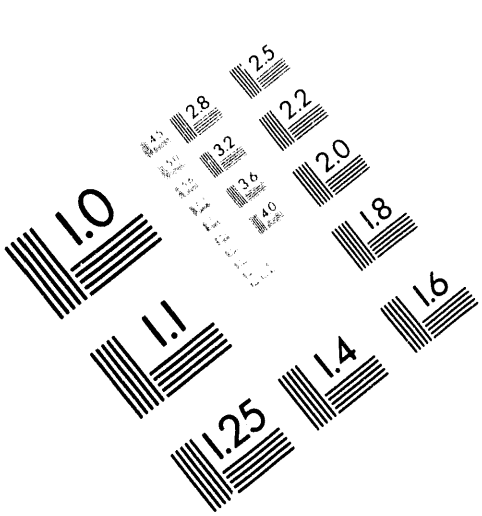

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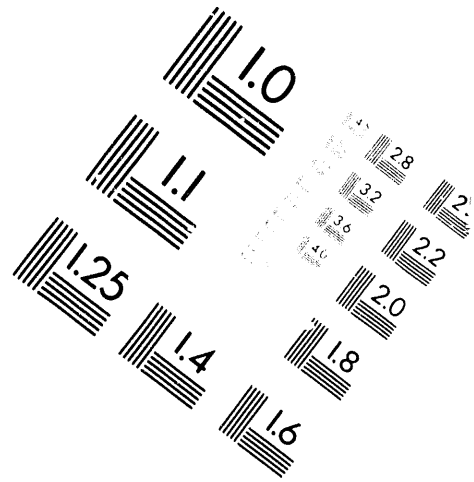

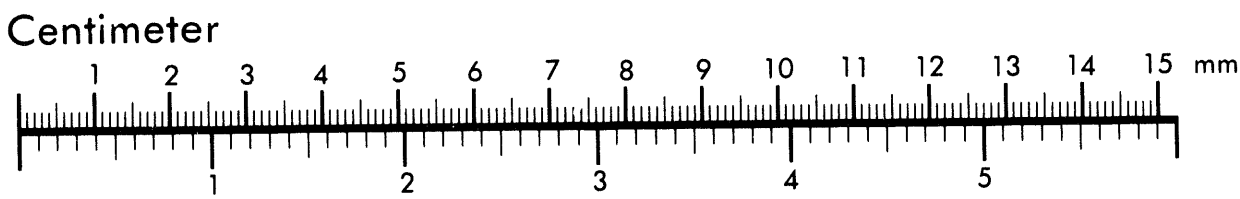

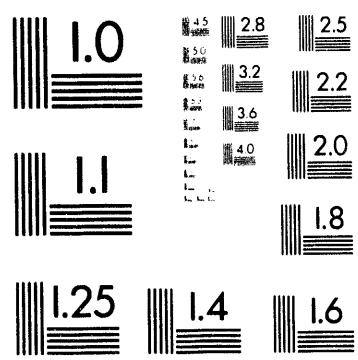

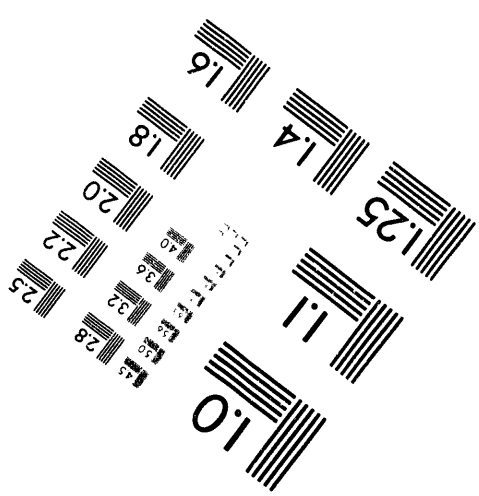

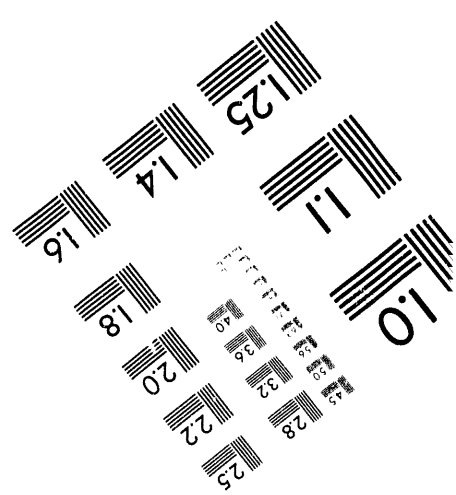

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WHC-EP-0784

Tank Exhaust Comparison with 40 CFR 61.93, Subpart H, and Other Referenced Guidelines for Tank Farms National Emission Standards for Hazardous Air Pollutant (NESHAP) Designated Stacks

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CAM	Continuous Air Monitor
DOE	U.S. Department of Energy
EDE	Effective Dose Equivalent
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facilities Compliance Agreement
L	Liter
NESHAP	National Emission Standards For Hazardous Air Pollutant
WHC	Westinghouse Hanford Company

TANK EXHAUST COMPARISON WITH 40 CFR 61.93, SUBPART H, AND OTHER REFERENCED GUIDELINES FOR TANK FARM'S NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANT (NESHAP) DESIGNATED STACKS

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) promulgated National Emission Standards for Emissions of Radionuclides other than Radon from U.S. Department of Energy (DOE) Facilities (40 CFR 61, Subpart H) on December 15, 1989. The regulations specify procedures, equipment, and test methods that are to be used to measure radionuclide emissions from exhaust stacks that are designated as National Emission Standards for Hazardous Air Pollutant (NESHAP) stacks. Designated NESHAP stacks are those that have the potential to cause any member of the public to receive an effective dose equivalent (EDE) greater than or equal to 0.1 mrem/year, assuming all emission controls were removed. Tank Farms currently has 33 exhaust stacks, 15 of which are designated NESHAP stacks. This document assesses the compliance status of the monitoring and sampling systems for the designated NESHAP stacks.

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TANK EXHAUST COMPARISON WITH 40 CFR 61.93, SUBPART H, AND OTHER REFERENCED GUIDELINES FOR TANK FARM'S NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANT (NESHAP) DESIGNATED STACKS

2.0 PURPOSE

The purpose of this document is to assess the compliance status of Tank Farm's designated NESHAP stacks as required by the Federal Facilities Compliance Agreement (FFCA) for Radionuclide NESHAP. The DOE and EPA Region 10 entered into the FFCA on February 7, 1994. The FFCA contains requirements for the following categories of radionuclide emission sources:

1. Previously Identified Designated Stacks
2. Remaining Registered Stacks
3. Identified Non-Registered Stacks
4. Other Potential Sources

One of the required FFCA submittals for Remaining Registered Stacks and Identified Non-Registered Stacks is an evaluation to determine which stacks should be designated NESHAP stacks (FFCA Appendix A, Section II, Paragraph 1; and Section III, Paragraph 2). The evaluation is documented in WHC-SD-WM-EMP-031 and was submitted to the EPA before the December 17, 1993 milestone. The evaluation designated nine stacks. Additional information became available after WHC-SD-WM-EMP-031 was submitted to the EPA, which necessitated the designation of an additional six stacks (for a total of 15).

This document (WHC-EP-0784) is a detailed description of existing monitoring systems and comparison with the requirements of 40 CFR 61.93 for Tank Farm's designated NESHAP stacks. This information is to be submitted to EPA by August 31, 1994 for the Remaining Registered Stacks, and by March 31, 1995 for all Identified Non-Registered Stacks (FFCA Appendix A, Section II, Paragraph 2 and Section III, Paragraph 2).

The EPA will provide the DOE with comments on this document, identifying actions necessary to achieve compliance with 40 CFR 61.93. Within 90 days of receiving the EPAs comments, the DOE is to submit an upgrade schedule to the EPA. The upgrade schedule will become part of the FFCA once approved by the EPA.

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TANK EXHAUST COMPARISON WITH 40 CFR 61.93, SUBPART H, AND OTHER REFERENCED GUIDELINES FOR TANK FARM'S NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANT (NESHAP) DESIGNATED STACKS

3.0 SCOPE

The scope of this document includes all tank farm stacks that were determined to be NESHAP stacks (with the exception of the 296-A-22 and 296-A-40 stacks). The NESHAP determinations are documented in WHC-SD-WM-EMP-031. The following stacks are evaluated in this document:

STACK	FACILITY
296-A-17	241-AY/AZ Tank Farm Exhauster
296-P-26	241-AY/AZ Tank Farm Backup Exhauster
296-A-25	244-A Double Contained Receiver Tank Exhauster
296-A-27	241-AW Tank Farm Exhauster
296-A-29	241-AN Tank Farm Exhauster
296-B-28	244-B Double Contained Receiver Tank Exhauster
296-C-5	244-CR Vault Exhauster
296-P-16	241-C-105/106 Tank Exhauster
296-P-23	241-SY Tank Farm Exhauster
296-P-28	241-SY Tank Farm Backup Exhauster
296-S-15	241-SX Tank Farm Exhauster
296-S-22	244-S Double Contained Receiver Tank Exhauster
296-T-18	244-TX Double Contained Receiver Tank Exhauster

The two designated Tank Farm stacks that are not evaluated in this document are the 296-A-22 stack (242-A evaporator vessel vent) and 296-A-40 stack (241-AP Tank Farm exhauster). These stacks are evaluated in WHC-EP-0542 and WHC-EP-0543, respectively.

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TANK EXHAUST COMPARISON WITH 40 CFR 61.93, SUBPART H, AND OTHER REFERENCED GUIDELINES FOR TANK FARM'S NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANT (NESHAP) DESIGNATED STACKS

4.0 STRUCTURE OF POINT-BY-POINTS

The format and paragraph structure used for the point-by-points are described below. The regulation and section are bold and underlined, followed by a verbatim or summarized list of the regulatory requirement(s) in small font. The applicable documentation is listed below, followed by a discussion of existing conditions and comparison with the regulation. For example:

Regulation, Section Procedural, technical, or other requirement taken verbatim or summarized from the regulation.

Documentation: Applicable DOE or Westinghouse Hanford Company (WHC) documentation.

Comparison: A discussion of the existing condition and comparison with the regulation.

Unlike previous point-by-point comparisons, these point-by-point comparisons do not go through each regulation from beginning to end before going on to the next regulation. Instead, the document is organized to trace the path that a reader would take if he or she were to read through 40 CFR 61.93 from beginning to end, following references to the other regulations/standards. When one section of a regulation refers the reader to a section of a separate regulation (for example, Part 61 referring to Part 60) the regulation that the reader is referred to is indented. For example:

Regulation A, Section 1 Follow the requirements of Regulation B.

> **Regulation B** Procedural, technical, or other requirements taken verbatim from the regulation.
>
> Documentation: Applicable DOE or WHC documentation.
>
> Comparison: A discussion of the existing condition and comparison with the regulation.

Regulation A, Section 2 Procedural, technical, or other requirements taken verbatim or summarized from the regulation.

Sources referred to throughout this document, including in the appendices, are listed in Section 5.0, "References."

Where discussions/comparisons of the requirement is similar for all of the stacks, the reader is referred to Appendix N. Appendix N is provided to shorten this document by eliminating repeat or duplicated discussions/comparisons.

TANK EXHAUST COMPARISON WITH 40 CFR 61.93, SUBPART H, AND OTHER REFERENCED GUIDELINES FOR TANK FARM'S NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANT (NESHAP) DESIGNATED STACKS

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APPENDIX A

40 CFR 61.93, SUBPART H COMPARISON FOR 296-A-17

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NESHAP COMPLIANCE FOR THE AY/AZ TANK FARM EXHAUSTER STACK (296-A-17) PROVIDED BY TANK FARMS FACILITY ENVIRONMENTAL ENGINEERING

Subpart H Section 61.93(a) (see Appendix N)

Subpart H Section 61.93(b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or other procedures for which EPA has granted prior approval

Subpart H Section 61.93(b)(1) Effluent flow rate measurements shall be made using the following methods.

Subpart H Section 61.93(b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-62883 Arch. Struct. Sections and Details.

Comparison: Stack 296-A-17 has an inside diameter of 44.5 cm (17.5 in.) and is categorized as a stack or large vent.

40 CFR 60, Appendix A, Method 2, Section 1.2 This procedure is not applicable at measurement sites which fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions.

40 CFR 60, Appendix A, Method 1, Section 2.1 Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: WHC-SD-WM-ES-291

Drawing H-2-62883

Drawing H-2-62888

Comparison: The stack flow measurement location is 5.3 diameters downstream from the nearest flow disturbance (sample probe) and 18 diameters upstream from the nearest flow disturbance (top of stack), which meets the alternate location requirements.

40 CFR 60, Appendix A, Method 1, Section 2.4 Cyclonic flow may exist (1) after such devices as cyclones and internal demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined.

Documentation: Drawing H-2-62883

Drawing H-2-62888

Comparison: Stack 296-A-17 does not have devices such as cyclones, internal demisters, or tangential inlets between the fan inlet to the stack and the stack flow measurement location.

Method 2, Section 3.3 Measure the velocity head and temperature at the traverse points specified by Method 1.

Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

GUIDANCE/DATA SHEET FOR 241-AY/AZ EXHAUST STACK (296-A-17) FLOW MEASUREMENT

Comparison: Based on the distances to the nearest upstream and downstream flow disturbances and Part 60, Appendix A, Method 1, Figure 1-2, 16 measurements should be taken on each of two traverses. The referenced procedure calls for 16 measurements to be taken, but only along one traverse. The stack does not have a second flow measurement port.

Subpart H Section 61.93(b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to measure flow rates through pipes and small vents.

Documentation See documentation referenced for Section 61.93 (b)(1)(i).

Comparison Stack 296-A-17 has an inside diameter of 44.5 cm (17.5 in.) and is categorized as a stack or large vent; therefore, the requirements of Section 61.93(b)(1)(ii) do not apply.

Subpart H Section 61.93(b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates, only periodic measurements are necessary.

Documentation: RHO-CD-1092

SD-WM-CR-016

WHC-SD-WM-ES-291

Comparison: A flow rate with a variability of less than ± 20% has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. Flow rate measurements are therefore, taken periodically (quarterly). During 1992 and 1993, the measured flow rate for this stack varied by -14% and +15%.

Subpart H Section 61.93(b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods

Subpart H Section 61.93(b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1, Section 1.2 This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: WHC-SD-WM-ES-291

Drawing H-2-62883

Drawing H-2-62888

Comparison: This stack is 44.5 cm (17.5 in.) in diameter. The sampling site is located 2.2 diameters downstream from the exhaust recirculation duct outlet and 5.3 diameters upstream from the flow measurement port above roof. Stack 296-A-17 does not have devices such as cyclones, internal demisters, or tangential inlets between the fan inlet to the stack and the stack sampling location.

40 CFR 60, Appendix A, Method 1, Section 2.1 Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: See documentation referenced for Method 1, Section 1.2.

Comparison: See comparison for Method 1, Section 1.2.

Subpart H Section 61.93(b)(2)(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSI N13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

ANSI N13.1-1969, Section 4.2.1.2 The sampling point should be a minimum of five diameters (or five times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Documentation: WHC-SD-WM-ES-291

Drawing H-2-62883

Drawing H-2-62888

Comparison: The sampling point is located only 2.2 diameters downstream from the nearest prominent transition (exhaust recirculation outlet); however, the sampling location meets the minimum criteria of 40 CFR 60, Appendix A, Method 1. Moving the sample location to five duct diameters would significantly increase the sample line losses or require placement of the record sampler above the roof of the building, creating a safety hazard for personnel that service the unit.

ANSI N13.1-1969, Section 4.2.2.1 SAMPLING WITHOUT DIFFERENTIATION OR BIAS AS TO PARTICLE SIZE AND KIND. The sampler must not fractionate by particle size or in other ways distort the physical and chemical properties of the airborne radionuclide constituents.

Documentation: WHC-SD-WM-ES-291

NRC NuReg/GR-006, Serial #2145

Comparison: Theoretical calculations of sample line losses indicate that the sampling system is biased with respect to particle sizes. Because of the relatively long sample line 3.4 m (11 ft), large particles (on the order of 10 micron) may not be adequately sampled. The theoretically determined sampling system particle penetration percentage is on the order of 85 percent for small particles (3.5 micron), and 10 percent for large particles. Paragraph 3.1.1 of the Configuration and Efficiency Study justifies using a 3.5 micron particle size for evaluation of sampling system efficiency.

ANSI N13.1-1969, Section 4.2.2.2 (see Appendix N)

ANSI N13.1-1969, Section 4.2.2.3 PARTICLE SIZE FRACTIONATION DUE TO AN ISOKINETIC SAMPLING. In applications in which particle sizes may be expected to vary, it is recommended that the sampler arrangement be designed to permit near isokinetic flow into the sampler entry probe.

Documentation: WHC-SD-WM-ES-291

Comparison: The sampling system is designed to be isokinetic for a stack flow rate of 88,690 L/min (3132 ft^3/min) and sample (and continuous air monitor [CAM]) flow rate of 120 L/min (4.2 ft^3/min). The average sample flow rate for CY 1992 was 110 L/min (3.8 ft^3/min) [54 L/min (1.9 ft^3/min) was the average measured record sample flow and assume average CAM flow was also 54 L/min (1.9 ft^3/min)]. For this sample flow rate, isokinetic conditions would be achieved at a stack flow rate of 80,221 L/min (2833 ft^3/min). The average stack flow rate for 1992 was 90,551 L/min (3198 ft^3/min). The difference between the design flow rate and actual conditions will result in oversampling of large particles (>5 micron). The errors due to anisokinetic sampling are included in the theoretically determined sampling system particle penetration percentage discussed in ANSI N13.1-1969, Section 4.2.2.1.

ANSI N13.1-1969, Section 4.2.2.4 SAMPLE DISTORTION DUE TO CHEMICAL REACTIONS AND RELATED EFFECTS. Extreme care must be exercised in extracting a sample from an airstream when the air contains chemically reactive forms of radioactive isotopes. Materials to be avoided for sampling iodine are rubber, copper, and some plastics. When the air to be sampled is nearly saturated with water vapor, condensation may occur on the collector itself. When heavy moisture loadings are anticipated, heated sampling lines will be required to prevent condensation in the lines and to raise the collector temperature well above the dewpoint.

Documentation: Not applicable.

Comparison: This sampling system contains a silver zeolite cartridge for collecting radioactive iodine, tin, antimony, and ruthenium samples. The sampling system upstream of the silver zeolite cartridge does not contain rubber, copper, or plastic, which may absorb radioiodine or ruthenium. Although psychrometric data is not available for this stack, there are no indications that the effluent may be saturated (with water vapor) and may impact the sampling by condensing in sample lines, plugging the filter paper, or weakening the filter media. As a precaution, heat tape exists on the sample line to prevent condensation.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2 PARTICLE COLLECTORS WITHOUT SIGNIFICANT SIZE DIFFERENTIATION. At regular intervals and when any change is anticipated, the airborne material should be characterized as to physical and chemical nature.

Documentation: 65950-86-607

13314-89-032

WHC-SD-WM-EMP-031

Comparison: The airborne effluent upstream of the HEPA filters was characterized by the first referenced letter, then further characterized by the second referenced letter to include more detailed physical and chemical analysis and a pre-HEPA particle size study. This study determined that the particle size-distribution is bimodal. The two most prominent particle sizes are 0.1 micron and 4.0 micron; where 30 percent of the particles collected were 0.1 micron and 17 percent were 4.0 micron. The airborne effluent downstream of the HEPA filters has not been characterized, and may differ significantly in terms of particle size distribution. The operation of this system has not significantly changed in a manner that would increase concentrations in the effluent since the most recent off-gas study. In fact, airborne concentrations may be lower than previously measured because the airlift circulators were shut down on the 101 AZ and 102 AZ tanks in August 1993 and February 1994, respectively.

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3 GASES. Airborne radioactive volatile materials and so-called "permanent" gases such as tritium are frequently important contaminants and their sampling and collection require techniques and methods differing from those used in particulate sampling.

Documentation: WHC-SD-WM-EMP-031, Rev. 0

Comparison: The potential offsite dose from radioactive iodine gas is less than 10 percent of the total potential off-site dose from this stack. Therefore, the 296-A-17 stack sampling system does not require volatile radioactive gas sampling. However, the 296-A-17 stack sampling system does contain two Silver Zeolite cartridges for collecting radioactive iodine and other gases. See Appendix N for description of the sampling cartridges.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-92516 Sheet 1 of 4

Drawing H-2-92516 Sheet 2 of 4

WHC-SD-WM-ES-291

Comparison: The sample line is approximately 3.4 m (11 ft) long with two bends that are 45 degrees each with a minimum bend radius of 19 cm (7.5 in.) The sample line has an inside diameter of 1.6 cm (.62 in.)

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

See response under ANSI N13.1-1969, Section 4.2.1.2.

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

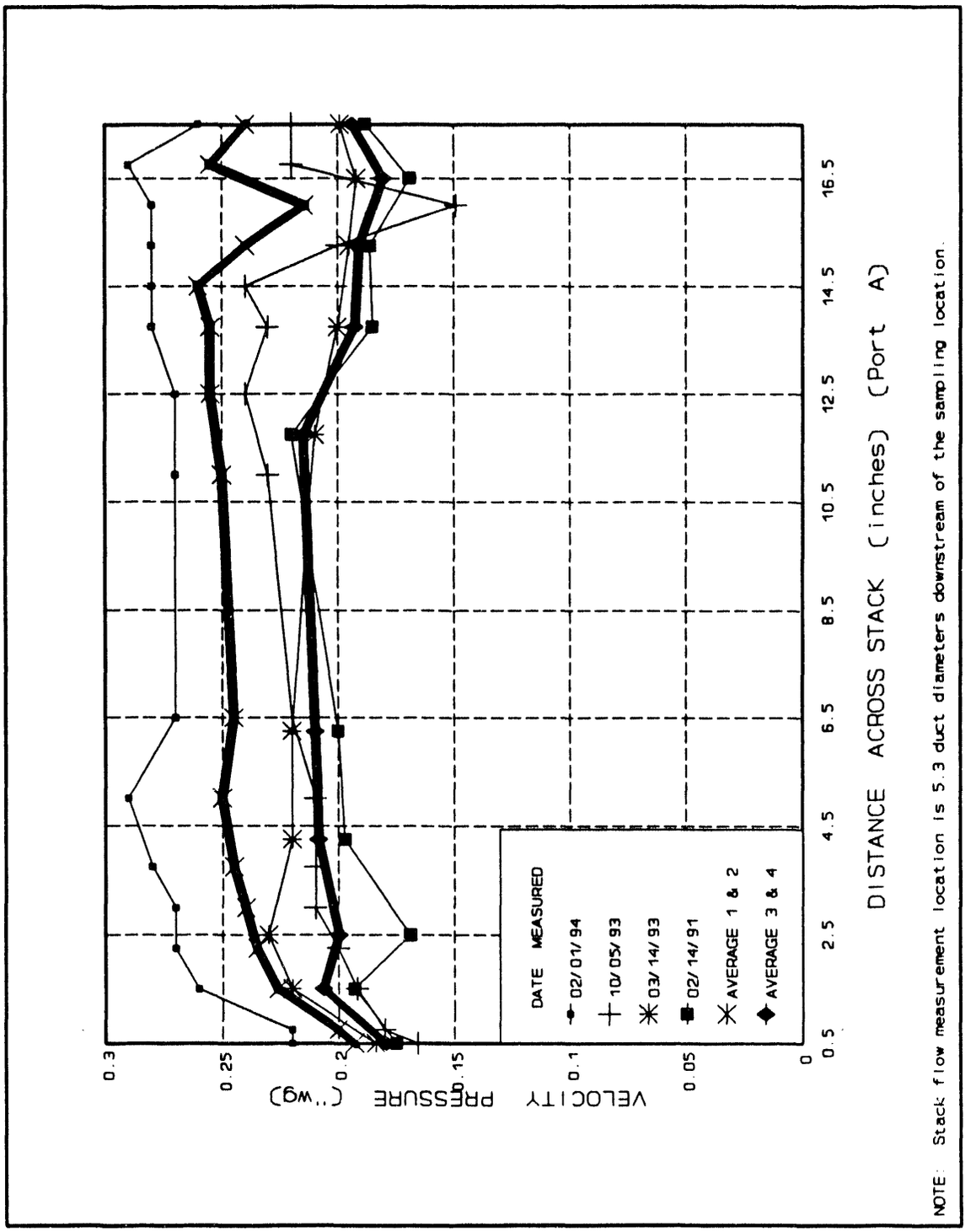
Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56

GUIDANCE/DATA SHEET FOR 241-AY/AZ PRIMARY EXHAUST STACK (296-A-17) FLOW MEASUREMENT

Comparison: The particle and gaseous composition are assumed to be uniform since this is a vertical stack and the effluent should be well mixed when it reaches the sampling location (i.e., Stack flow is turbulent). The velocity distribution is shown in Figure A-1. Stack flow measurements are taken 5.3 duct diameters downstream of the sampling location. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure A-1. Stack Flow Distribution 296-A-17.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-79962

Comparison: The sample probe has three nozzles that meet the requirements of Section A3.2. One of the dimensions needed to determine how the sample probe is centered in the stack could not be located on the drawings for this stack, and is relatively difficult to field verify due to the sampling probe mount being located 4.6 m (15 ft) above the ground in the 702 Filter Building. Because the sample probe has three nozzles and the span from the first to the third nozzle is 36.5 cm (14 3/8 in.) [the stack ID being 44.5 cm (17.5 in.)], it was assumed that the second nozzle is positioned on the centerline of the stack. To be located at the midpoints of three equal areas in the stack, the nozzles should be located at the following distances from the center of the stack 0, 15.49 and 20.19 cm (0, 6.098, and 7.947 in.) The nozzles are located at the following distances from the center of the stack 0, 15.88, and 20.64 cm (0, 6.25, and 8.125 in.). Therefore, the withdrawal points represent approximate equal areas.

