MAR 19 1997 20
Sta. 37

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1. EDT 618202

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) 300 Area LEF Engineering	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: Liquid Effluents/WM/RFSH	6. Design Authority/ Design Agent/Cog. Engr.: R.T. Stordeur	7. Purchase Order No.: N/A
8. Originator Remarks: Release of report prepared in 1995 by John Glissmeyer of PNNL for LEF.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: KI stack/340 Facility
11. Receiver Remarks: 11A. Design Baseline Document? ☐ Yes ☒ No		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: February 28, 1997

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Design- ator	Reason for Trans- mittal	Origin- ator Dispo- sition	Receiv- er Dispo- sition
1	HNF-SD-LEF-ER-002	N/A	0	Unabated Emission Source Term Estimate for the 340-NX Stack	E	1&2	1	

16. KEY					
Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged	

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
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18. R.T. Stordeur Signature of EDT Originator 3/13/97 Date	19. L.W. Roberts Authorized Representative for Receiving Organization 3/17/97 Date	20. D.L. Halgren Design Authority/ Cognizant Manager 3/14/97 Date	21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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Unabated Emission Source Term Estimate for the 340-NX Stack

R.T. Stordeur [J.A. Glissmeyer, PNNL]
Rust Federal Services of Hanford Inc., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

ECN: ~~635979~~ 618202 UC: 602
Org Code: 32330 Charge Code: A234C
B&R Code: EW3130020 Total Pages: 45

Key Words: 340 Facility, K1 ventilation system, 300 Area, 340-NX stack, 40CFR61 - Subpart H, HEPA, air monitoring/sampling.

Abstract: This document contains the sampling procedure, analytical results, and source term estimate from sampling work conducted on the main stack for the 340 Facility's vault ventilation system. Several air filter and carbon cartridges were collected upstream of the K1 off-gas control modules in order to determine the challenge source terms associated with various operating modes (e.g., under routine waste storage, during waste mixing, during waste transfer, etc.).

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Janis Bishop 3-19-97
Release Approval Date

Release Stamp

Approved for Public Release

TABLE OF CONTENTS

PURPOSE	1
SUMMARY	1
BACKGROUND	1
METHOD	1
Sampling location	1
Sampling Equipment	2
Sampling Plan	4
RESULTS	5
DISCUSSION	6
REFERENCES	8
APPENDIX A Sampling Procedure	A-1
APPENDIX B Sample Log Sheets	B-1
APPENDIX C Sample Analysis Results	C-1
APPENDIX D Summary Tables of Sample Results	D-1

UNABATED EMISSION SOURCE TERM ESTIMATE FOR THE 340-NX STACK

PURPOSE

EPA regulations (40CFR61, Subpart H) state that continuous air monitoring is required for a source if the potential emissions can result in a dose to the maximally exposed offsite individual exceeding 0.1 mrem/year. The objective of this work is to estimate the air emissions from the 340-NX stack if the filter system was absent or failed.

SUMMARY

The concentrations of airborne radionuclides before, during and after a liquid waste transfer were measured upstream of the 340-Building tank ventilation filters. Gross alpha, gross beta, Co-60 and Cs-137 were present before the transfer and (except for the Co-60) increased significantly during the transfer operations. Air sampling continued for five days after the transfer and (except for gross beta) the concentrations generally declined, but not to the pre-transfer condition. Offsite potential dose estimates were made assuming the emissions were unabated and occurred at a steady annual rate. The contributions from gross alpha and Am-241 were the most significant, with a combined potential dose of about 0.04 mrem/yr.

BACKGROUND

The 340-NX stack is the discharge point for the 340 Building vessel vault ventilation system. The vessels are steel tanks used for temporary storage of liquid radioactive wastes from the various facilities in the 300 Area. The liquids are periodically sampled and transferred to railcars for transport to Tank Farms in the 200 Areas. Propeller type agitators are used to mix the contents of the vessels when sampling and transferring are being conducted. The vessel vault air cleaning components include in series a moisture separator (which use is optional depending on damper alignments) and three filtration trains operated in parallel. Each train consists of a prefilter, a HEPA filter, a second HEPA filter, and an activated charcoal filter. It is expected that unabated emissions would be generated during liquid sampling and transfers or other times when the agitators are used.

METHOD

The general approach was to collect air samples upstream of the filter trains and with the moisture separator bypassed. Samples were to be collected during the different activities that might generate a source term.

Sampling Location

The air samples were obtained from the 14-in. diameter duct just upstream from

where the airflow is split for the three filter trains. Access to the duct is available through a 2-inch port normally used for injecting filter test aerosol. The port is on the side of the duct and 48-in. downstream of a 90-degree bend in the duct and 16-in. upstream of where the airflow splits into three parts. Westinghouse Ventilation and Balance obtained the air velocity data shown in Table 1 for that location. The average velocity data and one-standard deviation error bars are plotted in Figure 1.

Table 1. Air Velocity Measurements Across Duct at Sampling Location

Depth, in.	Air velocity, fpm, per traverse			Average
	1	2	3	
0.38	1602	1551	1551	1568
1.13	1699	1745	1791	1745
2.00	1651	1835	2002	1829
3.13	1887	2156	2081	2041
4.75	1962	2300	2081	2114
9.25	1602	2002	1878	1827
10.88	1387	1835	1791	1671
12.00	1328	1745	1551	1541
12.88	1201	1745	1444	1463
<u>13.63</u>	<u>1201</u>	<u>1651</u>	<u>1551</u>	<u>1468</u>
Average	1552	1856.5	1772.1	1727

Sampling Equipment

The sampling train consisted of a probe, valve, combination filter holder, backup filter holder, mass-flowmeter, and a vacuum pump. The probe was mounted on the same 2-inch sampling port that was used for the velocity measurements. The nozzle was sized so the velocity through the opening was 1820 ft/min when the sample flowrate was 45 LPM. A shroud was mounted on the front of the nozzle so the approaching airstream was aligned with the axis of the nozzle. The probe is shown in Figure 2.

Figure 1. Air Velocity Profile Across Duct

Figure 2. Air Sampling Probe

The combination filter holder contained a membrane filter for particle collection and a charcoal cartridge for radioiodine collection. While radioiodine was not expected in the exhaust air, the existing stack sampler uses the same cartridge type, so it was decided to collect comparable samples. The backup filter holder contained a glass fiber filter. The output of the mass flowmeter was recorded continuously with a data logger. The filtered sample airstream was returned to the ventilation system just upstream of one of the HEPA filters.

Sampling Plan

It was planned to collect samples during every phase associated with a liquid transfer operation. This operation occurs about 5 times a year. Table 2 lists the samples collected. Sample 1 covered a period when there was no activity with the tanks and would represent the potential emission during most of the operations in a year. Sample 2 covers the time when the tank is agitated to mix the liquid preparatory to collecting a liquid sample. The tank is sampled prior to a transfer to characterize the tank contents. Sample 3 covers the time during the liquid transfer. The agitator is operated during the transfer. Sample 4 represents the first few days following a transfer. Sample 5 consisted of installing the sample collection filters and removing them again to determine the potential for cross contaminating samples. There was no airflow through the sampler during Sample 5. Each sample set consisted of primary and backup particle filters and a charcoal cartridge. After the completion of the tests, the sampling probe was submitted for analysis of radionuclides that may have deposited internally. This sample was prepared by washing the inside of the components with an acid solution. This step was repeated and the solutions analyzed separately. The procedure for operating the sampler is included in Appendix A. Appendix B contains the sample log sheets.

