	09:25	09:42	<0.5
97-	34968	107	109	201	09:05	09:12	<0.5
97-	34969	30	2	202	09:07	09:12	<0.5
97-	34970	95	74	203	09:08	09:13	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	34971	61	3	204	09:09	09:13	<0.5
97-	34972	46	81	205	09:10	09:14	<0.5
97-	34973	4	80	213	09:11	09:15	<0.5
97-	34974	6	112	214	09:12	09:15	<0.5
97-	34975	25	8	215	09:13	09:16	<0.5
97-	34976	41	83	216	09:14	09:16	<0.5
97-	34977	78	70	217	09:15	09:16	<0.5

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SEP 05 1997

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report - AVI

Project:	**AMERICAN NUCLEAR, INC.**	**Date Set:**	**06-21-97**
Location:	**Gas Hills - Tailings Pond #2**	**Date Remove:**	**06-22-97**
Report Date:	**June 24, 1997**	**Date Counted:**	**06-23-97**
Weather:	**Clear & sunny, slight breeze, min. temp 57°.**		

Lab ID		LAACC #	Canister #	Location	06-21-97 Time Set	06-22-97 Time Remove	Radon Flux pCi/m^2s
97-	34978	3	114	218	09:16	09:21	<0.5
97-	34979	48	9	219	09:17	09:22	<0.5
97-	34980	92	12	220	09:18	09:22	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	34981	15	56	221	09:19	09:23	<0.5
97-	34982	22	120	243	09:20	09:26	<0.5
97-	34983	45	85	242	09:21	09:27	<0.5
97-	34984	21	55	241	09:23	09:28	<0.5
97-	34985	105	7	241	09:23	09:49	<0.5
97-	34986	5	105	240	09:24	09:50	<0.5
97-	34987	113	27	239	09:26	09:50	<0.5
97-	34988	58	108	238	09:27	09:51	<0.5
97-	34989	64	94	237	09:28	09:51	<0.5
97-	34990	49	21	236	09:29	09:52	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	34991	9	23	235	09:30	09:52	<0.5
97-	34992	27	100	234	09:31	09:53	<0.5
97-	34993	93	91	233	09:32	09:53	<0.5
97-	34994	111	32	255	09:34	09:54	<0.5
97-	34995	28	16	256	09:36	09:55	<0.5
97-	34996	47	20	256	09:36	09:55	<0.5
97-	34997	53	26	257	09:37	09:56	<0.5
97-	34998	97	113	258	09:38	09:56	<0.5
97-	34999	51	11	259	09:40	09:57	<0.5
97-	35000	2	111	260	09:41	09:57	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	35001	110	25	261	09:42	09:58	<0.5
97-	35002	71	107	222	09:27	10:04	<0.5
97-	35003	13	75	244	09:30	10:06	<0.5*
97-	35004	91	42	245	09:31	10:07	<0.5
97-	35005	29	116	246	09:32	10:07	<0.5

***Unit was cracked.**

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Large Area Activated Charcoal Canister (LAACC) Radon Flux Report - AVI

Project:	**AMERICAN NUCLEAR, INC.**	**Date Set:**	**06-21-97**
Location:	**Gas Hills - Tailings Pond #2**	**Date Remove:**	**06-22-97**
Report Date:	**June 24, 1997**	**Date Counted:**	**06-23-97**
Weather:	**Clear & sunny, slight breeze, min. temp 57°.**		

Lab ID		LAACC #	Canister #	Location	06-21-97 Time Set	06-22-97 Time Remove	Radon Flux pCi/m^{2}s
97-	35006	33	33	247	09:34	10:08	1.8
97-	35007	65	78	248	09:35	10:08	<0.5
97-	35008	60	15	249	09:37	10:09	<0.5
97-	35009	32	45	250	09:39	10:09	<0.5
97-	35010	112	39	251	09:40	10:10	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	35011	77	82	252	09:42	10:10	<0.5
97-	35012	42	29	253	09:44	10:11	<0.5
97-	35013	109	10	254	09:45	10:11	<0.5
97-	35014	75	79	272	09:50	10:12	<0.5
97-	35015	34	51	271	09:50	10:13	<0.5
97-	35016	57	35	270	09:52	10:14	<0.5
97-	35017	31	48	269	09:54	10:15	<0.5
97-	35018	66	50	268	09:55	10:15	<0.5
97-	35019	96	72	262	09:43	10:23	<0.5
97-	35020	44	13	263	09:44	10:23	<0.5
97-	35021	52	59	371	09:45	10:22	<0.5
97-	35022	56	84	281	09:47	10:24	<0.5
97-	35023	24	24	280	09:48	10:25	<0.5
97-	35024	72	34	279	09:49	10:26	<0.5
97-	35025	69	69	278	09:51	10:27	<0.5
97-	35026	98	71	277	09:52	10:27	<0.5
97-	35027	1	47	276	09:53	10:28	0.5
97-	35028	99	68	275	09:54	10:28	0.5
Duplicate		-	-	-	-	-	0.5
97-	35029	50	4	274	09:55	10:29	0.5
97-	35030	12	41	273	09:56	10:30	0.5
97-	35031	108	38	289	09:58	10:31	0.5
97-	35032	79	17	290	10:00	10:31	0.6
97-	35033	8	49	291	10:02	10:32	0.7