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

Comparison: See ANSI N13.1-1969, Section 4.2.2.3 and Appendix A Section A3.1.

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-79962

Comparison: The nozzles are 1.3 cm (0.5 in.) OD with a side wall thickness of .17 cm (0.065 in.) [ID = .94 cm (0.37 in.)]. The three nozzle bends are specified as 3R or 6.35 cm (2.5 in.) minimum. The bend radius begins approximately 6.35 (2.5 in.) from the nozzle tip. Therefore, the probe complies with the requirements listed in Figure A5 for a multiprobe sampler.

Subpart H Section 61.93(b)(2)(iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX B

40 CFR 61.93, SUBPART H COMPARISON FOR 296-P-26

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NESHAP COMPLIANCE FOR THE AY/AZ TANK FARM BACKUP EXHAUSTER STACK (296-P-26) PROVIDED BY TANK FARMS FACILITY ENVIRONMENTAL ENGINEERING

Subpart H Section 61.93(a) (see Appendix N)

Subpart H Section 61.93(b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or other procedures for which EPA has granted prior approval.

Subpart H Section 61.93(b)(1) Effluent flow rate measurements shall be made using the following methods

Subpart H Section 61.93(b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-93100

Comparison: Stack 296-P-26 has an inside diameter of approximately 41 cm (16 in.) and falls into the category of a stack or large vent.

40 CFR 60, Appendix A, Method 2, Section 1.2 This procedure is not applicable at measurement sites which fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions.

40 CFR 60, Appendix A, Method 1, Section 2.1 Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: WHC-SD-WM-ES-291

Comparison: The stack flow measurement location is 5 diameters downstream from the nearest flow disturbance (diffuser plate just above fan) and 2 diameters upstream from the nearest flow disturbance (top of stack), which meets the alternate location requirements.

40 CFR 60, Appendix A, Method 1, Section 2.4 Cyclonic flow may exist (1) after such devices as cyclones and internal demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined.

Documentation: Not applicable.

Comparison: Stack 296-P-26 does not have devices such as cyclones, internal demisters, or tangential inlets between the fan inlet to the stack and the stack flow measurement location.

40 CFR 60, Appendix A, Method 2, Section 3.3 Measure the velocity head and temperature at the traverse points specified by Method 1.

Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

GUIDANCE/DATA SHEET FOR 241-AY/AZ EXHAUST STACK (296-P-26) FLOW MEASUREMENT

Comparison: Based on the distances to the nearest upstream and downstream flow disturbances and Figure 1-2, 16 measurements should be taken on each traverse. The referenced procedure calls for 16 measurements to be taken along each traverse.

Subpart H Section 61.93(b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to measure flow rates through pipes and small vents.

Documentation: See documentation referenced for Section 61.93 (b)(1)(i).

Comparison: Stack 296-P-26 has an inside diameter of 41 cm (16 in.) and falls into the category of a stack or large vent, therefore, the requirements of Section 61.93(b)(1)(ii) do not apply.

Subpart H Section 61.93(b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: RHO-CD-1092

SD-WM-CR-016

WHC-SD-WM-ES-291

Comparison: A flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rate measurement is therefore, taken periodically (quarterly). During 1992, the measured flow rate for this stack varied by -5 percent and +3 percent.

Subpart H Section 61.93(b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93(b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1, Section 1.2 This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: WHC-SD-WM-ES-291

Comparison: This stack is 16 in. in diameter. The sampling site is located 5 diameters downstream from the nearest flow disturbance (diffuser plate just above fan) and 2 diameters upstream from the nearest flow disturbance (top of stack). Stack 296-P-26 does not have devices such as cyclones, internal demisters, or tangential inlets between the fan inlet to the stack and the stack sampling location.

40 CFR 60, Appendix A, Method 1, Section 2.1 Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: See documentation referenced for Method 1, Section 1.2.

Comparison: See for Method 1, Section 1.2.

Subpart H Section 61.93(b)(2)(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSI N13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

ANSI N13.1-1969, Section 4.2.1.2 The sampling point should be a minimum of five diameters (or five times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Documentation: WHC-SD-WM-ES-291

Drawing H-2-93100

Comparison: The sampling point is located 5 diameters downstream from the nearest prominent transition (diffuser plate just above fan).

ANSI N13.1-1969, Section 4.2.2.1 SAMPLING WITHOUT DIFFERENTIATION OR BIAS AS TO PARTICLE SIZE AND KIND. The sampler must not fractionate by particle size or in other ways distort the physical and chemical properties of the airborne radionuclide constituents.

Documentation: WHC-SD-WM-ES-291

NRC NuReg/GR-006, Serial #2145

Comparison: Theoretical calculations of sample line losses indicate that the sampling system is biased with respect to particle sizes. The theoretically determined sampling system particle penetration percentage is on the order of 99 percent for small particles (3.5 micron), and 77 percent for large particles (10 micron). Paragraph 3.1.1 of the Configuration and Efficiency Study justifies using a 3.5 micron particle size for evaluation of sampling system efficiency.

ANSI N13.1-1969, Section 4.2.2.2 (see Appendix N)

ANSI N13.1-1969, Section 4.2.2.3 PARTICLE SIZE FRACTIONATION DUE TO ANISOKINETIC SAMPLING. In applications in which particle sizes may be expected to vary, it is recommended that the sampler arrangement be designed to permit near isokinetic flow into the sampler entry probe.

Documentation: WHC-SD-WM-ES-291

Comparison: The sampling system is designed to be isokinetic for a stack flow rate of 90,390 L/min (3192 ft^3/min) and sample flow rate of 62 L/min (2.2 ft^3/min). The average sample flow rate for CY92 was 57 L/min (2 ft^3/min). For this sample flow rate, isokinetic conditions would be achieved at a stack flow rate of 82,520 L/min (2914 ft^3/min). The average stack flow rate for 1992 was 150,578 L/m (5318 ft^3/min) [the difference between the ideal (isokinetic) and actual stack flow rate will result in oversampling of larger particles (>5 micron)]. The errors due to anisokinetic sampling are included in the theoretically determined sampling system particle penetration percentage discussed in ANSI N13.1-1969, Section 4.2.2.1.

ANSI N13.1-1969, Section 4.2.2.4 SAMPLE DISTORTION DUE TO CHEMICAL REACTIONS AND RELATED EFFECTS. Extreme care must be exercised in extracting a sample from an airstream when the air contains chemically reactive forms of radioactive isotopes. Materials to be avoided for sampling iodine are rubber, copper, and some plastics. When the air to be sampled is nearly saturated with water vapor, condensation may occur on the collector itself. When heavy moisture loadings are anticipated, heated sampling lines will be required to prevent condensation in the lines and to raise the collector temperature well above the dewpoint.

Documentation: Not applicable.

Comparison: This sampling system does not contain a silver zeolite cartridge for collecting radioactive iodine, tin, antimony, and ruthenium samples. Psychrometric data has not been collected for this stack, however, there are no indications that the effluent may be saturated (with water vapor) and may impact the sampling by condensing in sample lines, plugging the filter paper, or weakening the filter media. As a precaution, heat tape exists on the sample line to prevent condensation.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2 PARTICLE COLLECTORS WITHOUT SIGNIFICANT SIZE DIFFERENTIATION. At regular intervals and when any change is anticipated, the airborne material should be characterized as to physical and chemical nature.

Documentation: 65950-86-607

13314-89-032

WHC-SD-WM-EMP-031

Comparison: The airborne effluent upstream of the HEPA filters was characterized for the 296-A-17 stack by the first referenced letter, then further characterized by the second referenced letter to include more detailed physical and chemical analysis as well as a pre-HEPA particle size study. This study determined that the particle size distribution is bimodal. The two most prominant particle sizes are 0.1 micron and 4.0 micron; where 30 percent of the particles collected were 0.1 micron and 17 percent were 4.0 micron. Since the 296-P-26 exhauster uses the same ducting, deentrainer, and condenser as the 296-A-17 stack, the 296-P-26 exhauster effluent should be the same. However, the airborne effluent downstream of the HEPA filters has not been characterized, and may differ significantly in terms of particle size distribution. The operation of this system has not significantly changed in a manner that would increase concentrations in the effluent since the most recent off-gas study. In fact, airborne

concentrations may be lower than previously measured due to the airlift circulators being shut down on 101 AZ and 102 AZ in August 1993 and February 1994, respectively.

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3 GASES. Airborne radioactive volatile materials and so-called "permanent" gases such as tritium are frequently important contaminants and their sampling and collection require techniques and methods differing from those used in particulate sampling.

Documentation: WHC-SD-WM-EMP-031, Rev. 0

Comparison: The potential off-site dose from radioactive iodine gas is less than 10 percent of the total potential off-site dose from this stack. Therefore, the 296-P-26 stack sampling system does not require volatile radioactive gas sampling.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-93100 Sheet 2 of 3

WHC-SD-WM-ES-291

Comparison: The sample line is approximately 2.4 m (8ft) long with one 90 degree bend with a minimum bend radius of 4 cm [1.5 in.) (the actual bend radius is approximately 25.4 cm (10 in.)]. The sample line has an inside diameter of 1.6 cm (.62 in.).

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Comparison: See response to ANSI N13.1-1969, Section 4.2.1.2.

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

GUIDANCE/DATA SHEET FOR 241-AY/AZ BACKUP EXHAUST STACK (296-P-26) FLOW MEASUREMENT

Comparison: The particle and gaseous composition is assumed to be uniform because this is a vertical stack and the effluent should be well mixed when it reaches the sampling location (i.e., stack flow is turbulent). The stack flow measurements are taken just below the sampling location. A graph of historical stack flow measurements indicates a non-uniform flow distribution across the stack (see Figures B-1 and B-2). The disturbance in the flow is believed to be from the fan diffuser plate. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{Velocity\ Pressure}$$

Figure B-1. Stack Flow Distribution 296-P-26-A.

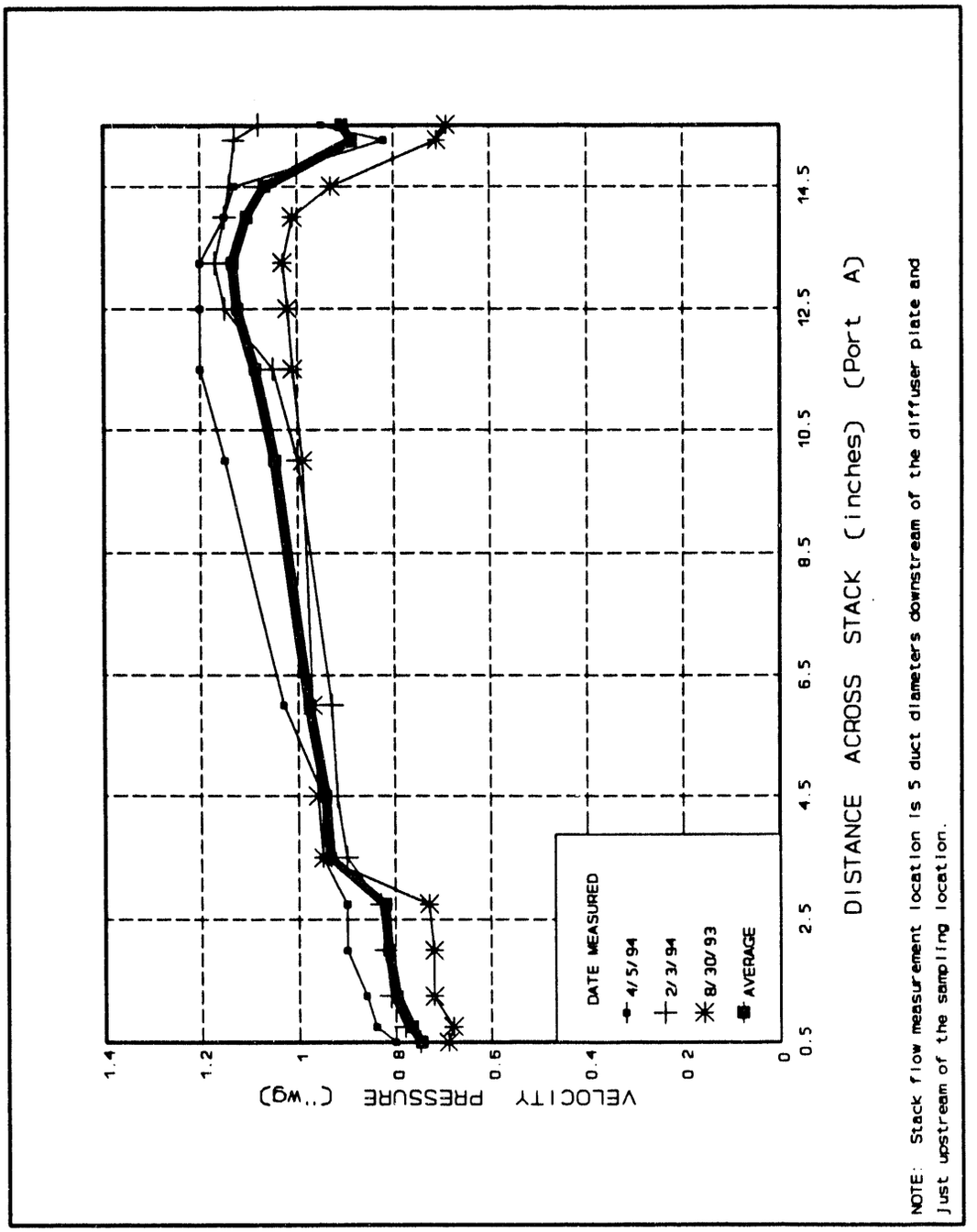
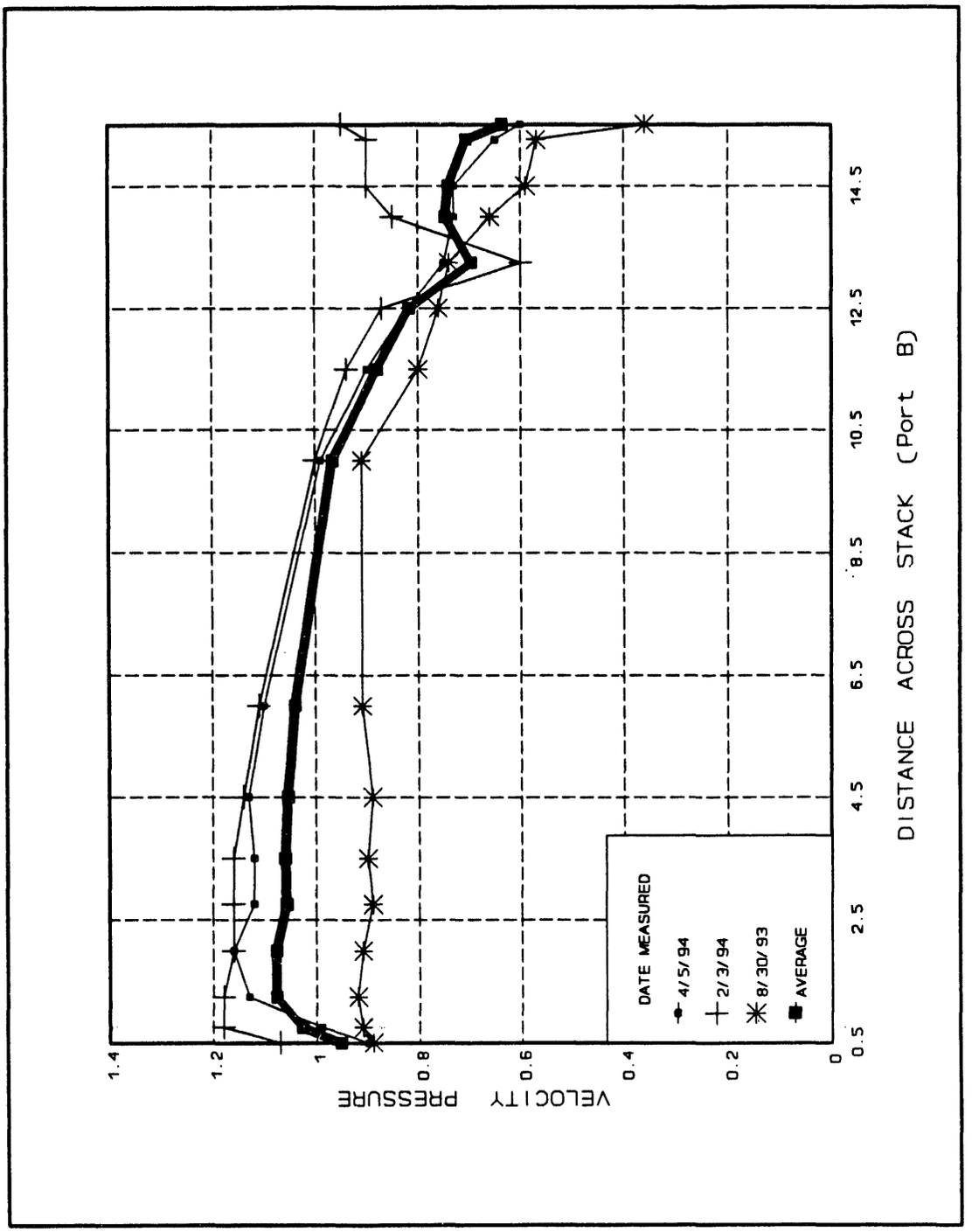


Figure B-2. Stack Flow Distribution 296-P-26-B.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-79962

Comparison: To be located at the midpoints of three equal areas in the stack, the nozzles should be located at the following distances from the center of the stack: 0, 14.2, 18.5 cm (0, 5.58, and 7.27 in.). The nozzles are located at the following distances from the center of the stack: 0, 14.0, 18.1 cm (0, 5.50, and 7.125 in.), and represent approximately equal areas.

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Comparison: (see response to ANSI N13.1-1969, Section 4.2.2.3, and Appendix A, Section A3.1)

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-79962

Comparison: The nozzles are .8 cm (0.31 in.) OD with a side wall thickness of .09 cm (0.035 in.) [ID = .6 cm (0.24 in.)]. The three nozzle bends are specified as 3.8 cm (1.5 in.) minimum. The bend radius begins approximately 3.8 cm (1.5 in.) from the nozzle tip.

Subpart H Section 61.93(b)(2)(iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX C

40 CFR 61.93, SUBPART H COMPARISON FOR 296-A-25

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NESHAP COMPLIANCE FOR THE 244-A DOUBLE CONTAINED RECEIVER TANK EXHAUSTER STACK (296-A-25) PROVIDED BY TANK FARMS FACILITY ENVIRONMENTAL ENGINEERING

Subpart H Section 61.93(a) (see Appendix N)

Subpart H Section 61.93(b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or other procedures for which EPA has granted prior approval:

Subpart H Section 61.93(b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93(b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-38215

Comparison: Stack 296-A-25 has an inside diameter of 10.2 cm (4.03 in.) and falls into the category of a small stack or duct, therefore, Method 2C should be used.

40 CFR 60, Appendix A, Method 2C, Section 1.1.1 The applicability of this method is identical to Method 2, except this method is limited to stationary source stacks or ducts less than about 0.30 m (12 in.) in diameter or 0.071 m^3 (113 $in.^2$) in cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.0081 m^2 (12.57 $in.^2$) in cross-sectional area.

Comparison: See documentation/discussion referenced in Subpart H, Section 61.93(b)(1)(i).

40 CFR 60, Appendix A, Method 2C, Section 3.0 Follow the general procedures in Section 3 of Method 2, except conduct the measurements at the traverse points specified in Method 1A.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1 Select a PM sampling site located preferably at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances such as bends, expansions, or contractions in the stack, or from a visible flame. Next, locate the velocity measurement site 8 equivalent diameters downstream of the PM sampling site. If such locations are not available, select an alternative PM sampling site that is at least 2 equivalent stack or duct diameters downstream and 2 $^1/_2$ diameters upstream from any flow disturbance. Then locate the velocity measurement site 2 equivalent diameters downstream from the PM sampling site.

Documentation: WHC-SD-WM-ES-291, Rev. 1

Field walkdown

Comparison: The stack flow measurement location is 8 diameters downstream from the nearest flow disturbance (fan inlet to stack) and 6.5 diameters upstream from the nearest flow disturbance (sampling location).

40 CFR 60, Appendix A, Method 1A, Section 2.2.2 Use Figure 1-2 of Method 1 to determine the number of traverse points, following the same procedure used for PM sampling traverses as described in Section 2.1.1 of Method 1.

Documentation: Guidance/Data Sheet for 244-A DCRT Exhaust Stack (296-A-25) Flow Measurement

Comparison: Figure 1-2 calls for 8 measurements to be taken along each traverse. The Guidance/Data Sheet also calls for 8 measurements. This stack only has one traverse, however, the traverse is in the same plane as the fan inlet to the stack and the sampling probe.

Subpart H Section 61.93(b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to measure flow rates through pipes and small vents.

Comparison: See response to Subpart H Section 61.93 (b)(1)(i).

Subpart H Section 61.93(b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates, only periodic measurements are necessary.

Documentation: RHO-CD-1092

SD-WM-CR-016

WHC-SD-WM-ES-291

Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

Comparison: A flow rate with a variability of less than $\pm$ 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rate measurement is therefore, taken periodically (quarterly). During 1991, the measured flow rate for this stack varied by -4 percent and +8 percent. Stack flow measurements have not been taken since 1991 because the exhauster has not been in operation.

Subpart H Section 61.93(b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93(b)(2)(i) Reference Method 1 of Appendix A, Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1, Section 1.2 This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m2(113 in.2) cross sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-38215.

Comparison: The stack is only 4 inches in diameter, therefore, Method 1A must be used.

40 CFR 60, Appendix A, Method 1A, Section 1.1 The applicability and principle of this method are identical to Method 1, except that this method's applicability is limited to stacks or ducts less than about 0.30 meter (12 in.) in diameter or 0.071 m^2 (113 $in.^2$) in cross-sectional area, but equal to or greater than about 0.10 meter (4 in.) in diameter or 0.0081 m^2 (12.57 $in.^2$) in cross-sectional area.

Documentation: Drawing H-2-38215.

Comparison: This stack is 4 inches in diameter.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1 Select a PM sampling site located preferably at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances such as bends, expansions, or contractions in the stack, or from a visible flame. Next, locate the velocity measurement site 8 equivalent diameters downstream of the PM sampling site. If such locations are not available, select an alternative PM sampling site that is at least 2 equivalent stack or duct diameters downstream and 2 $^1/_2$ diameters upstream from any flow disturbance. Then locate the velocity measurement site 2 equivalent diameters downstream from the PM sampling site.

Documentation: WHC-SD-WM-ES-291, Rev. 1

Comparison: The PM sampling site is located 14.5 diameters downstream from the nearest flow disturbance (fan inlet to stack) and 4.5 diameters upstream from the nearest flow disturbance (top of stack).

Subpart H Section 61.93(b)(2)(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSI N13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

ANSI N13.1-1969, Section 4.2.1.2 The sampling point should be a minimum of 5 diameters (or five times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Documentation: WHC-SD-WM-ES-291

Drawing H-2-38215

Comparison: The sampling point is located 13.5 diameters downstream from the nearest prominent transition (fan inlet to stack).

ANSI N13.1-1969, Section 4.2.2.1 SAMPLING WITHOUT DIFFERENTIATION OR BIAS AS TO PARTICLE SIZE AND KIND. The sampler must not fractionate by particle size or in other ways distort the physical and chemical properties of the airborne radionuclide constituents.

Documentation: WHC-SD-WM-ES-291

NRC NuReg/GR-006, Serial #2145

Comparison: Theoretical calculations of sample line losses indicate that the sampling system is biased with respect to particle sizes. The theoretically determined sampling system particle penetration percentage is on the order of 94 percent for small particles (3.5 micron), and 68 percent for large particles (10 micron). Paragraph 3.1.1 of the Configuration and Efficiency Study justifies using a 3.5 micron particle size for evaluation of sampling system efficiency.

ANSI N13.1-1969, Section 4.2.2.2 (see Appendix N)

ANSI N13.1-1969, Section 4.2.2.3 PARTICLE SIZE FRACTIONATION DUE TO ANISOKINETIC SAMPLING. In applications in which particle sizes may be expected to vary, it is recommended that the sampler arrangement be designed to permit near isokinetic flow into the sampler entry probe.

Documentation: WHC-SD-WM-ES-291

Comparison: The sampling system is designed to be isokinetic for a stack flow rate of 3230 L/min (144 ft^3/min) and sample flow rate of 60 L/min (2.2 ft^3/min). The average sample flow rate for CY91 was 53.8 L/min (1.9 ft^3/min). For this sample flow rate, isokinetic conditions would be achieved at a stack flow rate of 3510 L/min (124 ft^3/min). The average stack flow rate for 1991 was 5240 L/min (185 ft^3/min) (the difference between the ideal (isokinetic) and actual stack flow rate will result in oversampling of larger particles (>5 micron)]. The errors due to anisokinetic sampling are included in the theoretically determined sampling system particle penetration percentage discussed in ANSI N13.1-1969, Section 4.2.2.1.