Table 2. Sample Collection Plan

<u>Sample</u>	<u>Activity</u>	<u>Start</u>	<u>End</u>	<u>Duration, min.</u>
1	No activity	3/30/94 9:22	4/4/94 10:04	7242
2	Tank agitated for an hour for liquid sampling	4/4/94 10:31	4/4/94 13:09	158
3	Liquid transfer including continuous agitation	4/5/94 13:00	4/6/94 9:16	1216
4	After transfer	4/6/94 9:31	4/11/94 10:17	7246
5	Field blank installation	4/11/94	4/11/94	0

RESULTS

The samples were analyzed for gross alpha, gross beta, and gamma spectrometry as described in Appendix C. The particle filters were also qualitatively analyzed by alpha spectrometry and Pu-238, Pu-239, Pu-240, Am-241, uranium and thorium were identified. The analysis reports are found in Appendix C. Samples were identified by the sample number and a part identifier. The part identifiers were:

- a primary particle filter
- b radioiodine charcoal cartridge
- c backup particle filter
- e probe internal wash from nozzle to primary filter holder inlet

The envelopes used to contain the particle filters between the end of sampling and analysis were also analyzed for gross alpha and beta. Information on the minimum detectable activity for the analyses is also included in Appendix C.

Tables summarizing the results and estimated concentrations for each radionuclide and for each sample are included in Appendix D. The combined concentrations for the transfer event starting with liquid sampling and ending five days after the transfer are also calculated in Table D.5. The radionuclide content of the field blanks are shown in Table

D.6. On removing Sample 1, it was observed that the primary particle filter had become dislodged in the filter holder. Consequently, most of the radionuclide collection was in the charcoal cartridge and the backup filter. Condensate was observed inside the filter holders after Samples 1 and 3. Because of the observed condensate, cross contamination of the samples was a concern. However, the results for the field blanks in Table D.6 show that the potential for cross contamination was a small fraction of the content of the other samples.

The manila envelopes containing the exposed primary filter from Samples 3, 4 and the field blank apparently picked up some smearable contamination, presumably from contact with the filter. This constituted about 1 % of the total gross alpha and beta sample collected during the transfer (from Samples 2 - 4 combined). The deposits in the probe accounted for around 10% of the radionuclides collected during the transfer.

DISCUSSION

Figure 3 shows the radionuclide air concentrations for each sampling event. Prior to the transfer, there were alpha, beta, Co-60 and Cs-137 present in the airstream. Except for the Co-60, the concentration became elevated during the transfer operation starting with agitation to mix the tank contents for liquid sampling. Consequently, the source of airborne Co-60 may be different than for the other nuclides. Cs-137 was the only nuclide concentration which returned to the pre-transfer concentration over the five days following the transfer. Presumably, the others would have over a longer period.

Table 3 shows the total unabated quantity and concentration of radionuclides generated for the transfer event from the time of liquid sampling through the five days following the transfer. The annual unabated quantities are estimated assuming the transfer operation occurs five times in a year. These are then multiplied by dose conversion factors for the 300 Area (from WHC-EP-0498) to estimate the offsite dose potential if the emission were truly unabated. The dose factors were calculated assuming the emission occurs at a constant rate over a year. A dose factor was not available for Co-57, but it would be about 1/10th that of Co-60. The most significant constituent in terms of potential dose is the gross alpha at about 0.025 mrem per year followed closely by the Am-241 at 0.015 mrem per year. It is significant that the unabated gross alpha and Am-241 concentrations increased about four orders of magnitude during the transfer and they did not recede to their pre-transfer concentrations during the five days following the transfer. The potential dose from an unabated emission of the other nuclides was two or more orders of magnitude less.

Figure 3 Concentration for nuclides during each sampling event

Table 3 Estimated single event and annual emission and offsite dose

Nuclide	Scaled unabated Ci		Dose Conversion Factor	Potential Annual Dose
	1 transfer	5 transfers	mrem/Ciyr	mrem/yr
Alpha	2.873E-05	1.44E-04	173	2.49E-02
Beta	5.226E-05	2.61E-04	0.872	2.28E-04
Co-57	6.618E-07	3.309E-06		0.00E+00
Co-60	3.704E-07	1.852E-06	0.579	1.07E-06
Sb-125	3.944E-07	1.972E-06	0.0827	1.63E-07
Cs-134	7.516E-07	3.758E-06	0.624	2.34E-06
Cs-137	1.831E-05	9.153E-05	0.477	4.37E-05
Eu-152	5.087E-07	2.543E-06	0.307	7.81E-07
Eu-154	1.283E-06	6.417E-06	0.364	2.34E-06
Eu-155	4.274E-07	2.137E-06	0.0368	7.86E-08
Am-241	1.113E-05	5.564E-05	262	1.46E-02

REFERENCES

40 CFR 61, Subpart H, U.S. Environmental Protection Agency, *National Emissions Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities*. U.S. Code of Federal Regulations.

WHC-EP-0498. *Unit Dose Calculation Methods and Summary of Facility Effluent Monitoring Plan Determinations*. November 1991. Westinghouse Hanford Company, Richland, WA 99352.

APPENDIX A
SAMPLING PROCEDURE

Unabated Emission Sampling Procedure for 340-NX Stack

Prepared By: John Glissmeyer, PNL

March 24, 1994

Approved By:

3/24/94
John Glissmeyer, PNL Project Manager

3/28/94
Hans Vogel, 340 Building Cognizant Engineer

HNF-SD-LEF-ER-002, Rev. 0

UNABATED EMISSION SAMPLING PROCEDURE FOR 340-NX STACK

1. PURPOSE

This work package provides a safe and uniform method to install a probe in the exhaust duct leading to the K1 and stack and air sampling equipment at the 340 vault building.

2. REFERENCES

- 2.1. WHC-1-6, Radiological Control Manual

3. PERSONNEL REQUIREMENTS

- 3.1. Health Physics Technicians (HPT) for survey coverage as required.
- 3.2. One (1) Pipe Fitter to install the sampling probe and connect to sampling equipment as described in this work package. The Pipe Fitter may be required to reposition the probe during the two week sampling period. The Pipe Fitter will also remove the air sampling probe and equipment upon completion of the sampling period.
- 3.3. Two (2) NPO's to support and assist in the performance of this work package.

4. PRECAUTIONS AND LIMITATIONS

- 4.1. Contact 340 OPS planner on 373-0426 to arrange for HPT support.
- 4.2. Read the RWP (J-006) pertaining to the work defined in this work package and to any special radiological considerations required in order to make this work as safe as possible. In addition, view the work area for damaged or loose asbestos or other unsafe conditions prior to starting this task.
- 4.3. Review all applicable Job Hazard posting's which are specific to task and work area.
- 4.4. In the event this work package cannot be performed as written, stop work. Return equipment to safe configuration and inform the Cognizant Engineer on 376-0992 of required revision in order to complete this work package.

