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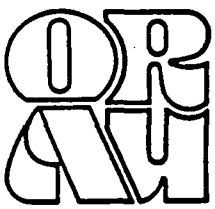

Prepared by
Oak Ridge Associated Universities

Prepared for
U.S. Nuclear Regulatory Commission's Region II Office

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RADIOLOGICAL MONITORING OF STACK EFFLUENTS WESTINGHOUSE ELECTRIC COMPANY COLUMBIA, SOUTH CAROLINA

E.J. DEMING

Radiological Site Assessment Program
Manpower Education, Research, and Training Division

DRAFT REPORT
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RADIOLOGICAL MONITORING OF STACK EFFLUENTS WESTINGHOUSE ELECTRIC COMPANY COLUMBIA, SOUTH CAROLINA

INTRODUCTION

The Westinghouse Electric Corporation in Columbia, South Carolina, is licensed by the Nuclear Regulatory Commission (NRC) to fabricate nuclear fuel for commercial reactors. Radioactive materials could potentially be released to the environment from the operations involved in fuel fabrication. Westinghouse Electric, in order to meet license conditions, maintains a stack monitoring program to ensure that all radioactive discharges to the environment are within established regulatory guidelines for radiation protection.

At the request of the Nuclear Regulatory Commission's Region II Office, the Radiological Site Assessment Program of Oak Ridge Associated Universities (ORAU) performed independent monitoring of stack effluent releases at the Westinghouse Electric plant to evaluate the adequacy of the Westinghouse monitoring program.

SITE DESCRIPTION AND INFORMATION

The Westinghouse Electric Corporation site is located on Bluff Road, south of Columbia, South Carolina (Figure 1). Westinghouse's fuel fabrication operations involve the conversion of UF_6 and uranyl nitrate into uranium dioxide, as well as the production of uranium dioxide fuel pellets which are then incorporated into fuel rods and assemblies. The U-235 content in the uranium ranges up to 5%. Additional activities at the Westinghouse site include scrap metal recovery and low-level waste incineration.

Operations which have a potential for generating airborne radioactive material are carried out under exhaust ventilation conditions. Conversion processes, scrap recovery, incineration, and several additional operations,

which may generate effluents with high moisture and temperature conditions and/or containing corrosives and uranium in gaseous form (UF_6), are vented through wet scrubber systems. The remaining ventilation systems are exhausted through dry systems equipped with prefilters at the process location and pre-filters and HEPA filters before final stack discharge.

All systems are continuously monitored by Westinghouse, using multi-point probes, or, on the smaller systems, single nozzle probes (Furnace and Development Stacks). Westinghouse samples for particulates, using Gelman AE fiberglass filter ~~papers~~ media. Previous studies have indicated that radionuclide concentrations in other than particulate form are insignificant. Sample filters are collected and replaced by the licensee on a daily basis.

SURVEY PROCEDURES

Objectives

The objective of the survey was to characterize stack effluents with regard to concentrations, isotopic composition, and particle size distributions. The resulting information was compared to measurements made by Westinghouse to evaluate the adequacy of the licensee's monitoring procedures.

Procedures

The survey was performed during September 11-19, 1986, in accordance with a plan approved by the Region II Office of the NRC. Stacks were selected for monitoring by ORAU, based on emissions data provided by the licensee. The stacks listed below were identified as routinely contributing significant fractions of the total plant air emissions.

Development Lab Exhaust #2
Conversion Enclosure Exhaust #2
Scrap Recovery System 2A
Conversion Exhaust System 1-A
Furnace Exhaust Line 5-N

Additionally, emissions from a roof exhaust vent, servicing the air compressor room, were monitored. The incinerator exhaust system, originally identified for monitoring, was not in operation during the time of the survey. Consequently, no data was obtained from this stack.

1. Holes, (approximately 4 cm in diameter), were drilled in the stacks by Westinghouse personnel to provide access for measuring air velocity and insertion of sample probes. Two holes were drilled at right angles to each other in each of the stacks. The holes were located as far downstream from the last transition or bend as the system design would permit.

2. A pitot tube and Alnor velometer were used for air flow determinations. Preliminary velocity measurements were made through direct velocity traverses at the section chosen for sampling, to detect any significant air flow variations. Measurements were made at predetermined locations in each of the stacks, based on recommendations found in EPA Standard Method # 1 (CF77). Figure 2 summarizes the criteria for selection of air flow measurement locations in circular ducts.

3. Velocity distribution measurements and calculations of corresponding nozzle diameter sizes were peformed to determine appropriate flow rates for isokinetic sampling. The nozzles were connected to probes supported by metal plates, which were held in position on the stack by flexible straps. Velocity profiles for each stack are presented in Table 1. The flow rates determined for each stack sampling location were in the range of 8.5-25 l/m.

4. Two sampling probes were installed in each of the stacks. Sampling was conducted for 4 days; the probes were repositioned every other day to obtain samples from various locations in the duct.

5. The Air Compressor Room roof exhaust vent was sampled by suspending an open-end filter holder fitted with a 47 mm diameter 0.8 µm membrane filter, in the discharge of the duct.

6. Conversion 1-A, Scrap Recovery 2-A, and Conversion Enclosure Exhaust #2, (all utilizing wet scrubber systems), were sampled using a combination of H_2O impingers and moisture traps, submerged in an ice bath. These were followed by 47 mm in-line #41 Whatman particulate filters (Figure 3).

   The Furnace Exhaust Line 5-N and the Development Lab Exhaust #2 were sampled using in-line filter holders containing 47 mm 0.8 µm millipore membrane filters (Figure 4).

7. Andersen Fractionating Particle Samplers were installed at the Furnace Exhaust Line 5-N and Development Lab Exhaust #2 for determination of particle size distribution. Samples were collected on glass fiber filters for approximately 24 hours, with a flow rate of 28.3 l/m (Figure 5).