ANSI N13.1-1969, Section 4.2.2.4 SAMPLE DISTORTION DUE TO CHEMICAL REACTIONS AND RELATED EFFECTS. Extreme care must be exercised in extracting a sample from an airstream when the air contains chemically reactive forms of radioactive isotopes. Materials to be avoided for sampling iodine are rubber, copper, and some plastics. When the air to be sampled is nearly saturated with water vapor, condensation may occur on the collector itself. When heavy moisture loadings are anticipated, heated sampling lines will be required to prevent condensation in the lines and to raise the collector temperature well above the dewpoint.

Documentation: None.

Comparison: Psychrometric data has not been collected for this stack, however, there are no indications that the effluent may be saturated (with water vapor) and may impact the sampling by condensing in sample lines, plugging the filter paper, or weakening the filter media. As a precaution, heat tape exists on the sample line to prevent condensation.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2 PARTICLE COLLECTORS WITHOUT SIGNIFICANT SIZE DIFFERENTIATION. At regular intervals and when any change is anticipated, the airborne material should be characterized as to physical and chemical nature.

Documentation: WHC-SD-WM-EMP-031

Comparison: Several different waste streams (ie. from different tank farms and facilities) could be transferred through this facility. The airborne material has not been characterized as to physical and chemical nature.

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3 GASES. Airborne radioactive volatile materials and so-called "permanent" gases such as tritium are frequently important contaminants and their sampling and collection require techniques and methods differing from those used in particulate sampling.

Documentation: WHC-SD-WM-EMP-031, Rev. 0

Comparison: The potential offsite dose from radioactive ruthenium, rhodium and iodine gas is less than 10 percent of the total potential off-site dose from this stack. Therefore, the 296-A-25 stack sampling system does not require volatile radioactive gas sampling.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-38215

WHC-SD-WM-ES-291

Comparison: The sample line is approximately 1.5 m (5 ft) long with one 90 degree bend with a minimum design bend radius of 10 * tubing diameter. The sample line has an inside diameter of 1.6 cm (.62 in.)

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably 10 or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Comparison: See response to ANSI N13.1-1969, Section 4.2.1.2.

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

GUIDANCE/DATA SHEET FOR 241-AY/AZ BACKUP EXHAUST STACK (296-A-25) FLOW MEASUREMENT.

Comparison: The particle and gaseous composition are assumed to be uniform since this is a vertical stack and the effluent should be well mixed when it reaches the sampling location (ie. stack flow is turbulent). The stack flow measurements are taken 5.5 duct diameters upstream of the sampling location. Stack flow distribution data was not available for this stack.

ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-95299

Comparison: The stack has an inside diameter of 10.24 cm (4.03 in.). A minimum of one probe is required by ANSI Section A3.2. The stack contains two probes; one for the record sample and the other for the Beta/Gamma CAM. Each probe is located approximately 1.3 cm (1/2 in.) off of the centerline of the stack.

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known to establish isokinetic flow and representative sample points.

Comparison: (see response to ANSI N13.1 Section 4.2.2.3, and Appendix A Section A3.1).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-95299

Comparison: The nozzles are 1.59 cm (0.625 in.) OD with a side wall thickness of 0.17 cm (0.065 in.) [ID = 1.3 cm (0.5 in.)]. The nozzle bend is specified as 6.4 cm (2.5 in.) minimum.

Subpart H Section 61.93(b)(2)(iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

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APPENDIX D

40 CFR 61.93, SUBPART H COMPARISON FOR 296-A-27

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NESHAP COMPLIANCE FOR THE 241-AW TANK FARM EXHAUSTER STACK (296-A-27) PROVIDED BY TANK FARMS FACILITY ENVIRONMENTAL ENGINEERING

Subpart H Section 61.93(a) (see Appendix N)

Subpart H Section 61.93(b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or other procedures for which EPA has granted prior approval:

Subpart H Section 61.93(b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93(b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocity and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-70358

Comparison: Stack 296-A-27 has an inside diameter of 25.4 cm (10 in.) and falls into the category of a small stack or duct, therefore, Method 2C should be used.

40 CFR 60, Appendix A, Method 2C, Section 1.1.1 The applicability of this method is identical to Method 2, except this method is limited to stationary source stacks or ducts less than about 0.30 m (12 in.) in diameter or 0.071 m^3 (113 $in.^2$) in cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.0081 m^2 (12.57 $in.^2$) in cross-sectional area.

Comparison: See documentation/discussion referenced in Subpart H, Section 61.93(b)(1)(i).

40 CFR 60, Appendix A, Method 2C, Section 3.0 Follow the general procedures in Section 3 of Method 2, except conduct the measurements at the traverse points specified in Method 1A.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1 Select a PM sampling site located preferably at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances such as bends, expansions, or contractions in the stack, or from a visible flame. Next, locate the velocity measurement site 8 equivalent diameters downstream of the PM sampling site. If such locations are not available, select an alternative PM sampling site that is at least 2 equivalent stack or duct diameters downstream and 2 $^1/_2$ diameters upstream from any flow disturbance. Then locate the velocity measurement site 2 equivalent diameters downstream from the PM sampling site.

Documentation: WHC-SD-WM-ES-291, Rev. 1

Field walkdown

Comparison: The stack flow measurement location is 5 diameters downstream from the nearest flow disturbance (fan inlets to

stack) and 1.5 diameters upstream from the nearest flow disturbance (sampling location).

40 CFR 60, Appendix A, Method 1A, Section 2.2.2 Use Figure 1-2 of Method 1 to determine the number of traverse points, following the same procedure used for PM sampling traverses as described in Section 2.2.1 of Method 1.

Documentation: Guidance/Data Sheet for 241-AW Exhaust Stack (296-A-27) Flow Measurement

Comparison: Figure 1-2 calls for 16 measurements to be taken along each traverse. The Guidance/Data Sheet also calls for 16 measurements.

Subpart H Section 61.93(b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to measure flow rates through pipes and small vents.

Comparison: See response to Section 61.93 (b)(1)(i).

Subpart H Section 61.93(b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: RHO-CD-1092

SD-WM-CR-016

WHC-SD-WM-ES-291

Comparison: A flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rate measurement is therefore, taken periodically (quarterly). During 1991, 1992, and 1993, the measured flow rate for this stack varied by 12 percent and + 19 percent.

Subpart H Section 61.93(b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93(b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1, Section 1.2 This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m2(113 in.2) cross sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-90906.

Comparison: The stack is 10 inches in diameter, therefore, Method 1A must be used.

40 CFR 60, Appendix A, Method 1A, Section 1.1 The applicability and principle of this method are identical to Method 1, except that this method's applicability is limited to stacks or ducts less than about 0.30 meter (12 in.) in diameter or 0.071 m^2 (113 $in.^2$) in cross-sectional area, but equal to or greater than about 0.10 meter (4 in.) in diameter or 0.0081 m^2 (12.57 $in.^2$) in cross-sectional area.

Documentation: Drawing H-2-90906.

Comparison: This stack is 10 inches in diameter.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1 Select a PM sampling site located preferably at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances such as bends, expansions, or contractions in the stack, or from a visible flame. Next, locate the velocity measurement site 8 equivalent diameters downstream of the PM sampling site. If such locations are not available, select an alternative PM sampling site that is at least 2 equivalent stack or duct diameters downstream and 2 $^1/_2$ diameters upstream from any flow disturbance. Then locate the velocity measurement site 2 equivalent diameters downstream from the PM sampling site.

Documentation: WHC-SD-WM-ES-291, Rev. 1

Drawing H-2-90906.

Comparison: The PM sampling site is located 10 diameters downstream from the nearest flow disturbance (fan inlet to stack) and 6 diameters upstream from the nearest flow disturbance (top of stack).

Subpart H Section 61.93(b)(2)(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSI N13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

ANSI N13.1-1969, Section 4.2.1.2 The sampling point should be a minimum of five diameters (or five times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Documentation: WHC-SD-WM-ES-291

Drawing H-2-90906

Comparison: The sampling point is located 6.5 diameters downstream from the nearest prominent transition (fan inlets to stack).

ANSI N13.1-1969, Section 4.2.2.1 SAMPLING WITHOUT DIFFERENTIATION OR BIAS AS TO PARTICLE SIZE AND KIND. The sampler must not fractionate by particle size or in other ways distort the physical and chemical properties of the airborne radionuclide constituents.

Documentation: WHC-SD-WM-ES-291

NRC NuReg/GR-006, Serial #2145, March 8, 1993

Comparison: Theoretical calculations of sample line losses indicate that the sampling system is biased with respect to particle sizes. The theoretically determined sampling system particle penetration percentage is on the order of 75 percent for small particles (3.5 micron), and 1 percent for large particles (10 micron). Paragraph 3.1.1 of the Configuration and Efficiency Study justifies using a 3.5 micron particle size for evaluation of sampling system efficiency.

ANSI N13.1-1969, Section 4.2.2.2 (see Appendix N)

ANSI N13.1-1969, Section 4.2.2.3 PARTICLE SIZE FRACTIONATION DUE TO ANISOKINETIC SAMPLING. In applications in which particle sizes may be expected to vary, it is recommended that the sampler arrangement be designed to permit near isokinetic flow into the sampler entry probe.

Documentation: WHC-SD-WM-ES-291

Comparison: The sampling system is designed to be isokinetic for a stack flow rate of 16,500 L/min (586 ft^3/min) and sample flow rate of 62 L/min (2.2 ft^3/min). The average sample flow rate for CY92 was 62 L/min (2.0 ft^3/min). For this sample flow rate, isokinetic conditions would be achieved at a stack flow rate of 15,092 L/min (533 ft^3/min). The average stack flow rate for 1992 was 29,800 L/min (1055 ft^3/min) [the difference between the ideal (isokinetic) and actual stack flow rate will result in oversampling of larger particles (>5 micron)]. The errors due to anisokinetic sampling are included in the theoretically determined sampling system particle penetration percentage discussed in ANSI N13.1-1969, Section 4.2.2.1.

ANSI N13.1-1969, Section 4.2.2.4 SAMPLE DISTORTION DUE TO CHEMICAL REACTIONS AND RELATED EFFECTS. Extreme care must be exercised in extracting a sample from an airstream when the air contains chemically reactive forms of radioactive isotopes. Materials to be avoided for sampling iodine are rubber, copper, and some plastics. When the air to be sampled is nearly saturated with water vapor, condensation may occur on the collector itself. When heavy moisture loadings are anticipated, heated sampling lines will be required to prevent condensation in the lines and to raise the collector temperature well above the dewpoint.

Documentation: Not applicable.

Comparison: This sampling system contains a Silver Zeolite cartridge for the purpose of collecting radioactive iodine, tin, antimony, and ruthenium. The sampling system upstream of the silver zeolite cartridge contains a 20.3 cm (8 in.) section of rubber tubing but does not contain copper or plastic. Psychrometric data has been collected for this stack. The data indicates that the dew point of the effluent is approximately 60 degrees F. However, there are no indications that the effluent may be saturated (with water vapor) and may impact the sampling by condensing in sample lines, plugging the filter paper, or weakening the filter media. As a precaution, heat tape exists on the sample line to prevent condensation.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2 PARTICLE COLLECTORS WITHOUT SIGNIFICANT SIZE DIFFERENTIATION. At regular intervals and when any change is anticipated, the airborne material should be characterized as to physical and chemical nature.

Documentation: WHC-SD-WM-EMP-031

Comparison: The airborne effluent from this stack has not been characterized.

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3 GASES. Airborne radioactive volatile materials and so-called "permanent" gases such as tritium are frequently important contaminants and their sampling and collection require techniques and methods differing from those used in particulate sampling.

Documentation: WHC-SD-WM-EMP-031, Rev. 0

Comparison: The potential offsite dose from radioactive iodine gas is less than 10 percent of the total potential off-site dose from this stack. Therefore, the 296-A-27 stack sampling system does not require volatile radioactive gas sampling. However, the 296-A-27 stack

sampling system does contain two Silver Zeolite cartridges. See Appendix N for description of the sampling cartridges.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: WHC-SD-WM-ES-291

Comparison: The sample line is approximately 3.3 m (10.9 ft) long with one 90 degree bend with a design bend radius of 91 cm (36 in.). The sample line has an inside diameter of 0.94 cm (0.37 in.).

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Comparison: See response to ANSI N13.1-1969, Section 4.2.1.2.

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Documentation: Maintenance Engineering Services Maintenance Procedure 7-GN-56, Rev 1

GUIDANCE/DATA SHEET FOR 241-AY/AZ BACKUP EXHAUST STACK (296-A-27) FLOW MEASUREMENT

Comparison: The partical and gaseous composition are assumed to be uniform since this is a vertical stack and the effluent should be well mixed when it reaches the sampling location (i.e., stack flow is turbulent). The stack flow distribution at the sampling location is uniform, however, this distribution is based on a very limited amount of data (see Figures D-1 and D-2). Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure D-1. Stack Flow Distribution 296-A-27-A.

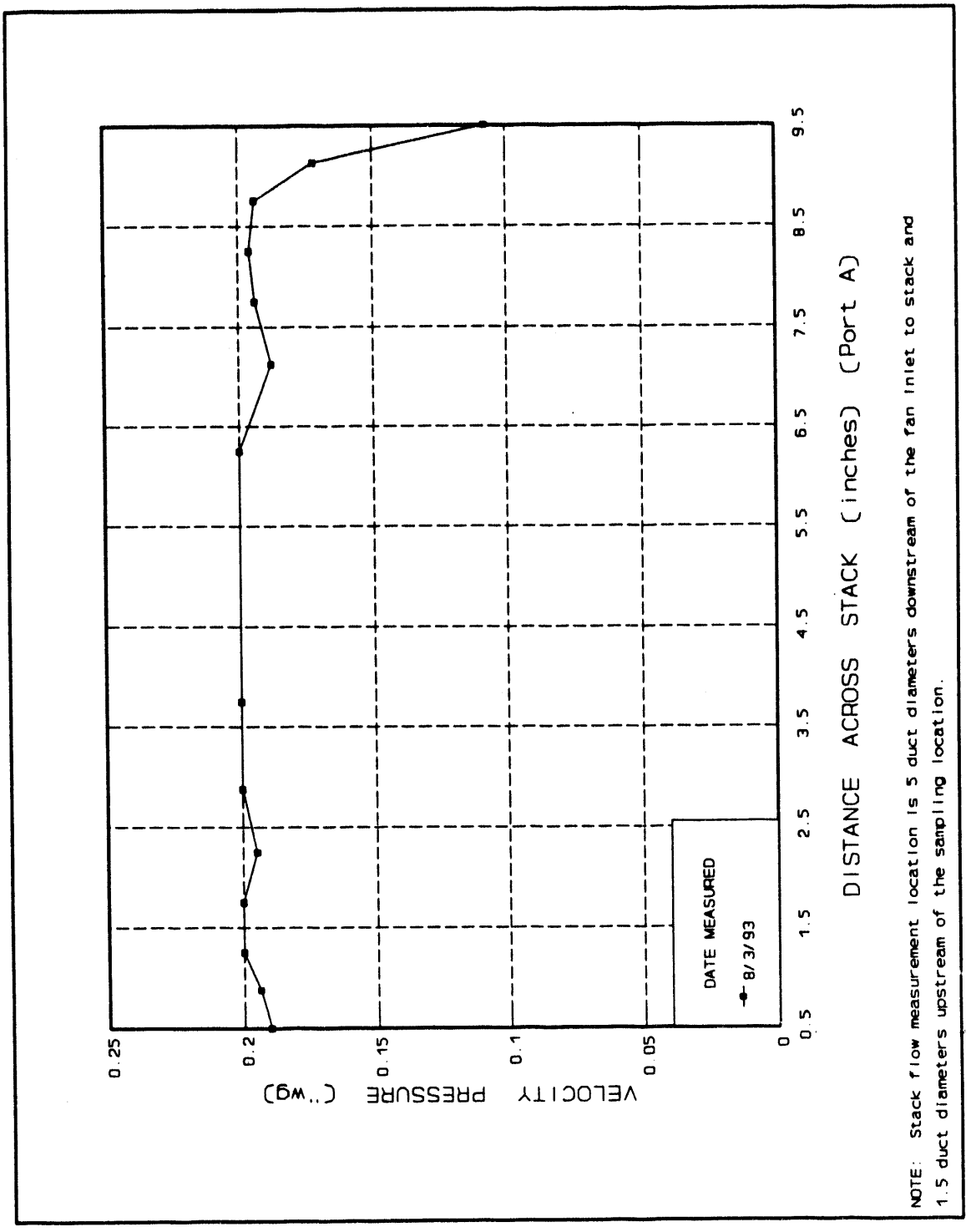
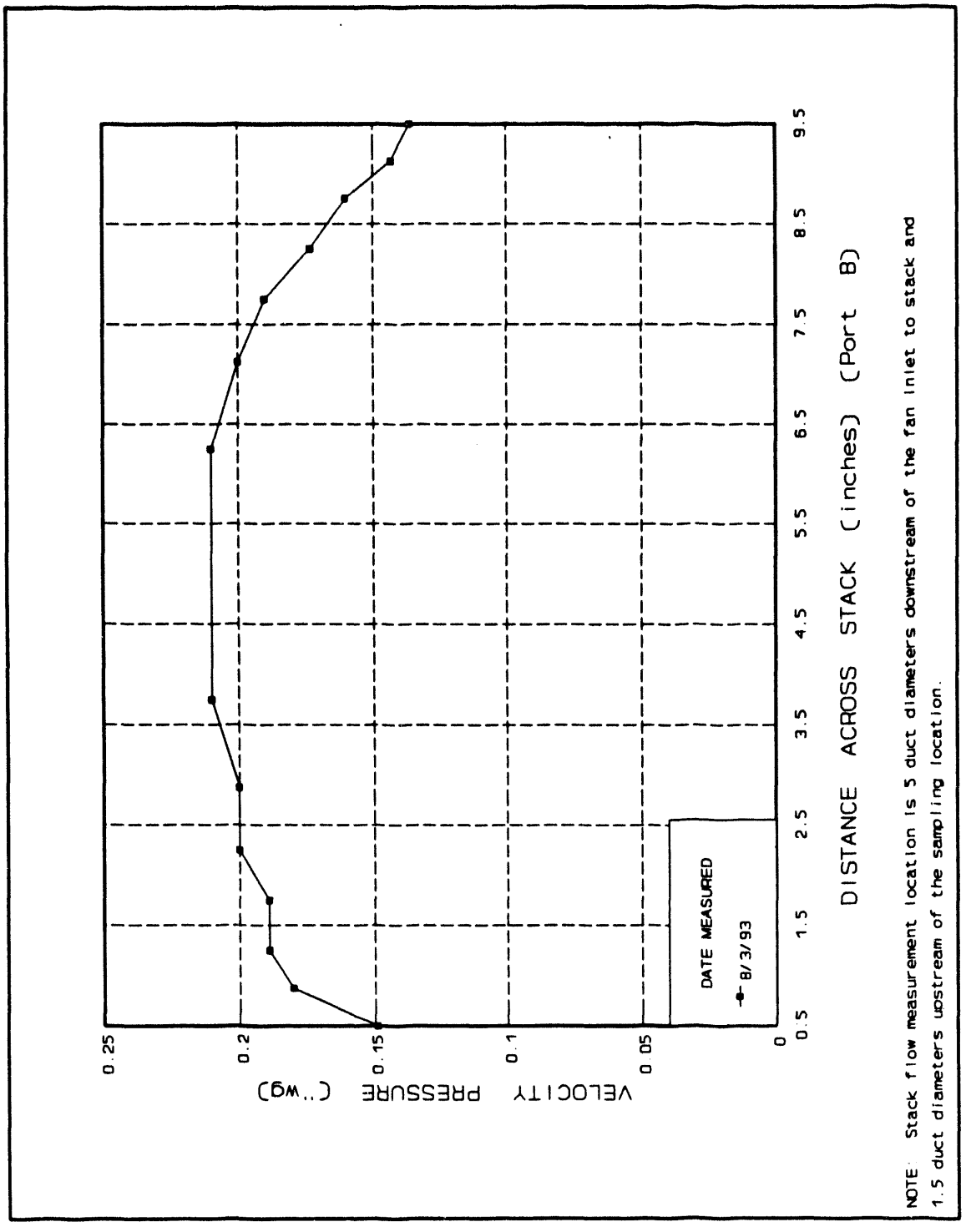


Figure D-2. Stack Flow Distribution 296-A-27-B.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-70358

Comparison: The stack has an inside diameter of 25 cm (10 in.). A minimum of two sample points are required by ANSI Section A3.2. The stack contains two sample points on the sample probe. To be located at the midpoints of three equal areas in the stack, the nozzles should be located at the following distances from the center of the stack: 0 and 10.9 cm (0 and 4.3 in.). The nozzles are located at 0 and 10.8 cm (0 and 4.25 in.) from the center of the stack, and represent approximately equal areas.

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Comparison: (See response to ANSI N13.1 Section 4.2.2.3 and Appendix A Section A3.1.

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-70358

Comparison: The nozzles are 1.4 and 1.7 cm (0.54 and 0.675 in.) OD with a side wall thickness of .22 and 2.3 cm (0.088 and 0.91 in.) respectively [ID = .92 and 1.25 cm (0.364 and 0.493 in.) respectively]. The nozzle bends are specified as 3.2 and 4.76 cm (1.25 and 1.875 in.) respectively.

Subpart H Section 61.93(b)(2)(iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

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APPENDIX E

40 CFR 61.93, SUBPART H COMPARISON FOR 296-A-29

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 241-AN TANK FARM EXHAUSTER STACK NUMBER 296-A-29

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-71936

Comparison: Method 2 is for stacks larger than 30 cm (12 in.). This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 25 cm (10 in.). Method 2C is applicable for small stacks. See discussion under Method 2C below.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: Not applicable.

Comparison: Method 2A is not applicable for stacks. If it is applicable for pipes and ducts where the entire effluent is run through a measuring device, this method may be applicable to the sampling systems themselves.

40 CFR 60, Appendix A, Method 2C Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts: This method allows for the following:

1. The selection of the measurement site according to Method 1A in Appendix A of 40 CFR 60
2. The selection of the number of traverse point measurements according to Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60
3. The location of the individual traverse measurement points according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1 of Appendix A of 40 CFR 60.
4. Apparatus
5. Procedure.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-AN PRIMARY EXHAUST STACK (296-A-29) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawing H-2-71936

Comparison: See the discussion below under "Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements. There are two perpendicular ports where this measurement site is located. This site is 5.7 cm (2.25 in.) below the longest nozzle opening of the sample probe. This location is 67.5 in. (6.8 duct diameters) below the top of the stack and 163 cm (64 in.) (6.4 duct diameters) above the fan discharge into the stack. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 12 measurements if the flow disturbances upstream of the site is greater than 6 duct diameters. Measurements are taken on each of 16 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. This is performed in each of the two perpendicular flow measurement ports.

A standard pitot tube is used as specified. However, the procedure is not duplicated. A new procedure is under development that will duplicate the regulatory procedure.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP#
01/31/91	786	NONE
04/03/91	816	NONE
07/11/91	666	NONE
10/20/92	747	2E-92-01245
03/05/93	761	2E-93-00137
05/18/93	780	2E-93-00571

01/05/94	829	2E-93-1141
AVERAGE		769
VARIABILITY		-13%/+8%
STANDARD DEVIATION		54
95% CONFIDENT INTERVAL		132
RANGE		637 to 901.

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore, constant. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster always runs.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-71936

Comparison: This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 25 cm (10 in.). See Method 1A below.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least 8 stack or duct diameters downstream and 2 diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least 2 stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Not applicable. This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 25 cm (10 in.).

40 CFR 60, Appendix A, Method 1A Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts This method is applicable to stacks or ducts less than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1: PM Measurement
Method 1A calls for the sampling sites to be preferably located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-AN PRIMARY EXHAUST STACK (296-A-29) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawings H-2-71936

Comparison: The opening of the longest sample nozzle is 165.7 cm (65.25 in.) below the top of the stack and 168.3 cm (66.25 in.) above the fan discharge into the stack. The flow measurement ports are 5.7 cm (2.25 in.) below the opening of the longest sample nozzle.

Flow measurements are accomplished via Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2. There are two perpendicular ports chosen for the measurement at this same location.

Measurements are taken on each of 16 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A to this same regulation. This is performed in each of the two perpendicular flow measurement ports.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance of this standard start in Section 4. *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 Samples should be representative with respect to physical and chemical composition of airstream.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No particle size studies have been performed at this facility, although a particle loss determination has been informally (at this time) accomplished. Information given in WHC-SD-WM-EMP-031, Rev 0 suggests that the sample should consist mainly of ^{137}Cs, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3 Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases the selection of these three elements in programming will be a compromise between idea values and those which provide safety and yet are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be small fragments of solids. . . . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of ^{137}Cs and ^{241}Am. These radionuclides are particulate in nature and not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling. .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: The tanks at this facility contain radioactive iodine, however, the potential off-site dose from the radioactive iodine is less than 10 percent of the total potential off-site dose from this stack. Therefore, radioactive volatile sampling is not required.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: H-2-71936

Comparison: The sample line is approximately 1.5 m (5 ft) long from the record sampler probe connection outside the stack to the top of the sample cabinet. The tubing is 1.3-cm (1/2 in.) O.D. X 0.065 WALL. There is a single bend radius that is designed to be as large as possible (5 in. minimum).

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 **Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.**

Documentation: Not applicable.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE, 241-AN PRIMARY EXHAUST STACK (296-A-29) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was seen to be 21,491 L/min (759 ft^3/min). For a 25-cm (10-in.) stack, this amounts to a velocity of 7 m (23 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .21 m (0.68 ft)/second. Above that turbulent flows exist. The velocity distribution is uniform, however, this distribution is based on a very limited amount of data (see Figures E-1 and E-2).

Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure E-1. Stack Flow Distribution 296-A-29-A.

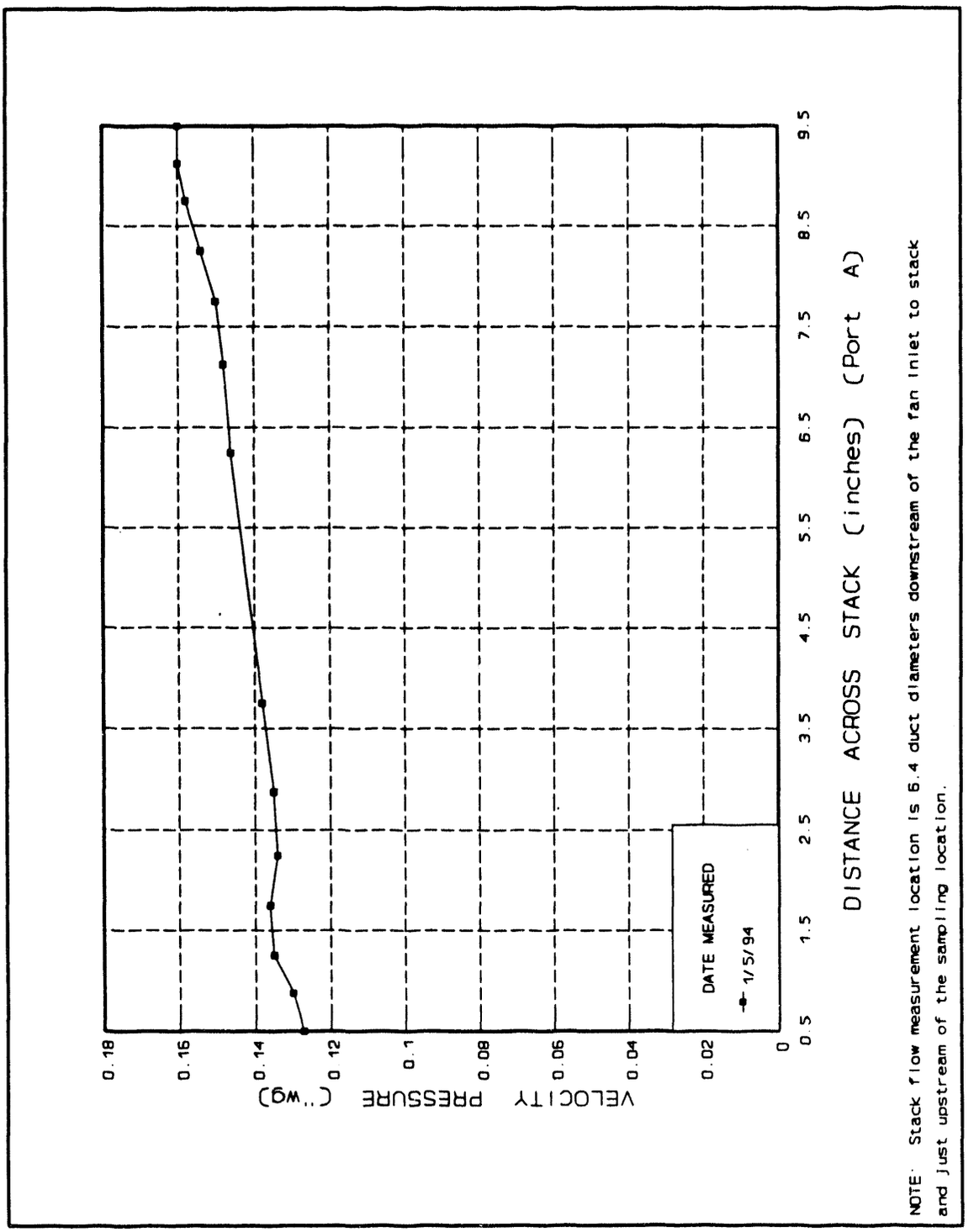
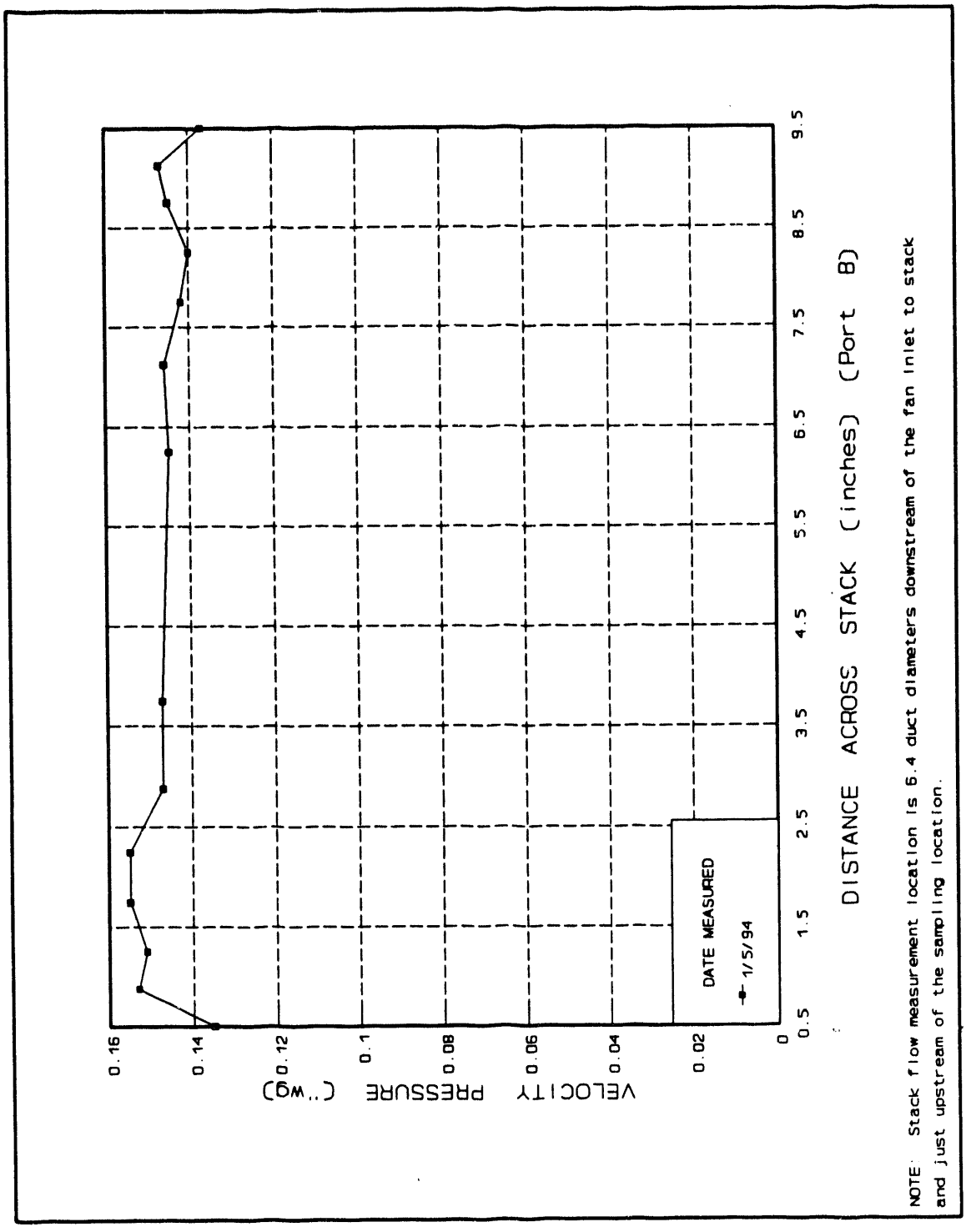


Figure E-2. Stack Flow Distribution 296-A-29-B.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-71955

Comparison: This drawing shows the probe with two nozzles. This is as recommended in this section of the ANSI N13.1-1969 Standard, Appendix A, paragraph A3.2.

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-AN PRIMARY EXHAUST STACK (296-A-29) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawing H-2-71936

Comparison: The designed isokinetic flow rate in the stack is 16,592 L/min (586 ft^3/min), based on a sample flow of 62 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. From 1992 data, the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 42.5 to 70.8 L/min (1.5 to 2.5 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 11,326 to 18,858 L/min (400 to 666 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 21,491 L/min (759 ft^3/min) with a 95 percent confidence that this flow rate will be between 17,753 to 25,257 L/min (627 to 892 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-71955

Comparison: This drawing shows the probe with two nozzles as follows:

Nozzle A has an ID of .92 cm (0.364 in.), a bend radius of 3.2 cm (1.25 in.), and a length under the bend radius of 3.2 cm (1.25 in.).

Nozzle B has an ID of 1.252 cm (0.4930 in.), a bend radius of 4.76 cm (1.875 in.), and a length under the bend radius of 4.76 cm (1.875 in.)

According to ANSI the bend radius and the vertical should both be 5 times the inside diameter. Five times the inside diameter of Nozzle A is 4.6 cm (1.82 in.) and of Nozzle B is 6.2 cm (2.46 in.). In addition, both nozzles are tapered to a knife edge. Lastly, the nozzles are approximately centered in equal annular areas.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is references as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843.

Because particle sizes are not known, a spread of particle sizes were used (i.e, 10, 3.5 and 1 micron in size). The results are as follows:

Table C14. Stack Number 296-A-29 Sampling System Particle Penetration Percentage.

	PARTICLE SIZE							
Range	10 μm		PRE-HEPA SPREAD (0.05 to 10 μm)		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total	Probe	Total
Minimum	91.5	0.2	97.4	64.5	96.7	58.6	98.9	96.0
Average	102.6	0.7	99.8	69.2	98.8	70.6	99.2	96.9
Maximum	125.2	3.1	104.9	77.1	102.9	82.6	99.8	98.0

The variables used in this program are as follows:

Stack diameter 10 in = 0.254 m
Area = πR^2 = 0.05067 m^2

Stack Stream Velocity (m/s): 5.84 to 8.31

Average: 7.07

Probe Equivalent Radius = 0.3064 in.
Probe Equivalent Diameter = 0.6128 in. = 15.56555853 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min
Sample Flow rate (L/min): 42.48 to 70.79

Average: 56.63

Line Length = 5 ft = 1.524 m
Tube ID = 0.370 in. = 9.398 mm
one 90° bend

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX F

40 CFR 61.93, SUBPART H COMPARISON FOR 296-B-28

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 244-BX DOUBLE CONTAINED RECEIVER TANK EXHAUSTER STACK NUMBER 296-B-28

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-73839

Comparison: Method 2 is for stacks larger than 30 cm (12 in.). This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.). Method 2C is applicable for small stacks. See discussion under Method 2C below.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: Not applicable.

Comparison: Method 2A is not applicable for stacks. It is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

40 CFR 60, Appendix A, Reference 2C Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts This method allows for the following:

1. The selection of the measurement site according to Method 1A in Appendix A of 40 CFR 60
2. The selection of the number of traverse point measurements per Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60
3. The location of the individual traverse measurement points per Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60
4. Apparatus
5. Procedure.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE/DATA SHEET FOR 244-BX DCRT EXHAUST STACK (296-B-28) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: See the discussion below under "Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements. The measurement site is 1.8 m (6 ft) (12 duct diameters) below the top of the stack, .76 m (2.5 ft) (5 duct diameters) below the bottom of the record sampler probe nozzle opening and .60 m (2 ft) (4 duct diameters) above the fan discharge into the stack. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 16 measurements if the flow disturbances upstream of the site is less than 6 duct diameters. However, this figure is mainly for large stacks (although it is referenced for use with small stacks). In a stack that is 15 cm (6 in.) in diameter, an increasing number of measurement points is senseless. Logically, there comes a point when additional data points are no longer useful. Therefore it was decided that measurements would be taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. This is performed in each of the two perpendicular flow measurement ports.

A standard pitot tube is used as specified. However, the procedure is not duplicated. A new procedure is under development which will duplicate the regulatory procedure.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates, only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP#
02/06/91	262	NONE
05/30/91	243	NONE
08/12/91	220	NONE
05/04/93	233	2E-92-00903

AVERAGE	240
VARIABILITY	-8%/+9%
STANDARD DEVIATION	18
95% CONFIDENCE INTERVAL	56
RANGE	183 to 296

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore constant. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster does not always run. Its purpose is to run when the temperature of the waste in the tank is above 60 °C (140 °F) and/or while waste is being transferred through this facility.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-73839

Comparison: This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.). See Method 1A below.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site
Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Comparison: Not applicable. This stack is smaller than the 12 in. applicability criteria; it is only 6 in. (15.24 cm).

40 CFR 60, Appendix A, Method 1A **Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts This method is applicable to stacks or ducts less than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.**

40 CFR 60, Appendix A, Method 1A, Section 2.1.1: PM Measurement
Method 1A calls for the sampling sites to be preferably located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

Documentation: Drawing H-2-73839

GUIDANCE/DATA SHEET FOR 244-BX DCRT EXHAUST STACK (296-B-28) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.).

This stack is 15 cm (6 in.) in diameter. The sample probe location is located 1.5 m (5 ft) above the fan discharge into the stack. The closest flow disturbances are the CAM sample probe, located 4 duct diameters downstream, and the fan inlet to the stack, located 10 duct diameters upstream of the sample probe.

Flow measurements are accomplished via Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2. There are two perpendicular ports chosen for the measurement. These ports are one duct

diameter below the center line of the record sample probe (the record sample probe extends 15 vertical cm (6 in.) down from its centerline) and 9 duct diameters above the fan discharge into the stack. Although this location is not downstream of the sample probe, it is considered to be a conservative location for measurement purposes for two reasons:

1. There are two sample probes on this stack. One is for a continuous monitor and one is for the record sampler. Each probe draws a sample at a rate of approximately 57 L/min (2 ft^3/min) of air flow from the stack to total 113 L/min (4 ft^3/min). This sample flow taken from the average stack flow given above of 6,795 L/min (240 ft^3/min), will result in 6,654 L/min (235 ft^3/min) downstream of all three sample probes. Although 113 L/min (4 ft^3/min) only represents 2 percent of the average stack flow, a more conservative representation of the actual totalized flow can be gained from the measurement occurring below the sample probes. Totalized flow is necessary for total emission calculations.

2. Since the probes are removing air from the stack stream, the location of the flow measurement below the sample probes give a truer representation of the flow rate for the first sample probe (the record sampler). This allows for a truer representation of the isokinetic flow conditions, used to determine the efficiency of the system.

   Measurements are taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A to this same regulation. This is performed in each of the two perpendicular flow measurement ports.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative sampler of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance for this standard begins in Section 4.0 *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 **Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.**

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 **Samples should be representative with respect to physical and chemical composition of airstream.**

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No particle size studies have been performed at this facility, although a particle loss determination has been informally (at this time) accomplished. Information provided in WHC-SD-WM-EMP-031, Rev 0 suggest that the sample should consist mainly of ^{137}Cs, $^{239/240}Pu$, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming **Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases the selection of these three elements in programming will be a compromise between idea values and those which provide safety and yet are technically, economically, and conveniently achieved.**

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General **Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments pf solids. . . . .**

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information shown in WHC-SD-WM-EMP-031 suggests that the sample should consist mainly of ^{137}Cs, $^{239/240}Pu$, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling. .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: H-2-73809

Comparison: The sample line is approximately 1.5 m (5 ft) long. The tubing is 1.3 cm (1/2-in.) O.D. X 0.035 WALL. There is one 90 degree bend.

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably 10 or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

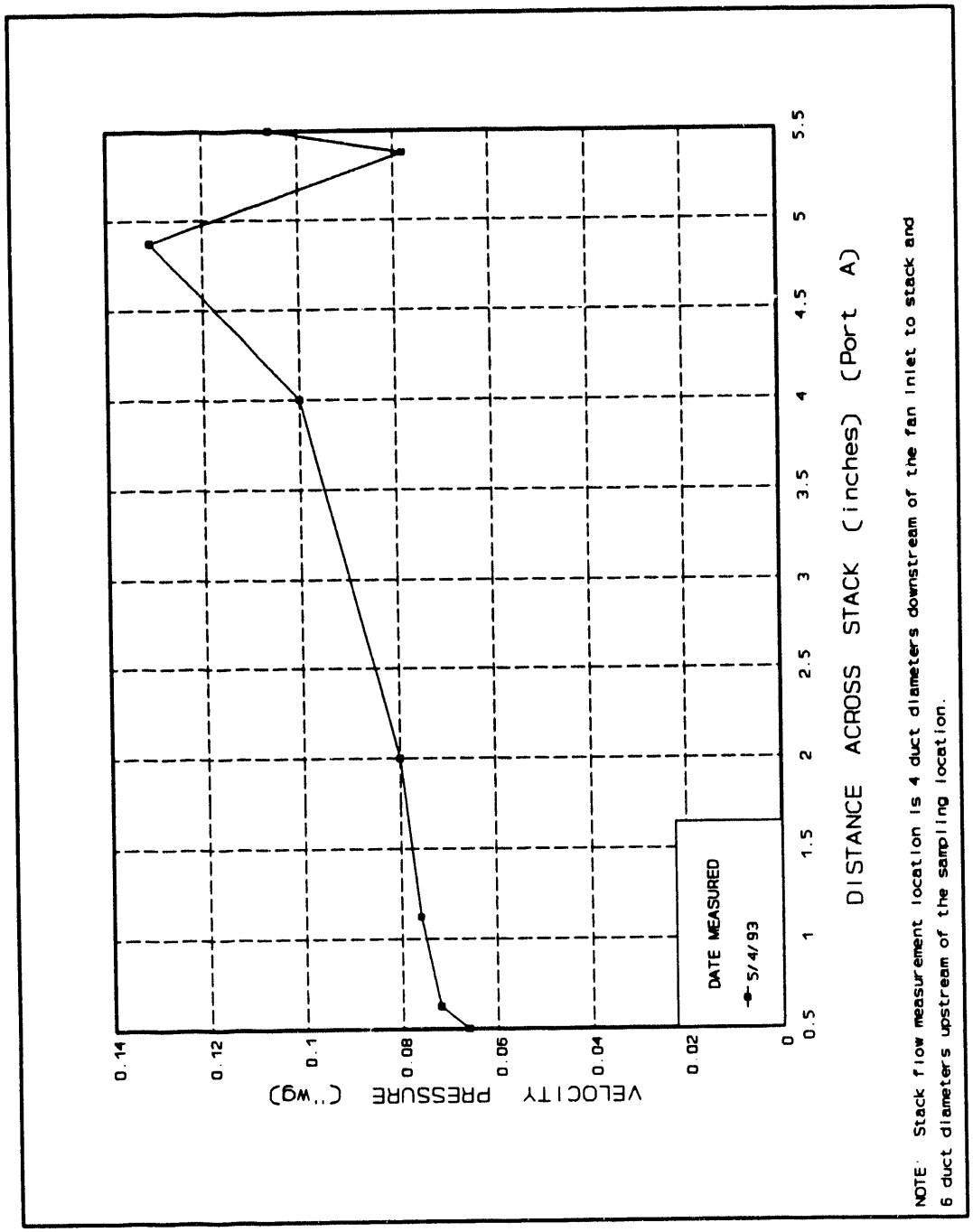
Documentation: Not applicable.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental

GUIDANCE/DATA SHEET FOR 244-BX DCRT EXHAUST STACK (296-B-28) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was seen to be 6,796 L/min (240 ft^3/min). For a 6 in. stack, this amounts to a velocity of 6.1 m (20 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below 0.68 ft/second. Above that turbulent flows exist. Again according to ANSI N13.1-1969 Section A3.3.2 "as the flow becomes more turbulent, the velocity becomes more nearly uniform across the duct." The velocity distribution at the flow measurement location is relatively uniform (see Figure F-1), but is based on a very limited amount of data. Note that the flow measurement location is six duct diameters upstream from the sampling location. Since there are no flow disturbances between the flow measurement location and the sampling location, the distribution at the sampling location should be more uniform. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure F-1. Stack Flow Distribution 296-B-28-A.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-73809

Comparison: This drawing shows the probe with one nozzle. This is as recommended in this section of the ANSI N13.1-1969 Standard for this size stack (6 in.).

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

GUIDANCE/DATA SHEET FOR 244-BX DCRT EXHAUST STACK (296-B-28) FLOW MEASUREMENT

Comparison: The velocity distribution is not known. However, uniform distribution may be assumed (see discussion under "ANSI N13.1-1969, Appendix A, Section A3.1" above).

The designed isokinetic flow rate in the stack is 7,673 L/min (271 ft^3/min), based on a sample flow of 62 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. From 1992 data, it can be shown that the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 6.7 to 59.5 L/min (0.9 to 2.1 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 3,143 to 1,334 L/min (111 to 259 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 6,796 L/min (240 ft^3/min) with a 95 percent confidence that this flow rate will be between 5,182 to 8,381 L/min (183 to 296 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-73809

Comparison: This drawing shows the probe as a 1.3-cm (1/2-in.) SCHD 80 pipe with a 8-cm (3-in.), 90 degree radius bend and a 3 in. vertical length under that. The inside diameter of this probe is 1.387 cm (0.546 in.) According to ANSI the bend radius, as well as the vertical should

both be 5 times the inside diameter. Five times the inside diameter of this probe is 6.93 cm (2.73 in.). In addition the nozzle is tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is reference as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843. This program also provides for anisokinetic sampling affects as discussed in ANSI N13.1-1969, Appendix C.

Because particle sizes are not know a spread of particle sizes were used i.e., 10, 3.5 and 1 micron in size. The results are as follows:

STACK NUMBER 296-B-28 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	87.2	3.6	95.9	78.8	98.7	97.2
Average	100.3	16.8	98.4	86.4	99.2	98.0
Maximum	140.3	69.3	105.7	97.6	100.2	99.4

The variables used to derive the values in this table are as follows:

Stack diameter 6 in. = 0.1524 m
Area = πR^2 = 0.01824 m^2

Stack Stream Velocity (m/s): 4.73 to 7.66

Average: 6.21

Probe Equivalent Radius = 0.273 in.
Probe Equivalent Diameter = 0.546 in. = 13.8684 mm

Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 25.49 to 59.47

Average: 42.48

Line Length = 5 ft = 1.524 m
Tube ID = 0.43 in. = 10.922 mm
one 90 ° bend

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

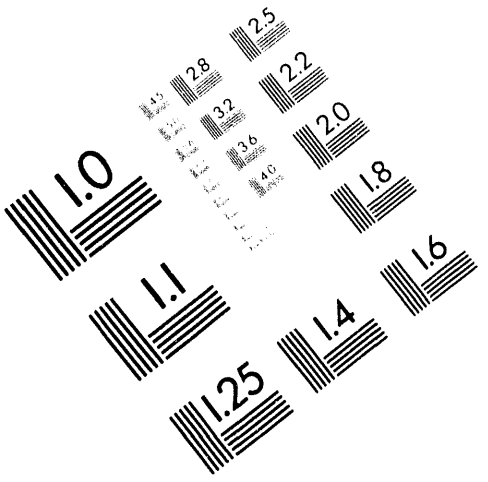
Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX G

40 CFR 61.93, SUBPART H COMPARISON FOR 296-C-5



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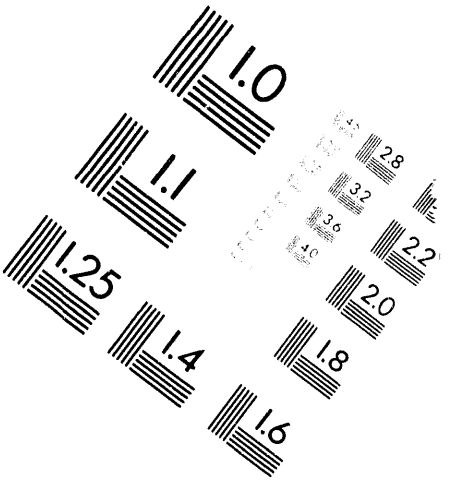

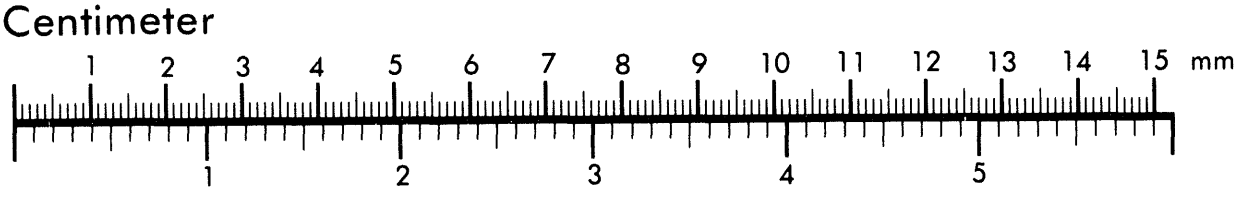

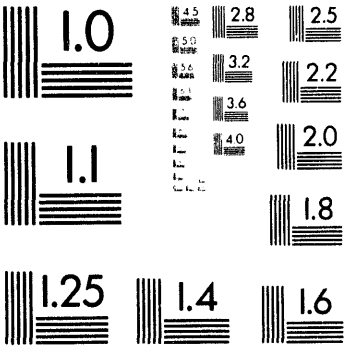

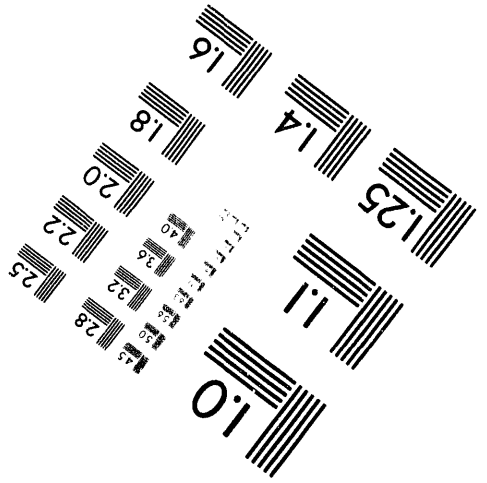

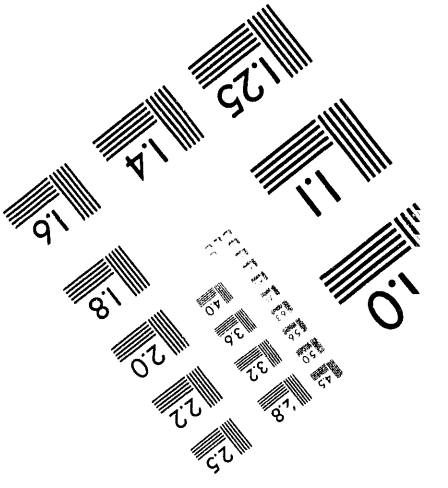

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 244-CR VAULT EXHAUSTER STACK NUMBER 296-C-05

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

40 CFR 60, Appendix A, Method 2 Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube) Method 2 is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow. This procedure is not applicable for:

- cyclonic or swirling gas streams;
- stack diameters smaller than 0.30 m (12 in.) or stack cross sectional areas less than 0.071 m^2 ($113in^2$);
- measurement sites which fail to meet the criteria of Method 1 in 40 CFR 60, Appendix A, § 2.1)

Documentation: Maintenance Engineering Services Maintenance Procedure 1202, Rev 0

WHC-SD-WM-WP-147, Rev 1

Comparison: The referenced procedure has been written to mirror the 40 CFR 60, Appendix A, Method 2 procedure. Implementation of this procedure is addressed in the referenced procedure upgrade program. Implementation involves writing facility specific procedures from the main referenced procedure. The specific procedure development is underway. The measurement site selection requirement is addressed next.