5. PREREQUISITES

- 5.1. Release from 340 Operations manager must be obtained prior to beginning this work package.
- 5.2. A pre-job Safety Meeting attended by all personnel who will either support the activities or participate.
- 5.3. Comply with the RWP prepared for this task, J-006, and with WHC-CM-1-6, Radiological Control Manual.

6.0 TOOLS, EQUIPMENT AND MATERIALS

- 6.1. Radiological protective clothing and respiratory equipment as specified in RWP RR-145 J-006.
- 6.2. Tools and miscellaneous hardware for the installation and connection of the probe and air sampling equipment.

7.0 INSTRUCTIONS

- 7.1. Contact 340 operations Planner on 376-0426 to schedule this work package.
- 7.2. The supervisor will evaluate and report any injury occurring on the job and provide an appropriate response to determine the injured employee's condition and to administer first aid if required. In addition, if the injured employee's condition is considered serious, the supervisor or other designated person will use the nearest phone and dial "911" for assistance.

HNF-SD-LEF-ER-002, Rev. 0

- 7.3. Ensure that the K1 ventilation system is operating prior to removing the access port cap. The strong vacuum in the duct will minimize the potential for contamination.
- 7.4. Ensure that the sampling filters and iodine cartridge are installed in the holders. The primary filter (47mm membrane Versapor 3000) and the iodine cartridge go in the 1st filter holder (the one closest to the valve). A 47 mm glass fiber filter is used as a backup and it goes in the 2nd filter holder.
- 7.5. Remove the 2" access port cap from the half nipple welded to the duct. Ensure that the 1" ball valve on the probe assembly is in the closed position. Insert the probe assembly into the duct, and screw the male Swagelok connector into the threaded access port coupling. Point the probe into the airstream using the alignment marks on the probe assembly and set the correct depth into the duct (line up mark "1" on the probe with the end of the male Swagelok connector). Tighten the Swagelok connector nut. This will hold the probe in position "1".
- 7.6. Connect the mass flowmeter (1/4" FPT) to the pneumatic controller (3/8" FPT) and vacuum pump assembly. Neglect this step if these two units have already been assembled.
- 7.7. Place the data logger, mass flowmeter, pneumatic controller and vacuum pump assembly by the NE corner of the control room. Cut the 1/2" poly tubing to length sufficient to reach from the probe to the upstream side of the mass flowmeter. Connect the poly tubing to the mass flowmeter.
- 7.8. Route the vacuum pump discharge line to the lower 1" port immediately downstream of the 35% roughing filter housing. Remove the cap, and replace with the closed ball valve, fitted with the tubing connector.
- 7.9. Connect the discharge side of the vacuum pump to the ball valve using 1/2" polyethylene tubing and Swagelok connectors.
- 7.10. Change the air sampling filter on the permanent, downstream monitoring equipment for the 340 K1 stack.
- 7.11. Open the ball valve on the discharge side of the vacuum pump. Open the ball valve on the probe assembly. Turn on the data recorder. Turn on the vacuum pump. Check for proper operation of the temporary air sampling arrangement. The flowrate should be 1.59 cfm (45 lpm).
- 7.12. The probe assembly and air sample monitoring equipment will be in place for approximately two weeks. Health Physics personnel who conduct the daily operational checks on the permanent air monitoring equipment will also perform daily checks of the data recorder and vacuum pump for the temporary probe. If any of the temporary equipment appears to be operating poorly or not at all, phone 376-8552 or 376-6906 as well as the Cognizant Engineer on 376-0992.
- 7.13. CHANGING SAMPLES
 - a. Upon completion of the temporary sampling, turn off the vacuum pump. Close the ball valves on the probe assembly and vacuum pump discharge line. Perform one of the following two procedures as directed by the cog engineer or the PNL engineer supervising the measurement.
 - b. TO REPLACE AIR SAMPLE FILTERS - Enter the sample OFF time and final flowrate on the log sheet. Follow the steps as described in step 7.13.a. Sample containers should be labelled with the sample ID. Loosen the Swagelok connection between the first filter holder and the ball valve. Slide the filter holder adapter tube out of the swagelok connector on the ball valve. (Optional: In inclement weather, remove the poly tube from backup filter holder and take the filter holders to an area protected from the weather to change the samples.) Unscrew the filter holder adapter tube from the filter holder and remove the filter disk. Unscrew the holder to remove the iodine cartridge. The assisting HPT should then package and label the filter disk and iodine cartridge separately in preparation for their analyses. Insert a new filter disk and iodine cartridge, reassemble the filter holder adapter, and reassemble the adapter to the Swagelok connection on the ball valve. Open the ball valves on the probe assembly and the vacuum pump discharge line. Turn on the vacuum pump. Temporary monitoring has been reestablished. Log the sample ON time and new ID numbers on a new log sheet.

HNF-SD-LEF-ER-002, Rev. 0

- c. TO REMOVE PROBE ASSEMBLY - Follow the steps as described in step 7.13.a. Enter the sample OFF time and final flowrate on the log sheet. Sample containers should be labelled with the sample ID. Disassemble the poly tubing from the end of the backup in-line filter holder. Disconnect the poly tubing from the backup filter holder and cover the open ends with tape. Loosen the Swagelok connection holding the probe on the duct. Carefully remove the probe from the duct. Wipe clean the exterior portion of the probe which was in the duct. Place the probe assembly in a plastic bag. Replace the cap on the duct opening. Unscrew the primary filter holder adapter tube from the filter holder and remove the filter disk. Remove the iodine cartridge from the filter holder. Remove the backup filter from the backup filter holder. The assisting HP should then separately package and label the primary filter disk, the iodine cartridge and the backup filter. Reassemble the backup filter holder and the iodine cartridge part of the primary filter holder. The assisting HP should then package the filter holders for temporary storage at 340 in case a repeat sampling needs to be done. Package and label the probe assembly in preparation for its analysis. The assisting HP is to then label the package "filter holder assembly". Remove the vacuum pump discharge line and ball valve from the access port. Close access port by replacing the threaded cap. Survey all of the polyethylene tubing and monitoring equipment as required.

8.0 RESTORATION

- 8.1. Notify 340 Operations Manager and Cognizant Engineer that work package is complete and for system restoration verification.

9.0 DISPOSITION

- 9.1. Report deficiencies or problems to the Cognizant Engineer at 376-0992 for additional corrective actions.
- 9.2. Inform Operations Management and Maintenance Supervisor that procedure is complete.
- 9.3. All radiological and hazardous waste materials generated in the conduct of this work package shall be packaged, inventoried and disposed of in accordance with 340 plant operating procedures. SW-100-002.

WORK PERFORMED BY: _____ DATE: _____

WORK APPROVED BY: _____ DATE: _____

HNF-SD-LEF-ER-002, Rev. 0

DATA SHEET

Record all inspection activities and or deficiencies on the attached Data and Sample Custody/Log Sheets.

