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State of Idaho

INEL Oversight
Program

**Radiological Air Monitoring and Sample Analysis
Research and Development Progress Report**

January - March 1993

MASTER

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PREFACE

The INEL Oversight Program (OP) began work in 1992 to establish a network of permanent air monitoring stations around the perimeter of the Idaho National Engineering Laboratory (INEL). Sponsored as a Department of Energy (DOE) research and development grant, the project was designed to provide the public with an independent assessment of air quality resulting from operations at the INEL. This progress report summarizes the results of air sampling during the first quarter of 1993.

During 1992 and the first half of 1993, the OP obtained and operated air sampling equipment from EPA-Las Vegas and EG&G Idaho. These samplers were obtained on loan until the OP could develop specifications for and purchase instruments to be used in the permanent air monitoring network. These samplers were deployed at selected air sampling locations, while quality assurance plans and specifications for permanent samplers were developed.

The results presented in this progress report should be considered as research data. During the initial phase of establishing the air monitoring network, several modifications were made to sampling instruments and, in some cases, sampling locations. Therefore, the OP did not complete a formal quality assurance plan during this developmental program.

DISCLAIMER

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I.

INTRODUCTION

Sponsored by a Department Of Energy (DOE) research and development grant, the State of Idaho INEL Oversight Program (OP) personnel designed an independent air monitoring system that provides detection of the presence of priority airborne contaminants potentially migrating beyond INEL boundaries. Initial locations for off-site ambient air monitoring stations were chosen in consultation with: DOE and NOAA reports; Mesodif modeling; review of the relevant literature; and communication with private contractors and experts in pertinent fields.

Idaho State University (ISU) has initiated an Environmental Monitoring Program (EMP). The EMP provides an independent monitoring function as well as a training ground for students. Students learn research techniques dedicated to environmental studies and learn analytical skills and rules of compliance related to monitoring. The EMP studies are conducted by personnel based on the ISU campus in Pocatello, Idaho.

ISU-EMP assisted OP in specific aspects of identifying optimum permanent monitoring station locations, and in selecting appropriate sample collection equipment for each station. The authorization to establish, prepare and install sampling devices on selected sites was obtained by OP personnel in conjunction with ISU-EMP personnel. All samples described in this program are collected by OP or ISU-EMP personnel and returned to the ISU for analysis.

This report represents the summary of results of those samples collected and analyzed for radioactivity during the months of January, February, and March 1993.

II.

SAMPLING METHODS

Continuous low volume air sampling equipment, obtained on loan from EG&G of Idaho, have been installed in the five locations listed below.

Each air sampling unit consists of a motor-mounted rotary vane pump, two temperature-compensated Rockwell model S-275 digital gas flow meters, a 0" to 30" Hg vacuum gauge, connecting hoses, and a combination cartridge and filter paper holder for sampling radioiodine and particulates. The equipment is contained in a heavy gauge aluminum weatherhouse that allows the sampling of environmental air at one and one-half meters above ground level.

The membrane filters are Gelman Versapor 1200 (V-1200), 47 mm in diameter with an efficiency >99% for 0.3 micron particles. The charcoal sampler cartridges used for airborne radioiodine sampling (Science Applications, Inc. model BG-300) are designed and tested by the manufacturer to ensure a high quantity of radioiodine capture.

The membrane filter and charcoal sampler cartridge are changed every week. The membrane filter is analyzed for alpha and beta activity. The 13-weekly membrane filters collected from each site every calendar quarter are analyzed for gamma activity. The charcoal cartridges are analyzed each week for radioiodine.

III.

SAMPLING LOCATIONS

Initial locations for off-site ambient air monitoring stations were chosen in consultation with: DOE and NOAA reports; Mesodif modeling; review of the relevant literature; and communication with private contractors and experts in pertinent fields.

Atomic City

The Atomic City station, located south of the INEL in Bingham County at latitude 43°26'37.4" and longitude 112°48'44.57" is reached by way of Highway 26 at the site currently maintained by RESL.

Atomic City has the highest population density adjoining the INEL boundary. Furthermore, the DOE, through modeling, identified Atomic City as potentially having the highest maximally exposed off-site individual.

Lost River Rest Stop

The Lost River Rest Stop, the alternative site to the Big Southern Butte is located on I-26 in Butte County at latitude 43°32'54.8" and longitude 113°00'26.09.