40 CFR 60, Appendix A, Method 1, § 2.1, Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-92519

Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE/DATA SHEET 244-CR VAULT EXHAUST STACK (296-C-5) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: This is an 46-cm (18-in.) circular diameter stack. The stack extension sets approximately 15.2 m (50 ft) in height above ground level [202.1 m (663 ft) above sea level]. The sample probe is located 340 cm (134 in.) above the fan discharge into the stack (7.4 duct diameters) and 991 cm (390 in.) below the top of the stack (21.7 duct diameters). There is a single port 1.07 m (42 in.) (2.3 duct diameters) above the fan discharge into the stack and 2.34 m (92 in.) (5.1 duct diameters) below the sample probe location in the stack. There are 16 annular traverse measurements taken from this port. Each traverse point is located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: None.

Comparison: Method 2A is not applicable for stacks. If is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP#
01/09/91	1,092	NONE
04/18/91	1,392	2E 35017
07/16/91	1,408	NONE

11/24/92	3,085	2E-92-01248
03/08/93	2,894	2E-93-00156
04/28/93	3,012	2E-93-00572
07/21-93	3,697	2E-93-00956
AVERAGE		2,369
VARIABILITY		-54%/+56%
STANDARD DEVIATION		1,039
95% CONFIDENT INTERVAL		2,542
RANGE		Too variable

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore, variable. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster runs continuously except for maintenance.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1, Sample and Velocity Traverses for Stationary Sources

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when: (1) flow is cyclonic or swirling (see section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-92519

Comparison: This stack is 18 in. in diameter and therefore this method is applicable.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in

the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: Drawing H-2-92519

Comparison: Also see comparison under 40 CFR 60, Appendix A, Method 1, § 2.1, Selection of Measurement Site, under "40 CFR 60, Appendix A, Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)" above. This is a 46-cm (18 in.) circular diameter stack which extends approximately 15.2 m (50 ft) in height above the ground level. The sample probe is located 3.40 cm (134 in.) above the fan discharge into the stack (7.4 duct diameters) and 9.91 m (390 in.) below the top of the stack (21.7 duct diameters).

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance for this standard begins in Section 4.0 *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2, Sampling from a Duct or Exhaust Stack Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1, Section 2.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2, Samples Representative with Respect to Physical and Chemical Composition These subsections (4.2.2.1, 4.2.2.2, 4.2.2.3, and 4.2.2.4) discuss losses in general. These sections touch on chemical composition of the stream being sampled, particle size, probe location, delivery lines, collection filters, and refers to Appendixes B and C of the standard.

Documentation: WHC-SD-WM-ES-291, Rev 1

WHC-SD-WM-EMP-031, Rev 0,

Comparison: Particle size studies have not been performed at this facility. Particle loss determination has been accomplished. (refer to WHC-SD-WM-ES-291). See comparison under ANSI N13.1-1969, Appendix B below.

Information provided in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}CS, $^{239/240}Pu$, and ^{241}Am. These radionuclides are particulate in nature. They are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases, the selection of these three elements in programming will be a compromise between idea values and those which provide safety and yet are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information provided in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, $^{239/240}Pu$ and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 **Minimization of the length and bends of sample delivery lines will contribute to representative sampling.**

Documentation: Drawing H-2-92519

Comparison: The sample line is approximately 3.7 m (12 ft) long from the probe connection outside the stack to the top of the sample cabinet. There is a less-than-90° bend (approximately 75°) located just outside the stack at the sample point which is designed to have a bend radius of less than 19 cm (7.5 in.). There is another gradual bend (approximately 15°) located approximately .6 m (2 ft) above the sample cabinet. The tubing is 1.9 cm (3/4 in.) O.D. X 0.09 cm (0.035 in.) WALL. This makes the inside diameter 1.7 cm (0.68 in.).

ANSI N13.1-1969, Appendix A, Section A2 **The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.**

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1, Section 2.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 **Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.**

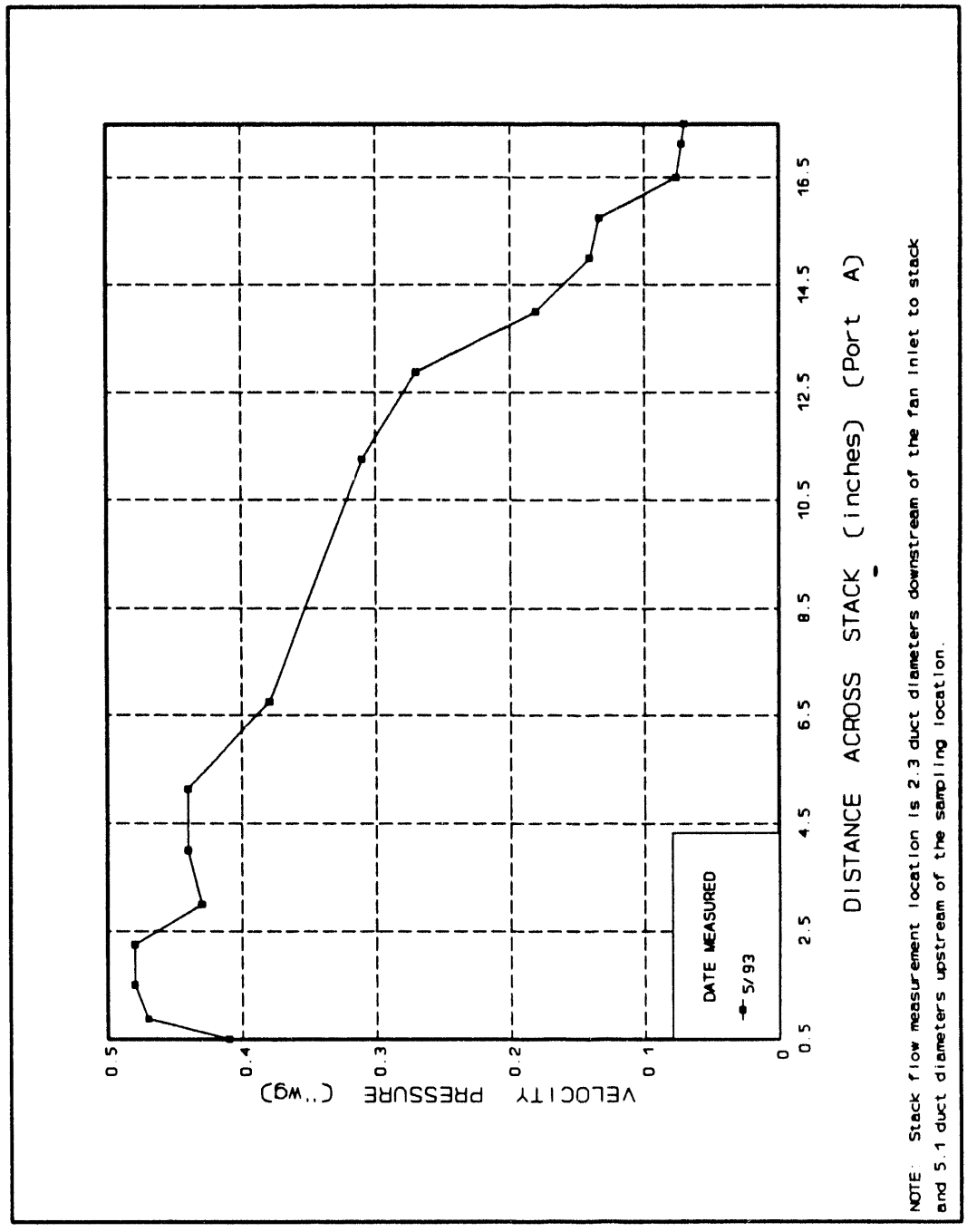
Documentation: Not applicable.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE/DATA SHEET, 244-CR VAULT EXHAUST STACK (296-C-5) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was 67,078 L/min (2,369 ft^3/min). For an 46-cm (18-in.) stack, this amounts to a velocity of 6.80 m (22.3 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .21 m (0.68 ft)/second. Above that turbulent flows exist. According to ANSI N13.1-1969 Section A3.3.2 "as the flow becomes more turbulent, the velocity becomes more nearly

uniform across the duct." Significant duct diameters do exist for the flow profile to be uniform according to Method 1 (see comparison discussion under "Method 1, Section 2.1: Selection of Measurement Site"). Figure G-1 is a plot of the velocity distribution, which is based on a very limited amount of data. Note that the sampling location is 5.1 duct diameters downstream from the flow measurement location. Since there are no flow disturbances between the flow measurement location and the sampling location, the distribution at the sampling location should be much more uniform. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure G-1. Stack Flow Distribution 296-C-5-A.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-92523

Comparison: This drawing shows the probe with a single nozzle. The nozzle is located approximately 13 cm (5 in.) off from the center line of the stack.

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Not applicable.

Comparison: The designed isokinetic flow rate in the stack is 43,661 L/min (1,542 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data as well as instrumentation errors must be accounted for. From 1992 data, it can be shown that the actual sample flow at the sample nozzle opening (taking into account variability in the readings and instrumentation errors) is from 42.5 to 65.1 L/min (1.5 to 2.3 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 29,759 to 45,643 L/min (1,051 to 1,612 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 67,078 L/min (2,369 ft^3/min) with a minimum and maximum flow rate between 30,920 to 104,680 L/min (1,092 and 3,697 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-92523

Comparison: This drawing shows the probe nozzles as 3/4 in. OD by 0.035 WALL. This gives the ID as 1.73 cm (0.68 in.). The nozzle has a 8.9-cm (3.5-in.) minimum bend radius and is approximately 8.9-cm (3.5 in.) in length under the bend radius. According to ANSI, the bend radius, and the vertical should both be 5 times the inside diameter. Five times the inside diameter of this probe is 3.6 cm (1.4 in.). In addition the nozzle is tapered to a knife edge. Therefore, the sampling probe complies with this section of ANSI.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is referenced as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843. This program also provides for anisokinetic sampling affects as discussed in ANSI N13.1-1969, Appendix C.

Because particle sizes are not known a spread of particle sizes were used (i.e., 10, 3.5 and 1 micron in size). The results are as follows:

STACK NUMBER 296-C-5 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	91.4	52.5	97.3	91.6	99.2	98.6
Average	110.4	69.2	100.4	95.2	99.6	99.0
Maximum	165.3	109.7	110.1	104.7	100.5	100.1

The variables used in this program are as follows:

Stack diameter 18 in = 0.4572 m
Area = πR^2 = 0.16417 m^2

Stack Stream Velocity (m/s): 3.14 to 10.63

Average: 6.81

Probe Equivalent Radius = 0.34 in
Probe Equivalent Diameter = 0.68 in = 17.272 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 42.48 to 65.13

Average: 53.80

Line Length = 12 ft = 3.6576 m
Tube ID = 0.68 in = 17.272 mm
two 45 ° bends

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

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APPENDIX H

40 CFR 61.93, SUBPART H COMPARISON FOR 296-P-16

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 241-C-105/106 TANK FARM EXHAUSTER EXHAUST STACK NUMBER 296-P-16

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

40 CFR 60, Appendix A, Method 2 Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube) Method 2 is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow. This procedure is not applicable for:

- Cyclonic or swirling gas streams;
- Stack diameters smaller than 0.30 m (12 in.) or stack cross sectional areas less than 0.071 m^2 (113in^2);
- Measurement sites which fail to meet the criteria of Method 1 in 40 CFR 60, Appendix A, § 2.1)

Documentation: Maintenance Engineering Services Maintenance Procedure 1202, Rev 0

WHC-SD-WM-WP-147, Rev 1

Comparison: The referenced procedure has been written to mirror the 40 CFR 60, Appendix A, Method 2 procedure. Implementation of this procedure is addressed in the referenced procedure upgrade program. Implementation involves writing facility specific procedures from the main referenced procedure. The specific procedure development is underway. The measurement site selection requirement is addressed next.

40 CFR 60, Appendix A, Method 1, § 2.1, Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-95268

Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE/DATA SHEET FOR 241-C-105/106 EXHAUSTER STACK (296-P-16) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: This is a 41-cm (16-in.) circular diameter stack (16 gauge). The stack extension sets approximately 3.0 m (10 ft) in height above the fan discharge. The sample probe is located 89 cm (35 in.) below the top of the stack and 2.2 m (85 in.) above bottom of the stack extension (closest upstream flow disturbance). The finished grade that this stack sets on is at an elevation of 196.69 m (645.3 ft) above sea level. There are two ports 90 degrees apart approximately 8 cm (3 in.) [2.08 m (82 in.) above the bottom of the stack extension] below the sample probe centerline. The nozzle openings of the sample probe are a maximum of 11.4 cm (4.5 in.) below the probe centerline. Because of this, only one of these ports can be used for flow measurements. There are 16 annular traverse measurements taken from this port. Each traverse point is located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: None.

Comparison: Method 2A is not applicable for stacks. If is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

Date	Flow (ft^3/min)	WP#
11/15/90	3,034	NONE
01/09/91	3,682	NONE
04/15/91	2,772	NONE
07/08/91	3,049	NONE
06/07/92	3,020	2E-92-00274
10/29/92	3,045	2E-92-01247
03/08/93	3,951	2E-93-00136

AVERAGE 3,222
VARIABILITY -14%/+23%
STANDARD DEVIATION 425
95% CONFIDENT INTERVAL 1,040
RANGE 2,182 to 4,261

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore, variable. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster runs continuously except for maintenance.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-95268

Comparison: This stack is 41 cm (16 in.) in diameter and therefore this method is applicable.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: Drawing H-2-95268

Comparison: Also see comparison under 40 CFR 60, Appendix A, Method 1, § 2.1, Selection of Measurement Site, under "40 CFR 60, Appendix A, Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)" above. This is a 41-cm (16-in.) circular diameter stack which extends approximately 3.0 m (10 ft) in height above the fan discharge. The sample probe is located approximately 2.2 duct diameters below the top of the stack and only 5.3 duct diameters above the bottom of the stack extension which is above the fan discharge into the stack.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance of this standard start in Section 4. *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is in Section 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2, Sampling from a Duct or Exhaust Stack Sampling point should be a minimum of five diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1, Section 2.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2, Samples Representative with Respect to Physical and Chemical Composition These subsections (4.2.2.1, 4.2.2.2, 4.2.2.3, and 4.2.2.4) discuss losses in general. These sections touch on chemical composition of the stream being sampled, particle size, probe location, delivery lines, collection filters, and refers to Appendixes B and C of the standard.

Documentation: WHC-SD-WM-ES-291, Rev 1

WHC-SD-WM-EMP-031, Rev 0

Comparison: Particle size studies have not been performed at this facility. Particle loss determination has been accomplished however (refer to WHC-SD-WM-ES-291). See comparison under ANSI N13.1-1969, Appendix B.

Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of ^{137}Cs, and $^{239/240}Pu$. These radionuclides are particulate in nature. They are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases the selection of these three elements in programming will be a compromise between idea values and those which provide safety and yet are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of ^{137}Cs, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-95267

Comparison: The sample line is approximately 2.59 m (8.5 ft) long from the probe connection outside the stack to the top of the sample cabinet. There is a single bend radius which is designed to be 10 times the diameter of the tubing. The tubing is 1.9 cm (3/4 in.) O.D. X 0.17 cm (0.065 in.) WALL. This makes the inside diameter 1.57 cm (0.62 in.).

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1, Section 2.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

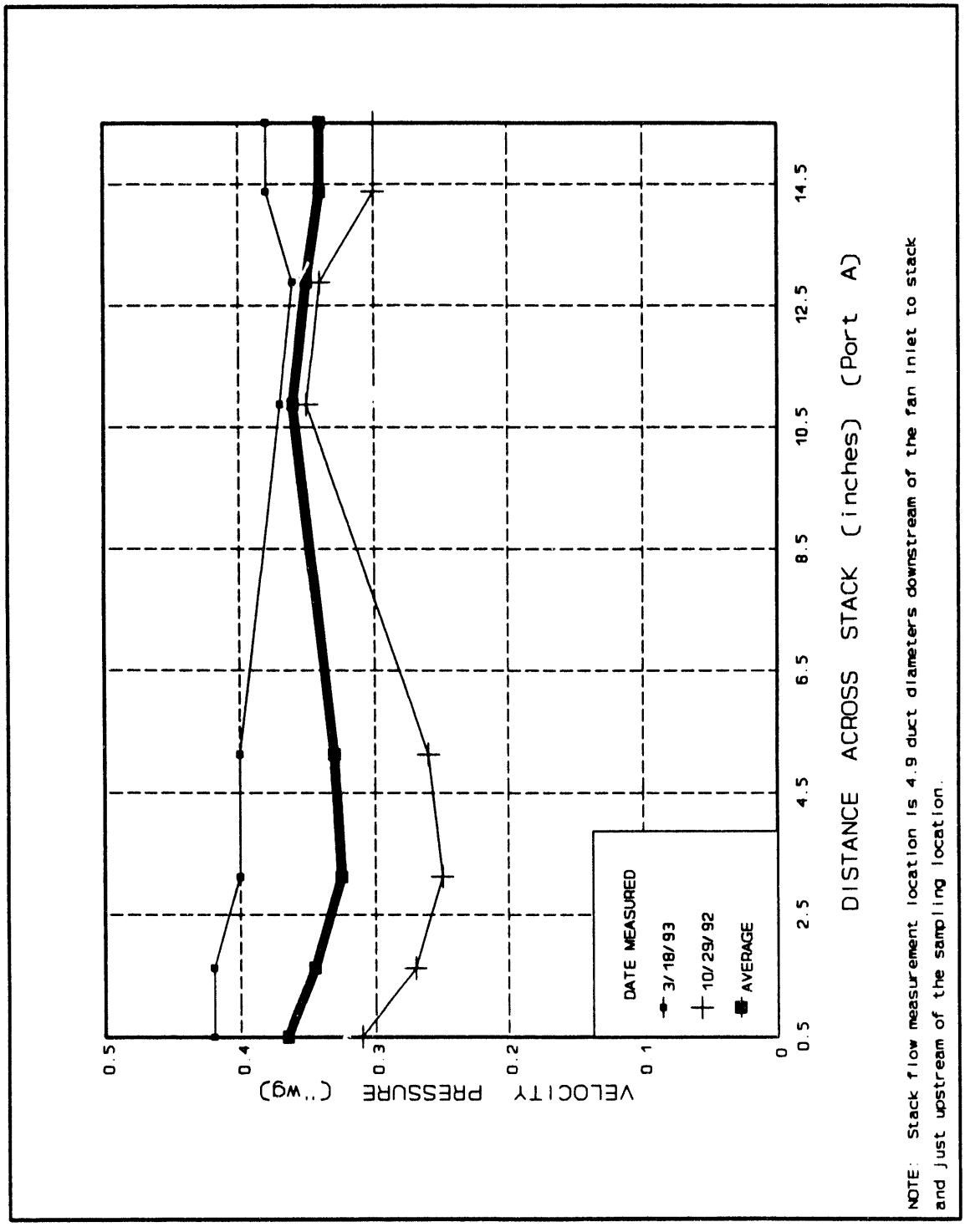
Documentation: None.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE/DATA SHEET FOR 241-C-105/106 EXHAUSTER STACK (296-P-16) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was seen to be 91,230 L/min (3,222 ft^3/min). For a

40.6 cm (16 in.) stack, this amounts to a velocity of 11.73 m (38.5 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .207 m (0.68 ft)/second. Above that turbulent flows exist. The velocity distribution at the sampling site is uniform (see Figure H-3), but is based on a limited amount of data. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure H-3. Stack Flow Distribution 296-P-16-A.



ANSI N13.1-1969, Appendix A, Section A3.2 **A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.**

Documentation: Drawing H-2-95269

Comparison: This drawing shows the probe with three nozzles. Each nozzle is located approximately in the center of each of 3 equal annular areas. This is as recommended in this section of the ANSI N13.1-1969 Standard for this size stack (16 in.).

ANSI N13.1-1969, Appendix A, Section A3.3 **The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.**

Documentation: None.

Comparison: The velocity distribution is not known.

The designed isokinetic flow rate in the stack is 90,381 L/min (3,192 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data as well as instrumentation errors must be accounted for. From 1992 data, it can be shown that the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 42.5 to 65.1 L/min (1.5 to 2.3 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 61,613 to 94,486 L/min (2,176 to 3,337 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 91,230 L/min (3,222 ft^3/min) with a 95 percent confidence interval that the flow rate will be between 61,783 to 120,649 L/min (2,182 to 4,261 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 **Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.**

Documentation: Drawing H-2-95269

Comparison: This drawing provides the probe nozzles as .79 cm (5/16 in.) OD by 0.09 cm (0.035 in.) WALL. This gives the ID as .6160 cm (0.2425 in.). In addition, each nozzle has a 3.81 cm (1.5 in.) minimum bend radius and is approximately 9.53 cm (3.75 in.) in length under the bend radius. According to ANSI the bend radius, as well as the vertical should both be 5 times the inside diameter. Five times the inside diameter of this probe is 3.0798 cm (1.2125 in.). In addition the nozzle is tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is references as N. K. Anand, A. R. McFarland, F. S. Wong, C. J. Kocmound, DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843. This program also provides for anisokinetic sampling affects as discussed in ANSI N13.1-1969, Appendix C.

Since particle sizes are not know a spread of particle sizes were used 10, 3.5 and 1 micron in size. The results are as follows:

Table C20. STACK NUMBER 296-P-16 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	77.5	38.4	92.9	86.6	98.0	97.3
Average	94.0	54.4	96.3	90.6	98.4	97.8
Maximum	129.9	84.0	104.7	99.5	99.3	98.8

The variables use in this program are as follows:

Stack diameter 16 in. = 0.4064 m
Area = πR^2 = 0.1297 m^2

Stack Stream Velocity (m/s): 7.94 to 15.50

Average: 11.72

Probe Equivalent Radius = 0.2100 in.
Probe Equivalent Diameter = 0.4200 in. = 10.66856695 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 42.48 to 65.13

Average: 53.80

Line Length = 8.5 ft = 2.5908 m
Tube ID = 0.62 in. = 15.748 mm
one 90 ° bend.

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

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APPENDIX I

40 CFR 61.93, SUBPART H COMPARISON FOR 296-P-23

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 241-SY TANK FARM EXHAUSTER STACK NUMBER 296-P-23

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-93430

Comparison: Method 2 is for stacks larger than 30 cm (12 in.). This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 20 cm (8 in.). Method 2C is applicable for small stacks. See discussion under Method 2C below.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: Not applicable.

Comparison: Method 2A is not applicable for stacks. It is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

40 CFR 60, Appendix A, Reference 2C Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts: This method allows for the following:

1. The selection of the measurement site according to Method 1A in Appendix A of 40 CFR 60.
2. The selection of the number of traverse point measurements according to Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60.
3. The location of the individual traverse measurement points according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.
4. Apparatus
5. Procedure.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-SY PRIMARY EXHAUST STACK FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawing H-2-93427

Comparison: See the discussion below under "Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements. There are two perpendicular ports where this measurements site is located. This site is in the plane of the nozzle opening of the sampler probes. This location is 3 duct diameters below the top of the stack and approximately 6 duct diameters above the fan section of the stack. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 12 measurements if the flow disturbances upstream of the site is greater than or equal to 6 duct diameters. Measurements are taken on each of 16 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. This is performed in each of the two perpendicular flow measurement ports.

