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NESHAP Quality Assurance Project Plan for Radioactive Air Emissions Data

Prepared for the U.S. Department of Energy
Assistant Secretary for Environment, Safety and Health

FLUOR DANIEL HANFORD, INC.
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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NESHAP QUALITY ASSURANCE PROJECT PLAN FOR RADIOACTIVE AIRBORNE EMISSIONS

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SUMMARY

This quality assurance project plan addresses the quality assurance requirements for monitoring and reporting radioactive air emissions. After sample collection and analysis, air emissions are calculated, and the data reported annually to the U.S. Environmental Protection Agency, the Washington State Department of Health, and the U.S. Department of Energy. Hanford Site radioactive air emissions are reported to the U.S. Environmental Protection Agency in compliance with Title 40, *Protection of the Environment*, Code of Federal Regulations, Part 61, *National Emissions Standards for Hazardous Air Pollutants*, Subpart H, *National Emissions Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities*. Reporting to Washington State Department of Health is performed in compliance with *Washington Administrative Code*, 246-247, *Radiation Protection – Air Emissions*. Reporting to the U.S. Department of Energy is performed in compliance with requirements of U.S. Department of Energy Order 5400.1, *General Environmental Protection Program*. This QAPjP combines the former quality assurance plans WHC-EP-0528 and WHC-EP-0536 into this single document.

Fluor Daniel Hanford, Inc. has contracted with Waste Management Federal Services of Hanford, Inc., Air and Water Services, to implement the data handling for radioactive air emissions sampling and monitoring in accordance with federal and state requirements. This quality assurance project plan is prepared in accordance with *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, and 40 Code of Federal Regulations 61, Appendix B, Method 114, *Test Methods for Measuring Radionuclide Emissions from Stationary Sources*.

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GLOSSARY

ABCASH	Automated Bar Coding of Air Samplers at Hanford
AWS	Air & Water Services
BHI	Bechtel Hanford, Inc.
CFR	Code of Federal Regulations
CY	calendar year
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
EDE	effective dose equivalent
EDP	electronic data processing
EIS/ODIS	effluent information system/onsite discharge information system
EP	Environmental Protection
EPA	U.S. Environmental Protection Agency
ERS	environmental release summary
ESH&Q	Environmental Safety, Health, & Quality
FDH	Fluor Daniel Hanford, Inc.
FEMP	facility effluent monitoring plan
HNF	Hanford Nuclear Facility (document identifier)
INEEL	Idaho National Environmental and Engineering Laboratory
MCL	maximum concentration limit
MDC	minimum detectable concentration
MEI	maximally exposed individual
ND	nondetectable
NESHAP	*National Emission Standards for Hazardous Air Pollutants*
PHMC	Project Hanford Management Contract
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
QAPjP	quality assurance project plan
QAPP	quality assurance program plan
QC	quality control
QS	quality systems
V/B	ventilation and balance
WDOH	Washington State Department of Health
WMH	Waste Management Federal Services of Hanford, Inc.
WSCF	Waste Sampling and Characterization Facility

DEFINITION OF TERMS

Accuracy. Accuracy can be interpreted as the measure of bias in a system. Accuracy is the degree of agreement of a measurement with a true or known value. Accuracy normally is assessed by evaluating matrix-spiked samples and calibration sources.

Activity. The nuclear transformations that occur as a radioactive material decays.

Audit. Audits are considered to be systematic checks to verify the quality of operation of one or more elements of the total measurement system. In this sense, audits can be of two types: (1) performance audits, in which quantitative data are obtained independently for comparison with data routinely obtained in a measurement system or (2) system audits, involving a qualitative onsite evaluation of laboratories or other organizational elements of the measurement system for compliance with established quality assurance program and procedure requirements. For effluent monitoring on the Hanford Site, performance audit requirements are fulfilled by periodic submittal of blind samples to the primary laboratory, or the analysis of split samples by an independent laboratory. System audit requirements are implemented through the use of standard surveillance procedures.

Background. The normal or natural condition in an environmental parameter that is used to compare results from analyses of environmental samples.

Comparability. Comparability is an expression of the relative confidence with which one data set can be compared to another.

Completeness. Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions.

Compliance assessment. A documented examination of a facility or an activity to verify compliance with requirements.

Compliance assessment checklist. A series of close-ended questions designed to determine whether the assessed activity is in compliance with the applicable requirements.

Contamination. The presence of an unwanted substance in an area.

Curie. A unit of activity represents 3.7 E+10 nuclear transformations per second.

Detection limit. The smallest concentration of radioactive material in a sample that yields a net count (above system background) that is detected with a 95% confidence level.

$$DL = [((4.6)(S_b)) + (2.72/T)] / [(E)(V)(2.22\ E{+}06)(Y)(e^{-(k)(dt)})]$$

Where

DL = detection limit (microcuries per unit mass or volume)

S_b = standard deviation of the background counting rate (counts per minute)

T = sample count time in minutes

E = counting efficiency (counts per disintegration)

V = sample size (in units of mass or volume)

2.22 E+06 = number of disintegrations per minute per microcurie

Y = fractional radiochemical yield (when applicable)

e = base of natural logs (approximately 2.718)

k = radioactive decay constant for the particular radionuclide

dt = elapsed time between sample collection (and end of sample collection period) and the time of counting.

Deviation. Deviation refers to a planned departure from established criteria that might be required as a result of unforeseen field situations or that might be required to correct ambiguities in procedures that could arise in practical applications.

Effective dose equivalent (H_E or EDE). The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighing factor. This sum is a risk-equivalent value and can be used to estimate the health-effects risk of the exposed individual. The tissue-specific weighing factor represents the fraction of the total health risk resulting from uniform whole-body radiation that would be contributed by that particular tissue. The EDE includes the committed EDE from internal deposition of radionuclides and the EDE caused by penetrating radiation from sources external to the body; expressed in units of rem (or sievert).

Effluent. Any treated or untreated air emission or liquid discharge at a U.S. Department of Energy (DOE) site or from a DOE facility. The term includes onsite discharge to the atmosphere, lagoons, ponds, cribs, injection wells, French drains, or ditches. The term does not include solid waste stored or removed for disposal or waste contained in retention basins or tanks before treatment and/or disposal.

Effluent monitoring. Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents for the purpose of characterizing and quantifying contaminants, assessing radiation exposures of members of the public, providing a means to control effluents at or near the point of discharge, and demonstrating compliance with applicable standards and permit requirements.

Emission. Refer to effluent.

Environmental monitoring. Environmental monitoring is the collection and analysis of samples or direct measurements (i.e., continuous monitoring) of environmental media. Environmental monitoring consists of two major activities: effluent monitoring and environmental surveillance.

Environmental surveillance. Environment surveillance is the collection and analysis of samples or direct measurements of air, water, soil, foodstuff, biota, and other media from DOE sites and their environs for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public, and assessing the effects, if any, on the local environment.

Exhaust stack. A building stack that vents air or gaseous material to the atmosphere.

Facility. A reprocessing plant, tank farm, shop, laboratory, or powerhouse on the Hanford Site.

Flow totalizer. The cumulative measurement over time of the total quantity of the effluent in terms of mass or volume.

Gaseous effluent. A gaseous or vapor substance discharged from a facility into the environment.

Gaseous radioactive effluents. Radioactive particles, mists, vapors, fumes, and/or gases contained or entrained in airborne effluents.

Grab sample. A single sample removed from a waste stream before release to the environment

HEPA. High-efficiency particulate air filter. To qualify as a HEPA, a filter must achieve an efficiency of 99.97 percent under laboratory conditions and 99.95 percent after installation in the removal of airborne particulates of greater than 0.3 micron in size.

Minimum detectable concentration (MDC). MDC represents the lowest level of detection agreed on by the analytical laboratory and formally established in applicable contracts or work orders that the laboratory attests can be reliably achieved within contractually (or work order) established limits of precision and accuracy under routine laboratory operating conditions. MDC is based on analytical experience and the data need of individual projects; the MDC represents the minimum acceptable standard against which analytical data are judged.

Nonconformance. Nonconformance is a deficiency in characteristic, documentation, or procedure that renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When minor, the deficiency does not effect a permanent or significant change in quality if it is not corrected and can be brought into conformance with immediate corrective action, the deficiency is not categorized as a nonconformance. However, if the nature of the condition is such that it cannot be immediately and satisfactorily corrected, the deficiency will be documented in accordance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision. Precision is a measure of the repeatability or agreement of individual measurements of the same parameters under similar conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average value. Precision normally is expressed in terms of standard deviation, but also could be expressed as the coefficient of variation (i.e., relative standard deviation) and range (i.e., maximum value minus minimum value). Precision is assessed by means of duplicate/replicate sample analysis.

Proportional sampling or monitoring. For continuous airborne effluents, the ratio of the sample flow rate (e.g., the flow through the filter) to the discharge flow rate is constant within acceptable limits. For continuous liquid effluents, the ratio of the sample volume to the discharge volume is constant. For batch releases, the ratio of the sample volume to batch volume is constant from batch to batch (this applies only to the final volumetric composition of the record sample as analyzed by the laboratory).

Quality assurance. QA refers to the total integrated quality planning, quality control (QC), quality assessment, and corrective action activities that collectively ensure that data from monitoring and analysis meet all end user requirements and/or the intended end use of the data..

Quality assurance project plan. A QAPjP is an orderly assembly of management policies, project objectives, methods, and procedures that define how data of known quality are produced for a particular project, investigation, or monitoring program.

Quality control. For the purposes of effluent monitoring, QC refers to the routine application of procedures and defined methods to the performance of sampling, measurement, and analytical processes.

Record sample. A record sample is a representative sample collected in a sampling system for laboratory analysis used as a basis for reporting the amount and type of radionuclides that are released to the environment.

Reference samples. Reference samples are a type of laboratory QC sample prepared from an independent traceable standard at a concentration other than that used for analytical equipment calibration, but within the calibration range. Such reference samples are required for every analytical batch or every 20 samples, whichever is greater.

Representative. The term 'representative' can be interpreted as the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. 'Representative' is a qualitative parameter that is most concerned with the proper design of a sampling program.

Sample. A physical specimen of air or water.

Sampling schedule. A description of routine sampling necessary to support the effluent monitoring program. Sampling schedules specify the effluent, location, size, type, and frequency of samples to be collected.

Sampling system. Instrumentation and equipment that remove a part of a liquid or airborne waste stream for subsequent quantitative determination of a stream parameter. The system generally employs such devices as filters, other sample collection media, or effluent traps of some kind. A continuous sampling system removes a part of the stream continuously except during sample change, maintenance, repair, or other necessary outages. A grab sampling system removes an instantaneous part of the stream or removes a part of the stream over a time period.

Validation. Validation refers to a systematic process of reviewing a body of data against a set of criteria to ensure that the data are acceptable for the intended use. Validation methods might include review of verification activities (i.e., QC program), editing, screening, cross-checking, historical trending, and/or technical review.

Verification. Verification refers to the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities could include inspections, audits, surveillances, or technical review.

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1.0 INTRODUCTION

This QAPjP describes the QA requirements and responsibilities for radioactive air emission measurement activities conducted by the Project Hanford Management Contractor (PHMC) team. This QAPjP is prepared in accordance with *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (QA/R-5).

Radioactive air emission measurement requirements are defined in Subpart H of Title 40, *Code of Federal Regulations* (CFR), Part 61, *National Emission Standards for Hazardous Air Pollutants* (NESHAP). Continuous monitoring requirements apply to stacks whose potential emissions exceed 1 percent of the standard of 10 millirem annual effective dose equivalent (EDE) to the maximally exposed individual (MEI)from operations on the Hanford Site. Title 40, CFR Part 61, Appendix B, Method 114, *Test Methods for Measuring Radionuclide Emissions from Stationary Sources* specifies the QA requirements and that a QAPjP should be prepared to meet the requirements of this regulation. All sources of radioactive air emissions from the PHMC team managed facilities and projects are subject to Washington Administrative Code (WAC) 246-247-075. This QAPjP describes how the applicable QA activities are implemented.

Subpart H, Section 61.94(a), also requires that owners or operators of DOE facilities provide annual monitoring reports with radioactive air emissions and the offsite dose for the previous year to the U.S. Environmental Protection Agency (EPA) Headquarters and regional offices by June 30 of each calendar year (CY). On the Hanford Site, activities associated with this report are categorized as follows:

- Identification of point sources emitting airborne radionuclides
- Collection of representative stack and vent samples for analyses
- Measurement of stack and vent air flows
- Analyses of air samples collected from airborne streams
- Data collection, compilation, calculation, verification, and reporting of radioactive air emissions
- Dose calculations.

This QAPjP addresses the QA activities associated with monitoring and reporting activities. Laboratories performing analyses also have QA program plans (QAPPs) to address conduct of analyses.

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2.0 PROJECT MANAGEMENT

The management and oversight activities associated with radioactive air emissions are directed by the Fluor Daniel Hanford (FDH) Environmental Safety, Health, and Quality (ESH&Q) Division and the Environmental Protection (EP) organization.

By direction from FDH, Waste Management Federal Services of Hanford (WMH) Air & Water Services (AWS) maintains and implements a comprehensive effluent and environmental monitoring program conducted in compliance with applicable environmental regulations, DOE Orders, and the FDH management control systems. The following sections describe the various elements of monitoring and reporting radioactive air emissions from stacks or vents.

2.1 REPORTING ACTIVITIES

Radioactive air emissions data are used to support various reports as follows.

- Radioactive airborne activity from Hanford Site discharge points is reported to the DOE effluent information system/onsite discharge information system (EIS/ODIS) located at Idaho National Environmental and Engineering Laboratory (INEEL) in Idaho Falls, Idaho, in accordance with DOE Order 5400.1, *General Environmental Protection Program.*

- Summary emissions release data from all Hanford facilities is incorporated into the annual Hanford Site environmental report prepared by PNNL. Data are used by PNNL in modeling the offsite dose to the public from onsite operations as required in DOE Order 5400.1.

- Releases of airborne radioactivity from the Hanford Site, and the subsequent offsite dose to the hypothetical MEI, are reported to the EPA per 40 CFR 61, Subpart H.

- Radioactive air emissions for those facilities co-operated by FDH and Bechtel Hanford, Inc. (BHI) are reported in the annual environmental release report, per requirements of DOE Order 5400.1.

- Quantified data on releases from ongoing activities through the use of structured data collection and trend reporting are provided to management.

The collection, compilation, calculation, and verification of radioactive air emissions data are the final steps in a formal process in which samples are collected from selected stacks and vents and analyzed in a laboratory for radioactive materials present. The sample data are verified and compiled for reporting to the EPA, Washington State Department of Health (WDOH), and the DOE, Richland Operations Office (DOE-RL). These activities began before 40 CFR 61, Subpart H, was established to satisfy reporting requirements contained in DOE Orders and are mandated by the *Federal Facility Compliance Agreement for Radionuclide NESHAP* (EPA and DOE-RL 1994).

2.2 RADIOACTIVE AIR EMISSIONS MEASUREMENT ACTIVITIES

The general categories of activities specific to radioactive air emissions, which are outlined in succeeding sections, measurement include the following:

- Collection of laboratory analyses performed to detect the presence of radioactive materials on particulate filter media, charcoal cartridge filters, silver zeolite cartridges, sodium hydroxide media, and silica gel or Drierite™ ($CaSO_4$) cartridges
- Compilation of laboratory analyses with measured stack flow data or maximum stack flow rates to derive releases of radioactivity (i.e., curies) and average concentrations of radioactivity in sampled emissions
- Calculation of quantities of radionuclides released and average concentrations for a CY, for a specific discharge point, or a specific area on the Hanford Site
- Verification of obtained data
- Preparation and release of the reports identified in Section 2.1.

2.3 REQUIREMENTS AND APPLICABILITY TO FLUOR DANIEL HANFORD, INC. TEAM QUALITY ASSURANCE PROGRAM

This QAPjP is prepared in accordance with the guidance in *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80 (and the successor document QA/R-5) and 40 CFR 61, Appendix B, Method 114. This QAPjP describes the means selected to implement the applicable QA program requirements defined by the *Project Hanford Quality Assurance Program Description* (HNF-MP-599), Quality *Assurance Program Plans* (HNF-PRO-261), and the *Waste Management Federal Services Quality Assurance Program Plan* (HNF-SD-SM-QAPP-036). The implementing procedures, plans, and instructions are appropriate for the control of radioactive air emissions data required by Method 114 and applicable DOE Orders.

Distribution and control of this QAPjP is in compliance with HNF-PRO-224. This QAPjP will be reviewed and updated annually or whenever changes are made to the program.