COMMENTS:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

[illegible]

APPENDIX B
SAMPLE LOG SHEETS

AIR SAMPLE LOG AND CHAIN OF CUSTODY

Type: <i>Unabated particulate and iodine</i>	Location: <i>340 Vault</i>	Filter type: <i>a. Gelman Versapor 300</i> <i>b. H-O TC-12 c. Gelman Type AE</i>	Sample ID: <i>1a, 1b, 1c</i>
Time/Date ON: <i>30 Mar 0922</i>		OFF: <i>4 Apr 1004</i>	Checked By:
Time/Date Checked:	Flowrate <i>lpm</i>	Adjustment	Checked By:
<i>3/30 0922</i>	<i>45</i>	<i>N.A.</i>	<i>HR Vogel</i>
<i>3/30 1400</i>	<i>45</i>	<i>Adjusted from 43 lpm</i>	<i>HR Vogel</i>
<i>3/31 0900</i>	<i>45</i>	<i>Adjusted from 42 lpm</i>	<i>HR Vogel</i>
<i>4/1 1025</i>		<i>Adjusted from 42 lpm</i>	<i>HR Vogel</i>
<i>4/4/94 1004</i>	<i>43</i>		<i>HR Vogel</i>

Total Elapsed Time: (*Start* ^{*42*} ~~*30*~~ min) = 119.70 hr = 7,182 min

Total Sample Volume:

Sampler SN: *N.A.*Flowmeter SN: *Sierra SN. 9504 Model 760*Flowmeter Checked By: *HR Vogel*
Time/Date *3/25/94*Calibrator SN: *Fisher Porter Rotameter*
710 C 11083

Relinquished By: Time/Date Accepted By: Time/Date

Notes: Probe installed and samples loaded 29 Mar 94, 1:45 pm.

Rerouted electrical and data bus wires to correct tripping hazard. 3/30/94 0830.

4/4/94 Sample 1a & inside actuator were damp.

AIR SAMPLE LOG AND CHAIN OF CUSTODY

Total Elapsed Time: $2\text{hr} - 38^{\text{hr}}_{54^{\text{min}}} = 1\text{hr} 18^{\text{hr}}_{14^{\text{min}}}$	
Total Sample Volume:	
Sampler SN: <i>N.A.</i>	Flowmeter SN: <i>Sierra SN 7504 Model 7</i>
Flowmeter Checked By: <i>J. J. J. J.</i>	Calibrator SN: <i>Fisher Port or Rotameter 710C 11083</i>
Time/Date <i>3/25/94</i>	

Notes:

1. Agitator TK-1, A.G-1 on 10:35 am, off 11:35 am
2. Samples were dry this time.
3. Samples hot with radon? 2c 35,000 dpm/B & 10,500 dpm/c
2c 3,000 dpm/B + 700 dpm/c

BEST AVAILABLE COPY

BEST AVAILABLE COPY

Project No. 21709 Date of Work 4/14/94
Entered By J. J. J. J. J. Date 4/14/94
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Signed 1. _____ Date _____
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87. _____ Date _____
88. _____ Date _____
89. _____ Date _____
90. _____ Date _____
91. _____ Date _____
92. _____ Date _____
93. _____ Date _____
94. _____ Date _____
95. _____ Date _____
96. _____ Date _____
97. _____ Date _____
98. _____ Date _____
99. _____ Date _____
100. _____ Date _____

AIR SAMPLE LOG AND CHAIN OF CUSTODY

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AIR SAMPLE LOG AND CHAIN OF CUSTODY

[illegible]

BEST AVAILABLE COPY

Project No. 21709 Date of Work 4-11-74
Entered By NA Hart Date 4-11-74
Disclosed To and Understood By _____
Signed 1. _____ Date _____
2. _____ Date _____

APPENDIX C
SAMPLE ANALYSIS RESULTS

Project Number 20063

Internal Distribution

File/LB

Date November 18, 1994

To John Glissmeyer

From Sandy Fadeff and Gwen Brodaczynski

Subject Alpha Spectrometry Analysis of Filter Samples

Five samples were mounted for alpha spectrometry counting in an attempt to determine what alpha isotopes are contributing to the total alpha count rate. A detector was identified that could accommodate these large filter samples, however it is not maintained according to our alpha spectrometry procedure. The results are provided to you as an indication only and will not meet the rigor required for data validation.

Distinct peaks were measured in the alpha spectrometer on two samples: 3-a and 4-a. In both cases, a peak at about 5.5 MeV (corresponding to ^{238}Pu and ^{241}Am) was the most prominent. A significantly smaller and more diffuse peak was located around 5.16 MeV (corresponding with the ^{239}Pu energies). Sample 4-a indicated a slight possibility of U and Th isotopes could be present. No peaks for Cm, U, or Th were found in sample 3-a. The results are summarized in Table 1. No detectable activity was found in the remaining samples by this analysis method.

Sample ID	^{238}Pu	^{238}Pu & ^{241}Am	U	Th	Cm
3-a	found	found	not found	not found	not found
4-a	found	found	possible	possible	not found
5-a	*****no peaks found*****				
3-c	*****no peaks found*****				
4-c	*****no peaks found*****				
5-c	*****no peaks found*****				

All data are maintained by the ACL, Building 325, room 5. If you have any questions, call me at 376-7015.

Reviewed by
J.R. Greenwood
11-18-94

Author: Sandra K Fadeff at "PNL26"
Date: 10/6/94 4:31 PM
Priority: Normal
TO: John A Glissmeyer at "PNL83"
CC: Sandra K Fadeff
Subject: Activated charcoal air filter samples

----- Message Contents -----

The I-131 mda calculation was run on your samples. They are as follows:

94-10408 1.4 pCi/sample

94-10409 2.1 pCi/sample

94-10410 2.6 pCi/sample.

Please cross-reference the internal sample ID's provided above with your sample ID's given on the initial report.

If you need further information or a more formal report, please let me know.

Thanks,
Sandy

Project Number 20063

Internal Distribution

File/LB

Date September 26, 1994

To John Glissmeyer

From Sandy Fadeff *S.K. Fadeff*Subject 340nx Filter Sample Results

Six air filter samples, 3 carbon cartridge filter samples, and one probe were analyzed for gross alpha, gross beta, and gamma analyses. Details of the analyses are described below. The results are summarized on the attached table.

Five of the air filter samples were counted directly by gas-flow proportional counting according to procedure PNL-ALO-484. The highest activity sample (4-a) was leached with HCl and HNO₃, filtered, brought to 10 mL volume and a 1 mL aliquot was counted. The combined activities of the solution, original filter, and the leachate filtration filter are reported. Visible contamination was present in several of the envelopes as dark circles, the same size as the filter sample. These were cut out and counted as filter samples and are reported as a separate value with the sample.

The gas-flow proportional counters are calibrated with a ²³⁹Pu alpha source and a ⁹⁰Sr/⁹⁰Y beta source. The activities are not corrected for cross-talk of the beta activity into the alpha channel and vice versa. The reported error is the propagated error of the counting, calibration, and volume measurements. Because different isotopes have different counting efficiencies, it is more appropriate to apply a larger error of 50% to the reported beta activity.

The charcoal cartridge filters were prepared by cutting the plastic housing and pouring the charcoal into a 4 oz. plastic jar.