A standard pitot tube is used as specified. However, the procedure is not duplicated. A new procedure is under development which will duplicate the regulatory procedure.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates, measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP#
09/18/90	747	NONE
12/13/90	946	NONE
03/20/91	894	NONE
04/30/91	780	2W-91-00196
06/18/91	784	2W-91-00539
08/12/91	816	2W-91-01003
09/17/91	855	2W-91-01079

10/08/92	769	2W-92-00785
02/01/93	974	2W-92-01284
05/05/93	1,062	2W-93-00318
AVERAGE		863
VARIABILITY		-13%/+23%
STANDARD DEVIATION		104
95% CONFIDENCE INTERVAL		235
RANGE		627 to 1,098

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore, variable. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster does always run.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-93430

Comparison: This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 20.32 cm (8 in.). See Method 1A below.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least 8 stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least 2 stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Not applicable. This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 20.32 cm (8 in.).

40 CFR 60, Appendix A, Method 1A, Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts This method is applicable to stacks or ducts less than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1: PM Measurement Method 1A calls for the sampling sites to be preferably located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-SY PRIMARY EXHAUST STACK FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawings H-2-46172, H-2-93427, H-2-93428, H-2-93430

Comparison: This location of the plane of the nozzle opening of the sampler probes is 3 duct diameters below the top of the stack and approximately 6 duct diameters above the fan section of the stack.

Flow measurements are accomplished via Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2. There are two perpendicular ports chosen for the measurement at this same location.

Measurements are taken on each of 16 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A to this same regulation. This is performed in each of the two perpendicular flow measurement ports.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance of this standard start in Section 4. *Principles.* Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 Samples should be representative with respect to physical and chemical composition of airstream.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No particle size studies have been performed at this facility, though a particle loss determination has been informally (at this time) accomplished. Information provided in WHC-SD-WM-EMP-031, Rev 0 suggest that the sample should consist mainly of ^{137}Cs, with small amounts of ^{90}Sr. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases, the selection of these three elements in programming will be a compromise between idea values and those which provide safety and are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of ^{137}Cs. This radionuclide is particulate in nature and is not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: H-2-73812

Comparison: The sample line is approximately 3.0 m (10 ft) long. The tubing is 1.9-cm (3/4-in.) O.D. X 0.17 cm (0.065 in.) WALL. There is a single bend radius which is designed to be 10 times the diameter of the tubing.

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably 10 or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 **Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.**

Documentation: Not applicable.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE, 241-SY PRIMARY EXHAUST STACK FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was observed to be 24,436 L/min (863 ft^3/min). For an 20-cm (8-in.) stack, this amounts to a velocity of 12.5 m (41 ft)/sec. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .207 m (0.68 ft)/second. Above that turbulent flows exist. The velocity distribution at the sampling site is uniform (see Figures I-1 and I-2), but is based on a limited amount of data. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure I-1. Stack Flow Distribution 296-P-23-3.

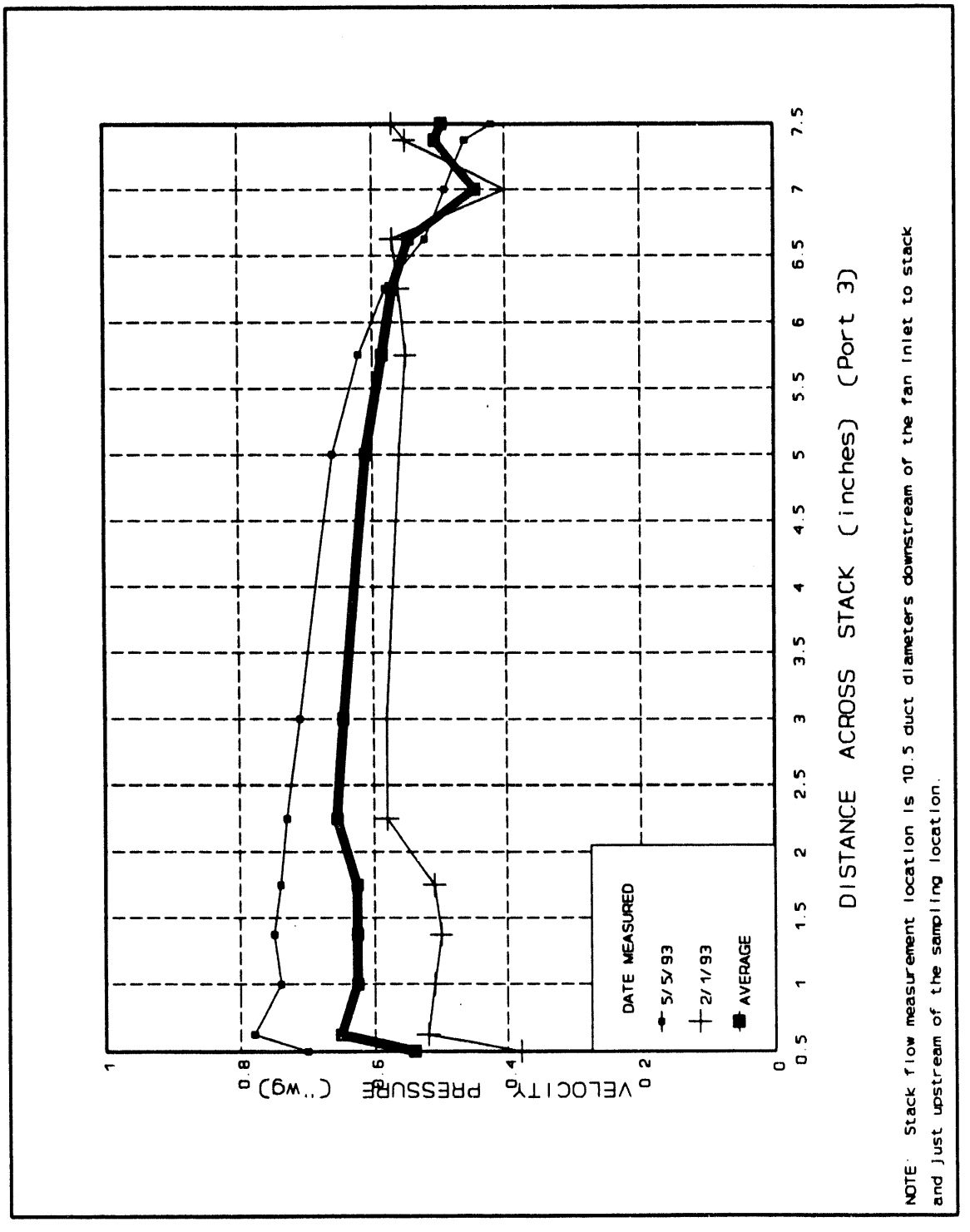
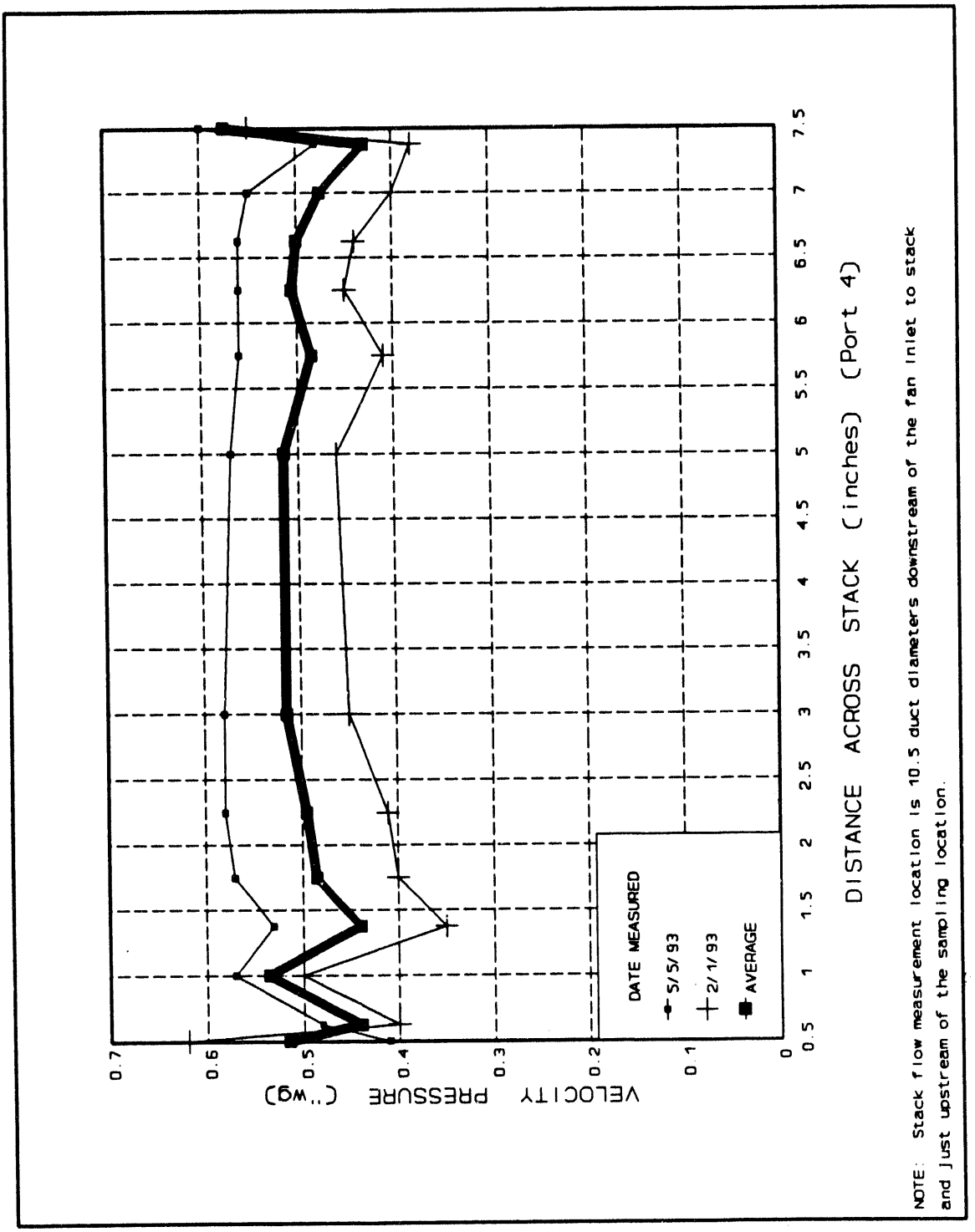


Figure I-2. Stack Flow Distribution 296-P-23-4.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-93428

Comparison: This drawing shows the probe with one nozzle. This is as recommended in this section of the ANSI N13.1-1969 Standard, Appendix A, paragraph A3.2 which states "For ducts less than 8 in. in diameter (20 CM) one sample point is adequate; . . ."

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-SY PRIMARY EXHAUST STACK FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawing H-2-93427

Comparison: The velocity distribution is not known. However, uniform distribution may be assumed (see discussion under "ANSI N13.1-1969, Appendix A, Section A3.1" above).

The designed isokinetic flow rate in the stack is 21,548 L/min (761 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. From 1992 data, the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 45.3 to 68.0 L/min (1.6 to 2.4 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 15,658 to 23,501 L/min (553 to 830 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above provides the actual flow rates measured in the stack. The average of this data is 24,436 L/min (863 ft^3/min) with a 95 percent confidence that this flow rate will be between 17,753 to 31,090 L/min (627 to 1,098 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-93428

Comparison: This drawing shows the probe as a 1.3 cm (1/2 in.) OD by 0.09 cm (0.035 in.) WALL pipe. This gives an ID of 1.09 cm (0.43 in.). This probe has a bend radius of 5.72 cm (2 and 1/4 in.) and a vertical length below the bend of 12.07 cm (4 and 3/4 in.). According to ANSI the bend radius, and the vertical should both be 5 times the inside diameter. Five times the inside diameter of this probe is 5.46 cm (2.15 in.). In addition the nozzle is tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is references, as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843.

Because particle sizes are not known a spread of particle sizes were used (i.e., 10, 3.5 and 1 micron in size). The results are as follows:

STACK NUMBER 296-P-23 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE							
Range	10 μm		PRE-HEPA SPREAD (0.05 to 10 μm)		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total	Probe	Total
Minimum	79.9	36.1	94.2	84.8	93.3	86.6	98.0	97.4
Average	97.2	52.9	98.3	89.2	97.0	90.9	98.4	97.9
Maximum	131.2	81.0	106.8	97.1	105.0	99.4	99.3	98.8

The variables used in this program are as follows:

Stack diameter 8 in. = 0.2032 m
Area = πR^2 = 0.032429 m^2

Stack Stream Velocity (m/s): 9.12 to 15.98

Average: 12.56

Probe Equivalent Radius = 0.215 in.
Probe Equivalent Diameter = 0.43 in. = 10.922 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 45.31 to 67.96

Average: 56.63

Line Length = 10 ft = 3.048 m
Tube ID = 0.62 in. = 15.748 mm
one 90 degree bend.

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX J

40 CFR 61.93, SUBPART H COMPARISON FOR 296-P-28

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 241-SY TANK FARM BACKUP EXHAUSTER STACK NUMBER 296-P-28

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-93000

Comparison: Method 2 is for stacks larger than 30 cm (12 in.). This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 20 cm (8 in.) Method 2C is applicable for small stacks. See discussion under Method 2C below.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: Not applicable.

Comparison: Method 2A is not applicable for stacks. If is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

40 CFR 60, Appendix A, Method 2C Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts: This method allows for the following:

1. Selecting the measurement site per Method 1A in Appendix A of 40 CFR 60
2. Selecting the number of traverse point measurements per Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60
3. Locating the individual traverse measurement points per Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.
4. Apparatus
5. Procedure.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-SY PRIMARY BACKUP PORTABLE EXHAUST STACK (296-P-28) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawing H-2-93000

Comparison: See the discussion below under "Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements. There is one port where this measurements site is located. This site is in the plane of the nozzle opening of the sampler probes. This location is 56 cm (22 in.) (2.7 duct diameters) below the top of the stack and 97 cm (38 in.) (4.7 duct diameters) above the fan section of the stack. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 16 measurements if the flow disturbances upstream of the site is greater less than 6 duct diameters. However, this figure is mainly for large stacks (though it is referenced for use with small stacks). In a stack that is 20 cm (8 in.) in diameter, an increasing number of measurement points is senseless. Logically, there comes a point when additional data points are no longer useful. Therefore it was decided that measurements would be taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. There is only one port at this location, so only one set of traverse points can be taken.

A standard pitot tube is used as specified. However, the procedure is not duplicated. A new procedure is under development which will duplicate the regulatory procedure.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates, only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available, the Job Control System Work Package number and date the measurement was taken is given below:

DATE	FLOW (ft^2/min)	WP Number
02/28/91	682	2W 25017
05/06/91	665	2W-91-00401
08/05/91	793	2W-91-00859
10/27/92	603	2W-92-00964
05/28/93	783	2W-93-00312
AVERAGE		705
VARIABILITY		-14%/+11%
STANDARD DEVIATION		81
95% CONFIDENT INTERVAL		225
RANGE		480 to 930.

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore constant. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster does not always run.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when (1) flow is cyclonic or swirling (see section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-93000

Comparison: This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 20 cm (8 in.). See Method 1A below.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site
Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Not applicable. This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 20.32 cm (8 in.).

40 CFR 60, Appendix A, Method 1A Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts This method is applicable to stacks or ducts less than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1: PM Measurement
Method 1A calls for the sampling sites to be preferably located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-SY PRIMARY BACKUP PORTABLE EXHAUST STACK (296-P-28) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawings H-2-93000 and H-2-93001

Comparison: The center line of the sampling probe is located 43 cm (17 in.) below the top of the stack. The nozzle opening is 13 cm (5 in. below this or 56 cm (22 in.) (2.7 duct diameters) below the top of the stack. This location is 97 cm (38 in.) (4.7 duct diameters) above the fan section of the stack.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance of this standard start in Section 4. *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupied by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 Samples should be representative with respect to physical and chemical composition of airstream.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No particle size studies have been performed at this facility, although a particle loss determination has been informally (at this time) accomplished. Information given in WHC-SD-WM-EMP-031, Rev 0 suggest that the sample should consist mainly of ^{137}Cs, with small amounts of ^{90}Sr. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases the selection of these three elements in programming will be a compromise between idea values and those which provide safety and yet are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information provided in WHC-SD-WM-EMP-031 suggests that the sample should consist mainly of ^{137}Cs. This radionuclide is particulate in nature and is not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: H-2-93001

Comparison: The sample line is approximately 51 cm (20 in.) long from the probe connection outside the stack to the sample cabinet. The tubing is 1.3 cm (1/2 in.) O.D. X 0.17 cm (0.065 in.) WALL. There are no bends, the sample tube is horizontal from the stack to the cabinet.

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

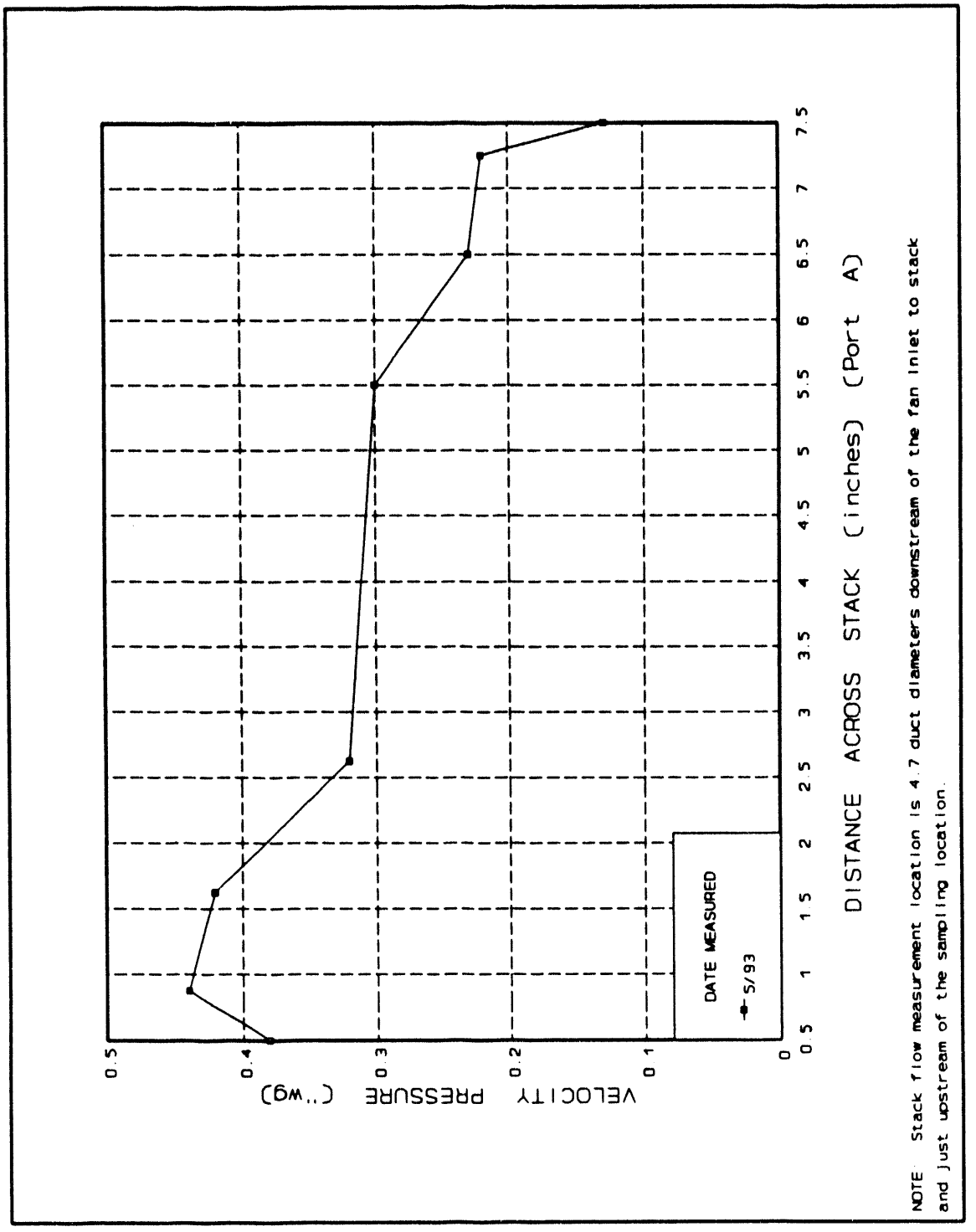
ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Documentation: None

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE, 241-SY PRIMARY BACKUP PORTABLE EXHAUST STACK (296-P-28) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was seen to be 19,962 L/min (705 ft^3/min). For an 20-cm (8-in.) stack, this amounts to a velocity of about 10 m (33 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .2 m (0.68 ft)/second. Above that turbulent flows exist. Figure J-1 is a plot of the velocity distribution, which is based on a very limited amount of data. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure J-1. Stack Flow Distribution 296-P-28-A.



ANSI N13.1-1969, Appendix A, Section A3.2 **A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.**

Documentation: Drawing H-2-93001

Comparison: This drawing shows the probe with two nozzles that are joined outside the stack. This is as recommended in this section of the ANSI N13.1-1969 Standard, Appendix A.

ANSI N13.1-1969, Appendix A, Section A3.3 **The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.**

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE, 241-SY PRIMARY BACKUP PORTABLE EXHAUST STACK (296-P-28) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Drawing H-2-93001

Comparison: The designed isokinetic flow rate in the stack is 25,993 L/min (918 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. Data, 1992, shows that the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 36.8 to 76.4 L/min (1.3 to 2.7 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 15,347 to 31, 911 cm (542 to 1,127 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 19,962 L/min (705 ft^3/min) with a 95 percent confidence that this flow rate will be between 13,591 to 26,333 L/min (480 and 930 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 **Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.**

Documentation: Drawing H-2-93001

Comparison: This drawing shows the probe with a .71 cm (9/32 in.) nozzle piece attached to a 1/2 OD by 0.065 WALL pipe. This shows the nozzle opening with an ID of .71 cm (0.28125 in.) and a tube or pipe ID of .94 cm (0.37 in.). This probe has a bend radius of 6.4 cm (2.5 in.) and a vertical length below the bend of 7.95 cm (3.13 in.). According to ANSI the bend radius, as well as the vertical section should both be 5 times the inside diameter. Five times the inside diameter of the probe nozzle is 4.70 cm (1.85 in.). Five times the inside diameter of the tube is 3.6 cm (1.4 in.). In addition, the nozzle tips are tapered to knife edges.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is referenced as N. K. Anand, A. R. McFarland, F. S. Wong, C. J. Kocmound, DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843.

Because particle sizes are not known a spread of particle sizes were used (i.e., 10, 3.5 and 1 micron in size). The results are as follows:

Table C24. Stack Number 296-P-28 Sampling System Particle Penetration Percentage.

	Particle Size					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	71.0	17.7	91.3	83.9	97.7	97.6
Average	81.6	29.4	93.5	90.8	98.0	97.9
Maximum	117.5	65.5	101.6	100.9	99.0	98.9

The variables used in this program are as follows:

Stack diameter 8.125 in = 0.206375 m
Area = πR^2 = 0.03345 m^2

Stack Stream Velocity (m/s): 6.77 to 13.12

Average: 9.95

Probe Equivalent Radius = 0.19888 in
Probe Equivalent Diameter = 0.3977617 in = 10.103 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min
Sample Flow rate (L/min): 36.81 to 76.46

Average: 56.63

Line Length = 1.7 ft = 0.508 m
Tube ID = 0.37 in. = 9.398 mm
no bends

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

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APPENDIX K

40 CFR 61.93, SUBPART H COMPARISON FOR 296-S-15

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 241-SX TANK FARM EXHAUSTER STACK NUMBER 296-S-15

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

40 CFR 60, Appendix A, Method 2 Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube) Method 2 is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow. This procedure is not applicable for:

- Cyclonic or swirling gas streams
- Stack diameters smaller than 0.30 m (12 in.) or stack cross sectional areas less than 0.071 m^2 (113in^2)
- Measurement sites which fail to meet the criteria of Method 1 in 40 CFR 60, Appendix A, § 2.1)

Documentation: Maintenance Engineering Services Maintenance Procedure 1202, Rev 0

WHC-SD-WM-WP-147, Rev 1

Comparison: The referenced procedure has been written to mirror the 40 CFR 60, Appendix A, Method 2 procedure. Implementation of this procedure is addressed in the referenced procedure upgrade program. Implementation involves writing facility specific procedures from the main referenced procedure. The specific procedure development is underway. The measurement site selection requirement is addressed next.

40 CFR 60, Appendix A, Method 1, § 2.1, Selection of Measurement Site
Sampling or velocity measurement is performed at a site located at least 8 stack or duct diameters downstream and 2 diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and less than a half diameter upstream from a flow disturbance.

Documentation: Drawings H-2-35834 and H-2-35835

Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE/DATA SHEET FOR 241-SX EXHAUST STACK (296-S-15) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: This is a 1.07-m (42 in.) circular diameter stack approximately 4.6 m (15 ft) in height. The sample probe is located approximately 1.37 m (54 in.) below the top of the stack and 81 cm (32 in.) above the fan discharge into the stack. There are two ports 90 degrees apart approximately six inches below the sample probe [66 cm (26 in.) above the fan discharge]. Because there are not enough stack diameters to acquire a good flow measurement on the stack from the two ports just described, a location along the duct work before the fan was chosen to acquire these measurements.

There were three 61-cm (24-in.) diameter, circular ducts leading into the stack, before the fans. One of these ducts is disconnected and sealed. The location chosen to acquire flow measurements are on the two active ducts is as follows:

Flow measurements are taken on the northern most duct from a single port which is 99 cm (29 in.) upstream from the flow disturbance presented by the structure containing the HEPA filters for that duct and approximately 3.4 m (11 ft) downstream from the flow disturbance caused by the plenum containing the heaters.