Located between and southwest of meteorological observation stations at Arco (outside the INEL boundary) and the INEL Central Facilities (on-site), the Lost River Rest Stop is situated in the general release flow pattern from the Central Facility. There is some uncertainty whether the release flow actually approaches ground level at the station or several miles to the SW.

Howe

The Howe station, located northwest of the INEL in Butte County at latitude 43°49'39.9" and longitude 112°59'04." is near the Bernice school house site. The station, located on private property denoted by the characters "B-4" is reached via Highway 33 east.

Oriented northwest-southeast and sitting at the mouth of the valley, Howe faces the southern slope of the Saddle and Lemhi Mountain Ranges. Since these mountain ranges receive intense solar heat from mid-morning through mid-afternoon, strong, predominately northwesterly thermal up-drafts push significant quantities of air up-slope from the Little Lost Valley.

The air monitoring station is in the center of the valley channel flow pattern.

Mudlake

The Mudlake Station, situated in Jefferson County, northeast of the INEL at latitude 43°50'29.9" and longitude 112°30'08.4" is an off site population center. The Mudlake Station rests on relatively flat and unobstructed land. Located near the Idaho Transportation Department's maintenance shed (approximately 16 miles on Highway 33/Idaho 28S), the Mudlake station is reached via I-15 North to Highway 33/Idaho 28S (west on exit 143).

Evaluation of the Mudlake sector reveals unusual seasonal wind patterns. Winds at Mudlake have broad southeastern and northwestern components. These light opposing winds are the result of retreating southwest winds with an appearance of drainage winds (or vice versa). This type of flow, at the north end, results from an eddy that is mechanically induced by elevated terrain to the south and east. Contributing to the production of the eddy is the overall stability of the temperature.

Monteview

Located in Jefferson County, northeast of the INEL at latitude 43°59'29.9" and longitude 112°32'9.0" the Monteview station is reached by Highway 28, one mile north of the Monteview store (mile marker 2540 North East) near the Mudlake Telephone Relay Station.

The Monteview station exhibits diurnal winds characteristic of the Snake River Plain. Predominate wind flows are produced by channeled canyon cold air drainage and diurnal northeast winds. Monteview is also an off site population center.

FIGURE 1. Air Monitoring Locations

IV.

ANALYTICAL METHODS

ALPHA AND BETA DETECTION

A thin-window gas flow proportional counting system is used to measure the overall alpha and/or beta radioactivity of water samples and air particulate filters. Calibration for alpha counting was accomplished using National Institute of Standards and Technology (NIST) traceable americium-241. Calibration of the proportional counting system for beta counting was accomplished using NIST traceable cesium-137.

The analysis of air particulate filters is delayed for five or more days to allow the radon-222 and radon-220 (thoron) daughter products to decay. The weight of the particulate collected is measured and recorded.

The filter is counted for alpha (at least 20 minutes) and/or beta (30 minutes) activity on a proportional counter. Detection capability depends upon the sample air volume actually passed through the filter, the background and the efficiency for the counting instrument. Self absorption is not considered in the case of air particulate filters because of the impracticality of determining the penetration depth of the deposit into the membrane filter. Because the radioactive species are not identified, no decay corrections are made.

GAMMA DETECTION

Gamma detection is accomplished with a coaxial, closed-end, germanium detector. The detector is centered in four and one-half inches of lead in an 11-inch concentric shield, and stabilized via an integral cryostat. The amplifier supplies 4 kilovolts bias, amplifies the signal from the preamplifier, and channels the signal to the multi-channel analyzer. A preamplifier sends digital information from the detector. Data are displayed and analyzed on a microcomputer using a commercial set of programs for acquiring and analyzing data. The instrument is calibrated to 0.5 keV/channel (0.06 to 2 MeV range) using NIST traceable standards.

Analysis of Charcoal Cartridges (Air Iodine)

Charcoal cartridges are assayed simultaneously by positioning them around the side of the detector. Counts are obtained for at least 1000 minutes. The detector is calibrated for each position. The detection limit for iodine-131 in each charcoal cartridge can be determined (assuming no positive iodine-131) uniquely from the volume of air which passed through it. In the event iodine-131 is observed in the initial counting of a set, each charcoal cartridge is then counted separately by

positioning it directly on the face of the detector.