Sample Analysis and Interpretation of Results

Samples were returned to Oak Ridge for analysis. Gross alpha concentrations were determined for particulate filters and the water collected from the impingers and vacuum traps. Alpha spectrometry for isotopic uranium concentrations ~~were~~ was peformed on a composite of the samples collected from the Conversion Exhaust 1-A Stack and ~~a~~ of the samples from the room exhaust vent. (These were the only samples with sufficient activity to enable such measurement). Particle size distributions were determined for samples from the Development Lab Exhaust, based on Andersen Sampler information (AN84). Lung solubility determinations were not made on any of the samples, due to insufficient sample activity. Additional information concerning analytical equipment and procedures can be found in Appendices A and B, respectively.

RESULTS

Gross Alpha Concentrations

Results of stack monitoring are presented in Tables 3-7. The Development Lab Stack #2 was sampled from four locations across the stack traverse. The

average gross alpha concentration measured during the sampling period was 2.61×10^{-13} µCi/ml. Values ranged from 1.41×10^{-13} to 4.39×10^{-13} µCi/ml (Table 3). The gross alpha concentrations measured in samples collected by Westinghouse personnel during the same time period ranged from 0.13×10^{-13} µC/ml to 9.9×10^{-13} µCi/ml with an average concentration of 4.24×10^{-13} µCi/ml.

Gross alpha levels measured at various locations within the Conversion Enclosure Exhaust #2 Stack, as determined by ORAU, ranged from $<0.1 \times 10^{-13}$ µCi/ml to 2.1×10^{-13} µCi/ml (Table 4). For comparison, the licensees results for the same time period ranged from 1.9×10^{-13} uCi/ml to 11×10^{-13} µCi/ml.

Table 5 presents results of monitoring of the Scrap Recovery System 2A. Gross alpha concentrations measured by ORAU were all less than calculated minimum detectable activities. Concentrations reported by Westinghouse Electric Corporation were 3.2×10^{-13} µCi/ml to 26×10^{-13} µCi/ml.

The gross alpha concentrations measured in varying locations within the Conversion Exhaust System 1-A stack ranged from $<0.10 \times 10^{-13}$ µCi/ml to 1.60×10^{-13} µCi/ml (Table 6). In comparison, gross alpha results reported by Westinghouse Electric Corporation for the same time period ranged from 3.2×10^{-13} µCi/ml. (ranged from 3.2×10^{-13} µCi/ml to what?)

Gross alpha levels measured by ORAU in the Furnace Exhaust Line 5-N ranged from 0.35×10^{-13} µCi/ml to 0.78×10^{-13} µCi/ml (Table 7). Concentrations reported by the licensee ranged from 3.2×10^{-13} µCi/ml to 5.4×10^{-13} µCi/ml.

Table 8 presents the results of monitoring of the roof exhaust vent. The results reported by Westinghouse were 4-25 times higher than the concentrations reported by ORAU. ORAU concentrations were from 0.72×10^{-13} µCi/ml to 4.38×10^{-13} µCi/ml while Westinghouse concentrations ranged from 18×10^{-13} µCi/ml to 32×10^{-13} µCi/ml.

Isotopic Composition

Alpha spectroscopy analysis of composited samples from Conversion Exhaust 1-A and samples from the roof exhaust vent indicated uranium-235 enrichments of 1.2 to 3.4%.

Particle Size Distributions

Particle size distributions determined from samples collected by Andersen Fractionating Particle Samplers at the Development Lab Exhaust #2 Stack are illustrated in Figure 6. The activity median aerodynamic diameter was determined to be 2.6 μm for the Development Stack.

DISCUSSION OF RESULTS

Gross Alpha Concentrations

A comparison of gross alpha concentrations measured by ORAU and Westinghouse Electric Corporation indicates reasonable agreement on most of the sampled stacks. The measurements from the Development & Conversion Enclosure #2, Conversion Exhaust System 1-A and the Furnace Exhaust Line 5N Stacks, indicated agreement within a factor of 2 to 10 at all of the sampling locations. Results reported by ORAU and Westinghouse Electric Corporation from the Scrap Recovery System 2A were all less than the calculated minimum detectable activities with the exception of the one? measurement made on 9/16/86; the licensees reported value for this measurement was almost a factor of 10^2 higher than the measurement made by ORAU. The minimum detectable activity reported by Westinghouse was greater than those reported by ORAU due to shorter sample count times, differences in counter efficiency, and background measurements. The largest consistant discrepancy between values reported by ORAU and Westinghouse Electric Corporation occurred in concentrations from the Air Compressor Room exhaust vent. The values reported by Westinghouse were typically 20 to 30 times higher than the concentrations reported for this location by ORAU during the same time period. The higher values reported by

Westinghouse, for all comparison sampling, is believed due to the short decay time allowed by Westinghouse between sample collection and counting. This short time would not be sufficient to permit decay of all naturally occurring thoron daughter products collected on the sample.

Guideline concentrations for uranium in air in unrestricted areas, as defined in 10CFR20, range from 3×10^{-12} to 2×10^{-11} µCi/ml (CF85). The highest concentration measured by ORAU was 4.39×10^{-13} µCi/ml, almost an order of magnitude less than the most restrictive of the NRC uranium air concentration guidelines.

Isotopic Compositions

The measured uranium isotopic composition of effluents from the Conversion Exhaust 1A Stack and the air compressor room exhaust is in agreement with WEC's reported U-235 enrichment of up to 5%.