This QAPjP is applicable to the monitoring and reporting of radioactive air emissions from stacks managed by the PHMC team. The following table lists the major (or designated) stacks, along with the document describing its monitoring compliance:

PHMC Active Stack	Compliance Document
291-A-1	Appendix B
296-B-1	DOE/RL-97-17
296-B-10	Appendix C
296-A-42	DOE/RL-98-27
296-A-25	Appendix E
296-B-28	Appendix E
296-C-5	Appendix E
296-C-6	DOE/RL-95-45
296-P-16	Appendix E
296-P-32	DOE/RL-97-05
296-P-33,34	DOE/RL-94-118
291-Z-1	Appendix D
296-S-22	Appendix E

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PHMC Active Stack	Compliance Document
296-T-18	Appendix E
340-NT-EX	Appendix F
EP-324-01-S	Appendix G
EP-327-01-S	Appendix H
296-W-4	DOE/RL-93-15

PHMC Inactive or Passive Stacks	Status
296-A-12	Not operational, being deactivated
296-A-17/296-P-26	Not operational, being deactivated
296-B-2	Passive ventilation, no record sampling
296-U-11	Not operational, new emission unit

2.4 MINIMUM QUALITY ASSURANCE REQUIREMENTS

The following QA elements, as a minimum, are addressed:

- Establishment of a sample tracking system for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system (40 CFR 61, Appendix B, Method 114, Section 4.6)
- Assignment of a unique sampling point identification by electronic data processing (EDP) code by AWS for use in analysis of site samples
- Establishment of required sample analyses and minimum detectable concentrations for specific radionuclides for radioactive air emissions and sample scheduling (40 CFR 61, Appendix B, Method 114, Section 4.3.4)
- Data quality objectives for the laboratory identified in a statement of work or contractual agreement (40 CFR 61, Appendix B, Method 114, Section 4.3.5)
- Definition of reporting requirements for laboratories performing analyses
- Definition of data assessment procedures for evaluation of sample analyses and operations data
- Definition of requirements for reporting to the EPA and the DOE-RL (40 CFR 61, Appendix B, Method 114, Section 4.9).

2.5 RADIOACTIVE AIR EMISSIONS MONITORING PROGRAM

FDH has primary responsibility for preparing all reports of radioactive air releases from record stacks and vents for submission to the EPA and the DOE-RL. Major subcontractors (MSC) are responsible for implementation of requirements listed in HNF-PRO-2364 for radioactive air emissions monitoring and sampling systems. Additional responsibilities include providing information on analytes of interest and required minimum detectable quantities, and conducting compliance assessments of radioactive air emissions sampling and monitoring equipment and records within the facilities managed by the PHMC team.

Responsibilities assigned for sampling, analyses, data compilation, reporting, and oversight are described in the following sections and are shown in the organization matrix in Table 2-1 (40 CFR 61, Appendix B, Method 114, Section 4.1). FDH EP and the Facility Evaluation Board (FEB) organizations direct the management and oversight activities associated with radioactive air emissions are directed by FDH ESH&Q Division and the EP organization.

2.5.1 Radioactive Air Emissions Monitoring

WMH has responsibility for compiling and verifying sample analyses, compiling stack flow rates and operations data, performing final calculations, and preparing reports for FDH. WMH establishes sample schedules and provides technical requirements of radioactive air sample analysis, including the list of specific radionuclides to be analyzed and lower limits of detection for the laboratory. These activities are performed in accordance with HNF-PRO-2364 and WHC-IP-1066.

2.5.2 Radioactive Air Emissions Data Management

WMH has responsibility for compiling radioactive air sampling data and flow rates for regulatory reports. Additional responsibilities include verification of sample analysis parameters received from laboratories and providing sampling schedules. Within WMH, the AWS assigns EDP codes for onsite laboratory analysis of stack/vent samples and establishes the analyses to be performed by that laboratory. In addition, AWS provides the data quality objectives for the sampling analysis activities, compares sample analysis results with previously released information to establish trends in releases, and identifies required investigations of any anomalous data. AWS validates the data against the DQOs to assure the data is acceptable for its intended use, as required by QAMS 005 and QA/R-5.

2.5.3 Responsible Organizations

FDH ESH&Q directs QA support of quality-affecting activities such as inspections, inspection planning, document review and approval, participation in management self-assessments, and oversight of their quality-affecting activities through performance assessments. The FEB performs routine assessments for NESHAP compliance. The FDH office of QA has the following four departments:

- QA Services
- Performance Assurance (Facility Evaluation Board)
- QA Programs
- Codes, Standards, & Corrective Action Management.

Within WMH, the Quality Systems (QS) group under Hanford Analytical Laboratory Operations is responsible for surveillance of activities associated with control of laboratory analysis activities, including the following:

- Reviewing and approving laboratory analytical procedures for QA/quality control (QC) requirements
- Surveillance of laboratory activities associated with radioanalyses of stack samples
- Participating as a QA/QC specialist in laboratory reviews and audits.

2.5.3.1 FDH ESH&Q Division. EP is a group within FDH ESH&Q Division. EP is responsible for management of the radioactive air emission program for facilities managed under the PHMC. Other responsibilities include submitting all the required reports to EPA and DOE-RL. EP has contracted the radioactive air emissions data management functions to WMH.

The FEB is a group in the performance assurance department of FDH QA. The FEB is responsible for independent assessments of radioactive air emissions monitoring program and the laboratory QA/QC functions.

2.5.3.2 Health Physics Personnel. Health physics personnel provide the sampling effort for the radionuclide air emissions under the technical direction of an environmental compliance officer. The automated bar coding of air samples at Hanford (ABCASH) system provides automated data acquisition and tracking of air filter sample information. The sampling collection, tracking, and handling requirements for the effluent samples are contained in HNF-PRO-2364. FDH prepares procedures for sample collection and the sample tracking system that are used by the health physics organizations. BHI collects and sends samples to the laboratory for BHI stacks, in accordance with BHI-SH-04. The sampling activities are done in accordance with the stack monitoring and sampling requirements of 40 CFR 61, Appendix B, Method 114.

2.5.3.3 Quality Systems. WMH QS personnel perform assessments of radioactive air emissions sample collection, analysis, and reporting for facilities managed by the PHMC team. WMH QS is committed to performing at least one annual audit/appraisal on air emissions activities. QS personnel perform surveillances to verify activities described in Section 2.2. These activities include the review and approval of laboratory analytical procedures for QA and QC requirements, surveillance of AWS and laboratory activities associated with radionuclide emissions stack monitoring, and participating in laboratory reviews and audits under the direction of the QA organization.

2.5.3.4 Ventilation and Balance. Ventilation and balance (V/B) personnel from Lockheed Martin Hanford Corporation perform measurements of stack flow rates on a periodic schedule established by the facilities and provide measurement results.

2.5.3.5 Environmental Compliance Officers. ECOs, or their designees, review and verify the average stack flow data from measurements performed by V/B personnel. The ECOs are responsible for monitoring emissions from stacks at their facilities and reviewing the analytical requirement letter of instruction to the laboratory produced by the AWS group. Cognizant engineers are responsible for staying abreast of changes in emissions where the addition or deletion of radionuclides might be necessary for laboratory analysis [e.g., maintaining a current facility effluent monitoring plan (FEMP)].

2.5.3.6 Waste Sampling and Characterization Facility. WSCF personnel perform radiochemical analyses on sample media collected from PHMC team and BHI managed stacks. The specific radionuclides to be analyzed are determined by the AWS group with the assistance of the ECOs for all contractors including BHI. Laboratory responsibilities include the incorporation of the laboratory analytical data into existing laboratory data files for timely electronic transmission to the AWS group. WSCF has a QA plan and analytical procedures that meet the requirements of 40 CFR 61, Appendix B, Method 114. The QA activities identified in Method 114 are described in the appendices.

2.5.3.7 Pacific Northwest National Laboratory (PNNL) Risk Analysis and Health Protection - PNNL is designated by DOE-RL to perform dose modeling for the Hanford Site, including dose modeling for stacks co-operated by FDH and BHI. PNNL derives the EDE by using EPA-approved dose models (CAP88-PC), in combination with the Hanford Site model [GENII (PNL-6584)] used to calculate the contribution of long-lived daughter ingrowth. Data supplied by the PNNL health physics organization are included in the annual report of air emissions prepared for the EPA and in the PNNL Hanford Site Environmental Report prepared for DOE (e.g., PNL-11795).

2.5.3.8 Bechtel Hanford Inc. BHI personnel or their preselected subcontractor personnel are responsible for collecting samples and obtaining flow rate measurements for BHI managed facilities. Stack samples are submitted to WSCF for analysis and the flow rate measurements are provided to the AWS group. BHI also is responsible for reviewing various information and reports generated per this QAPjP and for conducting compliance assessments. BHI activities, such as sample collection, are addressed in BHI-QA-03, Plan #61, *Quality Assurance Project Plan for Radiological Air Emissions.*

Table 2-1. Organizational Responsibilities for Radioactive Air Emissions Data Compilation and Reporting (40 CFR 61, Method 114).

Item	Task	Approval	Performed by	Review	Validation
1	Provide analytical criteria and detection limits for radioanalysis to onsite and offsite laboratories		WMH	FDH BHI	
2	Sample schedules, statement of work		WMH	QS BHI	
3	Collect samples of radioactive air emissions from stacks and record information on sample envelope data		FDH BHI	FDH BHI	WMH
4	Analyze samples	WSCF	WSCF	WMH BHI	
5	Audit laboratory QA/QC		BHI-QS FEB	FEB	
6	Prepare radioactive air emissions data compilation and reporting procedures		WMH	QS BHI	
7	Verify measured stack flow data from V/B and transmit to WMH for annual reporting		BHI FDH	BHI FDH	FDH
8	Verify sample analyses		FDH BHI	FDH BHI	WSCF WMH
9	Prepare annual environmental release report	FDH-EP	WMH	FDH BHI	
10	Compile sampling results, flow data, and data on duration of operation into annual releases in curie quantities and annual average concentrations		WMH	FDH BHI QS	
11	Prepare EIS/ODIS report, annual air emissions report, and annual effluent release report for FDH team	FDH-EP	WMH	FDH PNNL BHI	
12	Compute annual effective dose equivalent to maximally exposed individual for air pathway from operations		PNNL*	WMH FDH	
13	Conduct programmatic audits of emissions data handling		QS BHI FEB		
14	Conduct compliance assessments on radiation air sampling and monitoring systems		FDH BHI WMH		

BHI Bechtel Hanford, Inc.
EIS/ODIS Effluent information system/onsite discharge information system
FEB Facility Evaluation Board
FDH Fluor Daniel Hanford, Inc. and the major subcontractors
PNNL Pacific Northwest National Laboratory
QA/QC quality assurance/quality control
QS WMH Quality Systems
V/B ventilation and balance
WMH Waste Management Federal Services of Hanford (Air & Water Services group)
WSCF Waste Sampling and Characterization Facility
* Review and approval by the Hanford Environmental Dose Overview Panel.

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3.0 MEASUREMENT AND DATA ACQUISITION

All laboratory QA/QC requirements for the PHMC team and BHI are, and will be identified in a contractual agreement or statement of work (e.g., the most current version of HNF-EP-0835). Included in the contractual agreement are specific requirements for the following:

- Defining analytes of interest for the analytical laboratories from emission characterizations provided by the facility. Radionuclides requiring routine analyses depending on the individual emission unit
- Prescribing analytical detection limits and requiring precision and accuracy appropriate to the radioactive air emissions sample analyses for facilities co-operated by DOE-RL and either FDH or BHI
- Defining data representativeness, completeness, and comparability.

3.1 ANALYTES OF INTEREST AND ANALYTICAL METHOD SELECTION

Annually, FDH publishes a statement of work (HNF-EP-0835) that identifies analytes of interest (radionuclides) for each sample location and the criteria for analytical methods. The information in the statement of work is based on the following.

- Sampling systems will be provided for all airborne effluents that have the potential to emit radionuclides. For sources with potential emissions less than 0.1 mrem/yr, periodic confirmatory measurements will be made to verify low emissions.
- Quality records of measurements will be kept for any point of release that, if unfiltered, could present a maximum offsite exposure of greater than 0.1 millirem per year EDE.
- Where the ratio of radioisotopes present in the emissions is unknown or changing, the isotope present with the highest dose factor will be assumed for gross beta/gamma and gross alpha activity.
- Based on Subpart H criteria for continuous monitoring of major stacks, additional specific radionuclide analysis will be performed (e.g., quarterly composites) for radionuclides that contribute more than 10% of the potential offsite dose.

3.2 REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

Goals for data representativeness, completeness, and comparability are addressed in HNF-EP-0835. The total measurement error for analytical data, excluding errors caused by facility stream volume measurement, will be computed at the 95 percent confidence level. The statement of work specifies the minimum detectable concentration (MDC) for services provided by WSCF (the most current version of HNF-EP-0835). Requirements for data representativeness, completeness, and comparability, specific to the laboratory performing the sample analyses are addressed in HNF-EP-0835.

Completeness objectives for contractually and procedurally established requirements (i.e., precision, accuracy, timeliness, etc.) will be met for 90 percent of the requested determinations. Corrective action measures using specified procedures will be initiated by AWS, QS, ECOs, or the laboratory as appropriate.

3.3 SAMPLING SCHEDULE

Record sampling is used as the basis for reporting radioactive air emissions to the EPA and the DOE-RL. As used in this QAPjP, a record sample is a representative sample collected in a sample system for laboratory analysis. Record sampling intervals are specified in the statement of work for all FDH and BHI co-operated facilities. Any change in record sampling schedules for radioactive stacks or vents, including temporary or one-time deviations for emergencies, requires that the AWS group be notified. It is the responsibility of the AWS group to relay such notification to the FDH EP group.

3.4 SAMPLE CHAIN OF CUSTODY

During the collection process, radioactive air emissions samples from major stacks are subject to the controls identified in HNF-PRO-2364 and/or the facility chain-of-custody procedure for PHMC team managed facilities. Sample labels (or envelopes) and/or barcode readers (via ABCASH) are used to record information on sample location, time on and off, flow rate, rotameter, vacuum, EDP code, and signature of sample taker, as described in HNF-PRO-2364. Sample receipt, storage, analyses, and disposal are governed by procedures in place at the laboratory (HNF-SD-CP-QAPP-017, Section 6.3).

Tracking of radioactive air emissions sample handling and analyses is controlled through assignment of unique EDP codes for each sample location. These unique EDP codes are used by the analytical laboratory to report results. Each radioactive effluent sample is assigned a unique sample identification number (QA Method 4.6). A unique sample number also is assigned to composite air samples and the individual samples making up the composite are identified.

4.0 ASSESSMENT/OVERSIGHT

For radioactive air emissions samples analyzed by WSCF, the following requirements are stipulated by contract.

- The laboratory will ensure the integrity and validity of analytical test results through implementation of an internal QC program that includes written procedures and a corrective action system for discrepant results. This internal QC program should address data reduction, verification, and reporting at the laboratory. Any QA procedures for software used in data analysis also should be addressed by this program.
- The laboratory will prepare and analyze spiked, blank, and replicate samples to verify the accuracy and precision of all analytical results.
- Precision and accuracy data will be obtained from analysis of QC samples to demonstrate conformity with QC requirements.
- The contract laboratory will provide reports on precision and accuracy. The contract laboratory also will provide reports on participation in the EPA Environmental Radioactivity Laboratory Intercomparison Studies Program and the DOE Quality Assessment Program laboratory intercomparisons.

The QC test results and laboratory intercomparison scores will be provided quarterly. The QC tests will be for accuracy, precision, completeness, and background. Test results should be presented in bar-line graph or comparable style. All tests will be in accordance with applicable requirements and procedures contained in the references listed in Section 1.0 of HNF-EP-0835. Precision and accuracy are described in Appendix A. AWS duplicates effluent and environmental samples for analysis. The laboratory does not know the identity of these samples when analyzing the samples.

The minimum detectable levels or concentrations for the radionuclides analyzed will be identified in the laboratory contractual agreement (QA Methods 4.5). Where the analytical results are below minimum detectable concentrations (MDCs), emissions will be reported as nondetectable (ND) curies.

4.1 PERFORMANCE AND SYSTEM AUDITS

Internal audits within FDH QA are conducted by an independent technical assessments group. The audit program will perform audits on the activities identified in this QAPjP. FDH QA is responsible for establishing an independent assessment program to measure the adequacy of FDH team management processes to satisfy the requirements of 10 CFR 830.120 and DOE Order 5700.6C. Surveillance or assessments are performed and documented. Audits are performed routinely by WDOH.

WMH QS is responsible for surveillance of activities associated with control of laboratory analysis. These responsibilities include:

- Reviewing and approving laboratory analytical procedures for QA/QC requirements
- Surveillance of laboratory activities associated with the radionuclide emissions stack monitoring
- Participating as a QA/QC specialist in laboratory reviews and audits
- Participation in laboratory intercomparison programs.

4.2 CORRECTIVE ACTION

A corrective action management system is described in HNF-PRO-052. Adverse conditions that require corrective action will be analyzed promptly, resolved, followed up, and tracked to completion. A graded approach will be used to determine the extent of corrective action for each adverse condition. Nonconformance control is described in HNF-PRO-298.

4.3 QUALITY ASSURANCE RECORDS

Surveillance, nonconformance, audit, and corrective action documentation will be considered QA records and will be documented and dispositioned as required in HNF-PRO-222. Compliance assessment checklists are not considered QA records.