Analysis of Air Particulate Filters

The 13 airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted for 1000 minutes.

V. DATA REPORTING CONVENTIONS

All analytical results, including negative results, are reported in units of activity concentration $\pm$ one standard deviation.

Analytical results which exceed minimum detectable concentration (MDC) are indicated. The MDC is an a priori estimate of the activity concentration that can be practically achieved under a specificified set of typical measurement conditions. The MDC value is calculated using 4.66 times the standard deviation of the background counting rate and appropriate correction factors including volume and efficiency. The calculation is for a 5% risk of false detection and false non-detection.

For most gamma results, only activity concentrations exceeding the MDC are reported. The MDC is calculated using the spectral band around the emission energy. For certain radionuclides such as cesium-137, analytical results, including negative results, can be reported.

VI.

RESULTS

The corrected volume and sample residue for each of the weekly air particulate filters are listed in Table 1. Several of samples had low volumes indicating a flow rate of less than 1.5 cfm. This was particularly evident for samples collected for the period of 1/29/93 to 2/05/93. These low values may have been due to the filters freezing and therefore causing an artificially high vacuum reading. This reading is used with the initial vacuum reading to determine a correction factor. As this end value has equal weight with the beginning value an artificially high value will cause the total volume to be reported low. These weekly values were not used to calculate the monthly averages.

Results of particulate alpha and beta activity on the membrane filters for this period are listed in Table 2. Alpha activity ranged from -0.1 to 6.1 E-3 pCi per cu. meter. Beta activity ranged from 15 to 205 E-3 pCi per cu. meter. The higher concentrations of both alpha and beta occurred with those samples reporting low sample volumes. These concentrations are within the range of values expected from naturally occurring radioactivity. The monthly average of the gross beta concentrations are presented in Figure 2A through 2E.

Results of gamma analysis of the particulate filters (Table 3) reveals the presence of a small quantity of the naturally occurring Be-7 on the filters.

No radioactive isotopes of iodine were detected on the charcoal cartridges collected weekly from all four air monitoring stations. The typical MDC was 5 E-3 pCi per cu. meter.

TABLE 1

**Corrected Volume and Sample Residue of Air Particulate Filters
First Quarter 1993**

(Results: Volume in m³ and Residue in mg)

<u>LOCATION</u>	<u>COLLECTION PERIOD</u>	<u>CORR. VOLUME</u>	<u>RESIDUE</u>
Montevieu	12/31 - 01/08	561	13.0
	01/08 - 01/15	553	6.5
	01/15 - 01/24	728	7.5
	01/24 - 01/29	340	17.0
	01/29 - 02/05	364*	17.2
	02/05 - 02/12	581	5.7
	02/12 - 02/19	546	6.5
	02/19 - 02/26	567	3.1
	02/26 - 03/05	541	7.2
	03/05 - 03/12	570	5.2
	03/12 - 03/19	606	6.0
	03/19 - 03/26	560	9.4
	03/26 - 04/02	571	5.3
Mud Lake	12/31 - 01/08	663	10.1
	01/08 - 01/15	482	7.0
	01/15 - 01/24	631	39.8
	01/24 - 01/29	331	20.3
	01/29 - 02/05	322*	20.5
	02/05 - 02/12	492	5.4
	02/12 - 02/19	475	6.1
	02/19 - 02/26	478	13.8
	02/26 - 03/05	278*	8.9
	03/05 - 03/12	490	3.8
	03/12 - 03/19	492	5.2
	03/19 - 03/26	472	9.1
	03/26 - 04/02	483	5.9

* indicates low volume (less than 1.5 cfm)

TABLE 1 (continued)

(Results: Volume in m³ and Residue in mg)