All air filter samples and charcoal cartridge filters were counted by gamma spectrometry according to PNL-ALO-494. Only the isotopes detected are reported on the attached table. Other isotopes, not detected, are listed on attachments 1-11. Detection limits vary according to the amount of activity from other isotopes that are present in the samples. (The Compton continuum raises the sample-spectrum background.)

The sample probe was washed according to your verbal instructions. The long tube and assembly with the handle was treated as one sample. The handle was placed in the open position and one end of each assembly was stoppered with a plastic-lined rubber stopper. Each piece was filled with 4-M HNO₃ and allowed to stand approximately 30 min. The acid leach was poured off and the pieces were filled with deionized water which was then poured off into the nitric acid leach, the combined acid leach and water rinse comprised the first probe washing sample. The leaching process was repeated once to provide a second probe washing sample. The solutions were evaporated to dryness onto a 2-inch counting planchet. They were then counted for gross alpha, gross beta, and by

John Glissmeyer
September 26, 1994
Page 2

gamma spectrometry. The second probe washing represents less than 6% of the activity found in the first probe washing.

All results for this project are stored in the ACL Laboratory Support Office, building 325, room 5. If you have any questions, please call me at 376-7015.

Reviewed by
JRH
9-26-94

Special WHC Air Samples Collected Upstream of 340-NX Stack Filters

Radiochemistry Group, 329 building
Analytical Chemistry Laboratory

Activity Summary

All analyses were performed on various dates in September 1994. Specific dates can be provided on request.

Client ID	ACL ID	Gross Alpha		Gross Beta		Gross Alpha		Gross Beta	
		pCi/filter	+/- 2σ	pCi/filter	+/- 2σ	pCi/envelope	+/- 2σ	pCi/envelope	+/- 2σ
3-a	94-10402	3690	190	12030	750	19.5	1.5	45.3	3.2
4-a	94-10403	18000	2400	38000	2600	339	16	587	36
5-a	94-10404	3.74	0.45	10.10	0.90	0.91	0.30	1.42	0.42
3-b	94-10408	na		na		na		na	
4-b	94-10409	na		na		na		na	
5-b	94-10410	na		na		na		na	
3-c	94-10405	2.47	0.37	48.0	3.2	0.07	0.15	0.51	0.34
4-c	94-10406	13.21	0.92	41.4	2.8	5.00	0.68	9.5	1.0
5-c	94-10407	1.02	0.23	3.20	0.46	0.24	0.16	0.83	0.37
4-c	94-10411a	2220	270	5520	380	First probe washing			
4-c	94-10411b	125	21	112	8.6	Second probe washing			

Gamma Spectrometry, pCi/filter												Reference date: 9/19/94 (except for 94-10411a and b, 9/22 and 9/23, respectively)							
Client ID	ACL ID	Co-57	+/- 2σ	Co-60	+/- 2σ	Sb-125	+/- 2σ	Cs-134	+/- 2σ	Cs-137	+/- 2σ	Eu-152	+/- 2σ	Eu-154	+/- 2σ	Eu-155	+/- 2σ	Am-241	+/- 2σ
3-a	94-10402	130	25	67	17			259	36	7075	500			212	55	90	58	1199	80
4-a	94-10403	306	26	236	46	335	89	119	22	3688	280	309	98	508	103	221	52	6903	354
5-a	94-10404																	2.686	1.904
3-b	94-10408									18.2	4.6								
4-b	94-10409									13.4	6.1							28.5	7.5
5-b	94-10410	no isotopes detected																	
3-c	94-10405									45.5	4.8								
4-c	94-10406									9.2	2.5							6.3	2.2
5-c	94-10407	no isotopes detected																	
4-c	94-10411a	121	10	51	13			32.9	8.4	1586	42	123	49	197	37	52	26	714	30
4-c	94-10411b	5.1	1.6	3.2	1.7					37.9	3.3							22.6	2.6

Cognizant Scientist: D. K. Jodgy

Date: 9/26/94

Reviewer: L.R. Greenwood

Date: 9-26-94

VAX/VMS Nuclide Identification Report V2.8 Generated 8-SEP-1994 10:11:29

Configuration : DKB200:[USER]94-10402.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10402 T340 airfilter
 Sample date : 7-SEP-1994 00:00:00 Acquisition date : 6-SEP-1994 14:59:45
 Sample ID : 94-10402 Sample quantity : 1.0000
 Sample type : Sample geometry : air filter
 Detector name : F Detector geometry:
 Elapsed live time: 0 00:30:00.00 Elapsed real time: 0 00:30:03.45 0.2%
 Peak Width (FWHM): 3.00 Confidence level : 5.00 %
 Energy tolerance : 2.00 keV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report *Sample 3a*

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi)
NA-22	98.	1274.53	3.5218E+01
K-40	22.	1460.83	1.7647E+02
CR-51	326.	320.08	2.1461E+02
MN-54	21.	834.83	1.1180E+01
CO-58	28.	810.75	1.2500E+01
NB-94	71.	871.09	2.1176E+01
SB-125	486.	427.88	1.0719E+02
EU-152	40.	1408.01	1.1658E+02
TH-210	604.	46.52	4.1008E+02
TH-226	389.	351.87	6.6681E+01
TH-228	383.	215.75	6.4897E+03
TH-232	40.	911.16	5.7394E+01
U-235	468.	185.74	3.4142E+01
NP-237	339.	311.90	5.5361E+01
U-238	44.	1001.00	2.9137E+03

MAX/VMS Nuclide Identification Report V2.8 Generated 8-SEP-1994 10:15:42

Configuration : DKB200:[USER.GEA]94-10403.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10403 t340 airfilter
 Sample date : 7-SEP-1994 00:00:00 Acquisition date : 6-SEP-1994 15:00:22
 Sample ID : 94-10403 Sample quantity : 1.0000 airfilter
 Sample type : Sample geometry : air filter
 Detector name : E Detector geometry:
 Elapsed live time: 0 00:30:00.00 Elapsed real time: 0 00:30:01.86 0.1%
 Peak Width (FWHM): 3.00 Confidence level : 5.00 %
 Energy tolerance : 2.00 keV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

sample 4a

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/airfil)
CR-51	202.	320.08	1.6062E+02
MN-54	43.	834.83	1.6806E+01
CO-58	45.	810.75	1.6844E+01
NB-94	120.	871.09	2.9178E+01
PB-210	1328.	46.52	5.3333E+02
RA-226	225.	351.87	4.8803E+01
Tl-228	255.	215.75	4.8683E+03
Th-232	31.	911.16	5.2998E+01
U-235	326.	185.74	2.6162E+01
Np-237	193.	311.90	3.9533E+01
U-238	44.	1001.00	3.0845E+03

VAX/VMS Nuclide Identification Report V2.8 Generated 8-SEP-1994 10:17:38

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Configuration      : DKB200:[USER.GEA]94-10404.CNF;1
Lyses by          : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
Sample title       : 94-10404 t340 airfilter
Sample date        : 7-SEP-1994 00:00:00 Acquisition date : 6-SEP-1994 16:37:07
Sample ID          : 94-10404 Sample quantity : 1.0000 airfilter
Sample type        : Detector geometry : air filter
Detector name      : F Detector geometry:
Elapsed live time  : 0 08:00:00.00 Elapsed real time: 0 08:00:26.88 0.1%
Peak Width (FWHM) : 3.00 Confidence level : 5.00 %
Energy tolerance   : 2.00 keV Half life ratio : 8.00 %
Errors propagated  : Yes Systematic Error : 0.00 %
Efficiency type    : Empirical Efficiencies at : Peak Energy
Abundance limit    : 75.00