5.0 DATA VALIDATION AND USABILITY

Analytical procedures used for radioactive air emissions analyses are provided in Appendix A, which provides a point-by-point comparison to Method 114 requirements. Per the regulations, analytical methods or procedures based on reference methods identified in 40 CFR 61, Appendix B, Method 114 will be used, or alternate methods will be developed and approved before use for all analyses required for NESHAP compliance.

5.1 CALIBRATION

Calibration of all PHMC team managed measuring and test equipment, whether in place or purchased for radioactive air emissions sampling and monitoring, is controlled as required by HNF-PRO-490. Calibration procedures for instrumentation used for sampling and monitoring are included in the appendices (Method 114, Section 4.3.6) and referenced in operating procedures for PHMC team managed facilities. Activities conducted in support of radioactive air emissions data compilation and reporting do not require equipment calibration.

5.2 MONITORING AND REPORTING CRITERIA

Criteria for radioactive air emissions sampling and monitoring at PHMC team managed facilities are identified in HNF-PRO-2364. Sampling and monitoring requirements for BHI are identified in BHI-EE-02. Annual emissions are reported to the EPA in compliance with 40 CFR 61, Subpart H, Section 61.94. Additional reporting requirements are as follows:

- Determining radionuclide emissions to the air
- Describing radioactive materials used on the Hanford Site
- Listing stacks, vents, or other points where radioactive materials are released to the ambient air
- Supplying all input parameters for the computer dose calculation models and the source of these data
- Reporting compliance with the standard that emissions from the Hanford Site not exceed those amounts that would cause any member of the public to receive in any year an EDE of 10 millirem per year.

Annual reports showing the Hanford Site contribution to the EIS/ODIS report are prepared in compliance with DOE Order 5400.1. Information is sent to the EIS/ODIS database by electronic transfer from the Environmental Release Summary (ERS) database.

Information compiled for the EIS/ODIS report of radioactive air emissions is included in the annual environmental release report for the Hanford Site prepared annually by PNNL in compliance with DOE Order 5400.1. This report, which is prepared for transmittal to DOE Headquarters, includes data on emissions from discharge points on the Hanford Site and the resultant offsite dose to the public. Annual summaries of radioactive air emissions, organized by area and discharge point, also are included.

5.3 DATA REDUCTION

To compile radioactive air emissions for inclusion in the annual report prepared in compliance with 40 CFR 61, Subpart H, AWS receives sample analyses from WSCF via the ABCASH database. The analyses are combined with stack flow rates and stack operation data to determine average annual concentrations and activities (i.e., curies) of radionuclides released. The formulas and methods for compiling data for BHI and FDH co-operated facilities are included in WHC-IP-1066. This is accomplished by the ERS database.

5.4 DATA VERIFICATION AND VALIDATION

Data compilation includes only those activities necessary to verify and validate sample collection data, analyses, and stack operating data to ensure the effluent data conforms to specified requirements. Results received from the contract laboratory or facility operations are reviewed. The completeness of the data and compliance to the statement of work (if applicable) are reviewed. The sample location and sample number (using ABCASH) reported by the contract laboratory are verified with the sample tracking database entries. Any discrepancies between the database and laboratory report are investigated by comparison with the sample logbook and chain-of-custody form.

Facility personnel are responsible for reviewing the sample collection data and laboratory analytical results quarterly. If any anomalous data appear, a more extensive review is made. This review includes the comparison of sample envelope parameters versus the laboratory input of the sample and the comparison of present measured stack flows with past flow measurements. Data is validated against the DQOs per HNF-IP-1066, Sections 8.3 and 8.4. Anomalies in laboratory sample results that indicate increased emissions in the absence of process changes are investigated by verbal and written requests made to the laboratory and to cognizant facility personnel for an operations review. Sample analysis data verified as missing because of sample loss or collection failure are interpolated by the electronic database averaging the results of the sample analyses for the previous sampling period and the period following the lost sample. For periodic confirmatory measurements taken four times a year, the emissions are calculated over the sampling period and averaged over the entire year.

If data are missing, the health physics organization is contacted to provide the missing data. If the **TIME ON** does not agree with the **TIME OFF** of the preceding week's sample, the preceding week's sample **TIME OFF** is used. Discrepancies in sample flow rate are resolved by contacting the health physics organization to verify data.

5.5 DATA REPORTING

Radioactive air emissions are reported each year in the following reports.

5.5.1 Effluent Information System/Onsite Discharge Information System Report

The EIS/ODIS report consists of the total curies released and the total emissions volume for every discharge stack or vent included in the EIS/ODIS for the Hanford Site. The information is compiled and transmitted via direct electronic file transfer to the INEEL. These data, sent electronically by April 1st each year, represent releases from the previous CY.

5.5.2 Hanford Site Environmental Report

For the Hanford Site environmental report prepared by PNNL, AWS combines the EIS/ODIS emissions data for stacks and vents by area and specific radionuclide. The emissions data are incorporated into the text portion of the report and the data are provided to PNNL. PNNL uses the emissions data to calculate offsite dose to the MEI for inclusion in the report. This report is published by September 1 each year.

5.5.3 Air Emissions Report

For the annual air emissions report required by 40 CFR 61, Subpart H, radioactive air emissions by area, radionuclide, and stack/vent are compiled. The offsite dose is provided by the PNNL health physics organization for the air pathway. This report is transmitted to the EPA by June 30 each year.

5.5.4 Environmental Release Report

The annual environmental release report, average annual concentrations, total curies released, and total stack volumes for stacks and vents are incorporated, along with information concerning nonradioactive air emissions, into the section of the environmental release report that addresses the airborne releases. This report is published by August 31 each year.

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APPENDIX A

METHOD 114 COMPARISON FOR WSCF LABORATORY

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APPENDIX A

METHOD 114 COMPARISON FOR WSCF LABORATORY

Emissions monitoring practices are evaluated in this appendix for compliance with the radionuclide emission requirements defined in Title 40, CFR Part 61, Subpart H.

The effluents from emission points are well characterized. The characterizations of radionuclide composition in emissions are in complete agreement with the operations carried out in respective facilities generating radioactive air emissions. The laboratory receives bi-weekly or quarterly main stack air filter samples depending on the NESHAP category. These are usually 47-millimeter filters (acrylic copolymer on nylon). Before analysis is performed, samples are held for 7 days so that radon/daughters, if present in the filters, can decay.

The radionuclides ^{129}I, ^{106}Ru, ^{113}Sn, and ^{125}Sb are sampled at the AW, AY/AZ, and AP Tank Farms main stacks, and also at the 242-A Evaporator vessel vent and PUREX Facility main stacks. Samples are collected using silver zeolite cartridges that are sent to the laboratory for identification of radionuclides and determination of activity.

After a 7-day decay period, the total alpha/beta activity concentrations in the air particulate samples are determined using procedure LA-508-415. This screening process is performed to make a quick evaluation of activity levels in the main stack air streams. If the activity level for a specific major stack is found to be significantly increased, as indicated by its total alpha/beta data, facility personnel must be aware of the change in emissions. The results of the total alpha/beta are downloaded from the computer that does the data analysis to a personal computer on the local area network. Radiological Control, Effluent Monitoring, and facility effluent personnel can access these data, usually the day after the filters are analyzed. Interested parties also can request a hard copy of the data report.

It is important to note that continuous process control air monitoring systems with alarms are installed at each major stack for near real-time response to elevated releases. These alarms allow rapid response from facility personnel if the situation warrants. For compliance, the screening of weekly total alpha/beta measurements is made assuming the most limiting alpha particulate ($^{239,240}Pu$) and the most limiting beta-emitting radionuclide (^{90}Sr) in the stack effluents.

To ensure compliance, the WSCF Laboratory can, upon request, perform specific radionuclide analyses on a composite of all filters collected during a calendar quarter. These analyses include gamma energy analysis (GEA), specific analysis for Pu and Am isotopes, and specific analysis for Sr isotopes. The Environmental Compliance Program (ECP) organization determines which analyses are performed for each particular composite.

Any requested GEA would be the first analysis performed (LA-508-462) on the composite (LA-548-421 for making a composite). The GEA determines the activities of the gamma emitters, particularly Cs-137, Co-60, Eu-154, Ru-106, Sn-113 and any other positive gamma peaks except radon and thoron daughters. After a GEA is complete, the quarterly composite of air filters is ashed, dissolved/leached, appropriately treated, and mounted for analysis of individual alpha emitters (LA-549-412 [dissolution], LA-943-424 [chemical separation], LA-508-462 [alpha spectrometry] for ^{241}Am, ^{238}Pu, ^{239,240}Pu) and beta emitters (LA-549-412 [dissolution], or LA-220-406 [separation by Sr-spec resin column], LA-508-415 [total beta counting] for ^{89,90}Sr/^{90}Y; LA-549-412 [dissolution], LA-218-411 [chemical separation for 3H, if needed], LA-548-411 [mounting in scintillation cocktail], LA-508-421 [scintillation counting], depending on the type of analyses requested.

The weekly samples for ^{129}I, ^{125}Sb, ^{113}Sn, and ^{106}Ru from each of the PUREX Facility, 242-A Evaporator, and AW, AY/AZ, and AP Tank Farm stacks are collected on silver zeolite cartridges and are analyzed by the GEA (LA-508-462 in conjunction with LA-548-421).

A point-by-point comparison of analyses performed with the regulatory requirements of Title 40, CFR 61, Subpart H, Method 114 (particularly Sections three and four as applicable to 222-S Laboratory operations) is provided in the following.

METHOD 114-TEST METHODS FOR MEASURING
RADIONUCLIDE EMISSIONS FROM STATIONARY SOURCES

1.0 Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

Response: **Provided as bold text.**

2.0 Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable adsorbers, condensers or bubblers to collect the radionuclides.

Response: **No response required.**

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see □ 61.18).

Refer to Appendixes B, C, D, E, F, G, and H.

2.2 Radionuclides as Gases

2.2.1 The Radionuclide Tritium (H-3). Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B-1, collected as a gas sample or may be oxidized using a metal catalyst to tritiated water and collected as described above.

2.2.2 Radionuclides of iodine. Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite and caustic solutions.

2.2.3 Radionuclides of Argon, Krypton and Xenon. Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low temperature sorption techniques, Appropriate adsorbers may include charcoal or metal zeolite.

2.2.4 Radionuclides of Oxygen, Carbon, Nitrogen and Radon. Radionuclides of these elements are measured directly using an in-line or off-line monitor. Radionuclides of carbon in the form of carbon dioxide may be collected by dissolution in caustic solutions.

2.3 Definition of Terms

In-line monitor means a continuous measurement system in which the detector is placed directly in or adjacent to the effluent stream. This may involve either gross radioactivity measurements or specific radionuclide measurements. Gross measurements shall be made in conformance with the conditions specified in Methods A-4, B-2, and G-4.

Off-line monitor means a measurement system in which the detector is used to continuously measure an extracted sample of the effluent stream. This may involve either gross radioactivity measurements or specific radionuclide measurements. Gross measurements shall be made in conformance with the conditions specified in Methods A-4, B-2 and G-4.

Sample collection means a procedure in which the radionuclides are removed from an extracted sample of the effluent using a collection media. These collection media include filters, absorbers, bubblers and condensers. The collected sample is analyzed using the methods described in Section 3.

Response: **No response required.**

3.0 Radionuclide Analysis Methods

A series of methods based on "principles of measurement" are described which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities which would interfere with the measurement.

Also identified (Table 1) are methods for a selected list of radionuclides. The listed radionuclides are those which are most commonly used and which have the greatest potential for causing dose to members of the public. Use of methods based on principles of measurement other than those described in this section must be approved in advance of use by the Administrator. For radionuclides not listed in Table 1, any of the described methods may be used provided the user can demonstrate that the applicability conditions of the method have been met.

The type of method applicable to the analysis of a radionuclide is dependent upon the type of radiation emitted, i.e., alpha, beta or gamma. Therefore, the methods described below are grouped according to principles of measurements for the analysis of alpha, beta and gamma emitting radionuclides.

3.1 Methods for Alpha Emitting Radionuclides

3.1.1 Method A-1, Radiochemistry-Alpha Spectrometry

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemical techniques. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a very thin film by electrodeposition or by coprecipitation on a very small amount of carrier, such as lanthanum fluoride. The deposited element is then counted with an alpha spectrometer. The activity of the nuclide of interest is measured by the number of alpha counts in the appropriate energy region. A correction for chemical yield and counting efficiency is made using a standardized radioactive nuclide (tracer) of the same element. If a radioactive tracer is not available for the element of interest, a predetermined chemical yield factor may be used.

Applicability: This method is applicable for determining the activity of any alpha-emitting radionuclide, regardless of what other radionuclides are present in the sample provided the chemical separation step produces a very thin sample and removes all other radionuclides which could interfere in the spectral region of interest. APHA-605(2), ASTM-D-3972(13).

Response: **Method involves dissolution (LA-549-412), chemical separation (LA-943-424), followed by alpha spectrometry (LA-508-462). This method meets all the requirements of the EPA-suggested method. This is used for analyzing ^{241}Am, ^{238}Pu, and ^{239,240}Pu in the air filter samples. The activities of these nuclides are determined by direct comparison with the recoveries of [National Institute of Standards and Technology (NIST) traceable] or certified ^{243}Am and ^{236}Pu or Pu-242 tracers.**

3.1.2 Method A-2, Radiochemistry-Alpha Counting

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemistry. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a thin film and counted with a alpha counter. A correction for chemical yield (if necessary) is made. The alpha count rate measures the total activity of all emitting radionuclides of the separated element.

Applicability: This method is applicable for the measurement of any alpha-emitting radionuclide, provided no other alpha emitting radionuclide is present in the separated sample. It may also be applicable for determining compliance, when other radionuclides of the separated element are present, provided that the calculated emission rate is assigned to the radionuclide which could be present in the sample that has the highest dose conversion factor. IDO-12096(18).

Response: **The method (A-2) of determining total alpha emitter activity of the separated element is not used because more than one alpha may be present.**

3.1.3 Method A-3, Direct Alpha Spectrometry

Principle: The sample, collected on a suitable filter, is counted directly on an alpha spectrometer. The sample must be thin enough and collected on the surface of the filter so that any absorption of alpha particle energy in the sample or the filter, which would degrade the spectrum, is minimal.

Applicability: This method is applicable to simple mixtures of alpha emitting radionuclides and only when the amount of particulates collected on the filter paper are relatively small and the alpha spectra is adequately resolved. Resolutions should be 50 keV (FWHM) or better, ASTM-D-3084(16). This is not done at the WSCF Lab. The 222-S counting room uses this method, however, for emergency air samples (red bordered samples).

Response: **This is not done at the WSCF Lab. This method is used, however, by the 222-S counting room for emergency air samples (red bordered processing and handling samples) The 222-S counting room uses procedure LO-150-133, then LA-508-110 for total alpha counts, and finally LA-508-051 for alpha spectrometry, which partially meets the requirements of the EPA method. The sample is counted on the alpha counter of known efficiency to obtain the total alpha counts. In the alpha energy analysis (AEA), the relative peak fractions of different alpha emitters identified in the sample are determined. The peak fractions are used to correct the total alpha counts and thus determine the activities of individual alpha nuclides present in the sample.**

3.1.4 Method A-4, Direct Alpha Counting (Gross alpha determination)

Principle: The sample, collected on a suitable filter, is counted with an alpha counter. The sample must be thin enough so that self-absorption is not significant and the filter must be of such a nature that the particles are retained on the surface.

Applicability: Gross alpha determination may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, or the identity and isotopic ratio of the radionuclides in the sample are well known, and (2) measurements using either Method A-1, A-2 or A-5 have shown that this method provides a reasonably accurate measurement of the emission rate. Gross alpha measurements are applicable to unidentified mixtures of radionuclides only for the purposes and under the conditions described in section 3.7. APHA-601(3), ASTM--D-1943(10).

Response: **The filter samples are counted in a low background thin-window gas-flow proportional counter with a guard detector operated in coincidence mode, which uses pulse height discriminator to separate alpha and beta activity. WSCF method follows the procedure LA-508-415, which meets all of the requirements stated in the EPA-suggested method.**

3.1.5 Method A-5, Chemical Determination of Uranium

Uranium: Uranium may be measured chemically by either colorimetry or fluorometry. In both procedures, the sample is dissolved, the uranium is oxidized to the hexavalent form and extracted into a suitable solvent. Impurities are removed from the solvent layer. For colorimetry, dibenzoylmethane is added, and the uranium is measured by the absorbency in a colorimeter. For fluorometry, a portion of the solution is fused with a sodium fluoride-lithium fluoride flux and the uranium is determined by the ultraviolet activated fluorescence of the fused disk in a fluorometer.

Applicability: This method is applicable to the measurements of emission rates of uranium when the isotopic ratio of the uranium radionuclides is well known. ASTM-E318(15), ASTM-D-2907(14).

Response: **Chemical determination of total U is not performed at WSCF. If the determinations of naturally occurring isotopic uranium activities (U-234, 235 and 238) are required, the filter sample undergoes dissolution (LA-549-412), followed by column separation (LA-923-401), and the mount gets counted by AEA (LA-508-462).**

3.1.6 Method A-6, Radon-222-Continuous Gas Monitor

Principle: Radon-222 is measured directly in a continuously extracted sample stream by passing the air stream through a calibrated scintillation cell. Prior to the scintillation cell, the air stream is treated to remove particulates and excess moisture. The alpha particles from radon-222 and its decay products strike a zinc sulfide coating on the inside of the scintillation cell producing light pulses. The light pulses are detected by a photomultiplier tube which generates electrical pulses. These pulses are processed by the system electronics and the read out is in pCi/l of radon-222.