Particle Size Distributions

An activity median aerodynamic diameter of 2.6 µm with a geometric standard deviation of 1.8 was determined for the Development Stack using information gathered using an Andersen Fractionating Particle Sampler. Sixty percent of the particles with a diameter of 2.6 µm are likely to be deposited in the nasal passage, twenty percent or less will deposit in the pulmonary parenchyma and the remainder will be deposited primarily in the trachea and bronchial tree.

SUMMARY

At the request of the NRC, ORAU performed stack effluent monitoring of four main exhaust stacks and a room exhaust vent at the Westinghouse Electric Company facility, near Columbia, South Carolina. The survey was conducted during the period of September 8 - 19, 1986. The objective was to evaluate the adequacy of the licensee's stack monitoring program.

The survey results indicate that the concentrations of uranium in stack effluents are well within the guideline levels for unrestricted areas.

Based on the results of this survey it is ORAU's conclusion that the Westinghouse stack monitoring program is adequate and that monitoring data accurately represents effluent releases to the atmosphere. If anything, the values reported by Westinghouse are conservative, perhaps due to a short sample hold time (24 hours) which would not allow complete decay of thoron daughter products.

WEC1

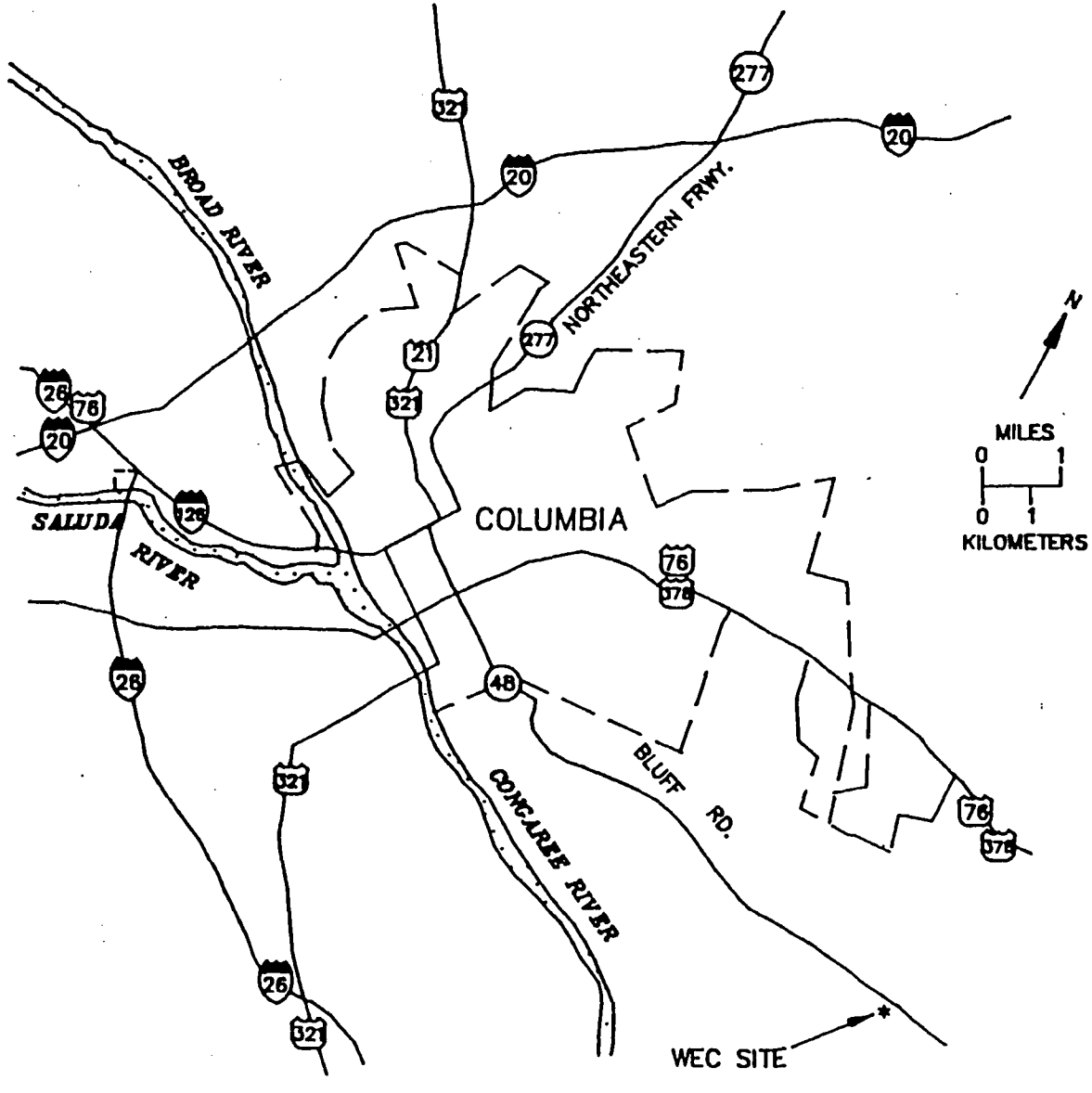
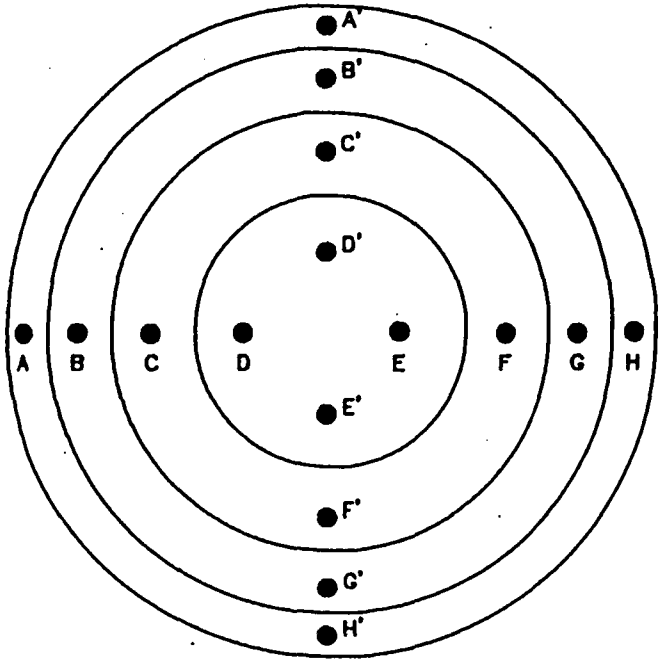