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Minimum Detectable Activity Report

Sample 5a

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/airfil)
NA-22	85.	1274.53	2.0436E+00
CR-51	394.	320.08	1.4842E+01
MN-54	202.	834.83	2.1567E+00
CO-57	604.	122.06	1.1563E+00
CO-58	180.	810.75	1.9906E+00
CO-60	112.	1332.50	2.4395E+00
NB-94	188.	871.09	2.1591E+00
FR-125	319.	427.88	5.4293E+00
C-134	302.	604.71	2.0583E+00
CS-137	273.	661.66	2.4077E+00
EU-152	109.	1408.01	1.2048E+01
EU-154	85.	1274.51	5.9444E+00
EU-155	554.	105.31	4.0357E+00
RA-226	527.	351.87	4.8494E+00
TH-228	521.	215.75	4.7329E+02
TH-232	184.	911.16	7.6727E+00
U-235	1022.	185.74	3.1521E+00
NP-237	407.	311.90	3.7897E+00

VAX/VMS Nuclide Identification Report V2.8 Generated 8-SEP-1994 10:19:26

Configuration : DKB200:[USER.GEA]94-10405.CNF;1
 Analyzes by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10405 t340 airfilter
 Sample date : 7-SEP-1994 00:00:00 Acquisition date : 6-SEP-1994 16:38:41
 Sample ID : 94-10405 Sample quantity : 1.0000 airfilter
 Sample type : Sample geometry : air filter
 Detector name : E Detector geometry:
 Elapsed live time: 0 08:00:00.00 Elapsed real time: 0 08:00:03.32 0.0%
 Peak Width (FWHM): 3.00 Confidence level : 5.00 %
 Energy tolerance: 2.00 keV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit: 75.00

Minimum Detectable Activity Report *sample cc*

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/airfil)
NA-22	78.	1274.53	2.0558E+00
CR-51	455.	320.08	1.5151E+01
MN-54	181.	834.83	2.1577E+00
CO-57	617.	122.06	1.1111E+00
CO-58	160.	810.75	1.9795E+00
CO-60	83.	1332.50	2.1952E+00
NB-94	163.	871.09	2.1259E+00
SR-125	342.	427.88	5.5590E+00
134	293.	604.71	2.0950E+00
EU-152	91.	1408.01	1.1514E+01
EU-154	78.	1274.51	5.9789E+00
EU-155	592.	105.31	4.0388E+00
TH-228	553.	215.75	4.4859E+02
TH-232	264.	911.16	9.7283E+00
U-235	1087.	185.74	2.9872E+00
NP-237	407.	311.90	3.5909E+00
AM-241	768.	59.54	2.6150E+00

VAX/VMS Nuclide Identification Report V2.8 Generated 8-SEP-1994 10:22:57

Configuration : DKB200:[USER.GEA]94-10406.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10406 t340 airfilter
 Sample date : 7-SEP-1994 00:00:00 Acquisition date : 7-SEP-1994 15:51:09
 Sample ID : 94-10406 Sample quantity : 1.0000 airfilter
 Sample type : Sample geometry : airfilter
 Detector name : E Detector geometry:
 Elapsed live time: 0 08:00:00.00 Elapsed real time: 0 08:00:03.39 0.0%
 Peak Width (FWHM): 3.00 Confidence level: 5.00 %
 Energy tolerance : 2.00 keV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

Sample 4C

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/airfil)
NA-22	95.	1274.53	2.2778E+00
CR-51	460.	320.08	1.5596E+01
MN-54	170.	834.83	2.0942E+00
CO-57	632.	122.06	1.1272E+00
CO-58	175.	810.75	2.0933E+00
CO-60	120.	1332.50	2.6508E+00
NR-94	164.	871.09	2.1365E+00
125	333.	427.88	5.4937E+00
CS-134	289.	604.71	2.0848E+00
EU-152	98.	1408.01	1.1988E+01
EU-154	95.	1274.51	6.6131E+00
EU-155	639.	105.31	4.1988E+00
TH-228	548.	215.75	4.4669E+02
TH-232	228.	911.16	9.0398E+00
U-235	1017.	185.74	2.8895E+00
NP-237	396.	311.90	3.5411E+00

VAX/VMS Nuclide Identification Report V2.8 Generated 8-SEP-1994 10:24:43

Configuration : DKB200:[USER.GEA]94-10407.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10407 t340 airfilter
 Sample date : 7-SEP-1994 00:00:00 Acquisition date : 7-SEP-1994 15:53:48
 Sample ID : 94-10407 Sample quantity : 1.0000 airfilter
 Sample type : Sample geometry : airfilter
 Detector name : F Detector geometry:
 Elapsed live time: 0 08:00:00.00 Elapsed real time: 0 08:00:26.77 0.1%
 Peak Width (FWHM): 3.00 Confidence level: 5.00 %
 Energy tolerance : 2.00 keV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

Sample *9/9/94*
~~ST~~ *5C*

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/airfil)
NA-22	107.	1274.53	2.2986E+00
CR-51	385.	320.08	1.5021E+01
MN-54	193.	834.83	2.1090E+00
CO-57	623.	122.06	1.1777E+00
CO-58	176.	810.75	1.9848E+00
CO-60	118.	1332.50	2.5009E+00
NB-94	155.	871.09	1.9618E+00
-125	305.	427.88	5.3119E+00
CS-134	321.	604.71	2.1216E+00
CS-137	240.	661.66	2.2611E+00
EU-152	90.	1408.01	1.0960E+01
EU-154	107.	1274.51	6.6775E+00
EU-155	621.	105.31	4.2742E+00
RA-226	471.	351.87	4.5833E+00
TH-228	541.	215.75	4.8276E+02
TH-232	233.	911.16	8.6239E+00
U-235	973.	185.74	3.0758E+00
NP-237	420.	311.90	3.8475E+00
AM-241	598.	59.54	2.3588E+00

VAX/VMS Nuclide Identification Report V2.8 Generated 9-SEP-1994 08:19:46

Configuration : DKB200:[USER.GEA]94-10408F.CNF;1
 analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 sample title : 94-10408 t340 charcoal filter
 Sample date : 8-SEP-1994 00:00:00 Acquisition date : 8-SEP-1994 15:09:51
 Sample ID : 94-10408 Sample quantity : 1.0000 sample
 Sample type : Sample geometry : 4oz pc jar
 Detector name : F Detector geometry:
 Elapsed live time: 0 08:00:00.00 Elapsed real time: 0 08:00:26.97 0.1%
 Peak Width (FWHM): 3.00 Confidence level : 5.00 %
 Energy tolerance: 2.00 keV Half life ratio : 8.00 %
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

sample 3b

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/sample)
NA-22	120.	1274.53	3.6338E+00
CR-51	405.	320.08	2.4707E+01
MN-54	202.	834.83	3.4974E+00
CO-57	618.	122.06	2.1023E+00
CO-58	204.	810.75	3.4747E+00
CO-60	117.	1332.50	3.6970E+00
NB-94	168.	871.09	3.2867E+00
CB-125	305.	427.88	8.7080E+00
-134	350.	604.71	3.6742E+00
EU-152	101.	1408.01	1.7079E+01
EU-154	119.	1274.51	1.0540E+01
EU-155	612.	105.31	7.9319E+00
RA-226	544.	351.87	7.9532E+00
TH-228	557.	215.75	7.8425E+02
TH-232	211.	911.16	1.3103E+01
U-235	1075.	185.74	5.2638E+00
NP-237	431.	311.90	6.2450E+00
AM-241	684.	59.54	4.7624E+00