Applicability: This method is applicable to the measurement of radon-222 in effluent streams which do not contain significant quantities of radon-220. Users of this method should calibrate the monitor in a radon calibration chamber at least twice per year. The background of the monitor should also be checked periodically by operating the instrument in a low radon environment. EPA 520/1-89-009(24).

Response: **Not applicable at WSCF.**

3.1.7 Method A-7, Radon-222-Alpha Track Detectors

Principle: Radon-222 is measured directly in the effluent stream using alpha track detectors (ATD). The alpha particles emitted by radon-222 and its decay products strike a small plastic strip and produce submicron damage tracks. The plastic strip is placed in a caustic solution that accentuates the damage tracks which are counted using a microscope or automatic counting system. The number of tracks per unit area is corrected to the radon concentration in air using a conversion factor derived from data generated in a radon calibration facility.

Applicability: Prior approval from EPA is required for use of this method. This method is only applicable to effluent streams which do not contain significant quantities of radon-220, unless special detectors are used to discriminate against radon 220. This method may be used only when ATDs have been demonstrated to produce data comparable to data obtained with Method A-6. Such data should be submitted to EPA when requesting approval for the use of this method. EPA 520/1-89-009(24).

Response: **Not applicable; direct monitoring of ^{222}Rn is not performed at WSCF.**

3.2 Methods for Gaseous Beta Emitting Radionuclides

3.2.1 Method B-1, Direct Counting in Flow-Through Ionization Chambers

Principle: An ionization chamber containing a specific volume of gas which flows at a given flow rate through the chamber is used. The sample (effluent stream sample) acts as the counting gas for the chamber. The activity of the radionuclide is determined from the current measured in the ionization chamber.

Applicability: This method is applicable for measuring the activity of a gaseous beta emitting radionuclide in an effluent stream that is suitable as a counting gas, when no other beta-emitting nuclides are present. DOE/EP-0096(17), NCRP-58(23).

Response: **Not applicable; not performed at WSCF.**

3.2.2 Method B-2, Direct Counting With In-line or Off-line Beta Detectors

Principle: The beta detector is placed directly in the effluent stream (in-line) or an extracted sample of the effluent stream is passed through a chamber containing a beta detector (off-line). The activities of the radionuclides present in the effluent stream are determined from the beta count rate, and a knowledge of the radionuclides present and the relationship of the gross beta count rate and the specific radionuclide concentration.

Applicability: This method is applicable only to radionuclides with maximum beta particle energies greater then 0.2 MeV. This method may be used to measure emissions of specific radionuclides only when it is known that the sample contains only a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. Specific radionuclide analysis of periodic grab samples may be used to identify the types and quantities of radionuclides present and to establish the relationship between specific radionuclide analyses and gross beta count rates.

This method is applicable to unidentified mixtures of gaseous radionuclides only for the purposes and under the conditions described in section 3.7.

Response: **Not applicable; not performed at WSCF.**

3.3 Methods for Non-Gaseous Beta Emitting Radionuclides

3.3.1 Method B-3, Radiochemistry-Beta Counting

Principle: The element of interest is separated from other elements, and from the sample matrix by radiochemistry. This may involve precipitation, distillation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet, and counted with a beta counter. Corrections for chemical yield and decay (if necessary) are made. The beta count rate determines the total activity of all radionuclides of the separated element. This method may also involve the radiochemical separation and counting of a daughter element, after a suitable period of ingrowth, in which case it is specific for the parent nuclide.

Applicability: This method is applicable for measuring the activity of any beta-emitting radionuclide, with a maximum energy greater than 0.2 MeV, provided no other radionuclide is present in the separated sample. APHA-608(5).

Response: **WSCF method for determining $^{90}Sr/^{90}Y$ in air filter samples is carried out using procedures LA-549-412 (dissolution of Versapor type filters) , LA-220-406 (chemical separation by Sr-spec resins), followed by procedure LA-508-415 (total beta counting). The laboratory method meets the requirements.**

3.3.2 Method B-4, Direct Beta Counting (Gross beta determination)

Principle: The sample, collected on a suitable filter, is counted with a beta counter. The sample must be thin enough so that self-absorption corrections can be made.

Applicability: Gross beta measurements are applicable only to radionuclides with maximum beta particle energies greater than 0.2 MeV. Gross beta measurements may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, and (2) measurements made using Method B-3 show reasonable agreement with the gross beta measurement. Gross beta measurements are applicable to mixtures of radionuclides only for the purposes and under the conditions described in section 3.7. APHA-602(4), ASTM-D-1890(11).

Response: **The filter samples are counted in a low background thin-window gas-flow proportional counter with a guard detector in coincidence mode, which uses pulse height discriminator to separate alpha & beta activity. For gross beta determination, procedure LA-508-415 is followed, which satisfies the method requirements.**

3.3.3 Method B-5, Liquid Scintillation Spectrometry

Principle: An aliquot of a collected sample or the result of some other chemical separation or processing technique is added to a liquid scintillation "cocktail" which is viewed by photomultiplier tubes in a liquid scintillation spectrometer. The spectrometer is adjusted to establish a channel or "window" for the pulse energy appropriate to the nuclide of interest. The activity of the nuclide of interest is measured by the counting rate in the appropriate energy channel. Corrections are made for chemical yield where separations are made.

Applicability: This method is applicable to any beta-emitting nuclide when no other radionuclide is present in the sample or the separated sample provided that it can be incorporated in the scintillation cocktail. This method is also applicable for samples which contain more than one radionuclide but only when the energies of the beta particles are sufficiently separated so that they can be resolved by the spectrometer. This method is most applicable to the measurement of low-energy beta emitters such as tritium and carbon-14. APHA.609(6), EML LV-539-17(19).

Response: **Not applicable. Record samples are not analyzed for ^{147}Pm or ^{3}H.**

3.4 Gamma Emitting Radionuclides

3.4.1 Method G-1. High Resolution Gamma Spectrometry

Principle: The sample is counted with a high resolution gamma detector, usually either a Ge(Li) or a high purity Ge detector, connected to a multi-channel analyzer or computer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclide. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separations may be made prior to counting but are usually not necessary.

Applicability: This method is applicable to the measurement of any gamma emitting radionuclide with gamma energies greater than 20 keV. It can be applied to complex mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gases. The method may also be applied to the analysis of gaseous gamma emitting radionuclides directly in an effluent stream by passing the stream through a chamber or cell containing the detector. ASTM-3649(9), IDO--12096(18).

Response: **An air filter or a composite of air filters collected biweekly during a quarter is counted on a high purity Ge (HPGe) detector connected to a computer-controlled multi-channel analyzer. Samples collected in silver zeolite cartridges (mounts prepared by LA-548-421) are counted on a n-type high purity Ge detector (very useful for low gamma & x-rays). WSCF method uses gamma ray spectroscopy with high resolution germanium detectors and follows procedure LA-508-462, which meets all the requirements in the EPA method.**

3.4.2 Method G-2, Low Resolution Gamma Spectrometry

Principle: The sample is counted with a low resolution gamma detector, a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube and connected to a multi-channel analyzer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclides. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separation may be used prior to counting to obtain less complex gamma spectra if needed.

Applicability: This method is applicable to the measurement of gamma emitting radionuclides with energies greater than 100 keV. It can be applied only to relatively simple mixtures of gamma emitting radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector. ASTM-D-2459(12), EMSL-LV-0539-17(19).

Response: **Not applicable because this method is not used in air filter analysis.**

3.4.3 Method G-3, Single Channel Gamma Spectrometry

Principle: The sample is counted with a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube connected to a single channel analyzer. The activity of a gamma emitting radionuclide is determined from the gamma counts in the energy range for which the counter is set.

Applicability: This method is applicable to the measurement of a single gamma emitting radionuclide. It is not applicable to mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector.

Response: **Not applicable because this technique is not used in air filter analysis.**

3.4.4 Method G-4, Gross Gamma Counting

Principle: The sample is counted with a gamma detector usually a thallium activated sodium iodine crystal. The detector is coupled to a photomultiplier tube and gamma rays above a specific threshold energy level are counted.

Applicability: Gross gamma measurements may be used to measure emissions of specific radionuclides only when it is known that the sample contains a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. When gross gamma measurements are used to determine emissions of specific radionuclides periodic measurements using Methods G-1 or G-2 should be made to demonstrate that the gross gamma measurements provide reliable emission data. This method may be applied to analysis of gaseous radionuclides directly in an effluent stream by placing the detector directly in or adjacent to the effluent stream or passing an extracted sample of the effluent stream through a chamber or cell containing the detector.

Response: **Not applicable.**

3.5 Counting Methods

All of the methods with the exception of Method A-5 involve counting the radiation emitted by the radionuclide. Counting methods applicable to the measurement of alpha, beta and gamma radiations are listed below. The equipment needed and the counting principles involved are described in detail in ASTM-3648(8).

3.5.1 Alpha Counting:

- ☐ Gas Flow Proportional Counters. The alpha particles cause ionization in the counting gas and the resulting electrical pulses are counted. These counters may be windowless or have very thin windows.
- ☐ Scintillation Counters. The alpha particles transfer energy to a scintillator resulting in a production of light photons which strike a photomultiplier tube converting the light photons to electrical pulses which are counted. The counters may involve the use of solid scintillation materials such as zinc sulfide or liquid scintillation solutions.
- ☐ Solid-State Counters. Semiconductor materials, such as silicon surface-barrier p-n junctions, act as solid ionization chambers. The alpha particles interact which the detector producing electron hole pairs. The charged pair is collected by an applied electrical field and the resulting electrical pulses are counted.
- ☐ Alpha Spectrometers. Semiconductor detectors used in conjunction with multi-channel analyzers for energy discrimination.

Response: **Thin-window-type gas flow proportional counters with automatic sample changers, and ion implanted solid state detectors connected to a multichannel analyzer (MCA) are used for alpha counting of air filters at WSCF. WSCF equipment meets the EPA specifications.**

3.5.2 Beta Counting:

- ☐ Ionization Chambers. These chambers contain the beta-emitting nuclide in gaseous form. The ionization current produced is measured.
- ☐ Geiger-Muller (GM) Counters-or Gas Flow Proportional Counters. The beta particles cause ionization in the counting gas and the resulting electrical pulses are counted. Proportional gas flow counters which are heavily shielded by lead or other metal, and provided with an anti-coincidence shield to reject cosmic rays, are called low background beta counters.
- ☐ Scintillation Counters. The beta particles transfer energy to a scintillator resulting in a production of light photons, which strike a photomultiplier tube converting the light photon to electrical pulses which are counted. This may involve the use of anthracite crystals, plastic scintillator, or liquid scintillation solutions with organic phosphors.
- ☐ Liquid Scintillation Spectrometers. Liquid scintillation counters which use two photomultiplier tubes in coincidence to reduce background counts. This counter may also electronically discriminate among pulses of a given range of energy.

Response: **Thin-window-type gas flow proportional counters with automatic sample changers and liquid scintillation spectrometers are used for beta counting. WSCF counting equipment meets the requirements.**

3.5.3 Gamma Counting:

- Low-Resolution Gamma Spectrometers. The gamma rays interact with thallium activated sodium iodide or cesium iodide crystal resulting in the release of light photons which strike a photomultiplier tube converting the light pulses to electrical pulses proportional to the energy of the gamma ray. Multi-channel analyzers are used to separate and store the pulses according to the energy absorbed in the crystal.

- High-Resolution gamma Spectrometers. Gamma rays interact with a lithium-drifted (Ge(Li)) or high-purity germanium (HPGe) semiconductor detectors resulting in a production of electron-hole pairs. An applied electrical field collects the charged pair. A very stable low noise preamplifier amplifies the pulses of electrical charge resulting from the gamma photon interactions. Multichannel analyzers or computers are used to separate and store the pulses according to the energy absorbed in the crystal.

- Single Channel Analyzers. Thallium activated sodium iodide crystals used with a single window analyzer. Pulses from the photomultiplier tubes are separated in a single predetermined energy range.

Response: **High-resolution gamma detectors (closed-end HPGe coaxial) connected to computer-controlled MCAs are used for air filter analysis. WSCF equipment exceeds the EPA requirements.**

3.5.4 Calibration of Counters

Counters are calibrated for specific radionuclide measurements using a standard of the radionuclide under either identical or very similar conditions as the sample to be counted. For gamma spectrometers a series of standards covering the energy range of interest may be used to construct a calibration curve relating gamma energy to counting efficiency.

In those cases where a standard is not available for a radionuclide, counters may be calibrated using a standard with energy characteristics as similar as possible to the radionuclide to be measured. For gross alpha and beta measurements of the unidentified mixtures of radionuclides, alpha counters are calibrated with a natural uranium standard and beta counters with a cesium-137 standard. The standard must contain the same weight and distribution of solids as the samples, and be mounted in an identical manner. If the samples contain variable amounts of solids, calibration curves relating weight of solids present to counting efficiency are prepared. Standards other than those prescribed may be used provided it can be shown that such standards are more applicable to the radionuclide mixture measured.

Response: **A mixed gamma standard (NIST traceable) emitting various gamma-rays ranging from 59 to 1850 keV is used, using vendor-supplied calibration software, for constructing efficiency versus energy calibration curves for different geometrical configurations used in gamma analysis. The calibration procedure for gamma ray spectrometer is documented in LQ-508-405. Calibration procedure meets the EPA criteria for gamma ray spectroscopic analysis.**

For calibration of beta detectors for $^{90}Sr/^{90}Y$ analysis, procedure LQ-508-002 is used in conjunction with LQ-508-005, which meets the requirements of the EPA-suggested method. A method standard also is used to check the performance and calibration of the detector.

For calibration of alpha/beta proportional counters, the procedure LQ-508-002 is carried out, which partially deviates from the EPA requirements. For gross alpha and gross beta measurements, WSCF instruments are calibrated separately with vendor supplied and certified filter standards made with NIST traceable alpha emitting ^{241}Am and beta emitting ^{137}Cs standards respectively, fabricated into the filter sample counting geometry. The efficiency based on ^{137}Cs is slightly higher than that based on ^{90}Sr/^{90}Y equilibrium mixture. The 5 percent would be considered a conservative estimate.

The gross alpha result, based on ^{241}Am efficiency, is essentially the same as that based on $^{239/240}$Pu efficiency because the alpha energies of both are high and very similar.

The reasons for choosing the ^{241}Am standard for alpha calibration are as follows:

- **^{241}Am is one of the alpha emitters that commonly is found in the main stack air samples.**
- **Alpha counting efficiency for ^{241}Am is usually the same for other alpha emitters that also are found in the air stack samples.**
- **The ^{241}Am standard also can be checked independently by gamma analysis.**

Because of technical difficulties, the calibration curves relating weight of solids present to counting efficiencies were not established in direct alpha/beta counting of air filter samples. However, the self-absorption factor (LA-508-432) is applied if gross alpha/beta analysis is performed on the acid leachate of the filter samples.

3.6 Radiochemical Methods for Selected Radionuclides

Methods for a selected list of radionuclides are listed in Table 1. The radionuclides listed are those which are most commonly used and which hove the greatest potential for causing doses to members of the public. For radionuclides not listed in Table 1, methods based on any of the applicable "principles of measurement" described in section 3.1 through 3.4 may be used.

Response: **The air samples from the main stacks are well characterized. Some of the radionuclides identified (^{241}Am, ^{238}Pu, ^{239,240}Pu, ^{90}Sr, and ^{137}Cs, are listed in Table 1 of Method 114 and are analyzed according to the approved methods given in the table. Other radionuclides (^{129}I, ^{106}Ru, ^{113}Sn, ^{125}Sb) not listed in the table are analyzed, depending on the type of radiation, by the methods outlined in Method 114.**

3.7 Applicability of Gross Alpha and Beta Measurements to Unidentified Mixtures of Radionuclides

Gross alpha and beta measurements may be used as a screening measurement as a part of an emission measurement program to identify the need to do specific radionuclide analyses or to confirm or verify that unexpected radionuclides are not being released in significant quantities.

Gross alpha (Method A-4) or gross beta (Methods B-2 or B-4) measurements may also be used for the purpose of comparing the measured concentrations in the effluent stream with the limiting "Concentration Levels for Environmental Compliance" in Table 2 of Appendix E. For unidentified mixtures, the measured concentration value shall be compared with the lowest environmental concentration limit for any radionuclide which is not known to be absent from the effluent stream.

Response: **This is not applicable because the air effluents from the main stacks are well characterized. However, gross alpha and beta analyses of air samples routinely are performed at WSCF before starting specific radionuclide analyses. Prompt and careful review of screening results would let facility personnel verify a significant release of a radionuclide into the air and quickly initiate corrective actions to minimize radionuclide emission into the environment. The gross alpha and beta results from analysis are compared for compliance to those listed in the appendix of DOE Order 5400.5.**

4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

Responsibilities for radioactive air emissions sampling activities are described in the main text of this document.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

Refer to Appendixes B, C, D, E, F, G, and H.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selections.