FIGURE 1: Map of Columbia, South Carolina, Area Indicating the Location of the Westinghouse Electric Corporation Site



Duct Diameter (cm)	# Of Points Per Traverse	DISTANCES OF POINTS FROM DUCT WALL (fraction of duct diameter)											
		A	B	C	D	E	F	G	H	I	J	K	L
<61	8	.032	.105	.194	.323	.677	.806	.895	.968	-	-	-	-
>61	12	.021	.067	.118	.177	.250	.356	.644	.750	.823	.882	.933	.979

FIGURE 2: EPA Standard Method 1 Criteria for Performing Air Velocity Measurements in Circular Ducts

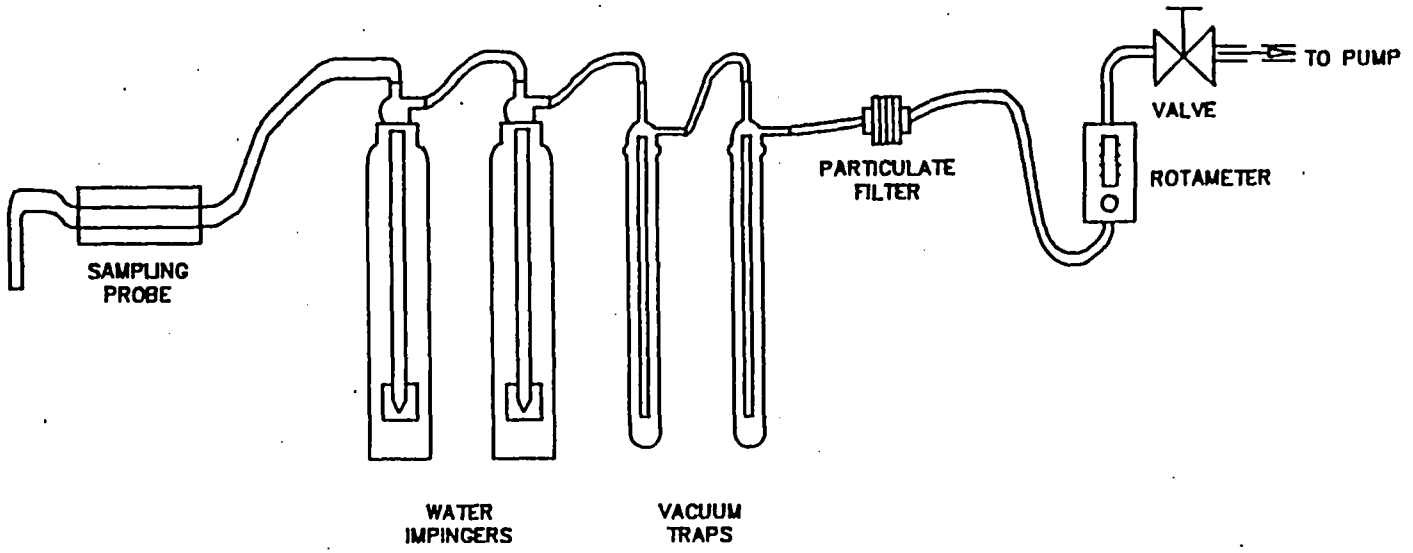


FIGURE 3: Diagram of Sampling System for Conversion 1–A, Recovery 2–A, and Conversion Enclosure Exhaust #2 Stacks

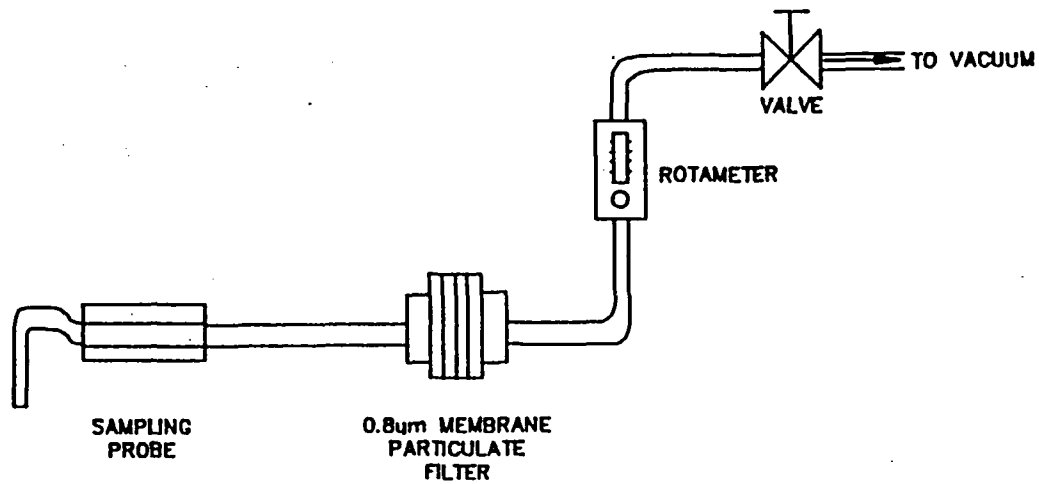


FIGURE 4: Diagram of the Sampling System for the Furnace Exhaust Line 5–A Stack, and the Development Lab Exhaust #2 Stack