<u>LOCATION</u>	<u>COLLECTION PERIOD</u>	<u>CORR. VOLUME</u>	<u>RESIDUE</u>
Howe	12/31 - 01/08	600	6.1
	01/08 - 01/15	520	7.1
	01/15 - 01/24	695	5.6
	01/24 - 01/29	377	13.1
	01/29 - 02/05	390*	21.4
	02/05 - 02/12	556	5.7
	02/12 - 02/19	531	5.1
	02/19 - 02/26	516	3.4
	02/26 - 03/05	519	8.6
	03/05 - 03/12	533	4.5
	03/12 - 03/19	546	3.4
	03/19 - 03/26	540	7.0
	03/26 - 04/02	549	6.4
Rest Area	12/31 - 01/08	640	5.8
	01/08 - 01/15	576	5.6
	01/15 - 01/24	730	4.4
	01/24 - 01/29	394	7.9
	01/29 - 02/05	553	24.9
	02/05 - 02/12	585	3.2
	02/12 - 02/19	567	5.1
	02/19 - 02/26	305*	2.4
	02/26 - 03/05	548	7.4
	03/05 - 03/12	564	5.9
	03/12 - 03/19	564	4.5
	03/19 - 03/26	559	5.9
	03/26 - 04/02	577	4.3

* indicates low volume (less than 1.5 cfm)

TABLE 1 (continued)

(Results: Volume in m³ and Residue in mg)

<u>LOCATION</u>	<u>COLLECTION PERIOD</u>	<u>CORR.VOLUME</u>	<u>RESIDUE</u>
Atomic City	12/31 - 01/08	598	6.2
	01/08 - 01/15	527	7.2
	01/15 - 01/24	684	8.0
	01/24 - 01/29	365	10.9
	01/29 - 02/05	404*	19.4
	02/05 - 02/12	563	4.4
	02/12 - 02/19	535	5.6
	02/19 - 02/26	419	3.3
	02/26 - 03/05	486	10.6
	03/05 - 03/12	497	5.5
	03/12 - 03/19	508	2.8
	03/19 - 03/26	496	6.9
	03/26 - 04/02	482	5.7

* indicates low volume (less than 1.5 cfm)

TABLE 2

**Gross Alpha and Beta of Air Particulate Filters
First Quarter 1993**

(Results in E-3 pCi/m³ $\pm$ 1 σ)

<u>LOCATION</u>	<u>COLLECTION PERIOD</u>		<u>GROSS ALPHA</u>	<u>GROSS BETA</u>
Monteview	12/31	- 01/08	1.3 $\pm$ 0.4	34 $\pm$ 3
	01/08	- 01/15	1.1 $\pm$ 0.4	45 $\pm$ 3
	01/15	- 01/24	0.9 $\pm$ 0.3	24 $\pm$ 3
	01/24	- 01/29	0.4 $\pm$ 0.4	98 $\pm$ 6
	01/29	- 02/05	4.4 $\pm$ 1.1	125 $\pm$ 6*#
	02/05	- 02/12	0.7 $\pm$ 0.4	58 $\pm$ 3
	02/12	- 02/19	3.2 $\pm$ 0.6	47 $\pm$ 4
	02/19	- 02/26	0.5 $\pm$ 0.3	16 $\pm$ 3
	02/26	- 03/05	1.9 $\pm$ 0.5	59 $\pm$ 4
	03/05	- 03/12	1.1 $\pm$ 0.4	27 $\pm$ 3
	03/12	- 03/19	0.7 $\pm$ 0.3	28 $\pm$ 3
	03/19	- 03/26	1.0 $\pm$ 0.4	15 $\pm$ 3
	03/26	- 04/02	1.3 $\pm$ 0.4	23 $\pm$ 3
Mud Lake	12/31	- 01/08	0.7 $\pm$ 0.3	35 $\pm$ 3
	01/08	- 01/15	2.0 $\pm$ 0.5	55 $\pm$ 4
	01/15	- 01/24	0.3 $\pm$ 0.2	24 $\pm$ 3
	01/24	- 01/29	0.6 $\pm$ 0.5	83 $\pm$ 6
	01/29	- 02/05	6.1 $\pm$ 1.4	205 $\pm$ 7*#
	02/05	- 02/12	2.0 $\pm$ 0.7	77 $\pm$ 4
	02/12	- 02/19	1.2 $\pm$ 0.4	44 $\pm$ 4
	02/19	- 02/26	0.5 $\pm$ 0.3	19 $\pm$ 4
	02/26	- 03/05	5.5 $\pm$ 1.1	144 $\pm$ 7*
	03/05	- 03/12	1.8 $\pm$ 0.5	29 $\pm$ 4
	03/12	- 03/19	1.8 $\pm$ 0.5	26 $\pm$ 4
	03/19	- 03/26	0.5 $\pm$ 0.4	24 $\pm$ 4
	03/26	- 04/02	0.9 $\pm$ 0.4	29 $\pm$ 4