Refer to Appendixes B, C, D, E, F, G, and H.

4.3.2 A description of sampling probes and representativeness of the samples.

Refer to Appendixes B, C, D, E, F, G, and H.

4.3.3 A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

Refer to Appendixes B, C, D, E, F, G, and H.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

Refer to Appendixes B, C, D, E, F, G, and H.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured. including frequency of analysis calibration procedures and frequency of calibration.

Response:

- **Total alpha/total beta activity is determined by procedure LA-508-415 on weekly /biweekly samples, and occasionally on daily air samples, per collection point. The calibration procedure is documented in LQ-508-002. The counting system is recalibrated only in the case of (1) major repairs or adjustments to the power supply or detector or (2) major calibration shift as indicated by the instrument control standards. The performance of the counting systems is checked by running the instrument control standards (^{147}Pm for low-energy beta, ^{60}Co for mid-energy beta, ^{137}Cs for high-energy beta, and ^{241}Am for alpha activity) separately. When a batch of air filter samples is run, all the performance standards (for counting frequency refer to LO-150-415) are also run with it. To verify that the counting system is working properly, the standard values from analysis should fall within the administrative limits set according to the appropriate QAPjP or statement of work.**

- **WSCF method for analysis of alpha emitters (^{241}Am, ^{238}Pu, and ^{239,240}Pu) involves various steps (LA-549-412 for dissolution, LA-943-424 for chemical separation, and LA-508-462 for final alpha spectrometry). The analysis of specific alpha emitters is done only on quarterly composites of weekly/biweekly air filters. The energy calibration and resolution of the AEA system over the energy range of 4 to 6 MeV are checked daily (procedure LA-508-471). Efficiency calibration of the AEA is performed by the procedure LA-508-404. The chemical yield that is used to correct the analyte activity is determined by using radioactive tracers (^{243}Am and ^{242} Pu or ^{236}Pu). Also direct comparison of the sample response with the tracer response (^{243}Am and ^{236}Pu or Pu-242) can be made to determine the activities of the radionuclides ^{241} Am and $^{238,239/240}$Pu present in the sample. For routine operation, AEA system performance is checked once every week for alpha efficiency calibration with a certified mixed alpha**

source standard. Each alpha energy peak identified in the standard must fall within administratively assigned certain channels ($\pm$20) or energy window of 100 keV on the MCA. For counting frequency of performance check standards, procedure LO-150-415 is followed. The recovery of the radionuclides and the calibration of the system are checked on a batch basis by running a method standard under the identical conditions as the sample.

- **The lab method for determining ^{90}Sr/^{90}Y beta activity consists of a dissolution step (LA-549-412), chemical separation (LA-220-406), and followed by total beta counting (LA-508-415). Analysis is done only on quarterly composites of weekly/biweekly air filters per collection point. The calibration procedure LQ-508-002 (for window-type gas flow proportional counter) is used in conjunction with LQ-508-005 (for mother/daughter case, i.e., ^{90}Sr/^{90}Y in-growth calibration). Recalibration of the system is performed only when the responsible scientist finds it necessary. The performance of the beta counting system is checked by running instrument control standards (^{60}Co, ^{137}Cs, and ^{147}Pm for beta activity) with each batch of samples. The complete procedure for the ^{90}Sr/^{90}Y analysis in the sample is carried out with a method standard (several filter papers spiked with ^{90}Sr, ^{241}Am, ^{239}Pu) on a batch basis. This checks the overall method performance. The chemical yield is determined by using the appropriate radioactive tracers (^{85}Sr) or stable Sr carrier.**

- **For analysis of gamma emitters ^{134}Cs, ^{137}Cs, ^{113}Sn, ^{106}Ru, ^{60}Co, Eu-154 and any other positive gamma peak except radon and thoron daughters, the procedure LA-508-462 is followed. Analysis is done on quarterly composites of weekly/biweekly air filter samples. For analysis of volatile radionuclides (^{129}I, ^{106}Ru, ^{113}Sn, ^{125}Sb) collected monthly on silver zeolite cartridge, the procedure LA-548-421 is used in conjunction with procedure LA-508-~~462~~. Calibration of the gamma ray spectrometer is done with the procedure documented in LQ-508-405 using a (NIST traceable) certified mixed gamma ray standard. Recalibration is carried out only when it is deemed necessary by a responsible scientist. The performance of each detector of the GEA system over the specified energy range is checked for energy and efficiency calibration once a day by running a mixed gamma check standard consisting of ^{241}Am for low energy, ^{137}Cs for mid energy, and ^{60}Co for high energy. The results of each of these radionuclides should fall within the administratively limits set according to the lab QA plan or appropriate statement of work. The daily performance results of the detectors are documented. Minor adjustments of the electronics (i.e., fine gain, pole zero of the amplifiers, lower level discriminator of analog-to-digital converter, etc.) are done from time to time when necessary for correcting small energy calibration shift. Whenever a minor electronic adjustment is done on a detector, it is followed by analysis of a performance check standard. For a major shift**

in the calibration, the system is then thoroughly calibrated for both energy and efficiency using LQ-508-405.

- **The content of the WSCF procedures, test plans, supporting documents, and drawings provide a sufficient level of detail to allow trained personnel to produce quality results safely. Laboratory procedures are controlled as required. The specific content of laboratory procedures is defined by its author, based on accepted methods such as 40 CFR 61, Appendix B, Method 114. The content must be agreed to by the peer and technical reviewers. While authors are responsible for the specific content of their procedures, authors address the following.**

<u>Summary</u> - MANDATORY - A short description or abstract of the procedure containing enough information to distinguish it from other procedures.

<u>Applications</u> - MANDATORY - Defines the scope and purpose of the specific procedure. This section may be combined with the following element under the title "Applications and Limitations."

<u>Limitations</u> - MANDATORY - Briefly describes those areas in which the procedure is not applicable. A statement of accuracy and precision will be given where appropriate.

<u>Quality Control Protocol</u> - Procedures used to support environmental projects that have specific quality control requirements. For these procedures, the source of the quality control requirements will be identified. The samples or project that this element applies to will be identified. The following information is typical of quality control requirements: frequency and type of calibration, reagent blank analysis, spike sample analysis, and duplicate sample analysis.

<u>Approval Designator</u> - MANDATORY - An approval designator will be identified for each procedure with a brief basis of determination statement.

The procedures are usually specific to one activity. These activities are well defined using common scientific instrumentation and equipment operated in an acceptable manner. The chemicals and materials used are normally small quantities with limited potential for environmental or personnel safety impact. In general, the equipment used in the laboratory is not classified as Safety Class 3 or higher.

<u>Safety</u> - MANDATORY - The procedure must identify applicable safety hazards.

- **HSRCM-1, *Hanford Site Radiological Control Manual***

Supporting document SD-CP-LB-003, *Safety in the Analytical Laboratory*, is the laboratory general safety document. The authors must review safety requirements and include safety warnings appropriate to the actions directed by the procedure.

Reagents - If the procedure requires analytical reagents, a list of reagents will be provided. The material safety data sheet (MSDS) number will be placed in brackets by each chemical name. Reagent makeup, storage container requirements, unique storage needs, shelf-life requirements, special labeling, and special preparation steps will be included. Reagent preparation described fully in other current documentation could be included by reference.

Equipment - Special equipment needs will be listed. Standard hood or glovebox equipment is assumed to be available at the work station and does not need to be listed. The fabrication of off-standard equipment will be referenced or described in this section.

Procedure Steps - MANDATORY - A step-by-step description of operations necessary to perform the task will be presented in a logical and sequentially numbered order or an assignment of responsibilities. CAUTIONS and WARNINGS notations will be included for the applicable safety hazard before the action is described. Steps with potential for criticality specification violation will be identified. Explanatory "Notes" may be included for clarification of process.

Calculations - Calculations required to complete the work will be described in this section. Examples with sample values may be included. All combined factors will be fully described and units noted.

Calibrations - When calibrations are required, a description of how to carry out required calibrations will be given.

Discussion - A discussion of the theoretical aspects of the procedure. Brief identification of unique characteristics and interfaces to aid in troubleshooting may be included.

References - A reference list of published information to provide a technical basis for the procedure may be included.

The mandatory topics are addressed in both procedures. However, the laboratories have technical, analytical, and administrative procedures. Non-mandatory topics are included if appropriate to the activity covered by the procedure.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

Refer to Appendixes B, C, D, E, F, G, and H.

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

Refer to Appendixes B, C, D, E, F, G, and H.

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

The objectives of the quality assurance program is documented (HNF-SD-CP-QAPP-017).

Precision is a measure of the agreement among individual measurements of the same parameter under similar conditions, and is estimated by means of duplicate/replicate analyses. Analytical method precision is estimated using laboratory control standards (method) over time and does not reflect the measure of precision in sample matrices.

Precision can be determined by the relative standard deviation or relative percent difference. The relative standard deviation (RSD) is used when at least three replicate measurements are performed on a given technique. The RSD is computed using the following equation:

RSD = 100*s/x where s is standard deviation with n-1 degrees of freedom, n total number of observed values, and x mean of observed values.

The relative percent difference (RPD) is used when two measurements exist. The RPD is computed using the following equation:

RPD = (x1 - x2)*100/x where x1, x2 are observed values and x mean of observed values.

Accuracy is defined as the closeness of agreement between an observed value and an accepted reference value. The accuracy of analytical methods is determined using percent recovery. As a basic QC protocol, the evaluation of blind, laboratory control (method standards) appropriate performance evaluation samples (DOE's Environmental Monitoring Laboratory [EML] or EPA's Environmental Monitoring Support Laboratory [EMSL]) may be used to provide the percent recovery (P). However, this can be superseded by the customer's requirements as stated in a statement of work.

P = 100 * R/K where R is the measured activity of the standard and K is the known value of the standard.

Completeness is a measure of the amount of usable/valid data obtained from a measurement system compared to the amount of data that was expected to be obtained under correct normal conditions. The objectives for completeness of analyses is 90 percent. The laboratory evaluates actual performance against the 90 percent objective. If the laboratory performance drops below this limit, management initiates corrective action. This action shall identify and correct those activities within the laboratory that have caused the drop in performance.

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

Quality performance within each analytical measurement system (AMS) is maintained by the ability to detect when an AMS is not performing to specifications and to document the deviation as well as the corrective action. The following QC options are used to evaluate the listed components that will affect the quality of the AMS. Where possible, the QC options presented will be used. Each analytical batch will have at least a blank, laboratory control standard (method), and samples.

Option	Component
Laboratory control sample or QC standard (method standard)	Accuracy, and gross operation of instrument, reagents, dilution, and technique
Replicate analysis (for composite only) *	Precision
Tracer	Matrix interference and chemical yield
Preparation blank	Contamination
Instrument control standards	Instrument stability

***[Each sample collection point produces only one filter sample that is sent to the laboratory for analysis. No replicate samples are available. Repeat counting of the sample mounts, if needed, can be performed using other detectors at the discretion of the scientist in charge.]**

Radioanalyte matrix spikes are not used. However, tracer Isotopes ^{243}Am, ^{242}Pu (or Pu-236) and ^{85}Sr are used in the analysis of ^{241}Am, ^{238}Pu, ^{239,240}Pu, and ^{90}Sr respectively in the quarterly composites of weekly/biweekly filter samples to determine matrix interference and the yield.

The laboratory does not split samples. There is no guarantee that the distribution of material on the filter will be homogeneous. Because of this, no sampling procedure, such as splitting, can be assured of producing two representative portions. Also, splitting the sample in effect dilutes the sample, which would adversely effect the method detection limits.

Blank filters from the same manufacturer and type are used in analysis of a batch of air filter composite samples. Blank filter holders (planchets) are used to check of the background of the counting instrument.

The parameters used in QC program to monitor and evaluate AMS performance on standards are warning and control limits. These usually are obtained by the statistical evaluation of the laboratory control standard data over time and set to two sigma (warning) and three sigma (control limit). However, the customer and the chemist may require setting the limit for accepting the accuracy or the recovery of a laboratory standard, such as □ 25 percent at the 95 percent confidence interval as stated in the statement of work (HNF-EP-0835-3).

The counting room instruments software can generate instrument control charts based on instrument control standard, background, efficiency data, etc. The method control chart can be generated from the Multi-LIMS. These charts are updated and evaluated on a regular basis.

The WSCF Radiochemistry Laboratory Quality Control Program also includes participation in the following performance evaluation programs:

- **USEPA National Exposure Research Laboratory, Characterization Research Division, Las Vegas**
- **DOE Environmental Measurements Laboratory, Quality Assessment Program, New York**

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

These samples come from fixed sample points and are analyzed according to an established statement of work that is reviewed and revised annually.

Where the barcoding of samples is performed, traceability begins with the ABCASH database issuance of a unique sample identifier (Sxxxxxx) for the customer. With this number, the database references the sample point, date and time the sample was in service, the date and time the sample was removed, and the total flow. ABCASH also generates chain-of-custody paperwork from the moment of sampling, to transportation, and receipt at the laboratory.

When the samples are brought to the laboratory, the sample custodian or chemical technician uses ABCASH to generate a laboratory receipt chain-of-custody by scanning the sample barcodes. The samples are entered into the laboratory database (Multi-LIMS/MLIMS) where another unique identifier is issued (WYYFxxxxxxx). For each sample covered by the statement of work, the MLIMS has the associated required analysis protocols and analytes. The database generates a worklist that lists each sample by both laboratory and customer ID, and the required analyses. The results of the initial analyses are transferred electronically from the instrument to the MLIMS database. After validation, the results are uploaded electronically to ABCASH. The samples are archived for quarterly compositing and eventual nondestructive and subsequent destructive analyses. The results of these analyses are input to MLIMS and again, after validation, the results are sent electronically to the customer's (ERS) database via ABCASH.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Personnel within the laboratory and data quality perform internal audits on laboratory analytical activities. These internal audits do not supplant the activities of the organizations directed by policy to perform company-wide audits and surveillances, nor does the laboratory QAPP cover them.

4.8 A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken and who is responsible for taking the corrective action.

The laboratories follow the corrective action system defined in the Quality Assurance Plan for the Waste Sampling and Characterization Facility, HNF-SD-CP-QAPP-0017.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits and description of corrective actions.

Refer to Section 4.0 of the main body of this report.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

Refer to main text.

APPENDIX B

METHOD 114 COMPARISON FOR STACK 291-A-1

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APPENDIX B

METHOD 114 COMPARISON FOR STACK 291-A-1

1.0 Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling; and (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors, including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the combination of monitoring and sample collection and analysis methods most applicable to the effluent stream to be measured.

2.0 Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable adsorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see 61.18).

The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-μm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 μm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).

[1]Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

2.2.1 The Radionuclide Tritium (H-3)

Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B-1, collected as a gas sample or may be oxidized using a metal catalyst to tritiated water and collected as described above.

No irradiated fuel has been introduced into the Plutonium-Uranium Extraction (PUREX) Plant for several years. No dissolutions have been performed since late 1989. Gaseous sampling systems have shown that the levels of ^{3}H and ^{14}C have fallen to levels at or below the analytical detection limits, which were well below environmental release and monitoring limits. Consequently, sampling for these nuclides is no longer required or performed.

2.2.2 Radionuclides of iodine

Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite and caustic solutions.

No irradiated fuel has been introduced into the PUREX Plant for several years. No dissolutions have been performed since late 1989. Furthermore, concentrations of radioiodine in any fuel available for processing have decayed to such a low level that there is no longer a need to monitor for iodine. Nevertheless, sampling for iodine continues. Because it is low level, this sampling may be discontinued at any time.

After flowing through the particulate filter media, the gas sample flows through a silver zeolite cartridge to capture iodine.

2.2.3 Radionuclides of Argon, Krypton and Xenon

Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low temperature sorption techniques, Appropriate adsorbers may include charcoal or metal zeolite.

No irradiated fuel has been introduced into the PUREX Plant for several years. No dissolutions have been performed since late 1989. Sampling for these nuclides is no longer required or performed. The release of other radioactive gases decreased even more rapidly than for these nuclides. Consequently, there is no need for gaseous nuclide sampling.

2.2.4 Radionuclides of Oxygen, Carbon, Nitrogen and Radon

Radionuclides of these elements are measured directly using an in-line or off-line monitor. Radionuclides of carbon in the form of carbon dioxide may be collected by dissolution in caustic solutions.

There is no longer need for gaseous radionuclide sampling (refer to Sections 2.2.1 through 2.2.3.

4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 Documentation identifying the organizational structure, functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program.

Refer to the main text for the organizational responsibilities.

4.2 Prescribed administrative controls to ensure prompt response in the event that emission levels increase due to unplanned operations.

The WDOH has issued new notification requirements. DOE-RL has requested and directed each contractor develop and implement reinforced policies regarding the required notifications to ensure compliance with these new regulatory requirements (reference Ltr 9752151 A from J. E. Rasmussen, RL, to H. J. Hatch, Fluor, Re: DE-AC06-96RL13200 - Notification Response, dated March 7, 1997. Notification procedures are provided in HNF-PRO-060, "*Reporting Occurrences...*"

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selection.