MAX/VMS Nuclide Identification Report V2.8 Generated 9-SEP-1994 15:31:43

Configuration : DKB200:[USER.GEA]94-10409-F.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10409 t340 charcoal filter
 Sample date : 8-SEP-1994 00:00:00 Acquisition date : 9-SEP-1994 08:27:29
 Sample ID : 94-10409 Sample quantity : 1.0000 sample
 Sample type : Sample geometry : 4oz pc jar
 Detector name : F Detector geometry:
 Elapsed live time: 0 02:58:12.15 Elapsed real time: 0 02:58:22.94 0.1%
 Peak Width (FWHM): 3.00 Confidence level : 5.00 %
 Energy tolerance : 2.00 KeV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

Sample 4b

Nuclide	Bkgnd Sum	Energy (keV)	MDA (pCi/sample)
NA-22	58.	1274.53	6.8433E+00
CR-51	172.	320.08	4.4002E+01
MN-54	83.	834.83	6.0317E+00
CO-57	247.	122.06	3.5848E+00
CO-58	52.	810.75	4.7607E+00
CO-60	39.	1332.50	5.7744E+00
NB-94	70.	871.09	5.6974E+00
-125	126.	427.88	1.5100E+01
CS-134	116.	604.71	5.6950E+00
EU-152	37.	1408.01	2.7764E+01
EU-154	59.	1274.51	1.9893E+01
EU-155	262.	105.31	1.3970E+01
RA-226	183.	351.87	1.2416E+01
TH-228	207.	215.75	1.2888E+03
TH-232	82.	911.16	2.2057E+01
U-235	398.	185.74	8.6313E+00
NP-237	175.	311.90	1.0716E+01

VAX/VMS Nuclide Identification Report V2.8 Generated 9-SEP-1994 15:57:28

Configuration : DKB200:[USER.GEA]94-10410F.CNF;1
 Analyzes by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10410
 Sample date : 8-SEP-1994 00:00:00 Acquisition date : 9-SEP-1994 13:58:11
 Sample ID : 94-10410 Sample quantity : 1.0000 sample
 Sample type : Sample geometry : 4oz pc jar
 Detector name : F Detector geometry:
 Elapsed live time: 0 01:57:23.05 Elapsed real time: 0 01:58:04.18 0.6%
 Peak Width (FWHM): 3.00 Confidence level : 5.00 %
 Energy tolerance : 2.00 keV Half life ratio : 8.00
 Errors propagated: Yes Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit: 75.00

Minimum Detectable Activity Report

Sample 56

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/sample)
NA-22	23.	1274.53	6.5778E+00
CR-51	113.	320.08	5.4507E+01
MN-54	50.	834.83	7.1392E+00
CO-57	148.	122.06	4.2177E+00
CO-58	46.	810.75	6.8193E+00
CO-60	25.	1332.50	6.9905E+00
NB-94	46.	871.09	7.0190E+00
SB-125	62.	427.88	1.6007E+01
CS-134	77.	604.71	7.0468E+00
CS-137	56.	661.66	7.3756E+00
EU-152	32.	1408.01	3.9272E+01
EU-154	23.	1274.51	1.9077E+01
EU-155	150.	105.31	1.6064E+01
RA-226	106.	351.87	1.4364E+01
TH-228	139.	215.75	1.6044E+03
TH-232	51.	911.16	2.6332E+01
U-235	257.	185.74	1.0519E+01
NP-237	119.	311.90	1.3404E+01
AM-241	167.	59.54	9.6346E+00

VAX/VMS Nuclide Identification Report V2.8 Generated 23-SEP-1994 09:07:26

Configuration : DKB200:[USER.GEA]94-10411A.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10411A 34ONX PROBE WASH
 Sample date : 22-SEP-1994 00:00:00 Acquisition date : 22-SEP-1994 15:04:21
 Sample ID : 94-10411 Sample quantity : 1.0000 sample
 Sample type : Sample geometry : 2IN PLATE LOW SH
 Detector name : F Detector geometry: CARD
 Elapsed live time: 0 01:00:00.00 Elapsed real time: 0 01:00:04.89 0.1%
 Peak Width (FWHM): 3.00 Confidence level : 25.00 %
 Energy tolerance: 2.00 keV Half-life ratio : 8.00
 Errors propagated: No Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

sample probe, first wash

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/sample)
CR-51	208.	320.08	3.5279E+01
MN-54	53.	834.83	3.7287E+00
CO-58	40.	810.75	3.1679E+00
NB-94	97.	871.09	5.2202E+00
SB-125	267.	427.88	1.6253E+01
PB-210	810.	46.52	8.5909E+01
RA-226	194.	351.87	9.4971E+00
TH-228	309.	215.75	1.1625E+03
i-232	36.	911.16	1.1409E+01
U-235	332.	185.74	5.7606E+00
NP-237	202.	311.90	8.5572E+00
U-238	69.	1001.00	7.6683E+02

VAX/VMS Nuclide Identification Report V2.8 Generated 26-SEP-1994 08:32:00

Configuration : DKB200:[USER.GEA]94-10411B-F.CNF;1
 Analyses by : PEAK V16.3,PEAKEFF V2.2,NID V2.6,MINACT V2.3
 Sample title : 94-10411b 340nx probe second wash
 Sample date : 23-SEP-1994 00:00:00 Acquisition date : 23-SEP-1994 14:47:56
 Sample ID : 94-10411b Sample quantity : 1.0000 sample
 Sample type : Sample geometry : 2-in plate, low
 Detector name : F Detector geometry: CARD
 Elapsed live time: 0 08:00:00.00 Elapsed real time: 0 08:00:27.10 0.1%
 Peak Width (FWHM): 3.00 Confidence level : 25.00 %
 Energy tolerance: 2.00 keV Half-life ratio : 8.00 %
 Errors propagated: No Systematic Error : 0.00 %
 Efficiency type : Empirical Efficiencies at : Peak Energy
 Abundance limit : 75.00

Minimum Detectable Activity Report

4-e second probe washing

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/sample)
NA-22	131.	1274.53	1.0571E+00
CR-51	443.	320.08	6.4624E+00
MN-54	193.	834.83	8.8903E-01
CO-58	174.	810.75	8.3291E-01
NE-94	184.	871.09	8.9917E-01
SB-125	348.	427.88	2.3212E+00
CS-134	310.	604.71	8.7113E-01
EU-152	93.	1408.01	4.6135E+00
J-154	131.	1274.51	3.0675E+00
EU-155	738.	105.31	1.9606E+00
RA-226	562.	351.87	2.0199E+00
TH-228	591.	215.75	2.0111E+02
TH-232	206.	911.16	3.4166E+00
U-235	1052.	185.74	1.2816E+00
NP-237	458.	311.90	1.6109E+00

June 2, 1994

NUCLIDE IDENTIFICATION REPORT
 PNL Analytical Chemistry Lab
 Radioanalytical group, 325 bldg.