* indicates low volume (less than 1.5 cfm)

values not used to calculate monthly averages (see text)

TABLE 2 (continued)

<u>LOCATION</u>	<u>COLLECTION PERIOD</u>		<u>GROSS ALPHA</u>	<u>GROSS BETA</u>
Howe	12/31	- 01/08	0.4±0.3	35±3
	01/08	- 01/15	0.9±0.4	60±4
	01/15	- 01/24	0.0±0.2	24±3
	01/24	- 01/29	0.4±0.4	68±5
	01/29	- 02/05	3.0±0.9	164±6*#
	02/05	- 02/12	0.8±0.4	75±4
	02/12	- 02/19	0.7±0.3	61±4
	02/19	- 02/26	0.2±0.3	20±3
	02/26	- 03/05	4.0±0.7	83±4
	03/05	- 03/12	0.7±0.3	44±4
	03/12	- 03/19	1.0±0.4	29±3
	03/19	- 03/26	1.0±0.4	28±3
	03/26	- 04/02	1.4±0.4	27±3
Rest Area	12/31	- 01/08	0.5±0.3	28±3
	01/08	- 01/15	1.4±0.4	44±3
	01/15	- 01/24	0.8±0.3	22±3
	01/24	- 01/29	-0.1±0.3	33±6
	01/29	- 02/05	0.6±0.4	80±4
	02/05	- 02/12	0.9±0.5	45±3
	02/12	- 02/19	0.9±0.4	42±3
	02/19	- 02/26	0.3±0.4	15±6*
	02/26	- 03/05	1.9±0.5	59±4
	03/05	- 03/12	0.8±0.4	34±3
	03/12	- 03/19	0.1±0.2	24±3
	03/19	- 03/26	0.4±0.3	22±3
	03/26	- 04/02	1.2±0.4	25±3

* indicates low volume (less than 1.5 cfm)

values not used to calculate monthly averages (see text)

TABLE 2 (continued)

<u>LOCATION</u>	<u>COLLECTION PERIOD</u>	<u>GROSS ALPHA</u>	<u>GROSS BETA</u>
Atomic City	12/31 - 01/08	0.9±0.3	34±3
	01/08 - 01/15	2.9±0.6	49±4
	01/15 - 01/24	0.6±0.3	26±3
	01/24 - 01/29	0.2±0.4	58±5
	01/29 - 02/05	2.0±0.8	153±6*#
	02/05 - 02/12	1.4±0.5	59±4
	02/12 - 02/19	1.5±0.4	73±4
	02/19 - 02/26	0.6±0.4	21±4
	02/26 - 03/05	2.3±0.6	93±4
	03/05 - 03/12	1.0±0.4	35±4
	03/12 - 03/19	0.9±0.4	23±4
	03/19 - 03/26	0.9±0.4	66±4
	03/26 - 04/02	0.9±0.4	31±4

* indicates low volume (less than 1.5 cfm)

values not used to calculate monthly averages (see text)

TABLE 3
Composite Analysis of Air Particulate Filters
Collection Period 12/31/92 to 04/02/93

(Results in pCi/m³ $\pm$ 1 σ)

<u>LOCATION</u>	<u>Be-7</u>	<u>Cs-137</u>
Monteview	66 $\pm$ 1 E-3*	7 $\pm$ 4 E-5
Mud Lake	51 $\pm$ 1 E-3*	2 $\pm$ 4 E-5
Howe	65 $\pm$ 1 E-3*	2 $\pm$ 4 E-5
Rest Area	60 $\pm$ 1 E-3*	-5 $\pm$ 3 E-5
Atomic City	81 $\pm$ 1 E-3*	2 $\pm$ 4 E-5

* = Exceeds Minimum Detectable Concentration

FIGURE 2A - Gross Beta Concentrations in Air

FIGURE 2B - Gross Beta Concentrations in Air

FIGURE 2C - Gross Beta Concentrations in Air

FIGURE 2D - Gross Beta Concentrations in Air

FIGURE 2E - Gross Beta Concentrations in Air

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