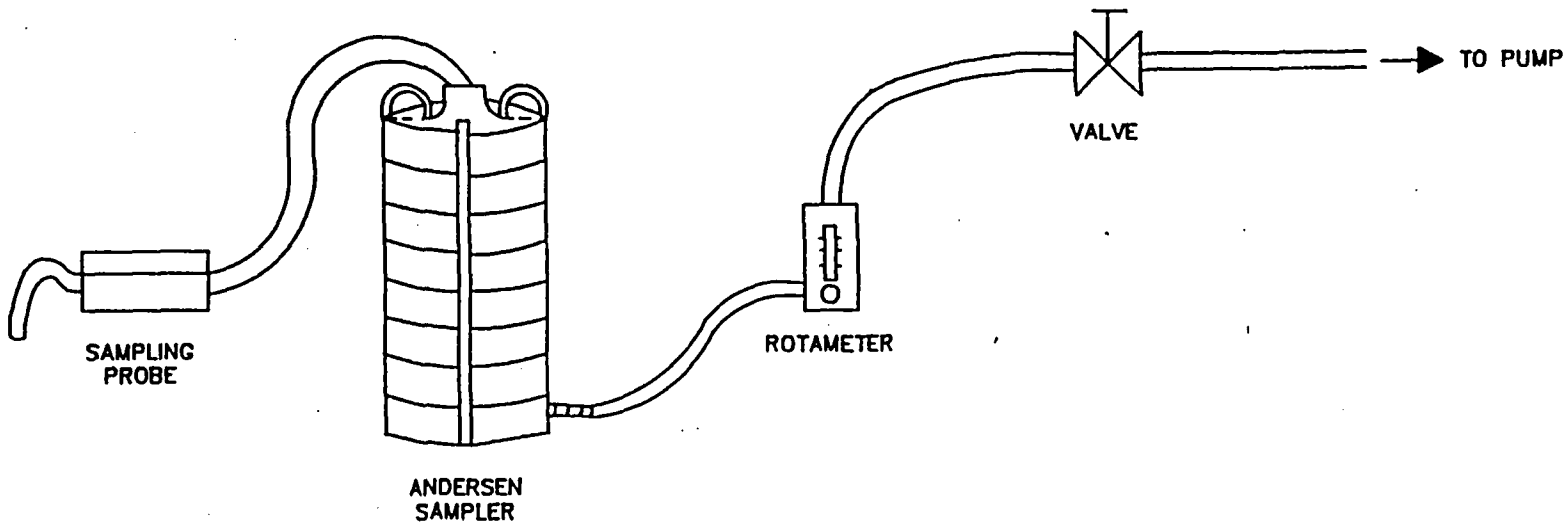


FIGURE 5: Diagram of the Sampling System Incorporating an Andersen Fractionating Particle Sampler