Flow measurements are taken on the southern most duct from a single port which is 99 cm (39 in.) upstream from the flow disturbance presented by a bend in the duct before the fans. This port is approximately 3.7 m (12 ft) downstream from the flow disturbance presented by the structure which houses the HEPA filters for that duct.

In both these ports, 16 annular traverse measurements are taken. Each traverse point is located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: None.

Comparison: Method 2A is not applicable for stacks. It is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend on the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates, only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP#
09/18/90	4,753	NONE
12/11/90	5,040	NONE
02/28/91	5,404	2W-90-02056
03/20/91	5,539	NONE
06/18/91	3,962	2W-91-00542
09/09/91	2,167	2W-91-01086
09/30/92	3,671	2W-92-00894
03/17/93	4,323	2W-92-01358
05/06/93	3,766	2W-93-00314
06/10/93	3,490	2W-93-00421
AVERAGE		4,212
VARIABILITY		-49%/+32%
STANDARD DEVIATION		1,024
95% CONFIDENCE INTERVAL		2,315
RANGE		1,896 to 6,527

Comparison: Although the regulations do not specifically define variable versus constants flow rate, a flow rate with a variability of less than $\pm$ 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore, variable. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster runs continuously except for maintenance.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when (1) flow is cyclonic or swirling (see Section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-35835

Comparison: This stack is 42 in. in diameter and therefore this method is applicable.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least 8 stack or duct diameters downstream and 2 diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Documentation: Drawing H-2-35835

Comparison: Also see comparison under 40 CFR 60, Appendix A, Method 1, § 2.1, Selection of Measurement Site, under 40 CFR 60, Appendix A, Method 2," Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube) above. This is a 1.07 m (42 in.) circular diameter stack approximately 4.6 m (15 ft) in height. The sample probe is located approximately 1.3 duct diameters below the top of the stack and only 0.8 duct diameters above the fan discharge into the stack.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance for this standard begins in Section 4. *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2, Sampling from a Duct or Exhaust Stack Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1, Section 2.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2, Samples Representative with Respect to Physical and Chemical Composition These subsections (4.2.2.1, 4.2.2.2, 4.2.2.3, and 4.2.2.4) discuss losses in general. These sections touch on chemical composition of the stream being sampled, particle size, probe location, delivery lines, collection filters, and refers to Appendixes B and C of the standard.

Documentation: WHC-SD-WM-ES-291, Rev 1

WHC-SD-WM-EMP-031, Rev 0

Comparison: Particle size studies have not been performed at this facility. Particle loss determination has been accomplished however (refer to WHC-SD-WM-ES-291). See comparison under ANSI N13.1-1969, Appendix B below.

Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases, the selection of these three elements in programming will be a compromise between ideal values and those which provide safety and are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-74913

Comparison: The sample line is approximately 2.4 m (8 ft) long from the probe connection outside the stack to the top of the sample cabinet. There are two bends less than 90 degree designed to have a minimum bend radius of 10 times the tube diameter. The tubing is 1.9 cm (3/4 in.) O.D. X 0.17 cm (0.065 in.) WALL. This makes the inside diameter 1.57 cm (0.62 in.).

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably 10 or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1, Section 2.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 **Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.**

Documentation: Not applicable.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE/DATA SHEET FOR 241-SX EXHAUST STACK (296-S-15) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was seen to be 119,262 L/min (4,212 ft^3/min). For a 42 in. stack, this amounts to a velocity of 2.23 m (7.30 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below 0.21 m (0.68 ft)/second. Above that turbulent flows exist. According to ANSI N13.1-1969 Section A3.3.2 "as the flow becomes more turbulent, the velocity becomes more nearly uniform across the duct." However, significant duct diameters do not exist for the flow profile to be uniform according to Method 1 (see comparison discussion under "Method 1, Section 2.1: Selection of Measurement Site").

ANSI N13.1-1969, Appendix A, Section A3.2 **A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.**

Documentation: Drawing H-2-95250

Comparison: This drawing shows the probe with five nozzles. Each nozzle is located approximately in the center of each of 5 equal annular areas. This is as recommended in this section of the ANSI N13.1-1969 Standard for this size stack [107 cm (42 in.)].

ANSI N13.1-1969, Appendix A, Section A3.3 **The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.**

Documentation: Not applicable.

Comparison: The velocity distribution is not known.

The designed isokinetic flow rate in the stack is 135,996 L/min (4,803 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. From 1992 data, the actual sample flow at the sample nozzle openings (taking into account variability in the readings and

instrumentation errors) is from 42.5 to 65.1 L/min (1.5 to 2.3 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 92,731 to 142,169 L/min (3,275 to 5,021 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 119,262 L/min (4,212 ft^3/min) with a 95 percent confidence interval that the flow rate will be between 53,685 to 184,811 L/min (1,896 to 6,527 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 **Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.**

Documentation: Drawing H-2-95250

Comparison: This drawing provides the probe nozzles as 1.3 cm (1/2 in.) OD by 0.12 cm (0.049 in.) WALL. This gives the ID as 1.021 cm (0.402 in.). In addition, each nozzle has a 5.72 cm (2 and 1/4 in.) bend radius and is approximately 2.5 cm (1 in.) in length under bend radius. According to ANSI the bend radius, and the vertical should both be 5 times the inside diameter. Five times the inside diameter of this probe is 5.11 cm (2.01 in.). In addition the nozzle is tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is references as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843. This program also provides for anisokinetic sampling affects as discussed in ANSI N13.1-1969, Appendix C.

Since particle sizes are not know a spread of particle sizes were used 10, 3.5 and 1 micron in size. The results are as follows:

STACK NUMBER 296-S-15 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	96.5	48.6	99.0	92.3	99.7	99.1
Average	99.0	57.8	99.6	93.7	99.8	99.3
Maximum	108.3	70.1	101.0	95.9	100.0	99.5

The variables use in this program are as follows:

Stack diameter 42 in. = 1.0668 m
Area = πR^2 = 0.8938 m^2

Stack Stream Velocity (m/s): 1.00 to 3.47

Average: 2.22

Probe Equivalent Radius = 0.449449664 in.
Probe Equivalent Diameter = 0.898899327 in. = 22.83204291 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 42.48 to 65.13

Average: 53.80

Line Length = 8 ft = 2.4384 m
Tube ID = 0.62 in. = 15.748 mm
two 45 ° bend

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX L

40 CFR 61.93, SUBPART H COMPARISON FOR 296-S-22

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 244-S DOUBLE CONTAINED RECEIVER TANK EXHAUSTER STACK NUMBER 296-S-22

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

Documentation: Drawing H-2-71048

Comparison: Method 2 is for stacks larger than 30 cm (12 in.). This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.). Method 2C is applicable for small stacks. See discussion under Method 2C below.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: Not applicable.

Comparison: Method 2A is not applicable for stacks. It is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

40 CFR 60, Appendix A, Reference 2C Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts: This method allows for the following:

1. The selection of the measurement site according to Method 1A in Appendix A of 40 CFR 60.
2. The selection of the number of traverse point measurements per Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60.
3. The location of the individual traverse measurement points according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.
4. Apparatus
5. Procedure.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE/DATA SHEET FOR 244-S DCRT EXHAUST STACK (296-S-22) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: See the discussion below under "Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements. The measurement site is 5 duct diameter under the nozzle opening of the record sampler probe and 4.75 duct diameters above the fan discharge to the stack. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 16 measurements if the flow disturbances upstream of the site is less than 6 duct diameters. However, this figure is mainly for large stacks (although it is referenced for use with small stacks). In a stack that is 15 cm (6 in.) in diameter, an increasing number of measurement points begins to get senseless. Logically, there comes a point when additional data points are no longer useful. Therefore it was decided that measurements would be taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. Only one port is at this location, so only one set of traverse points can be taken.

A standard pitot tube is used as specified. However, the procedure is not duplicated. A new procedure is under development that will duplicate the regulatory procedure.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP NO.
09/18/90	122	NONE
05/11/93	174	2W-92-00963
AVERAGE	148	
VARIABILITY		-18%/+18%
STANDARD DEVIATION		37
95% CONFIDENCE INTERVAL		467
RANGE		Not enough data points to establish.

Comparison: Although the regulations do not specifically define variable versus constant flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are constant with the little data available. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster does not always run. Its purpose is to run when the temperature of the waste in the tank is above 60 °C (140 °F) and/or while waste is being transferred through this facility.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected, and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when (1) flow is cyclonic or swirling (see section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-71048

Comparison: This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 15 cm (6 in.). See Method 1A below.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site Sampling or velocity measurement is performed at a site located at least 8 stack or duct diameters downstream and 2 diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Not applicable. This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 15 cm (6 in.).

40 CFR 60, Appendix A, Method 1A Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts This method is applicable to stacks or ducts less than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.

40 CFR 60, Appendix A, Method 1A, Section 2.1.1: PM Measurement
Method 1A calls for the sampling sites to be preferably located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

Documentation: Drawing H-2-71048

GUIDANCE/DATA SHEET FOR 244-TX DCRT EXHAUST STACK (296-T-18) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 15 cm (6 in.).

This stack is 15 cm (6 in.) in diameter. The sample probe location is located 5 ft above the fan discharge into the stack. The closest flow disturbances are:

Downstream the nozzle opening of the sample probe is 2 duct diameters below the nozzle opening of the CAM sample probe.

Upstream the fan discharge into the stack is 9.75 duct diameters below the sample probe.

Flow measurements are accomplished via Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2. One port is chosen for the measurement. The port is 5 duct diameter under the nozzle opening of the record sampler probe and 4.75 duct diameters above the fan discharge to the stack. Although

this location is not downstream of the sample probe, it is considered to be a conservative location for measurement purposes for two reasons:

1. Three sample probes are on this stack. Two are for continuous monitors and one is for the record sampler. Each probe draws a sample at a rate of approximately 57 L/min (2 ft^3/min) of air flow from the stack to total 170 L/min (6 ft^3/min). This sample flow taken from the average stack flow given above of 4191 L/min (148 ft^3/min), will result in 4021 L/min (142 ft^3/min) downstream of all three sample probes. Although 6 ft^3/min only represents 4 percent of the average stack flow, a more conservative representation of the actual totalized flow can be gained from the measurement occurring below the sample probes. Totalized flow is necessary for total emission calculations.

2. Because the probes are removing air from the stack stream, the location of the flow measurement below the sample probes give a truer representation of the flow rate for the first sample probe (the record sampler). This allows for a truer representation of the isokinetic flow conditions that are used to determine the efficiency of the system.

   Measurements are taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A to this same regulation.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance for this standard starts in Section 4. *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 Samples should be representative with respect to physical and chemical composition of airstream.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No particle size studies have been performed at this facility, although a particle loss determination has been informally (at this time) accomplished. Information given in WHC-SD-WM-EMP-031, Rev 0, suggests that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, $^{239/240}Pu$, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases the selection of these three elements in programming will be a compromise between idea values and those which provide safety and are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, $^{239/240}Pu$, and ^{241}Am. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility.

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-46785 and field walkdown

Comparison: The sample line is approximately .46 m (1.5 ft) long with a single 90 degree bend. The tube is 1.3 cm (1/2 in.) OD by 0.09 cm (0.035 in.) wall.

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably 10 or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

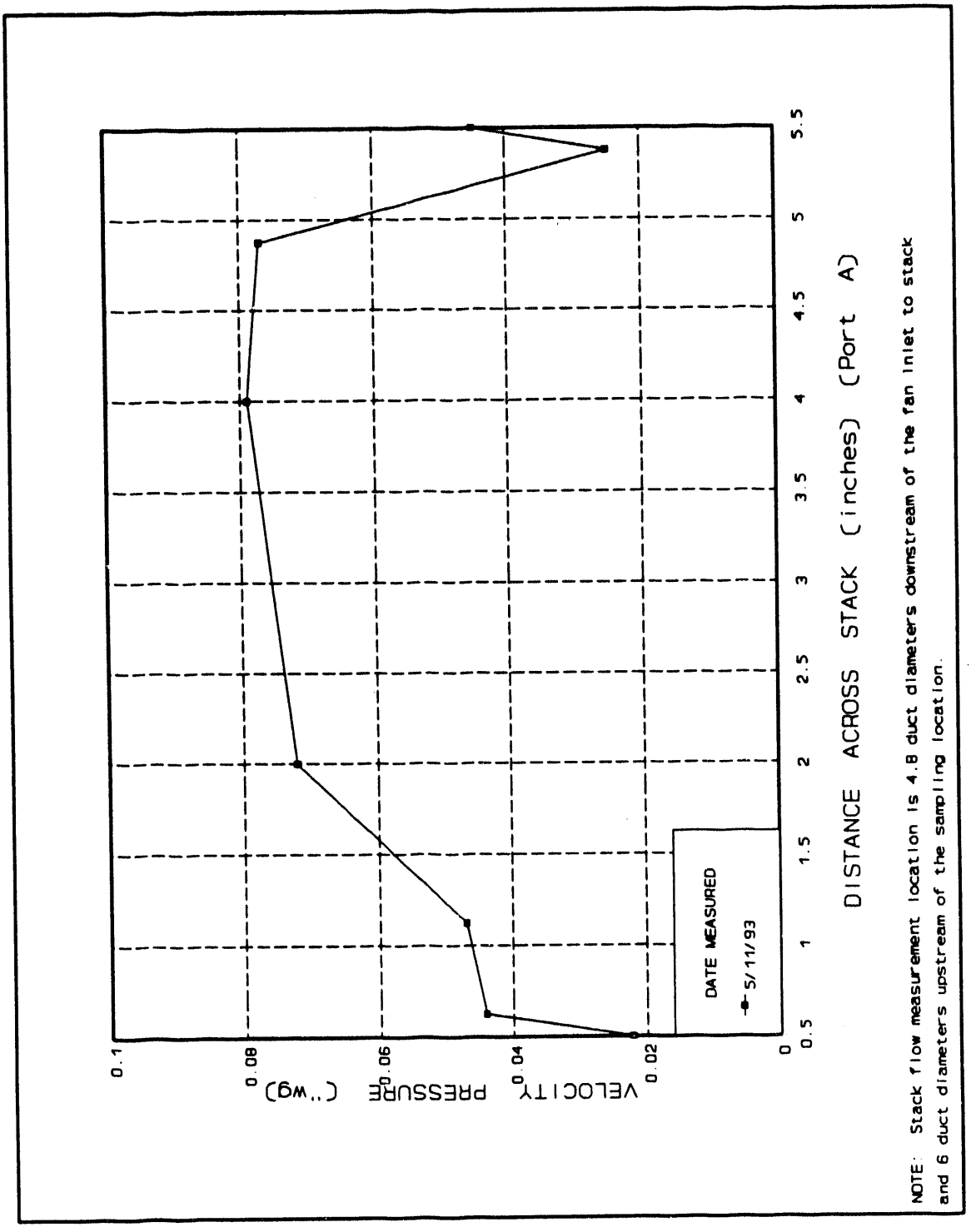
Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2 in conjunction with supplemental GUIDANCE/DATA SHEET FOR 244-TX DCRT EXHAUST STACK (296-T-18) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was seen to be 4191 L/min (148 ft^3/min). For a 15 cm (6 in.) stack, this amounts to a velocity of 3.8 m (12.6 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .207 m (0.68 ft)/second. Above that turbulent flows exist. Figure L-3 shows the velocity distribution for this stack. Note that this distribution is based on a very limited amount of data. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure L-1. Stack Flow Distribution 296-S-22-A.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-46785

Comparison: This drawing shows the probe with one nozzle. This is as recommended in this section of the ANSI N13.1-1969 Standard for this size stack 15 cm (6 in.).

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

GUIDANCE/DATA SHEET FOR 244-S DCRT EXHAUST STACK (296-S-22) FLOW MEASUREMENT

Comparison: The velocity distribution is not known. However, uniform distribution may be assumed (see discussion under "ANSI N13.1-1969, Appendix A, Section A3.1" above).

The designed isokinetic flow rate in the stack is 3313 L/min (117 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. From 1992 data, the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 39.6 to 73.6 L/min (1.4 to 2.6 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 2095 to 3907 L/min (74 to 138 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 4191 L/min (148 ft^3/min) with observable minimum and maximum flow rates between 3454 and 4927 L/min (122 and 174 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-46785

Comparison: This drawing provides the probe as a 1.91-cm (3/4-in.) SCHD 40 pipe with a 7.6 cm (3 in.) 90 degree radius bend and a 3 in. vertical length under that. The inside diameter of this probe is 2.093 cm (0.824 in.). According to ANSI the bend radius, and the vertical

should both be 5 times the inside diameter. Five times the inside diameter of this probe is 10.46 cm (4.12 in.). In addition the nozzle is tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is referenced as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843.

Because particle sizes are not known, a spread of particle sizes was used (i.e., 10, 3.5 and 1 micron in size). The results are as follows:

STACK NUMBER 296-S-22 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	95.5	9.2	98.4	78.7	99.5	97.6
Average	101.9	17.3	99.7	84.5	99.7	98.3
Maximum	115.2	40.1	101.9	91.0	100.1	99.1

The variables used in this program are as follows:

Stack diameter 6 in. = 0.1524 m
Area = πR^2 = 0.01824 m^2

Stack Stream Velocity (m/s): 3.16 to 4.50

Average: 3.83

Probe Equivalent Radius = 0.412 in.
Probe Equivalent Diameter = 0.824 in. = 20.9296 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 39.64 to 73.62

Average: 56.63

Line Length = 1.5 ft = 0.4572 m
Tube ID = 0.43 in. = 10.922 mm
one 90 degree bend.

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)

APPENDIX M

40 CFR 61.93, SUBPART H COMPARISON FOR 296-T-18

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POINT-BY-POINT NESHAP COMPLIANCE COMPARISON FOR THE 244-TX DOUBLE CONTAINED RECEIVER TANK EXHAUSTER STACK NUMBER 296-T-18

Subpart H Section 61.93 (a) (see Appendix N)

Subpart H Section 61.93 (b) Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) Reference Method 2 of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

Documentation: Drawing: H-2-73839

Comparison: Method 2 is for stacks larger than 30 cm (12 in.). This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.). Method 2C is applicable for small stacks. See discussion under Method 2C below.

Subpart H Section 61.93 (b)(1)(ii) Reference Method 2A of Appendix A to Part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Documentation: Not applicable.

Comparison: Method 2A is not applicable for stacks. It is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

40 CFR 60, Appendix A, Reference 2C Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts: This method allows for the following:

1. The selection of the measurement site according to Method 1A in Appendix A of 40 CFR 60.
2. The selection of the number of traverse point measurements per Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60.
3. The location of the individual traverse measurement points according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.
4. Apparatus
5. Procedure.

Documentation: Job Control System Work Packages listed under "Subpart H Section 61.93 (b) (1) (iii)"

GUIDANCE/DATA SHEET FOR 244-TX DCRT EXHAUST STACK (296-T-18) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: See the discussion below under "Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements. The measurement site is 1.3 cm (1/2 in.) duct diameter under the nozzle opening of the record sampler probe and 9.5 duct diameters above the fan discharge to the stack. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 16 measurements if the flow disturbances downstream of the site is less than 1.5 duct diameters. However, this figure is mainly for large stacks (although it is referenced for use with small stacks). In a stack that is 15 cm (6 in.) in diameter, an increasing number of measurement points begins to get senseless. Logically, there comes a point when additional data points are no longer useful. Therefore it was decided that measurements would be taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. This is performed in each of the two perpendicular flow measurement ports.

A standard pitot tube is used as specified. However, the procedure is not exactly duplicated as yet. A new procedure is under development that will duplicate the regulatory procedure.

Subpart H Section 61.93 (b)(1)(iii) The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Documentation: The following flows were obtained from this facility. Note, where available the Job Control System Work Package number and date the measurement was taken is given:

DATE	FLOW (ft^3/min)	WP#
08/20/90	185	NONE
11/28/90	328	NONE
02/26/91	333	NONE
05/20/91	237	2W-91-00399
08/26/91	284	2W-91-00856
04/14/93	305	2W-92-00525
05/13/93	281	2W-93-00313
AVERAGE		279
VARIABILITY		-34%/+19%
STANDARD DEVIATION		53
95% CONFIDENT INTERVAL		129
RANGE		150 to 408

Comparison: Although the regulations do not specifically define variable versus constant flow rate, a flow rate with a variability of less than ± 20 percent has been defined at the Hanford Site as being continuous. This criteria is specified in SD-WM-CR-016. The flow rates given above are therefore, variable. The schedule for taking these flows is quarterly. Although the quarterly schedule is not always met, the requirement at the Hanford Site is to take flow rates at least annually when the exhauster is running. This exhauster does not always run. Its purpose is to run when the temperature of the waste in the tank is above 60 °C (140 °F) and/or while waste is being transferred through this facility.

Subpart H Section 61.93 (b)(2) Radionuclides shall be directly monitored or extracted, collected, and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) Reference Method 1 of Appendix A Part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1 Sample and Velocity Traverses for Stationary Sources.

40 CFR 60, Appendix A, Method 1, Section 1.2: Applicability This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when (1) flow is cyclonic or swirling (see section 2.4); (2) a stack is smaller than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

Documentation: Drawing H-2-73839

Comparison: This stack is smaller than the 30-cm (12-in.) applicability criteria; it is only 15 cm (6 in.). See Method 1A below.

40 CFR 60, Appendix A, Method 1, Section 2.1: Selection of Measurement Site
Sampling or velocity measurement is performed at a site located at least 8 stack or duct diameters downstream and two diameters upstream from any disturbances such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least 2 stack or duct diameters downstream and a half diameter upstream from any flow disturbance.

Not applicable. This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.).

40 CFR 60, Appendix A, Method 1A, Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts **This method is applicable to stacks or ducts less than about 0.30 m (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 m (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.**

40 CFR 60, Appendix A, Method 1A, Section 2.1.1: PM Measurement
Method 1A calls for the sampling sites preferably to be located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

Documentation: Drawing H-2-73839

GUIDANCE/DATA SHEET FOR 244-TX DCRT EXHAUST STACK (296-T-18) FLOW MEASUREMENT

Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

Comparison: This stack is smaller than the 30 cm (12 in.) applicability criteria; it is only 15 cm (6 in.).

This stack is 15 cm (6 in.) in diameter. The sample probe location is located 1.5 m (5 ft) above the fan discharge into the stack. The closest flow disturbances are:

Downstream the nozzle opening of the sample probe is 2 duct diameters below the nozzle opening of the CAM sample probe.

Upstream the fan discharge into the stack is 9.5 duct diameters below the nozzle opening of the sample probe.

Flow measurements are accomplished via Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2. There are two perpendicular ports chosen for the measurement. These ports are one duct diameter below the center line of the record sample probe (the record sample probe extends 6 vertical inches down from its centerline) and 9.5 duct diameters above the fan discharge into the stack. Although this location is not downstream of the sample probe, it is considered to be a conservative location for measurement purposes for two reasons:

1. Three sample probes are on this stack. Two are for continuous monitors and one is for the record sampler. Each probe draws a sample at a rate of approximately 57 L/min (2 ft^3/min) of air flow from the stack to total 170 L/min (6 ft^3/min). This sample flow taken from the average stack flow given above of 7900 L/min (279 ft^3/min), will result in 2042 L/min (273 ft^3/min) downstream of all three sample probes. Although 170 L/min (6 ft^3/min) only represents 2 percent of the average stack flow, a more conservative representation of the actual totalized flow can be gained from the measurement occurring below the sample probes. Totalized flow is necessary for total emission calculations.

2. Because the probes are removing air from the stack stream, the location of the flow measurement below the sample probes give a truer representation of the flow rate for the first sample probe (the record sampler). This allows for a truer representation of the isokinetic flow conditions that are used to determine the efficiency of the system.

   Measurements are taken on each of 8 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A to this same regulation. This is performed in each of the two perpendicular flow measurement ports.

Subpart H Section 61.93 (b) (2) (ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities The guidance of this standard start in Section 4. *Principles*. Section 4.1 is *General*, Section 4.2 is *Representative Samples*, Section 4.2.1 is *Samples Representative According to Spacial Location*, Section 4.2.1.1 is *Sampling in a Zone Occupies by Workers*. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 Sampling point should be a minimum of 5 diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 Samples should be representative with respect to physical and chemical composition of airstream.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No particle size studies have been performed at this facility, although a particle loss determination has been informally (at this time) accomplished. Information given in WHC-SD-WM-EMP-031, Rev 0 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, and $^{239/240}Pu$. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases, the selection of these three elements in programming will be a compromise between ideal values and those which provide safety and yet are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1 (see Appendix N)

ANSI N13.1-1969, Section 4.3.2 (see Appendix N)

ANSI N13.1-1969, Section 4.3.3 (see Appendix N)

ANSI N13.1-1969, Section 4.3.4 (see Appendix N)

ANSI N13.1-1969, Section 4.3.5 (see Appendix N)

ANSI N13.1-1969, Section 5, Methods

ANSI N13.1-1969, Section 5.1, General Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . .

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: Information given in WHC-SD-WM-EMP-031 suggest that the sample should consist mainly of $^{89/90}Sr$, ^{137}Cs, and $^{239/240}Pu$. These radionuclides are particulate in nature and are not volatile.

ANSI N13.1-1969, Section 5.2, Particles

ANSI N13.1-1969, Section 5.2.1, Sample Delivery Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . .

ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation Various collectors are applicable to sampling airborne radioactive materials. . .

ANSI N13.1-1969, Section 5.2.2.1 (see Appendix N)

ANSI N13.1-1969, Section 5.2.2.1.7 (see Appendix N)

ANSI N13.1-1969, Section 5.3, Gases Airborne radioactive volatile materials and so-called "permanent" gases such as tritium are frequently important contaminants and their sampling and collection require techniques and methods differing from those used in particulate sampling.