Client: J Glinesmeyer
 Project: 340-NX Stack Filters
 WP #: ED 4254

Cognizant Scientist: J. R. Miller Date: 6-2-94
 Reviewer: L. O. Harvey Date: 6-2-94

ALO #	SAMPLE ID	Total Alpha	Total Beta	Co-60	Cs-134	Cs-137	Eu-154	Am-241
Activities (PicoCuries)								
94-5827	1-A	<0.87	9.0 +/-2.1					
94-5828	1-B		3.92 E3 +/-1.1E2			1.18 E4 +/-1.5 E2		
94-5829	1-C	2.78 +/-1.2	159 +/-7.6					
94-5830	2-A			2.14 E2 +/-2.0 E1	4.67 E3 +/-3.1 E2	1.73 E2 +/-2.3 E1	5.78 E2 +/-7.8 E1	
94-5831	2-B			< 34				
94-5832	2-C	<0.87	4.59 +/-2.0					

MDAs for these samples are: Alpha, 0.87 pCi; Beta, 2.0 pCi; Co-60, 34 pCi

APPENDIX D
SUMMARY TABLES OF SAMPLE RESULTS

Table D.1 Concentrations by isotope for Run 1, before agitation

RUN 1		Event: Pre-agitation	
Start	3/30/94 9:22	Stack cfm	1846
End	4/4/94 10:04	Samp lpm	44
Minutes	7242.00		
Sampled ml	3.19E+08		
Events/yr	5		

Nuclide	Filter	pCi on Sample		Envelope	Total	uCi/ml
		Charcoal	Backup			
Alpha			2.78		2.78	8.72E-15
Beta	9		159		168	5.27E-13
Co-57					0	0
Co-60		3920			3920	1.23E-11
Sb-125					0	0
Cs-134					0	0
Cs-137		11800			11800	3.7E-11
Eu-152					0	0
Eu-154					0	0
Eu-155					0	0
Am-241					0	0

Table D.2 Concentrations by isotope for Run 2, during 50 minute agitation to collect liquid sample

RUN 2		Event: Agitated 50 min	
Start	4/4/94 10:31	Stack cfm	1846
End	4/4/94 13:09	Samp lpm	45
Minutes	158.00		
Sampled ml	7.11E+06		
Events/yr	5		

Nuclide	Filter	pCi on Sample		Envelope	Total	uCi/ml
		Charcoal	Backup			
Alpha			4.59		4.59	6.46E-13
Beta					0	0
Co-57					0	0
Co-60					0	0
Sb-125					0	0
Cs-134	214				214	3.01E-11
Cs-137	4670				4670	6.57E-10
Eu-152					0	0
Eu-154	173				173	2.43E-11
Eu-155					0	0
Am-241	578				578	8.13E-11

Table D.3 Concentrations by isotope for Run 3, during transfer and agitation

RUN 3		Event: Transfer	
Start	4/5/94 12:55	Stack cfm	1846
End	4/6/94 9:16	Samp lpm	37.8
Minutes	1221.00		
Sampled ml	4.62E+07		
Events/yr	5		

Nuclide	Filter	pCi on Sample			Total	uCi/ml
		Charcoal	Backup	Envelope		
Alpha	3690		2.47	19.57	3712.04	8.04E-11
Beta	19.5		48	45.81	113.31	2.46E-12
Co-57	130				130	2.82E-12
Co-60	67				67	1.45E-12
Sb-125					0	0
Cs-134	259				259	5.61E-12
Cs-137	7075	18.2	45.5		7138.7	1.55E-10
Eu-152					0	0
Eu-154	212				212	4.59E-12
Eu-155	90				90	1.95E-12
Am-241	1199				1199	2.6E-11

Table D.4 Concentrations by isotope for Run 4, following transfer and agitation

RUN 4		Event: Post Transfer	
Start	4/6/94 9:31	Stack cfm	1846
End	4/11/94 10:17	Samp lpm	46
Minutes	7246.00		
Sampled ml	3.33E+08		
Events/yr	5		

Nuclide	Filter	pCi on Sample			Total	uCi/ml
		Charcoal	Backup	Envelope		
Alpha	18000		13.21	344	18357.21	5.51E-11
Beta	38000		41.4	596.5	38637.9	1.16E-10
Co-57	306				306	9.18E-13
Co-60	236				236	7.08E-13
Sb-125	335				335	1.01E-12
Cs-134	119	13.4			132.4	3.97E-13
Cs-137	3688		9.2		3697.2	1.11E-11
Eu-152	309				309	9.27E-13
Eu-154	508				508	1.52E-12
Eu-155	221				221	6.63E-13
Am-241	6903	28.5	6.3		6937.8	2.08E-11

Table D.5 Concentrations by isotope for combined event from liquid sampling through period after transfer

Sum of Samples 2-4		Event: Agitation Through Post Transfer Combined	
Start	4/4/94 10:31	Stack cfm	1846
End	4/11/94 10:17	Samp lpm	44.4
Minutes	10066.00		
Sampled ml	4.47E+08		
Events/yr	5		

Nuclide	Filter	pCi on Sample				Total	uCi/ml
		Charcoal	Backup	Envelope	Probe		
Alpha	21690	0	20.27	363.57	2325	24398.84	5.46E-11
Beta	38019.5	0	89.4	642.31	5632	44383.21	9.93E-11
Co-57	436	0	0	0	126.1	562.1	1.26E-12
Co-60	303	0	0	0	11.6	314.6	7.04E-13
Sb-125	335	0	0	0		335	7.5E-13
Cs-134	592	13.4	0	0	32.9	638.3	1.43E-12
Cs-137	15433	18.2	54.7	0	41.2	15547.1	3.48E-11
Eu-152	309	0	0	0	123	432	9.67E-13
Eu-154	893	0	0	0	197	1090	2.44E-12
Eu-155	311	0	0	0	52	363	8.12E-13
Am-241	8680	28.5	6.3	0	736.6	9451.4	2.11E-11

Table D.6 Results for field blanks

RUN 5		Event: Field blanks	
Start	4/4/94 10:04	Stack cfm	1846
End	4/4/94 10:04	Samp lpm	NA
Minutes	0.00		
Sampled ml	#VALUE!		
Events/yr	5		

Nuclide	Filter	pCi on Sample			Total
		Charcoal	Backup	Envelope	
Alpha	3.74		1.02	1.15	5.91
Beta	10.1		3.2	2.25	15.55
Co-57					0
Co-60					0
Sb-125					0
Cs-134					0
Cs-137					0
Eu-152					0
Eu-154					0
Eu-155					0
Am-241	2.686				2.686