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Large Area Activated Charcoal Canister (LAACC) Radon Flux Report - AVI

Project:	**AMERICAN NUCLEAR, INC.**	**Date Set:**	**06-21-97**
Location:	**Gas Hills - Tailings Pond #2**	**Date Remove:**	**06-22-97**
Report Date:	**June 24, 1997**	**Date Counted:**	**06-23-97**
Weather:	**Clear & sunny, slight breeze, min. temp 57°.**		

Lab ID		LAACC #	Canister #	Location	06-21-97 Time Set	06-22-97 Time Remove	Radon Flux pCi/m^{2}s
97-	35034	43	6	292	10:03	10:33	<0.5
97-	35035	73	77	293	10:08	10:33	0.5
97-	35036	20	37	267	09:57	10:52	1.1
97-	35037	90	102	266	09:59	10:52	<0.5
97-	35038	55	73	265	10:00	10:51	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	35039	106	90	264	10:03	10:51	<0.5
97-	35040	14	44	282	10:06	10:41	<0.5
97-	35041	10	40	283	10:08	10:41	<0.5
97-	35042	38	106	284	10:09	10:42	<0.5
97-	35043	80	103	285	10:11	10:42	<0.5
97-	35044	86	46	286	10:13	10:43	<0.5
97-	35045	70	1	287	10:14	10:43	<0.5
97-	35046	85	65	288	10:16	10:44	<0.5
97-	35047	94	31	Air Mon. Sta. Bkg.	10:30	11:05	0.6
Duplicate		-	-	-	-	-	0.6
97-	35048	82	93	294	10:10	10:45	0.5
97-	35049	7	30	295	10:11	10:46	<0.5
97-	35050	39	5	296	10:13	10:46	<0.5
97-	35051	88	36	297	10:14	10:47	<0.5
97-	35052	84	19	297	10:15	10:47	0.5
97-	35053	19	89	298	10:16	10:48	0.6
97-	35054	17	22	299	10:17	10:48	<0.5
97-	35055	76	18	300	10:18	10:49	0.6*
97-	35056	18	14	370	10:19	10:49	<0.5
Duplicate		-	-	-	-	-	<0.5
97-	35057	89	101	TP 23 Back	10:20	10:57	0.7

***Unit was cracked.**

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

Project:	AMERICAN NUCLEAR, INC.	**Date Set:**	06-21-97
Location:	Gas Hills - Tailings Pond #2	**Date Remove:**	06-22-97
Report Date:	June 24, 1997	**Date Counted:**	06-23-97
Weather:	Clear & sunny, slight breeze, min. temp 57°.		

Trip Blank - Lab ID	Cannister #	Radon Flux - pCi/m^2s*
97- 35058	1	<0.5
97- 35059	2	<0.5
97- 35060	3	<0.5
97- 35061	4	<0.5
97- 35062	5	<0.5
97- 35063	6	<0.5
97- 35064	7	<0.5
97- 35065	8	<0.5
97- 35066	9	<0.5
97- 35067	10	<0.5
97- 35068	11	<0.5
97- 35069	12	<0.5
97- 35070	13	<0.5
97- 35071	14	<0.5
97- 35072	15	<0.5
97- 35073	16	<0.5
97- 35074	17	<0.5
97- 35075	18	<0.5
97- 35076	19	<0.5
97- 35077	20	<0.5
97- 35078	21	<0.5
97- 35079	22	<0.5
97- 35080	23	<0.5
97- 35081	24	<0.5
97- 35082	25	<0.5