The 291-A-1 stack is 2.1 m (7 ft) in diameter. The record sampling site is located at a height of 18.3 m (60 ft) above grade. There are a total of two sampling sites and three sampling probes in current use.

The elevations of the sample ports are 18.3 and 22.6 m (60 and 74 ft) above grade, which is the location of the last major flow disturbance in the stack. The sample ports are, therefore, approximately 8.6 and 10.6 diameters downstream of the last major disturbance.

The stack is 61 m (200 ft) from grade, or 28.6 diameters. The sample ports are, therefore, approximately 20 and 18 diameters upstream of the next major flow disturbance.

The sites were chosen to provide representative sampling of the effluent and to comply with ANSI N13.1-1969. These sites also meet the criteria of Title 40, CFR 60, Appendix A, Method one.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sampling probe for the record sampler is mounted in the horizontal plane at the 18.3-m (60-ft) level. The sampling probes for the backup record sampler and the silver zeolite cartridge are located at 22.6 m (74 ft).

The sampling probe consists of "rakes" that is, multi-port probes. The rakes are paired, i.e., there are two rakes at each sample location. With the exception of the particulate record sample, each rake has six inlet ports. At the inlet, each port is tapered to a knife edge with a 15-degree angle. At the 22.6-m (74-ft) level, the backup record sample has six nozzles consisting of 0.64-cm (0.25-in.) outside diameter (OD) and 0.124-cm (0.049-in.)-wall 316 stainless steel tubing.

The six-point sample rakes collect samples from the approximate centers of equal-area annuli in the stack, alternating between the near and far sides of the annuli. For an annulus, the "center" is halfway between the inner and outer radii of an annulus.

The rake that currently collects the particulate record sample has 16 inlets, consisting of 304 stainless steel tubing at the 18.3-m (60-ft) level. At the inlet, each port is tapered to a knife edge with a 15-degree angle. The inlet ports have a 5.1-cm (2.0-in.) vertical section followed by a 5.1-cm (2.0-in.) radius bend leading into the rake at a 45-degree angle. The outer two ports are made of 0.95-cm (0.375-in.) OD, 0.165-cm (0.065-in.)-wall tube. The next six ports are made of 0.64-cm (0.25-in.) OD, 0.071-cm (0.028-in.)-wall tube. The inner eight ports are made of 0.64-cm (0.25-in.) OD, 0.089-cm (0.035 in.)-wall tube. The inlet ports are arranged symmetrically and approximately centered over equal-area semi-annuli.

The use of an isokinetic 16-point probe located more than 8 duct diameters downstream of the last major flow disturbance ensures compliant sampling.

4.3.3 A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

The sample is removed continuously from the effluent stream via the rake described in Section 4.3.2 of this appendix. The sample flows through the sample line and the particulates are collected on a sample filter. The sample filters are replaced monthly, and sometimes more often. The filter media is composited for quarterly analysis of specific radionuclide concentrations.

The filtered gas at the 22.6-m (74-ft level) flows through one silver zeolite cartridge to capture iodine and other volatile elements. Section 4.3.6 of this appendix describes the calibration of the sample flow rate measurement equipment.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

For a description of the laboratory analysis procedures for these analytes refer to Appendix A.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

The sample collection and monitoring system consists of a record sampler at the 18.3-m (60-ft) level, and a backup record sample and one silver zeolite cartridge at the 22.6-m (74-ft) level. The record sampler and silver zeolite cartridge are considered the regulatory portion of the system for reporting the amount and concentration of radionuclides released to the environment.

The sample from the probe [18.3-m (60-ft)] is split once and routed to another splitter. This second splitter splits the flow again to the record sampler. After exiting the record sampler, the air flows through a flow measurement and control system. Currently, a Kurz Model 5052 system measures the sample flow rate, a Kurz model 101-RM[2] totalizes the sample flow, and a Kurz 710RMD[2] (4200) adjusts a control valve to maintain a constant flow. The instruments are calibrated at least once per year. Currently the calibration procedure is PM 575.

After exiting the flow control valve, the air flows through a rotameter that provides backup indication. Yearly calibration is accomplished by comparison with a standard rotameter, using procedure PM 573.

4.3.7 A description of effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

A six-point Kurz probe continuously measures the flow through the stack at the 22.6-m (74-ft) level. The backup record sampler is also installed in this assembly. A Kurz Model 195B[3] transmitter sends the signal to a Kurz Model 142-RMD[3] and a Kurz Model 132[3], which then drives a recorder, which continuously records the flow rate. The total flow is recorded on a digital integrator, or can alternately be summed from the recorder trace. The six flow elements on the six-point probe are pre-calibrated by the manufacturer. The remaining instruments are calibrated once per year. Currently the calibration procedure is PM 575.

[2]Trademark of Kurz Instruments, Inc., Monterey, California.
[3]Trademark of Kurz Instruments, Inc., Monterey, California.

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data including a description of the procedures used to assess these parameters.

Refer to Appendix A. Also refer to text of this document.

4.5 The quality control program shall evaluate and track the quality of the emission measurement data against preset criteria. The program should include, where applicable, a system of replicates; spiked samples; split samples; blanks; and control charts. The number and frequency of such quality control checks shall be identified.

Refer to Appendix A.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sampling collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain integrity of the samples during collection, storage, and analysis.

Refer to Section 5 and Appendix A of this document.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Refer to Section 4.0 of this document.

4.8 A corrective action program shall be established including criteria for when corrective actions will be taken and who is responsible for taking the corrective action.

Refer to Section 4.0 of this document.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emission measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

Refer to Section 4.0 of this document.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

Refer to main text, plus the attached point-by-point comparisons to NESHAP QA criteria, which fulfills the QAPjP requirements for regulated stacks. Separate facility QAPjPs are not required.

APPENDIX C

METHOD 114 COMPARISON FOR STACK 296-B-10

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APPENDIX C

METHOD 114 COMPARISON FOR STACK 296-B-10

This section provides a line-by-line evaluation of quality assurance method requirements outlined in Title 40, CFR 61, Appendix B, Method 114, Section 4.0 (EPA 1991b) as they apply to the 296-B-10 stack at Waste Encapsulation Storage Facility, Hanford Site.

METHOD 114-TEST METHODS FOR MEASURING
RADIONUCLIDE EMISSIONS FROM STATIONARY SOURCES

1.0 Purpose and Background

This method provides the requirements for: (1) stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling; and (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

No response is required.

2.0 Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable sorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference, see section 61.18).

The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-μm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters

[1]Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 μm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).

2.2 Radionuclides as Gases.

The 296-B-10 Stack does not exhaust radionuclide gases; therefore, this section is not applicable to this stack.

2.3 Definition of Terms

No response is required.

3.0 Radionuclide Analysis Methods

The analysis methods have been evaluated by WSCF cognizant personnel and are included as Appendix A.

4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

For the organizational responsibilities, refer to main text.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

WDOH has issued new notification requirements. DOE-RL has requested and directed each contractor develop and implement reinforced policies regarding the required notifications to assure compliance with these new regulatory requirements (DOE-RL 1997). Notification procedures are provided in HNF-PRO-060.

If an increase in emission levels occurs the following documents will be used as appropriate.

DOE Order-0223, "Department of Energy Implementing Procedure"
HNF-IP-0236-BPC, "Emergency Plan for the B Plant Complex"
HNF-IP-0718, "Health Physics Technical Practices and Procedures"
E0-001-009 Emergency Response to 296-B-10 Stack Alarm.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selections.

The 296-B-10 Stack has an inside diameter (ID) of 1.1 meters (42 inches) and the probe location, approximately 17.4 meters (57 ft) from the base. There are five nozzles supplying the record sampler. ANSI N13.1, Section A3.2, recommends a minimum of five nozzles on a stack the diameter of the 296-B-10 Stack.

The procedure in Title 40, CFR 61, Appendix A, Method 1 requires sampling to be performed at least eight stack diameters downstream and two diameters upstream of any flow disturbances. Eight stack diameters correspond to 8.5 m (28 ft) and two stack diameters correspond to 2.1 meters (7 ft). As shown in the drawings, the 296-B-10 Stack complies with this procedure.

4.3.2 A description of sampling probes and representativeness of the samples.

The sampling probe consists of five nozzles, as shown on Drawing H-2-91142. The five nozzle inlets are 0.38 inches in diameter. The stack flow is fully turbulent (Reynolds number approximately 7.4 x 10^5) and, as stated in Section A.3.3.2 of ANSI N13.1-1969, "... as the flow becomes more turbulent, the velocity becomes more nearly uniform across the duct."

4.3.3 A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

Particulate radionuclides are collected with the record sampler, which uses 47-mm-diameter filter paper. This filter is a membrane filter which collects 0.3-µm particles with a collection efficiency of 95.8 percent. Record samplers are removed biweekly and the sampler runs continuously to ensure a representative sample.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis calibration procedures and frequency of calibration.

The analytes of interest for the 296-B-10 Stack can be found in *HNF-EP-0835-3*. For a description of the laboratory analysis procedures for these analytes, refer to Appendix A.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

Two vacuum pumps draw air through the sample transport lines at 4 cfm while the record sampler operations at 2.0 ft^3/min. The sample transport line drops almost with a 90 degree bend from the 57 foot level on the stack to the sample cabinet located at the base of the stack. The sample transport line is heat traced and insulated to inhibit condensation. The sample transport lines were installed with a minimum number of bends.

The sample passes through a 47-mm diameter filter paper in the record sampler. The filter paper is changed out biweekly and evaluated for gross alpha and gross beta activity. The samples are composited on a quarterly basis to provide isotopic radionuclide concentrations. The record sampler results provide the basis for reporting the amount and concentrations of radionuclides released to the environment. These reports are forwarded to all appropriate organizations and agencies. Downstream of the filter, the sampled air passes through a flow meter, a flow totalizer, a flow regulator, and a vacuum pump. In the event of a low flow in the record sampler line, a local alarm and a remote alarm are activated

Calibration and inspection of the system are accomplished at the following intervals:

Procedure	Frequency
WESF RadCon Task W-023	Biweekly
5-BC-035	6 Months
5-BM-054	6 Month
5-BC-093	6 Months
5-BC-077	6 Months
5-BC-067	Annual
5-BC-096	Annual
5-BC-106	Monthly
2C23049	Quarterly

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

The flow rate is measured annually (Procedure 7-GN-56).

Documentation: 7-GN-56

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

Refer to Appendix A. Also refer to HNF-EP-0528 for the QA requirements for compiling and reporting radioactive air emissions.

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

Refer to Appendix A of this document.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

Samples at WESF are tracked from collection to analysis in accordance with HNF-PRO-2364.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Refer to Section 4.0 of the main text.

4.8 A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken and who is responsible for taking the corrective action.

Refer to Section 4.0 of the main text.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits and description of corrective actions.

Refer to Section 4.0 of the main text.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

Refer to the main text, plus the attached point-by-point comparisons to NESHAP QA criteria, which fulfills the QAPjP requirements for regulated stacks. Separate facility QAPjPs are not required.

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APPENDIX D

METHOD 114 COMPARISON FOR STACK 291-Z-1

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APPENDIX D

METHOD 114 COMPARISON FOR STACK 291-Z-1

This section provides a line-by-line evaluation of quality assurance method requirements outlined in Title 40, CFR 61, Appendix B, Method 114, as they apply to the 291-Z-1 stack at the Plutonium Finishing Plant (PFP), Hanford Site.

METHOD 114-TEST METHODS FOR MEASURING RADIONUCLIDE EMISSIONS FROM STATIONARY SOURCES

1.0 Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

No response is required.

2.0 Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable sorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see □ 61.18).

The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-µm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters

[1]Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 μm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).

2.2 Radionuclides as Gases.

The 291-Z-1 stack does not exhaust radionuclide gases; therefore, this section is not applicable to this stack.

2.3 Definition of Terms

No response is required.

3.0 Radionuclide Analysis Methods

The analysis methods have been evaluated by the WSCF cognizant personnel and are included as Appendix A.

4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

For the organizational responsibilities, refer to the main body of this QAPjP.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

DOE/RL-94-02, *Hanford Emergency Response Plan* contains an emergency response plan to protect onsite personnel, public health and safety, and the environment in the event of operation, natural phenomena, and/or safeguards and security events at Hanford Site facilities. The requirements stated in the plan are implemented through subtier plans and implementing procedures.

Health physics personnel, in many situations, are the first to respond to a radiological emergency. The ability to assess and evaluate the situation and take immediate steps to minimize the effects of the event is crucial for controlling the emergency. These personnel use their training and procedures to make decisions during the initial response to an emergency.

An emergency response may be initiated by: (1) personnel observing the event; (2) alarms; (3) the Patrol Operation Center; or (4) the Emergency Control Center(s). The type of emergency determines the level of planning for response. For a planned response, health physics personnel shall be in teams of at least two. Out of necessity (e.g., backshift response), one member could be an Operations person or other emergency service person, such as a firefighter or patrol. If a rapid response is required, no undue risks should be taken nor should personnel safety be compromised. When an emergency causes a facility evacuation, preplanning (e.g., stay time, entry route) and approval of the Building or Facility Emergency Director is necessary to re-enter.

Although health physics personnel respond to an emergency using basic guidelines, an area or facility may have specific procedures that have priority over these guidelines.

HNF-IP-0718, Section 3.3.2, Rev. 2, "Gaseous Effluent Monitoring System Inspection and Sample Exchange". This procedure provides the steps needed to perform inspections of the Gaseous Effluent Monitoring Systems (Stack Packs) and the exchange sequence for effluent air samples.

ZH-100-101, "PFP Shiftly Gaseous Effluent Sampling and Monitoring System Operability Inspection." This procedure establishes the method of inspection, evaluation, and discrepancy reporting of the operational status of Gaseous Effluent Monitoring Systems (Stack Packs), in use at PFP.

ZH-100-102, "PFP Biweekly Gaseous Effluent Sampling and Monitoring System Inspection and Sample Exchange." This procedure provides health physics personnel with instruction necessary to perform routine weekly sample collection and sampler inspection for all PFP Stack Monitors.

ZH-100-107, "RCT Response to Room 714 Annunciator Panel Stack CAM High Radiation Alarms". This procedure provides the health physics staff at PFP the information necessary to respond to a stack effluent high radiation alarm.

ZH-100-108, "RCT Response to Room 714 Annunciator Panel Stack CAM Fail, Low Flow, Loss of Vacuum Alarms". This procedure provides the health physics staff at PFP the information necessary to respond to stack CAM Fail and loss of flow/vacuum alarms.

HNF-IP-0263-PFP, Section 6.0, Rev. 2, "Emergency Response Plans." This procedure establishes guidelines for actions to be taken if the PFP discharges highly radioactive gaseous material.

Notifications and reporting of specific events related to environmental releases and/or events involving effluents and/or hazardous materials are reported via instruction given in HNF-PRO-2364, and HNF-IP-0263-PFP, Building Emergency Plan for Plutonium Finishing Plant Complex, Emergency Response Plans, Section 6.6, "Radioactive Materials Response Plan." The purpose of these manuals and sections

is to establish and implement specific criteria and requirements for the identification, categorization, notification, and reporting of occurrences at the PFP, as required by HNF-PRO-060, "Reporting Occurrences and Processing Operations Information."

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selections.

A continuous effluent sample is extracted from the 291-Z-1 stack by a single probe located at the 15-m (50-ft) level of the stack. The stack diameter at this location is 4.8 m (15.75 ft). The nearest flow disturbances are at the inlet and outlet of the stack, approximately three stack diameters downstream and nine stack diameters upstream from the sampling location. The 15 m (50 ft) sampling location was selected after extensive studies were performed. The presence of an existing penetration in the stack at this level was an important factor in sample site location as this supplied PNNL an access point through which instrumentation could be inserted to study the effluent characteristics. The site was proven to be acceptable for sampling.

This sampling location meets the alternative site location requirements of Title 40, CFR 60, Appendix A, Method 1.

4.3.2 A description of sampling probes and representativeness of the samples.

The sampling probe consists of six nozzles branching from a single sample delivery line and is entirely of 300-series stainless steel (drawings H-2-28543 and H-2-28545). The collection probe spans the diameter of the stack with the nozzles centered in six equal annular areas. The bend radii of the collection tubes are 2.5 times the tube radius or 1.25 times the tube diameter. The sample delivery line increases in diameter as each branch line joins to keep the mass flow rate consistent with sample velocity. The probe delivers the sample to a 300-series stainless steel flow splitter for record and CAM samples.

The velocity distribution at the sampling site was measured before sampler construction. But as stated in ANSI N13.1, "as the flow becomes more turbulent, the velocity becomes more nearly uniform across the duct." Therefore, velocity distribution is of lesser importance for the 291-Z-1 stack as the flow is highly turbulent (Reynolds Number = 2,000,000). The flow rate for the 291-Z-1 stack varies only a few percent. The variation in 1988 was determined to be only 3 percent and for 1991 a variation of 4.5 percent was observed. Given these facts, the sample probe provides the sample collection system with a representative, isokinetic sample.