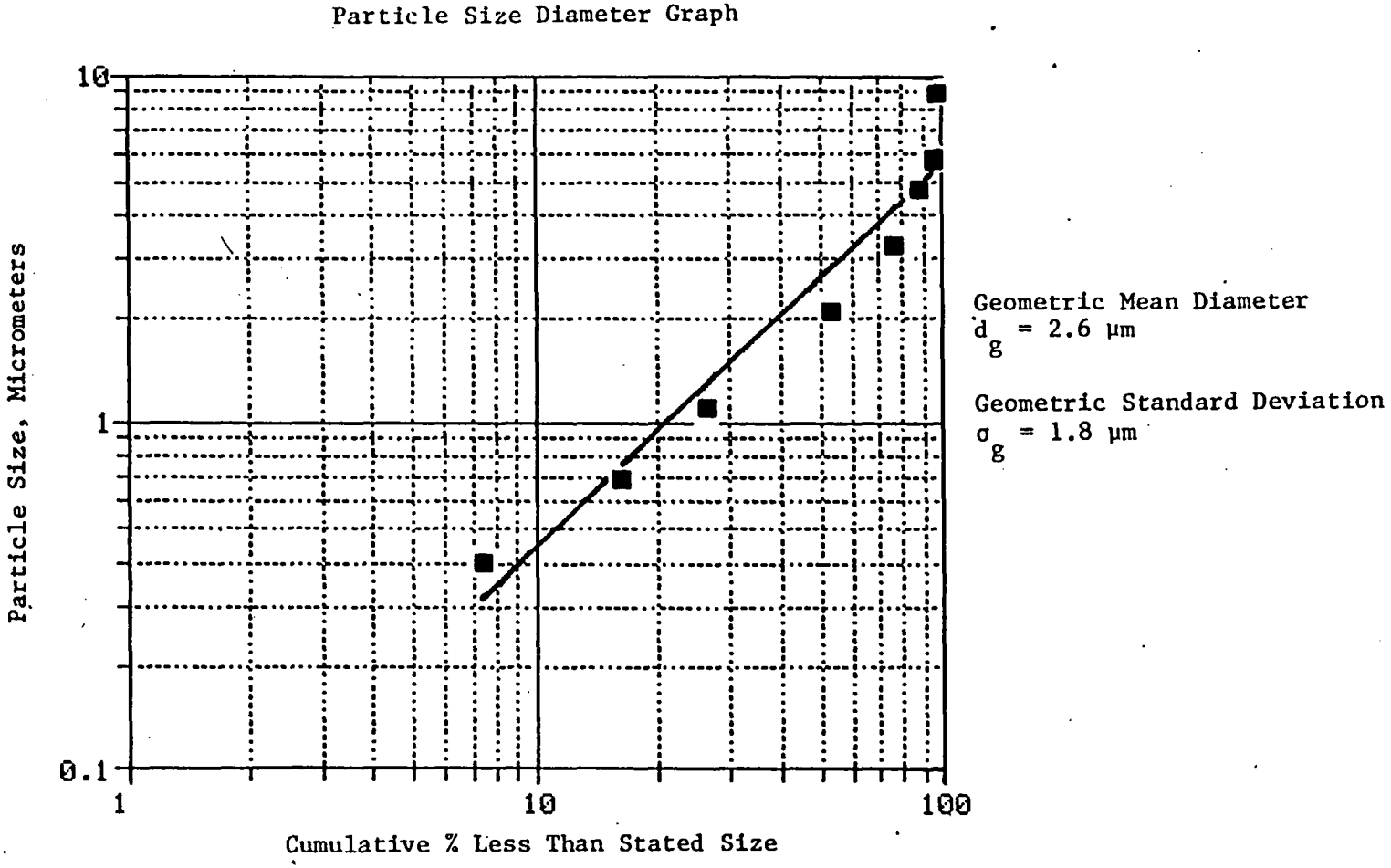


FIGURE 6: Particle Size Distribution of Andersen Fractionating Particle Sampling from the Development Lab Exhaust #2 Stack.

TABLE 1

VELOCITY PROFILES IN EXHAUST DUCTS
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Stack	Measurement Location (cm From Wall)	Velocity (m/min)	
		North	West
Development Lab #2	1.3	a	a
	3.4	305	320
	6.6	290	305
	11.2	290	290
	17.1	290	290
	23.1	290	305
	27.7	305	290
	30.7	305	290
	33.3	305	290
		North	
Conversion	2.5	579[b]	
Enclosure	5.8	640	
Exhaust #2	10.8	625	
	18.0	579	
	27.9	594	
	37.8	610	
	45.0	610	
	50.0	564	
	54.1	579	
			West[b]
	4.3		732
	7.6		701
	11.4		732
	16.3		671
	23.1		655
	32.4		625
	41.7		564
	47.9		549
	53.3		549
	57.2		518
	60.5		564
	63.5		564

TABLE 1 (Continued)

VELOCITY PROFILES IN EXHAUST DUCTS
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Stack	Measurement Location (cm From Wall)	Velocity (m/min)	
		Bottom	Southwest Side
Recovery 2A	2.5	1,036	975
	5.8	1,097	975
	10.8	1,128	1,067
	18.0	1,128	1,036
	27.9(Centerline)	1,036	1,036
	37.8	975	1,067
	45.0	914	1,067
	50.0	914	1,097
	54.1	1,006	1,006
		Bottom	Southwest Side
Conversion 1A	5.08	1,280	1,067
	8.9	1,280	1,189
	12.7	1,158	1,280
	18.4	671	1,463
	26.7	549	975
	36.8(Centerline)	305	305
	47.6	229	183
	55.2	610	610
	60.5	1,158	610
	64.8	1,494	366
	68.6	1,524	244
	72.4	1,341	274
		North	West
Furnace 5-N	1.3	a	a
	4.1	1,067	853
	7.4	1,219	914
	12.4	1,097	945
	19.1	914	975
	25.9(Centerline)	1,067	1,189
	30.7	1,189	1,311
	34.0	1,128	1,280
	36.8	1,067	1,219

[a]No measurement taken.
[b]Stack was oval; 55.9 x 64.8 cm so different measurement points were used on traverses.

TABLE 2

STACK SAMPLING FLOW RATES AND VOLUMES
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Stack	Date	Sampling Point and Location (cm from Duct Wall)	Velocity at Sampling Point (m/min)	Sampling Rate(l/min)	Sampling Time(min)	Sampling Volume($1x10^4$) liters?
Development	9/15-9/16	25.4 North	297	19.6	1,428	2.8
	9/15-9/16	17.1 West	290	19.4	1,428	2.8
	9/16-9/17	25.4 North	297	20.1	1,497	3.0
	9/16-9/17	17.1 West	290	19.6	1,497	2.9
	9/17-9/18	32.0 North	305	19.5	1,407	2.7
	9/17-9/18[b]	12.7 West	297	28.3	1,407	4.0
	9/18-9/19	32.0 North	305	20.3	1,440	2.9
	9/18-9/19	12.7 West	297	19.6	1,440	2.8
Conversion Enclosure Exhaust #2	9/15-9/16	14.0 Bottom	610	20.3	1,398	2.8
	9/15-9/16	32.5 Side	610	20.1	1,398	2.8
	9/16-9/17	14.0 Bottom	610	20.3	1,428	2.9
	9/16-9/17	32.5 Side	610	20.3	1,428	2.9
	9/17-9/18	52.1 Bottom	572	18.8	1,434	2.7
	9/17-9/18	41.9 Side	564	18.9	1,434	2.7
	9/18-9/19	52.1 Bottom	572	18.9	1,425	2.7
	9/18-9/19	41.9 Side	564	18.8	1,425	2.7
Scrap Recovery 2A	9/15-9/16	27.9 Bottom	1,036	a	a	a
	9/15-9/16	14.0 Side	1,052	a	a	a
	9/16-9/17	27.9 Bottom	1,036	10.7	1,470	1.6
	9/16-9/17	14.0 Side	1,052	10.8	1,470	1.6
	9/17-9/18	52.1 Bottom	960	10.1	1,431	1.4
	9/17-9/18	41.9 Side	1,067	11.1	1,431	1.6
	9/18-9/19	52.1 Bottom	960	9.2	1,440	1.3
	9/18-9/19	41.9 Side	1,067	a	a	a

TABLE 2 (Continued)