Documentation: WHC-SD-WM-EMP-031, Rev 0

Comparison: No volatile radionuclides are present at this facility

ANSI N13.1-1969, Section 6.0 (see Appendix N)

ANSI N13.1-1969, Appendix A, Section A1 Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Documentation: Drawing H-2-73812 and field walkdown

Comparison: The sample line is approximately .457 m (1.5 ft) long with a single 90 degree bend. The tube is 1.3 cm (1/2 in.) OD by 0.09 cm (0.035 in.) wall.

ANSI N13.1-1969, Appendix A, Section A2 The distance from the last upstream disturbance to the point of sample extraction should be a minimum of 5 and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

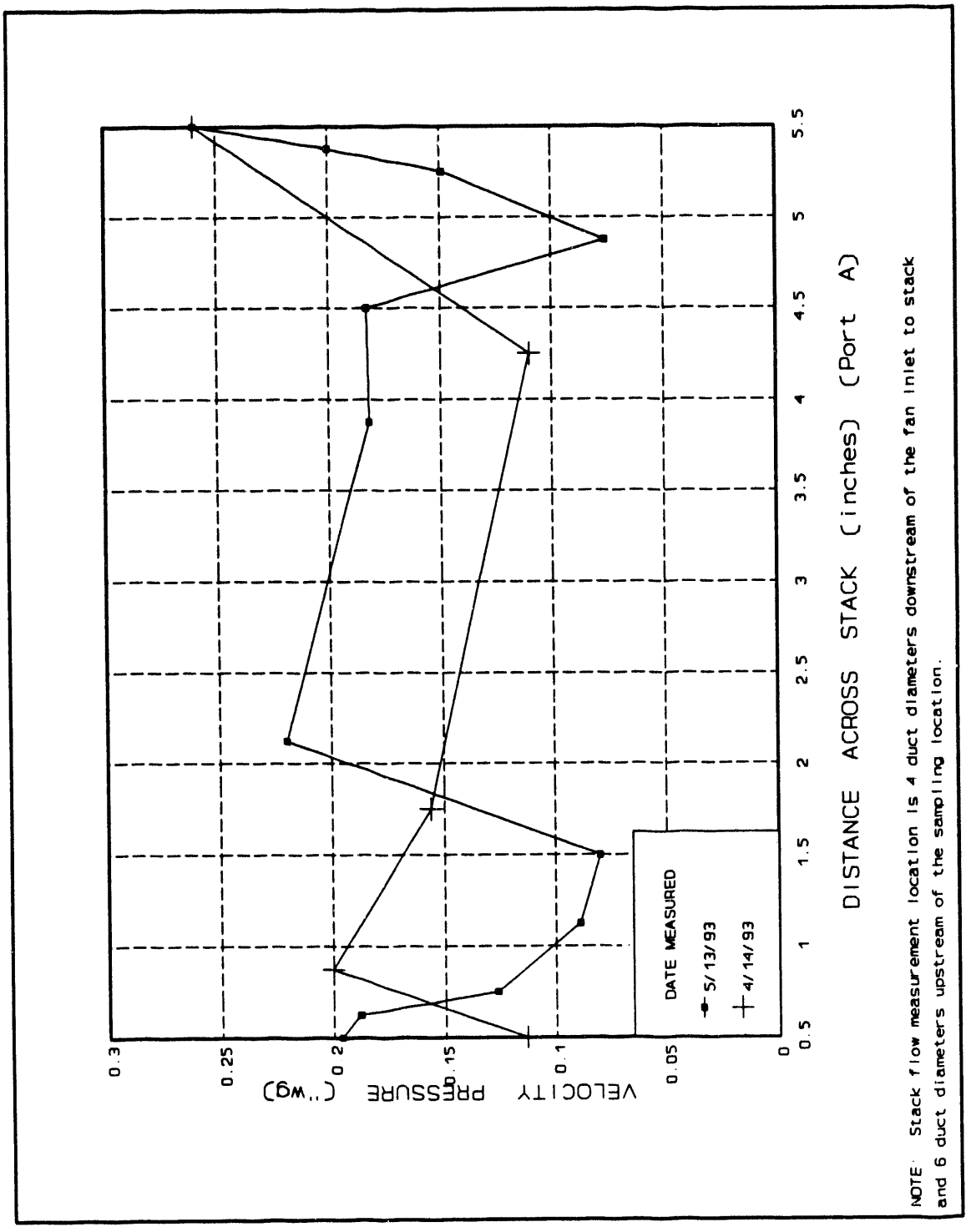
ANSI N13.1-1969, Appendix A, Section A3.1 Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Documentation: Not applicable.

Comparison: Velocity measurements are accomplished by Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE/DATA SHEET FOR 244-TX DCRT EXHAUST STACK (296-T-18) FLOW MEASUREMENT. From the section above, "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was observed to be 7900 L/min (279 ft^3/min). For a 15-cm (6-in.) stack, this amounts to a velocity of 7.3 m (24 ft)/second. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below .207 m (0.68 ft)/second. Above that turbulent flows exist. Figure M-1 shows the velocity distribution for this stack, which is based on a limited amount of data. Note that the flow measurement location is 6 duct diameters upstream from the sampling locating. Since there are no flow disturbances between the flow measurement location and the sampling location, the distribution should be much more uniform at the sampling location. Use the following equation to convert from velocity pressure (inches water, gauge) to velocity (feet per minute).

$$Velocity = 4005 * \sqrt{VelocityPressure}$$

Figure M-1. Stack Flow Distribution 296-T-18-A.



ANSI N13.1-1969, Appendix A, Section A3.2 A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Documentation: Drawing H-2-73812

Comparison: This drawing shows the probe with one nozzle. This is as recommended in this section of the ANSI N13.1-1969 Standard for this size stack [15 cm (6 in.)].

ANSI N13.1-1969, Appendix A, Section A3.3 The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Documentation: Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2

GUIDANCE/DATA SHEET FOR 244-TX DCRT EXHAUST STACK (296-T-18) FLOW MEASUREMENT

Comparison: The velocity distribution is not known. However, uniform distribution may be assumed (see discussion under "ANSI N13.1-1969, Appendix A, Section A3.1" above).

The designed isokinetic flow rate in the stack is 7673 L/min (271 ft^3/min), based on a sample flow of 62.3 L/min (2.2 ft^3/min). Although, it is not reasonable to assume that the design flow is maintained. To determine the true or actual operating condition isokinetic flow rate sample data and instrumentation errors must be accounted for. From 1992 data, the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 42.5 to 70.8 L/min (1.5 to 2.5 ft^3/min). From this, the actual or operating isokinetic flow rate in the stack is from 5210 to 8721 L/min (184 to 308 ft^3/min). Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 7900 L/min (279 ft^3/min) with a 95 percent confidence that this flow rate will be between 4247 to 11,552 L/min (150 to 408 ft^3/min).

ANSI N13.1-1969, Appendix A, Section A3.4 Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Documentation: Drawing H-2-73812

Comparison: This drawing shows the probe as a 1.3 cm (1/2-in.) SCHD 80 pipe with a 7.6-cm (3-in.) 90 degree radius bend and a 7.6-cm (3-in.) vertical length under that. The inside diameter of this probe is 1.387 cm (0.546 in.). According to ANSI the bend radius, and the vertical should both be 5 times the inside diameter. Five times the inside diameter of this probe is 6.93 cm (2.73 in.). In addition the nozzle is tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Documentation: WHC-SD-WM-ES-291, Rev 1

Comparison: The estimate made for this stack was made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is referenced as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial # 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843. This program also provides for anisokinetic sampling affects as discussed in ANSI N13.1-1969, Appendix C.

Because particle sizes are not know a spread of particle sizes were used 10, 3.5 and 1 micron in size. The results are as follows:

STACK NUMBER 296-T-18 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	84.0	8.8	95.2	76.9	98.6	96.8
Average	94.9	16.1	97.1	82.3	98.9	97.4
Maximum	129.8	39.4	103.8	91.9	99.6	98.5

The variables used to derive the values in this table are as follows:

Stack diameter 6.065 in. = 0.154 m
Area = πR^2 = 0.0186 m^2

Stack Stream Velocity (m/s): 3.81 to 10.35

Average: 7.08

Probe Equivalent Radius = 0.273 in.
Probe Equivalent Diameter = 0.546 in. = 13.8684 mm
Designed Sample Flow Rate = 2.2 ft^3/min = 62.29696 L/min

Sample Flow rate (L/min): 42.47 to 70.79

Average: 56.63

Line Length = 1.5 ft = 0.4572 m
Tube ID = 0.43 in. = 10.922 mm
one 90° bend

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling Evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines.

Subpart H Section 61.93 (b) (2) (iii) (see Appendix N)

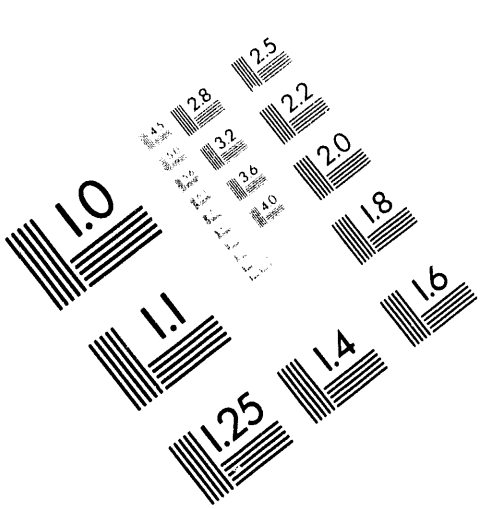
Subpart H Section 61.93(b)(2)(iv) (see Appendix N)

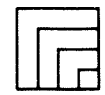
Subpart H Section 61.93(b)(3) (see Appendix N)

Subpart H Section 61.93(b)(4)(i) (see Appendix N)

Subpart H Section 61.93(b)(4)(ii) (see Appendix N)

Subpart H Section 61.93(b)(5) (see Appendix N)





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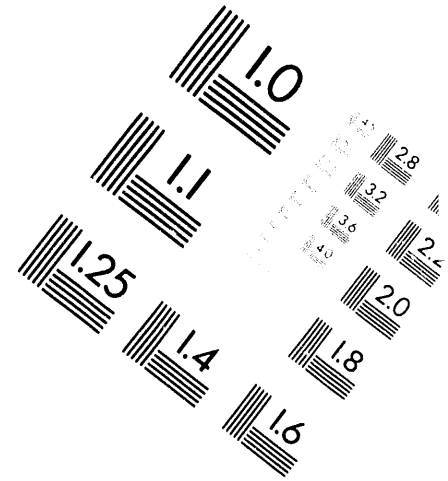
301/587-8202



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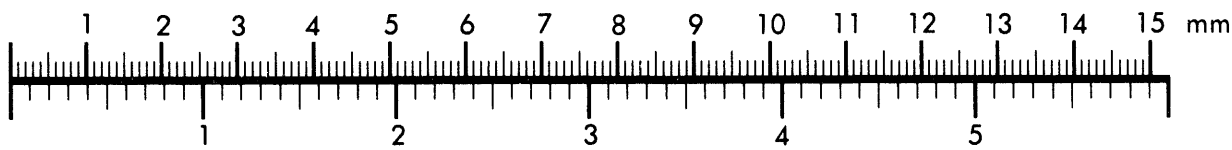

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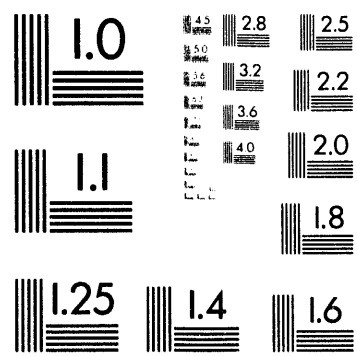

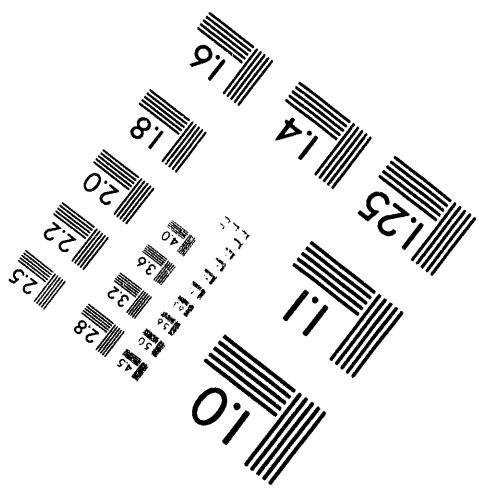

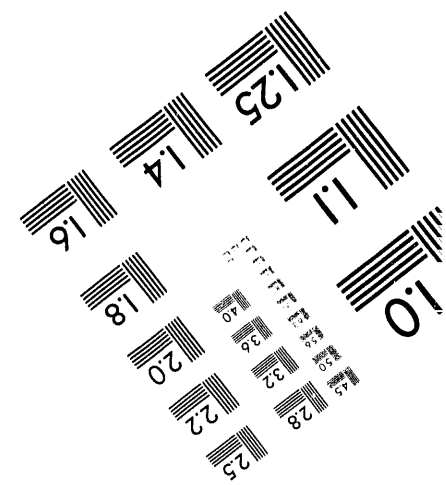

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APPENDIX N

SECTIONS COMMON TO EVERY POINT-BY-POINT

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SECTIONS COMMON TO EVERY POINT-BY-POINT

Subpart H Section 61.93 (a) To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval. DOE facilities for which the maximally exposed individual lives within 3 kilometers of all sources of emissions in the facility, may use EPA's COMPLY model and associated procedures for determining dose for purposes of compliance.

Documentation: WHC-SD-WM-EMP-031, Rev 0

DOE/RL-93-36

Comparison: The effective dose equivalent values to members of the public for the stacks in this document are listed below.

STACK #	RADIONUCLIDE	CAP-88 ** (mrem/Ci)	1992 EMISSIONS (Ci)	1992 EDE (mrem/year)
296-A-17	^{90}Sr ^{129}I ^{137}Cs TOTAL ALPHA	4.38E-02 2.91E-01 2.39E-02	4.6E-07 1.5E-04 4.0E-06 None Detected **TOTAL**	2.0E-08 4.4E-05 9.6E-08 0 **4.4E-05**
296-P-26	(emissions from this stack are reported with stack 296-A-17)			
296-A-25			None Detected	0
296-A-27	^{90}Sr TOTAL ALPHA	4.38E-02	4.2E-08 **TOTAL**	1.8E-09 **1.8E-09**
296-A-29	TOTAL ALPHA TOTAL BETA	4.38E-02	None Detected 4.1E-06 **TOTAL**	 1.8E-07 **1.8E-07**
296-B-28	TOTAL ALPHA TOTAL BETA	1.31E+01 4.38E-02	6.0E-10 2.4E-08 **TOTAL**	7.9E-09 1.1E-09 **8.9E-09**

STACK #	RADIONUCLIDE	CAP-88 ** (mrem/Ci)	1992 EMISSIONS (Ci)	1992 EDE (mrem/year)
296-P-28	(emissions from this stack are reported with stack 296-P-23)			
296-C-5	TOTAL ALPHA TOTAL BETA	1.31E+01 4.38E-02	2.9E-09 2.7E-07	3.8E-08 1.2E-08
			TOTAL	**5.0E-08**
296-P-16	TOTAL ALPHA TOTAL BETA	1.31E+01 4.38E-02	4.1E-09 1.3E-05	5.4E-08 5.7E-07
			TOTAL	**6.2E-07**
296-P-23	TOTAL ALPHA TOTAL BETA	7.79E+00 2.60E-02	6.6E-10 9.1E-07	5.1E-09 2.4E-08
			TOTAL	**2.9E-08**
296-S-15	TOTAL ALPHA TOTAL BETA	 2.60E-02	None Detected 1.1E-07	 2.9E-09
			TOTAL	**2.9E-09**
296-S-22			None Detected	0
296-T-18	TOTAL BETA	2.60E-02	3.0E-08	7.8E-10
			TOTAL	**7.8E-10**

** Assuming TOTAL BETA is from ^{90}Sr, TOTAL ALPHA is from ^{241}Am

ANSI N13.1-1969, Section 4.2.2.2 SAMPLING WITH DELIBERATE DIFFERENTIATION AS TO PARTICLE SIZES. **Because knowledge of particle size distribution is important to a correct evaluation of radiological effects, samplers and collectors may be deliberately designed to identify two or more size fractions of the airborne material.**

Documentation: RHO-CD-1092

Comparison: The sampling systems are not designed to deliberately differentiate between particle sizes.

ANSI N13.1-1969, Section 4.3.1 SENSITIVITY OF DETECTION AND MEASUREMENT. **Sensitivity and accuracy of the analytical or counting method will determine the minimum volume of air which must be sampled to obtain the requisite accuracy and precision of results.**

Documentation:

Comparison:

ANSI N13.1-1969, Section 4.3.2 PERMISSIBLE LEVELS AT POINT OF SAMPLING. If possible, the sample should be large enough to permit 1/10 the permissible level to be determined with reliability.

Documentation: None.

Comparison: Refer to ANSI N13.1-1969, Section 4.3.1

ANSI N13.1-1969, Section 4.3.3 RADIOACTIVITY DECAY. The radioactive half-life of the nuclide to be measured is an important consideration.

Documentation: WHC-EP-0536-1

Comparison: Radioactivity decay is addressed in Appendix G of the referenced plan.

ANSI N13.1-1969, Section 4.3.4 NATURAL RADIOACTIVE MATERIALS. The presence of natural radioactive materials of short half-life may mask the presence of significant quantities of longer lived materials.

Documentation: WHC-EP-0536-1

Comparison: Natural radioactive materials are addressed in Appendix G of the referenced plan.

ANSI N13.1-1969, Section 4.3.5 SPECIFIC NATURE OF THE OPERATION OR PROCESS. The nature of the operation which creates the potential for airborne radioactive materials may influence the sampling program. When the purpose of the sampling is to establish the total release of radioactive materials to the environment, the sampling program must be designed to ensure obtaining an adequate sample during accidental releases.

Documentation: WHC-SD-WM-EMP-031

Comparison: The operation of the facilities is described in the referenced document. The types of accidental releases that would most likely occur are 1) loss of negative tank pressure due to exhauster failure, 2) loss of negative tank pressure due to a gas bubble, 3) catastrophic failure, or 4) HEPA filter failure. In the first three instances, the environmental or area monitoring system would be relied upon to obtain a sample. In the fourth instance the stack sampling system and the area monitoring system would be relied upon to obtain a sample.

ANSI N13.1-1969, Section 5.2.2.1 FILTERS. Appropriate filtration should be chosen for sampling.

Documentation: Gelman Sciences, Inter-Office Memorandum to Karol Butcher October 30, 1991, RE: Versapor 3000, DOP efficiency.

WHC-IP-0692

Health Physics Procedure No. 3.3.2, Rev 2

Comparison: 47 mm Versapor 3000 or equivalent air sample filter is used for the record sampler. This filter is a membrane filter good for collecting 0.3 μm size particles with a collection efficiency of 95.8 percent.

ANSI N13.1-1969, Section 5.2.2.1.7 RELATED EQUIPMENT FOR FILTER SAMPLING. Filter holder and support should be chosen for proper chemical compatibility, mechanical strength, sealing, and ease of operation in changing filters. Sample air movers should have the capability of delivering the necessary air flow against the resistance of the sampling system. Proper location and choice of flow measurement device and flow rate control is important.

Documentation: WHC-SD-WM-ES-291

Comparison: The entire stack radionuclide sampling system consists of the following elements and their corresponding functions:

- The sampling probe withdraws the sample from the stack.
- The sample transport line transports the sample to a sample collection (the record sampler) and/or other detection devices (the CAMs).
- The collection and/or detection devices collect the sample.
- The rotameter measures the flow through the system.
- The gasmeter or totalizer totals the sample flow.
- The pressure or vacuum gauge measures the vacuum in the system.
- The flow switch indicates when the sample flow falls below established limits.
- The flow regulator is used to adjust the flow to maintain established flow rates within the system.

- The vacuum pump supplies the flow through the system.
- The timer indicates the length of time the collection devices have operated.

ANSI N13.1-1969, Section 5.3 GASES. **(NOTE: This section is not applicable to all of the stacks evaluated in this document)** **Airborne radioactive volatile materials and so-called "permanent" gases such as tritium are frequently important contaminants and their sampling and collection require techniques and methods differing from those used in particulate sampling.**

Documentation: WHC-IP-0718

- 200 Area Health Physics Procedure No. 3.3.2, Rev 1

Comparison: Silver zeolite cartridges are used and are designed to collect ^{129}I, ^{131}I, ^{125}Sb, ^{113}Sn, ^{103}Ru, and ^{106}Ru. WHC presently uses two manufacturers:

SAIC/RADECO
10373 Roselle Street
San Diego, Ca 92121

or

HI-Q Environmental Products Co
PO Box 2847
LaJolla, Ca 92038-2847.

The gross filter efficiency of a silver zeolite sampler is based on the particular absorbed/adsorbed radionuclide being evaluated and the porosity of the filter. For uses at the Hanford Site (i.e., ruthenium, iodine) the efficiency is 99.2 to 99.98 (taken from Table O-2 of Air Sampling Instruments, ACGIH, 7th edition, 1989).

ANSI N13.1-1969, Section 6.0 VALIDATION OF SAMPLE EFFECTIVENESS. **In a corresponding manner the results from sampling a stack or other exhaust from a facility should be consistent with the results obtained from air samples drawn downwind or in the vicinity of the facility.**

Documentation: DOE/RL-93-36

WHC-EP-0573-1

Comparison: The stack sampling results are compared in Section 4 of DOE/RL 93-36 to the area monitoring system results.

Subpart H Section 61.93(b)(2)(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurements described in Appendix B, Method 114.

Documentation: WHC-EP-0536-1

Comparison: A point-by-point comparison for 40 CFR 61, Appendix B, Method 114, Test Methods for Measuring Radionuclide Emissions from Stationary Sources is provided in WHC-EP-0536-1.

Subpart H Section 61.93(b)(2)(iv) A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

Documentation: WHC-EP-0536-1

Comparison: The quality assurance plan referenced above should be updated to include this stack.

Subpart H Section 61.93(b)(3) When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of Paragraph (b)(1) of this section, or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site selection and sample extraction procedures provided that:

Comparison: Not applicable to the discussion within this point-by-point.

Subpart H Section 61.93(b)(4)(i) Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess on 1 percent of the standard. All Radionuclides which could contribute greater than 10 percent of the potential effective dose equivalent for a release point shall be measured. With prior EPA approval, DOE may determine these emissions through alternative procedures. For other release points which have the potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions.

Documentation: WHC-SD-WM-EMP-031

Comparison: The referenced document identifies stacks which have the potential to discharge radionuclides into the air which could cause an effective dose equivalent in excess of 1 percent of the standard. Radionuclides which could contribute greater than 10 percent of the potential effective dose equivalent for each of the designated stacks are listed below.

STACK #	RADIONUCLIDES > 10% of EDE	RADIONUCLIDES MEASURED
296-A-17	^{137}Cs	$^{89/90}Sr$, $^{106}Ru/Rh$, ^{129}I, ^{137}Cs, Total Alpha, Total Beta
296-P-26	^{137}Cs	$^{89/90}Sr$, ^{137}Cs, Total Alpha, Total Beta
296-A-25	^{137}Cs, ^{154}Eu, ^{238}Pu, $^{239/240}Pu$, ^{241}Pu, ^{241}Am	Total Alpha, Total Beta
296-A-27	^{137}Cs, ^{241}Am	$^{89/90}Sr$, $^{106}Ru/Rh$, ^{129}I, ^{137}Cs, Total Alpha, Total Beta
296-A-29	^{137}Cs, ^{241}Am	$^{89/90}Sr$, ^{137}Cs, Total Alpha, Total Beta
296-B-28	^{137}Cs	Total Alpha, Total Beta
296-P-28	^{137}Cs	Total Alpha, Total Beta
296-C-5	$^{89/90}Sr$, ^{241}Am	Total Alpha, Total Beta
296-P-16	^{137}Cs, $^{239/240}Pu$	Total Alpha, Total Beta
296-P-23	^{137}Cs	Total Alpha, Total Beta
296-S-15	$^{89/90}Sr$, ^{137}Cs, ^{241}Am	Total Alpha, Total Beta
296-S-22	$^{89/90}Sr$, ^{90}Y, ^{137}Cs, $^{239/240}Pu$	Total Alpha, Total Beta
296-T-18	$^{89/90}Sr$, ^{137}Cs	Total Alpha, Total Beta

Subpart H Section 61.93(b)(4)(ii) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air for the purposes of this section, the estimated radionuclide release rates shall be based on the discharge of the effluent streams that would result if all pollution control equipment did not exist, but the facility operations were otherwise normal.

Documentation: WHC-SD-WM-EMP-031

Comparison: The potential off-site doses (ie assuming emission controls did not exist) for the designated stacks are listed below:

STACK #	POTENTIAL OFFSITE DOSE (mrem/year)
296-A-17	226.0
296-P-26	226.0
296-A-25	0.11
296-A-27	148.0
296-A-29	846.0
296-B-28	0.16
296-C-5	19.0
296-P-16	1.68
296-P-23	10.5
296-P-28	10.5
296-S-15	270.0
296-S-22	0.34
296-T-18	0.18

Subpart H Section 61.93 (b) (5) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standard if the owner or operator meets the following criteria:

Comparison: Not applicable to the discussion within this point-by-point.

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