4.3.3 A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

The sample collection probe extracts effluent from the stack at a flow rate of 4 ft^3/min. The sampler probe uses six nozzles for sampling the stack flow (drawing H-2-28545). A sample transport line extends approximately 1 m horizontally from the stack surface connection flange to the monitoring instruments located within an adjacent, elevated sample shack. The sample transport line is heated by a baseboard heater immediately below the line within the building to inhibit condensation of moisture and resultant sample flow retardation by maintaining the temperature above the dewpoint. The sample transport line was selected and installed to minimize particle loss attributed to gravity settling and turbulent impaction. The transport line length and tube transition severity of the sample transport line were minimized. The bend radii are 1.25 times the inside diameter of the collection tube. The sample stream passes through a flow splitter and is divided into two equal parts: the record sample loop and the CAM loop.

Particulate radionuclides are collected with a record sampler. The record sampler collects the particulates on a 47-mm-diameter filter (Gelman Sciences, Versapor™ Part # 66387 or XE20087, 3 µm or equivalent). This filter is a membrane filter composed of acrylic copolymer cast on a non-woven nylon substrate good for collecting 0.3-µm size particles with at least a 91 percent collection efficiency in air applications. The record sampler system provides a representation of the amount and concentrations of radioactive particulates being discharged. The record samples provide the basis for reporting the amount and concentration of radionuclides released to the environment. The filter media is exchanged bi-weekly and evaluated for gross alpha and gross beta activities by laboratory analysis. The filter media is then composited for quarterly analysis of specific radionuclide concentrations.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured. including frequency of analysis calibration procedures and frequency of calibration.

The analytes of interest for the 291-Z-1 Stack can be found in HNF-EP-0835. For a description of the laboratory analysis procedures for these analytes, refer to Appendix A.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

The sample flow rate is measured and regulated by instruments located downstream of the sample collection filter and CAM. The record sample loop passes in turn through an integrating flow meter (totalizer), a sight flow indicator (rotameter), a vacuum pressure indicator, a vacuum switch, a flow regulator, and a vacuum pump. The flow rate regulator is provided to

maintain a constant flow rate through the collection filter assembly to compensate for filter-loading effects. Audible and visible alarms signals indicating low vacuum pressure are provided remotely in the MICON Power Operations Station, Room 714, which is manned 24 hours per day. The annual calibration procedures and monthly functional tests for the 291-Z-1 Stack record sampler system components are included in ZSE-24A-001 (monthly) and ZSE-24A-002 (annual). Components included in the procedure(s) are the vacuum gauge, flow totalizer, rotameter, and vacuum switch.

One carbon vane vacuum pump is provided for the record sample system. Redundant vacuum systems are not furnished, but failure annunciation is provided and flow rates are checked periodically to demonstrate operability.

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

To comply with the Title 40, CFR, Part 61, Subpart H standards, volumetric flow rate for the 291-Z-1 stack is conservatively assumed to be 290,000 cubic feet per minute. On May 11, 1995, the EPA granted approval to the DOE-RL for the use of this value in calculations involving this stack.

On June 26, 1995, DOE-RL satisfied the only EPA approval condition by providing direction to use 290,000 cubic feet per minute. Finally, in a memorandum dated September 18, 1995, EPA, Region 10 declared the 291-Z-1 stack compliant with the requirements of Title 40, CFR, Part 61, Subpart H (95-PCA-914).

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

Refer to Appendix A. Also refer to HNF-EP-0835 for the QA requirements for compiling and reporting radioactive air emissions.

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

Refer to Appendix A.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

Refer to Section 5.0 of main text.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Refer to Section 4.0 of main text.

4.8 A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken and who is responsible for taking the corrective action.

Refer to Section 4.0 of main text.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits and description of corrective actions.

Refer to Section 4.0 of main text.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

Section 4.0 of main text, plus the attached point-by-point comparisons to NESHAP QA criteria, fulfill the QAPjP requirements for regulated stacks. Separate facility QAPjPs are not required.

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APPENDIX E

TANK FARMS TRANSITION PROJECT

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APPENDIX E

TANK WASTE REMEDIATION SYSTEM (TWRS)

296-P-32	244-AR Vault Portable Exhauster
296-A-25	244-A Lift Station
296-A-42	41-AY/AZ Tank Farm Exhauster
296-B-28	244-BX Double Contained Receiver Tank Exhauster
296-C-05	244-CR Vault Exhauster
296-C-06	241-C-106 Sluicing Exhauster
296-P-16	241-C-105/106 Tank Exhauster
296-S-22	244-S Double Contained Receiver Tank Exhauster
296-T-18	244-TX Double Contained Receiver Tank Exhauster

INTRODUCTION

This appendix contains the point-by-point comparison with Method 114 (EPA 1991) for all of the NESHAP Designated Stacks belonging to Tank Waste Remediation System (TWRS). The point-by-point sections common to all TF stacks are contained in Section I of this appendix, and the information that is specific to the individual stacks is contained in the sections that follow.

SECTION I	METHOD 114 COMPARISON FOR TFTP STACKS
SECTION II	296-P-32 STACK SPECIFICS
SECTION III	296-A-25 STACK SPECIFICS
SECTION IV	296-A-42 STACK SPECIFICS
SECTION V	296-B-28 STACK SPECIFICS
SECTION VI	296-C-05 STACK SPECIFICS
SECTION VII	296-C-06 STACK SPECIFICS
SECTION VIII	296-P-16 STACK SPECIFICS
SECTION IX	296-S-22 STACK SPECIFICS
SECTION X	296-T-18 STACK SPECIFICS

SECTION I: METHOD 114 COMPARISON FOR TANK WASTE REMEDIATION SYSTEM (TWRS) STACKS

1.0 Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling; and (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

2.0 Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable adsorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see □ 61.18).

The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-μm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 μm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).

2.2 Radionuclides as Gases.

Silver zeolite cartridges are used to collect ^{129}I and ^{106}Ru. The gross filter efficiency of a silver zeolite 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.

3.0 Radionuclide Analysis Methods

The analysis methods are included in Appendix A.

4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

For the organizational responsibilities, refer to main text.

1Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

WDOH has issued new clarification of notification requirements. DOE-RL has requested and directed each contractor develop and implement reinforced policies regarding the required notifications to assure compliance with these new regulatory requirements (DOE-RL 1997). Notification procedures are provided in HNF-PRO-453.

Meanwhile, numerous operating procedures, various alarm response procedures, and the Building Emergency Plan for Tank Farm Facilities (HNF-IP-0263-TF) is in place that satisfies this requirement.

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

This information is provided in each of the specific stack sections of this appendix.

4.3.2 A description of the sampling probes and representativeness of the samples.

This information is provided in each of the specific stack sections of this appendix.

4.3.3 A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

The type and number of equipment that make up the sample collection and monitoring systems vary from stack to stack. WHC-SD-WM-ES-291-1 includes a list of sampling/monitoring equipment located on each stack. In general, the sample collection and monitoring system consists of the following elements:

- **Sampling probe, which withdraws the sample from the stack**
- **Sample transport line, which transports the sample from the probe to the sample collection and/or detection devices**

- **Sample collection and/or detection devices**
- **Rotameter, which measures the flowrate through the sampling system**
- **Gas meter (or totalizer), which measures the volume of air that passed through the sampling system**
- **Vacuum gauge, which measures the vacuum in the sampling system**
- **Flow switch alarm switch which indicates when the sample flowrate falls below a preset limit**
- **Flow regulator, which maintains an established flow rate through the sampling/monitoring system**
- **Vacuum pump, which pulls the air sample through the sampling/monitoring system**
- **Timer, which indicates the length of time that the sampling system has been operating.**

The two types of sample collection devices used in Tank Farms are record samplers and silver zeolite samplers.

RECORD SAMPLER: Particulate radionuclides are collected with the record sampler. The record sampler holds the 47-mm sample filter paper (described in the response to paragraph 2.1 of this appendix).

Record air samples are routinely changed on a weekly or biweekly (every two weeks) basis. Record samplers are collection devices that do not require calibration.

SILVER ZEOLITE SAMPLER: Gaseous radionuclides are collected with a silver zeolite cartridge that is used to collect ^{129}I, ^{103}Ru, and ^{106}Ru (described in response to paragraph 2.2 of this appendix).

The silver zeolite cartridges currently are installed quarterly and exchanged weekly. The silver zeolite cartridges are collection devices that do not require calibration.

All of the stack sampling/monitoring systems have record samplers.

Not all of the stacks sampling/monitoring systems have silver zeolite cartridges. The specific stack sections of this appendix (Sections II through XIII) identify the stacks that have silver zeolite samplers.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

Radionuclides that should be measured are identified annually by Effluent Monitoring. The analytes of interest can be found in HNF-EP-0835. For a description of the laboratory analysis procedures for these analytes, refer to Appendix A.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

The sampling/monitoring system is calibrated annually by Maintenance Procedure 6-TF-077; Stack Sampling and Monitoring System Maintenance.

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

Effluent flow rates are measured quarterly by Vent & Balance personnel using Maintenance Procedure 6-TF-155; "Air Flow Tests for Tank Farm Stacks and Ducts".

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions.

Refer to Appendix A. Also refer to Section 5 of this plan for the QA requirements for compiling and reporting radioactive air emissions.

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

Refer to Appendix A.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through the all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

Refer to main text.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Refer to main text.

4.8 A corrective action program shall be established including criteria for when corrective actions will be taken and who is responsible for taking the corrective action.

Refer to main text.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emission measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

Refer to main text.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

The main text, plus the attached point-by-point comparisons to NESHAP QA criteria, fulfills the QAPjP requirements for regulated stacks. Separate facility QAPjPs are not required.

SECTION II: 296-P-32 STACK SPECIFICS

The 296-P-32 stack is used to ventilate the 244-AR Vault Tanks. This exhauster was permitted for use via DOE/RL-97-05 (AIR 97-1007). The specifics of this stack are contained therein.

SECTION III: 296-A-25 STACK SPECIFICS

This section contains information that is specific to the 296-A-25 Stack (244-A DCRT Exhaust Stack).

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

This stack has an inside diameter of 10.24 cm (4.03 in.). The sampling point 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).

The stack contains two probes; one for the record sample and the other for the Beta/Gamma CAM. Each sample probe has a single nozzle, as

recommended by ANSI N13.1, Section A3.2. Each probe is located approximately 1.3 cm (1/2 in.) off of the centerline of the stack.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sample probe is described in WHC-SD-WM-ES-291-1, and meets the guidance presented in ANSI N13.1, Section A3.4.

Theoretical calculations of sample line losses indicate that the sampling system is biased with respect to large particles. The predicted particle penetration fractions are 94.2 percent for 3.5-micron-sized particles and 67.9 percent for 10 micron.

SECTION IV: 296-A-42 STACK SPECIFICS

The 296-A-42 stack is used to ventilate the 241-AY and AZ Tank Farms. This exhauster was permitted for use via DOE/RL-98-27 (AIR 98-708). The specifics of this stack are contained therein.

SECTION V: 296-B-28 STACK SPECIFICS

This section contains information that is specific to the 296-B-28 Stack (244-BX Double Contained Receiving Tank (DCRT) Exhaust Stack).

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

The sampling site is located 10 duct diameters downstream of the fan discharge into the stack, and 4 duct diameters upstream of the CAM sample probe.

The sample probe has one nozzle, as recommended by ANSI N13.1, Section A3.2.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sample probe is described in WHC-SD-WM-ES-291-1, and meets the guidance presented in ANSI N13.1, Section A3.4.

Theoretical calculations of sample line losses indicate that the sampling system is very biased with respect to large particles. The predicted particle

penetration fractions are 86.4 percent for 3.5-micron-sized particles and 16.8 percent for ten micron.

SECTION VI: 296-C-5 STACK SPECIFICS

This section contains information that is specific to the 296-C-5 Stack (244-CR Vault Exhaust Stack).

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

The sampling site is located seven duct diameters downstream of the fan discharge into the stack and 22 duct diameters upstream of the top of the stack.

The sample probe has one nozzle, however, three are recommended by ANSI N13.1, Section A3.2.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sample probe is described in WHC-SD-WM-ES-291-1, and meets the guidance presented in ANSI N13.1, Section A3.4.

The sample probe nozzle is located approximately 13 cm (5 in.) off from the centerline of the stack.

Theoretical calculations of sample line losses indicate that the sampling system is somewhat biased with respect to large particles. The predicted particle penetration fractions are 95.2 percent for 3.5-micron-sized particles and 69.2 percent for ten micron.

SECTION VII: 296-C-06 STACK SPECIFICS

The 296-C-06 stack is used to ventilate the 241-C-106 single-shell tank during sluicing operations undertaken to retrieve the majority of waste contained therein. This exhauster was permitted for use via DOE/RL-95-45 (AIR 95-712). The specifics of this stack are contained therein.

SECTION VIII: 296-P-16 STACK SPECIFICS

This section contains information that is specific to the 296-P-16 Stack (C-105/106 Tank Exhaust Stack).

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

The sampling site is located two duct diameters upstream of the top of the stack and five duct diameters downstream of the stack extension (closest upstream flow disturbance).

The sample probe has three nozzles, as recommended by ANSI N13.1, Section A3.2.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sample probe is described in WHC-SD-WM-ES-291-1, and meets the guidance presented in ANSI N13.1, Section A3.4.

The sample probe nozzles are centered in equal annular areas.

The velocity profile at the flow measurement location indicates a uniform flow distribution. The flow measurement location is just upstream from the sampling location and 4.9 duct diameters downstream from the fan inlet to the stack.

Theoretical calculations of sample line losses indicate that the sampling system is biased with respect to large particles. The predicted particle penetration fractions are 90.6 percent for 3.5-micron-sized particles and 54.4 percent for 10 micron.

SECTION IX: 296-S-22 STACK SPECIFICS

This section contains information that is specific to the 296-S-22 Stack (244-S DCRT Exhaust Stack).

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

This stack is 15 cm (6 in.) in diameter. The sample probe is located two duct diameters upstream from the nozzle opening of the CAM sample probe, and 9.75 duct diameters downstream from the fan discharge into the stack.

The sample probe has one nozzle, as is recommended by ANSI N13.1, Section A3.2.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sample probe, which is described in WHC-SD-WM-ES-291-1, does not meet the guidance presented in ANSI N13.1, Section A3.4. Specifically, the nozzle bend radius and nozzle length do not meet the recommended minimums. This deficiency may contribute to the sampling system bias with respect to particle sizes.

Theoretical calculations of sample line losses indicate that the sampling system is very biased with respect to large particles. The predicted particle penetration fractions are 84.5 percent for 3.5-micron-sized particles and 17.3 percent for ten micron.

SECTION X: 296-T-18 STACK SPECIFICS

This section contains information that is specific to the 296-T-18 Stack (244-TX DCRT Exhaust Stack).

4.3 A description of the sample collection and analysis procedures used in measuring the emission, including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

This stack is 15 cm (6 in.) in diameter. The sample probe is located two duct diameters upstream of the nozzle opening of the CAM sample probe, and 9.5 duct diameters downstream from the fan discharge into the stack.

The sample probe has one nozzle, as is recommended by ANSI N13.1, Section A3.2.

4.3.2 A description of the sampling probes and representativeness of the samples.

The sample probe is described in WHC-SD-WM-ES-291-1, and meets the guidance presented in ANSI N13.1, Section A3.4.

Theoretical calculations of sample line losses indicate that the sampling system is very biased with respect to large particles. The predicted particle penetration fractions are 82.3 percent for 3.5-micron-sized particles and 16.1 percent for 10 micron

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APPENDIX F

METHOD 114 COMPARISON FOR STACK 340-NT-EX

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APPENDIX F

METHOD 114 COMPARISON FOR STACK 340-NT-EX

METHOD 114-TEST METHODS FOR MEASURING
RADIONUCLIDE EMISSIONS FROM STATIONARY SOURCES

1.0 Purpose and Background

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air: These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

2.0 Stack Monitoring and Sample Collection Methods

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable adsorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see □ 61.18).

The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-µm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 µm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).

[1]Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

2.2 Radionuclides as Gases

2.2.1 The Radionuclide Tritium (H-3). Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B-1, collected as a gas sample or may be oxidized using a metal catalyst to tritiated water and collected as described above.

The 340 Facility is not required to analyze for tritium because the estimated annual EDE to the MEI resulting from H-3 emissions is insufficient to require continuous emissions measurement, pursuant to 40 CFR 61.93 requirements.

2.2.2 Radionuclides of iodine. Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite and caustic solutions.

The 340 Facility is not required to continuously measure radioiodine emissions because the estimated annual EDE to the MEI resulting from radioiodine emissions is insufficient to require continuous emissions measurement, pursuant to 40 CFR 61.93 requirements.

2.2.3 Radionuclides of Argon, Krypton and Xenon. Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low temperature sorption techniques, Appropriate adsorbers may include charcoal or metal zeolite.

The 340 Facility is not required to continuously measure these noble gases because the estimated annual EDE to the MEI resulting from these emissions is insufficient to require continuous emissions measurement, pursuant to 40 CFR 61.93 requirements.