STACK SAMPLING FLOW RATES AND VOLUMES
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Stack	Date	Sampling Point and Location (cm from Duct Wall)		Velocity at Sampling Point (m/min)	Sampling Rate(l/min)	Sampling Time(min)	Sampling Volume($1x10^4$)
Conversion	9/15-9/16	19.7	Bottom		a	a	a
Exhaust 1A	9/15-9/16	55.4	Side		a	a	a
	9/16-9/17	19.7	Bottom	640	9.4	1,489	1.4
	9/16-9/17	55.4	Side	609	9.0	1,444	1.3
	9/17-9/18	68.8	Bottom	1,524	15.3	1,438	2.2
	9/17-9/18	37.6	Side	305	9.4	1,383	1.3
	9/18-9/19	68.8	Bottom	1,524	15.6	1,410	2.2
	9/18-9/19	37.6	Side	305	9.4	1,489	1.4
Furnace 5N	9/15-9/16	9.5	North	1,158	24.8	1,452	3.6
	9/15-9/16	19.1	West	975	20.7	1,449	3.0
	9/16-9/17	9.5	North	1,097	25.0	1,480	3.7
	9/16-9/17	19.1	West	975	21.2	1,462	3.1
	9/17-9/18	28.7	North	1,128	24.5	1,388	3.4
	9/17-9/18[b]	19.1	West	975	28.3	1,378	3.9
	9/18-9/19	28.7	North	1,128	24.5	1,388	3.4
	9/18-9/19	19.1	West	975	25.0	1,400	3.5

TABLE 2 (Continued)

STACK SAMPLING FLOW RATES AND VOLUMES
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Stack	Date	Sampling Point and Location (cm from Duct Wall)	Velocity at Sampling Point (m/min)	Sampling Rate(l/min)	Sampling Time(min)	Sampling Volume($1x10^4$)
Room Air Compressor Exhaust Vent	9/15-9/16	at exhaust	c	23.1	1,416	3.4
	9/16-9/17	at exhaust	c	23.6	1,435	3.4
	9/17-9/18	at exhaust	c	23.6	1,421	3.4
	9/18-9/19	at exhaust	c	23.6	1,502	3.6

[a]Equipment failure; no measurement.
[b]Andersen Fractionating Particle Sampler in place.
[c]No velocity measurement made.

TABLE 3

RESULTS OF STACK MONITORING
DEVELOPMENT LAB EXHAUST #2
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Date	Sample Location	Analysis By	Gross Alpha Concentrations $\times 10^{-13}$ µCi/ml
9/15-16/86	West 17.1 cm	ORAU	2.74 ± 0.16[a]
	North 25.4 cm	ORAU	2.76 ± 0.16
	Multi-point	WEC	<3.2
9/16-17/86	West 17.1 cm	ORAU	1.51 ± 0.12
	North 25.4 cm	ORAU	1.41 ± 0.11
	Multi-point	WEC	<3.2
9/17-18/86	West 12.7 cm	ORAU	b
	North 32.0 cm	ORAU	4.39 ± 0.20
	Multi-point	WEC	9.9
9/18-19/86	West 12.7 cm	ORAU	2.60 ± 0.16
	North 32.0 cm	ORAU	2.85 ± 0.16
	Multi-point	WEC	6.8

[a]Errors are 2σ based only on counting statistics.
[b]Andersen Fractionating Particle Sampler in place; no gross alpha concentration determined.

TABLE 4

RESULTS OF STACK MONITORING
CONVERSION ENCLOSURE EXHAUST #2
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Date	Sample Location	Analysis By	Gross Alpha Concentrations $\times 10^{-13}$ µCi/ml
9/15-16/86	Bottom 14.0 cm	ORAU	2.1 ± 1.5[a]
	Side 32.5 cm	ORAU	<0.1
	Multi-point	WEC	<3.2
9/16-17/86	Bottom 14.0 cm	ORAU	<2.2
	Side 32.5 cm	ORAU	2.0 ± 1.3
	Multi-point	WEC	11
9/17-18/86	Bottom 52.1 cm	ORAU	1.5 ± 1.1
	Side 41.9 cm	ORAU	<0.1
	Multi-point	WEC	5.9
9/18-19/86	Bottom 52.1 cm	ORAU	<1.0
	Side 41.9 cm	ORAU	<1.0
	Multi-point	WEC	9.2

[a]Errors are 2σ based only on counting statistics.

TABLE 5

RESULTS OF STACK MONITORING
SCRAP RECOVERY SYSTEM 2A
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Date	Sample Location	Analysis By	Gross Alpha Concentrations $\times 10^{-13}$ µCi/ml
9/15-16/86	Bottom 27.9 cm	ORAU	a
	Side 14.0 cm	ORAU	a
	Multi-point	WEC	26
9/16-17/86	Bottom 27.9 cm	ORAU	<0.14
	Side 14.0 cm	ORAU	<0.13
	Multi-point	WEC	12
9/17-18/86	Bottom 52.1 cm	ORAU	<0.17
	Side 41.9 cm	ORAU	<0.15
	Multi-point	WEC	<3.2
9/18-19/86	Bottom 52.1 cm	ORAU	<0.16
	Side 41.9 cm	ORAU	<0.20
	Multi-point	WEC	<3.2

[a]Equipment failure, no sample collected.

TABLE 6

RESULTS OF STACK MONITORING
CONVERSION EXHAUST SYSTEM 1A
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Date	Sample Location	Analysis By	Gross Alpha Concentrations $\times 10^{-13}$ µCi/ml
9/15-16/86	Bottom 19.7 cm	ORAU	a
	Side 55.4 cm	ORAU	a
	Multi-point	WEC	5.1
9/16-17/86	Bottom 19.7 cm	ORAU	<0.18
	Side 55.4 cm	ORAU	1.60 ± 0.43[b]
	Multi-point	WEC	3.8
9/17-18/86	Bottom 68.8 cm	ORAU	<0.10
	Side 37.6 cm	ORAU	<0.18
	Multi-point	WEC	<3.2
9/18-19/86	Bottom 68.8 cm	ORAU	<0.12
	Side 37.6 cm	ORAU	0.65 ± 0.30
	Multi-point	WEC	<3.2

[a]Equipment failure, no sample collected.
[b]Errors are 2σ based only on counting statistics.