Blank Charcoal cpm	Standard Number 1 cpm	Standard Number 2 cpm
96	1768	3472

Total Number of Laboratory Duplicates:	11
Total Number of Field Duplicates:	NA
Total Number of Trip Blank Cannisters:	24
Total Number of Measurements On Tailings Pond #2:	115
Average Radon Flux for Tailings Pond #2:	<0.5 pCi/m^2s**
Minimum Radon Flux for Tailings Pond #2:	<0.5 pCi/m^2s**
Maximum Radon Flux for Tailings Pond #2:	1.8 pCi/m^2s**

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

**Results are the same with and without the 2 cracked LAACC units.

Report Approved By: D Landa **Reviewed By:**

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ENERGY LABORATORIES, INC. - CASPER, WYOMING

STANDARD OPERATING PROCEDURES

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

Approved By:

Originator [signature] 6/10/97 *Date*

Technical Reviewer (if applicable) [signature] 6/10/97 *Date*

ELI Quality Assurance Officer [signature] 6-10-97 *Date*

ELI Laboratory Manager [signature] 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 Gardinier 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 ~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 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.

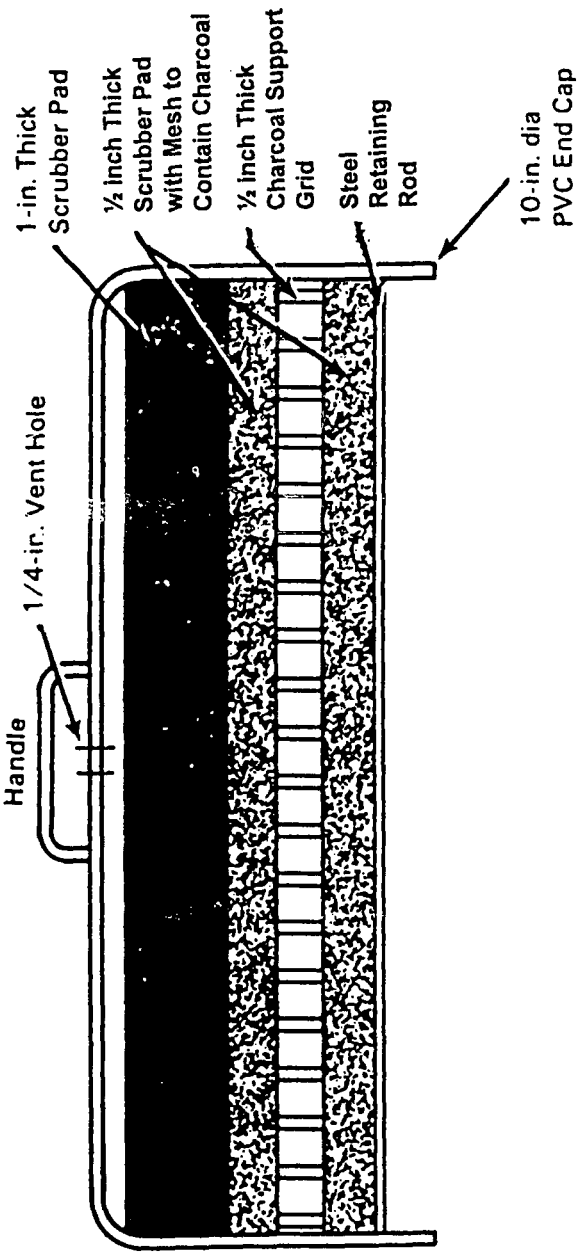
6.7. Copies of ELI's Quality Assurance and certifications are available upon request.

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.

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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	Sue 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**	**Date Set:**	**August 13, 1996**
		Date Remove:	**August 14, 1996**
Location:	**Project Name**	**Weather:**	***Fair/Clear/min. temp 50 degrees F.**
Report Date:	**September 10, 1996**	**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
45656	13	13	13	09:27	09:27	11.1
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

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

Project:	COMPANY NAME	**Date Set:**	August 13, 1996
		Date Remove:	August 14, 1996
Location:	Project Name	**Weather:**	*Fair/Clear/min. temp 50 degrees F.
Report Date:	September 10, 1996	**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
rage Radon Flux for #1-100	8.85 pCi/m2s

JUN

*Minimum temperature under 35 degrees Fahrenheit not acceptable.

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

Report Approved By:

Reviewed By:

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7.5 MEMO TO FILE REGARDING EPA'S UNOFFICIAL RADON FLUX AUDIT.

ELI SOP-50-907-01

MEMORANDUM

JUN 1 0 1997

DIST

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*

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLE :

PROJECT OVERVIEW AND LAACC GRID LAYOUT WITH LAACC GRID ID POINTS

THESE DRAWINGS CAN BE ACCESSED WITHIN THE ADAMS PACKAGE WITHIN THIS PACKAGE...

D01