TABLE 7

RESULTS OF STACK MONITORING
FURNACE EXHAUST LINE 5N
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Date	Sample Location	Analysis By	Gross Alpha Concentrations x 10^{-13} µCi/ml
9/15-16/86	North 9.5 cm	ORAU	0.44 ± 0.28[a]
	West 19.1 cm	ORAU	0.78 ± 0.37
	Multi-point	WEC	5.4
9/16-17/86	North 9.5 cm	ORAU	0.57 ± 0.30
	West 19.1 cm	ORAU	0.72 ± 0.35
	Multi-point	WEC	<3.2
9/17-18/86	North 28.7 cm	ORAU	0.35 ± 0.29
	West 19.1 cm	ORAU	b
	Multi-point	WEC	<3.2
9/18-19/86	North 28.7 cm	ORAU	0.69 ± 0.33
	West 19.1 cm	ORAU	0.52 ± 0.30
	Multi-point	WEC	<3.2

[a]Errors are 2σ based only on counting statistics.
[b]Anderson Fractionating Particle Sampler in place; no gross alpha concentration determined.

TABLE 8

RESULTS OF MONITORING
AIR COMPRESSOR ROOM EXHAUST VENT
WESTINGHOUSE ELECTRIC COMPANY
COLUMBIA, SOUTH CAROLINA

Date	Analysis By	Gross Alpha Concentrations $\times 10^{-13}$ µCi/ml
9/15-16/86	ORAU	1.39 ± 0.10[a]
	WEC	32
9/16-17/86	ORAU	0.78 ± 0.08
	WEC	20
9/17-18/86	ORAU	4.38 ± 0.18
	WEC	18
9/18-19/86	ORAU	0.72 ± 0.07
	WEC	20

[a]Errors are 2σ based only on counting statistics.

REFERENCES

AN84 Operating Manual for Andersen 1 ACFM Non-viable Ambient Particle Sizing Samplers, Andersen Samplers, Inc., February 1984.

CF77 Title 40, Code of Federal Regulations, Part 60, Standards of Performance for New Stationary Sources, 1977.

CF85 Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, 1985.

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

The display or description of a specific product is not to be construed as an endorsement of that product or its manufacturer by the authors or their employer.

A. Air Sampling

Aluminum in-line filter holders
47 mm
Cat. #996209
(Research Appliance, Co., Cambridge, MD)

Aluminum in-line filter holders
47 mm
Cat. #1235
(Gelman Sciences, Ann Arbor, MI)

Stack sampling nozzles
(NuTech Corp., Durham, NC)

Rotameters
Dwyer Model RMB
Dwyer Instruments Inc.
Michigan City, IN

Gast Vacuum Pumps
115v/60Hz
Cat. #P8400
(American Scientific Products, Stone Mountain, GA)

Andersen 1 ACFM
Non-viable Ambient Sizing Sampler
(Andersen Samplers, Atlanta, GA)

Velometer - all purpose set
Type 6000 a.p.
(Alnor Instrument Co., Niles, IL)

"Precision" Wet Test Meter
Used to calibrate rotameters
(Precision Scientific Co., Chicago, IL)

Additional Supplies
Plastic tubing, connectors, particulate filter paper (0.08 µm), Whatman #41 filter paper, glass impingers and vacuum traps

B. Laboratory Analysis

Automatic low-background Alpha-Beta Counter
Model LB5110-2080
(Tennelec, Inc., Oak Ridge, TN)

Alpha Spectrometry System
Tennelec Electronics, EG&G ORTEC

Surface Barrier Detectors
(Tennelec Inc., Oak Ridge, TN)

Multichannel Analyzer
ND66/680 System
(Nuclear Data, Schaumburg, IL)

APPENDIX B

ANALYTICAL PROCEDURES

APPENDIX B

Analytical Procedures

Gross Alpha Measurements

Gross alpha measurements on particulate filter samples were made using an automatic low-background proportional counter, Tennelec Model LB5110. Results of these gross alpha analyses were related to the total sample activity using ratios of analyzed volume to total sample volume.

Alpha Spectrometry

Filter samples collected from the Conversion Exhaust and Roof Exhaust Vent were ashed, and the residues were dissolved by pyrosulfate fusion and precipitated with barium sulfate. The barium sulfate precipitate is redissolved and the uranium is separated by liquid-liquid extraction. Uranium was then precipitated with a cerium fluoride carrier and counted using surface barrier detectors (ORTEC), alpha spectrometers (Tennelec), and an ND66 Multichannel Analyzer (Nuclear Data).

Particle Sizing

Sizing of the particulates collected by Andersen impactor was in accordance with instruction for radioactive particles as presented in the operating manual for that instrument.

Errors and Detection Limits

The uncertainties associated with the analytical data, presented in the tables of this report, represent the 95% (2σ) confidence levels based only on counting statistics. Other sources of error associated with the sampling and analyses introduce an additional uncertainty of $\pm$ 6 to 10% in the results.

Calibration and Quality Assurance

Laboratory analytical procedures are documented in manuals prepared by the ORAU Radiological Site Assessment Program.

Laboratory and analytical instruments are calibrated using NBS-traceable standards. Quality control procedures on all instruments included daily background and check-source mesurements to confirm acceptable equipment operation. The ORAU laboratory participates in the EPA Quality Assurance Program.