2.2.4 Radionuclides of Oxygen, Carbon, Nitrogen and Radon. Radionuclides of these elements are measured directly using an in-line or off-line monitor. Radionuclides of carbon in the form of carbon dioxide may be collected by dissolution in caustic solutions.

While some C-14 is managed at the 340 Facility, the estimated annual EDE to the MEI resulting from C-14 emissions is insufficient to require continuous emissions measurement, pursuant to 40 CFR 61.93 requirements. Upstream facilities do not discharge radioactive oxygen, nitrogen, or radon.

2.3 Definition of Terms

No response required.

3.0 Radionuclide Analysis Methods

The analysis methods are included in Appendix A.

4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

Refer to Sections 6.3 and 7.0 of main text.

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

DOE/RL-94-02, *Hanford Emergency Response Plan* contains an emergency response plan to protect onsite personnel, public health and safety, and the environment in the event of operation, natural phenomena, and/or safeguards and security events at Hanford Site Facilities. The requirements stated in the plan are implemented through subtier plans and implementing procedures. These implementing plans and procedures, established for response to emergencies by Hanford Site personnel and emergency management organizations, are contained in building emergency plans and operating procedures.

The health physics personnel, in many situations, are the first to respond to a radiological emergency. The ability to assess and evaluate the situation and take immediate steps to minimize the effects of the event is crucial for controlling the emergency. The health physics personnel use their training and experience to make decisions during the initial response to an emergency.

An emergency response may be initiated by: (1) personnel observing the event; (2) alarms; (3) the Patrol Operation Center; or (4) the Emergency Control Center(s). The type of emergency determines the level of planning for response. For a planned response, health physics personnel shall be in teams of at least two. Out of necessity (e.g., backshift response), one member could be an Operations person or other emergency service person, such as a firefighter or patrol. If a rapid response is required, no undue risks should be taken nor should personnel safety be compromised. When an emergency causes a facility evacuation, preplanning (e.g., stay time, entry route) and approval of the Building or Facility Emergency Director is necessary to re-enter.

Although health physics personnel respond to an emergency using basic guidelines, an area or facility may have specific procedures that have priority over these guidelines.

Notifications and reporting of specific events related to environmental releases and/or events involving effluents and/or hazardous materials are reported via instructions given in HNF-PRO-453.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rationale for site selections.

Drawing H-3-34406, "HVAC Elevations, Sections and Details," shows stack dimensions and sampling site location. As shown, the stack is 46 cm (18 in.) in diameter. The single sample point is located 3.9 m (12.8 ft) downstream (or 8.5 duct diameters) from the last disturbance and 0.9 m (3 ft) (or 2 duct diameters) from the point of release. This location meets the criteria specified in 40 CFR 61.93.

4.3.2 A description of sampling probes and representativeness of the samples.

The sampler consists of a single sample probe with three sample nozzles. The inside diameter of each nozzle is 0.427 in. Each nozzle represents an equal annular area of 0.597 ft^2. Drawings of the sample probe, containing design specifications, are maintained at the 340 Facility (ANC-W2309-ONB and AMC-W2309-ONA). Sample withdrawal velocity is maintained at or near as possible to the stack effluent velocity to obtain representative samples. An air profiling station, contained within the exhaust system ducting, produces a flat velocity profile of non-rotating, straight airflow. This allows for near isokinetic sampling and accurate measurement of the stack effluent velocity and volume.

4.3.3 A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

The equipment described in Sections 2.0, 4.3.1, and 4.3.2 of this appendix is used to collect radioactive particulate and radioiodine samples. The motive force for sample collection is a vacuum pump. Particulate samples are collected bi-weekly, and analyzed for gross alpha and beta activity. Quarterly, the particulate filters are composited and analyzed for Pu-238 and Am-241.

System calibration is performed annually using procedure 340-18-013, "Mass-Tron[2] Flow Transmitter Calibration" (1995). The stack and sample flows are measured using an Air Monitor Corp. Mass-Tron airflow-indicating transmitter. Based on stack flow, the sample flow is changed with a manual needle valve to maintain the same velocity in the sample line as in the stack.

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis calibration procedures and frequency of calibration.

Laboratory analysis procedures, including frequency of analysis calibration procedures, and frequency of calibration, are provided in Appendix A.

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

The sample flow rate is regulated using a manually controlled needle valve. Sample flow is indicated locally with an Air Monitor Corporation flow-indicating transmitter. Daily checks of the flow are made using scheduled Radiation Routine J-0003 to ensure near isokinetic sample flows. The flow indicating transmitter is calibrated annually in accordance with procedure 340-18-013.

4.3.7 A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

The flow measurements for Stack 340-NT-EX are performed annually in accordance with Maintenance Procedure 7-GN-166, Stack Air Flow Test. A pitot tube is inserted into a test port to measure the velocity pressure, which is converted to flow using a table and equation from the data sheet for the procedure. Control of measuring and test equipment is addressed in IP-1000, *300 Area Liquid Effluent Facilities Administration,* Section 4.12, *Control and Calibration of Measuring and Test Equipment.*

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

The objectives of the QA program are documented in main text of this document, and the statement of work (HNF-EP-0835-3).

4.5 A quality control program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates,

[2] Trademark of Air Monitor Corporation, Santa Rosa, California.

spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified.

Laboratory requirements are presented in Appendix A.

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage and analysis.

Sample control is maintained from sample generation through the analytical laboratory analysis by use of an EDP code and chain-of-custody form. On receiving the sample, the laboratory utilizes and electronic bar-code system which tracks the sample throughout all phases of sample analysis and reporting.

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Refer to Section 4.0 of main text.

4.8 A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken and who is responsible for taking the corrective action.

Refer to Section 4.0 of main text.

4.9 Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits and description of corrective actions.

Refer to Section 4.0 of main text.

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

The main text of this document, plus the attached point-by-point comparisons to NESHAP QA criteria, fulfill the QAPjP requirements for designated stacks. Separate facility QAPjPs are not required.

APPENDIX G

METHOD 114 COMPARISON FOR STACK EP-324-01-S

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APPENDIX G

METHOD 114 COMPARISON FOR STACK EP-324-01-S

1. *Purpose and Background*

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

2.0 *Stack Monitoring and Sample Collection Methods*

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable sorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see □ 61.18).

Response: **The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-μm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 μm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).**

2.2 Radionuclides as Gases.

Response: **The EP-324-O1-S stack is sampled for tritium, although emissions are not anticipated, and no further tritium projects are planned. Based on process knowledge, tritium sampling may be discontinued in the future.**

[1]Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

2.3 Definition of Terms

Response: **No answer is required.**

3. *Radionuclide Analysis Methods*

A series of methods based on "principles of measurement" are described which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities which would interfere with the measurement.

Also identified (Table 1) are methods for a selected list of radionuclides. The listed radionuclides are those which are most commonly used and which have the greatest potential for causing dose to members of the public. Use of methods based on principles of measurement other than those described in this section must be approved in advance of use by the Administrator. For radionuclides not listed in Table 1, any of the described methods may be used provided the user can demonstrate that the applicability conditions of the method have been met.

The type of method applicable to the analysis of a radionuclide is dependent upon the type of radiation emitted, i.e., alpha, beta or gamma. Therefore, the methods described below are grouped according to principles of measurements for the analysis of alpha, beta and gamma emitting radionuclides.

3.1 Methods for Alpha Emitting Radionuclides

Response: **Refer to Appendix A.**

3.2 Methods for Gaseous Beta Emitting Radionuclides.

Response: **Refer to Appendix A.**

3.3 Methods for Non-Gaseous Beta Emitting Radionuclides.

Response: **Refer to Appendix A.**

3.4 Gamma Emitting Radionuclides

Response: **Refer to Appendix A.**

3.5 Counting Methods. All of the methods with the exception of Method A-5 involve counting the radiation emitted by the radionuclide. Counting methods applicable to the measurement of alpha, beta and gamma radiations are listed below. The equipment needed and the counting principles involved are described in detail in ASTM-3648(8).

Response: **Refer to Appendix A.**

3.6 Radiochemical Methods for Selected Radionuclides. Methods for a selected list of radionuclides are listed in Table 1. The radionuclides listed are those which are most commonly used and which hove the greatest potential for causing doses to members of the public. For radionuclides not listed in Table 1, methods based on any of the applicable "principles of measurement" described in section 3.1 through 3.4 may be used.

Response: **Refer to Appendix A.**

3.7 Applicability of Gross Alpha and Beta Measurements to Unidentified Mixtures of Radionuclides. Gross alpha and beta measurements may be used as a screening measurement as a part of an emission measurement program to identify the need to do specific radionuclide analyses or to confirm or verify that unexpected radionuclides are not being released in significant quantities.

Gross alpha (Method A-4) or gross beta (Methods B-2 or B-4) measurements may also be used for the purpose of comparing the measured concentrations in the effluent stream with the limiting "Concentration Levels for Environmental Compliance" in Table 2 of Appendix E. For unidentified mixtures, the measured concentration value shall be compared with the lowest environmental concentration limit for any radionuclide which is not known to be absent from the effluent stream.

Response: **Refer to Appendix A.**

4.0 *Quality Assurance Methods*

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure, functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

Response: **Refer to main text.**

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

Response: **Health Physics Procedures Manual, HNF-IP-0718, Part 1.5 (Area Radiation Monitor Alarm Response, Rev. 0), and 1.6 (Automated Personnel Monitor Alarm Response, Rev. 0). This practice establishes requirements and provides guidance for responding to alarms that are the responsibility of Health Physics.**

This practice does not apply to alarms intentionally activated according to approved procedures, (e.g., functional test, source test). Facility specific procedures or desk instructions based on those procedures may be provided by the area health physics managers to address alarm systems specific to each facility.

Refer to HNF-PRO-388, Rev. 0. "Radiological Problem Reporting Program". The purpose of the Radiological Problem Report program is to provide a documented record of observed radiological problems, a mechanism for reporting these problems to management for action, a capability to track and monitor the progress of the planned corrective actions, and a database for assessing trends in radiological program performance and needed actions.

Refer to HNF-IP-0718, Part 1, Section 1.3, Rev. 0. General Emergency Radiological Recovery Checklist" An emergency is a sudden, unexpected event that requires

immediate response to mitigate impacts to people, property, or the environment. When radioactive material is involved, health physics plays a major role in evaluating, controlling, and recovering from the event. To be able to perform this function health physics personnel receive training to respond to a variety of emergency situations. The health physics procedures are written to provide guidelines to respond to emergencies. Together, the training and written procedure detail the health physics emergency response program.

<u>Emergency Response</u>- Health physics personnel are, in many situations, the first to respond to a radiological emergency. The ability to assess and evaluate the situation and take immediate steps to minimize the effects of the event is crucial for controlling the emergency. Health physics personnel must use their training and experience to make good decisions during the initial response to an emergency.

An emergency response may be initiated by personnel observing the event, alarms, the Patrol Operation Center, or the Emergency Control Center(s). For a planned response, health physics personnel shall be in teams of at least two. Out of necessity (e.g., backshift response), one member could be an operations person or other emergency service person such as fire or patrol. A rapid response is required; however, no undue risks should be taken nor should personnel safety be compromised. The type of emergency determines the level of planning for health physics response. For example, a small radioactive spill requires little planning for the initial response. However, when an emergency causes a facility evacuation, preplanning (e.g., stay time, entry route, etc.), and approval of the building/facility emergency director is necessary for a re-entry.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

Response: **The top of the EP-324-01-S stack is 150 ft above ground level. The record sampling port is located at a height of 88 feet above-ground. The sample port is approximately 9 diameters downstream of the last major disturbance and 6 diameters upstream of the stack exit (per drawing number H-3-49894).**

The site was chosen to provide representative sampling of the effluent and to comply with ANSI N13.1. The sample port was chosen to minimize the length of sample line in accordance with ANSI N13.1. The sample point meets the criteria of 40 CFR 60, Appendix A, Method 1.

4.3.2 A description of the sampling probes and representativeness of the samples.

Response: **The sampling probe for the record sampler consists of 6 nozzles branching from a single delivery line and is made entirely of 316 stainless steel tubing (Kurz Instruments Incorporated, Drawing 1497D7003). The use of an isokinetic six-point probe located 9 stack diameters downstream of the last major**

flow disturbance is believed to achieve representative sampling (sample flow rates are checked daily to ensure near isokinesis of ±10%).

4.3.3 A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

Response: **This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.**

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

Response: **The sample is removed continuously from the effluent stream by the probe described in Section 4.3.2. The sample then flows through the sample line and the particulates are collected on a sample filter. The sample filters are replaced bi-weekly, and evaluated for gross alpha and gross beta activities by laboratory analysis. The filter media is then composited for quarterly analysis of specific radionuclide concentrations.**

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

Response: **The frequency of sampling is detailed in the HNF-EP-0835-3.**

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

Response: **The sample flow rate is measured by a rotameter and corrected by a vacuum gage. It is calibrated annually and regulated by a flow control valve located downstream of the sample collection filter. Sample flow rates are reviewed daily and adjusted as needed, to ensure near isokinesis (±10%).**

4.3.7 A description of effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

Response: **Flow measurements are accomplished annually following Battelle AIR BALANCE-4 and preventive maintenance 55302 (soon to be replaced by Procedure 7-GN-166 in combination with a facility preventive maintenance procedure) using a Type-S pitot tube traverse. There are 4 ports spaced 90° apart located just below the sampling probe location on the stack. These measurements are taken at equal annular traverse points. The calibration procedures and frequencies for stack flow measurement devices are covered in 7-GN-166. Frequency of measurement is at least annual.**

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data including a description of the procedures used to assess these parameters.

Response: **Refer to main text.**

4.5 The quality control program shall be established to evaluate and track the quality of the emission measurement data against preset criteria. The program should include, where applicable, a system of replicates; spiked samples; split samples; blanks; and control charts. The number and frequency of such quality control checks shall be identified.

Response: **Refer to Appendix A.**

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sampling collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain integrity of the samples during collection, storage, and analysis.

Response: **Refer to Appendix A.**

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Response: **Refer to main text.**

4.8 A corrective action program shall be established including criteria for when corrective actions will be taken and who is responsible for taking the corrective action.

Response: **Refer to main text.**

4.9 Periodic reports to responsible management shall be prepared on the performance of the emission measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

Response: **Refer to main text.**

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

Response: **Refer to main text.**

APPENDIX H

METHOD 114 COMPARISON FOR STACK EP-327-01-S

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APPENDIX H

METHOD 114 COMPARISON FOR STACK EP-327-01-S

1. *Purpose and Background*

This method provides the requirements for: (1) Stack monitoring and sample collection methods appropriate for radionuclides; (2) radiochemical methods which are used in determining the amounts of radionuclides collected by the stack sampling and; (3) quality assurance methods which are conducted in conjunction with these measurements. These methods are appropriate for emissions for stationary sources. A list of references is provided.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives and type of radiation emitted. The appropriate combination of sample extraction, collection and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis which are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods which are applicable to the effluent stream to be measured.

2.0 *Stack Monitoring and Sample Collection Methods*

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using a suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases and in some circumstances iodine will be in the gaseous form. Radionuclides of these elements will require either the use of an in-line or off-line monitor to directly measure the radionuclides, or suitable sorbers, condensers or bubblers to collect the radionuclides.

2.1 Radionuclides as Particulates. The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1969 shall be followed in using filter media to collect particulates (incorporated by reference-see □ 61.18).

Response: **The Gelman Versapor[1] 3000 filter medium is an acrylic copolymer membrane supported by a non-woven nylon fabric. The manufacturer rates the collection efficiency of this medium at 91 percent for 0.3-μm aerosol. The Millipore AW19 filter medium is made of homogeneous microporous polymers of the cellulose esters formed around a cellulose web. The collection efficiency of this filter medium has been determined independently of the manufacturer. The collection efficiency is 99.9 percent for 0.3 μm aerodynamic diameter monodisperse particles for either side of the filter (ITRI-970501).**

2.2 Radionuclides as Gases.

Response: **The EP-327-O1-S stack is sampled for tritium, although emissions are not anticipated, and no further tritium projects are planned. Based on process knowledge, tritium sampling may be discontinued in the future.**

[1]Trademark of Gelman Sciences, Inc., Ann Arbor, Michigan.

2.3 Definition of Terms

Response: **No answer is required.**

3. *Radionuclide Analysis Methods*

A series of methods based on "principles of measurement" are described which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities which would interfere with the measurement.

Also identified (Table 1) are methods for a selected list of radionuclides. The listed radionuclides are those which are most commonly used and which have the greatest potential for causing dose to members of the public. Use of methods based on principles of measurement other than those described in this section must be approved in advance of use by the Administrator. For radionuclides not listed in Table 1, any of the described methods may be used provided the user can demonstrate that the applicability conditions of the method have been met.

The type of method applicable to the analysis of a radionuclide is dependent upon the type of radiation emitted, i.e., alpha, beta or gamma. Therefore, the methods described below are grouped according to principles of measurements for the analysis of alpha, beta and gamma emitting radionuclides.

3.1 Methods for Alpha Emitting Radionuclides

Response: **Refer to Appendix A.**

3.2 Methods for Gaseous Beta Emitting Radionuclides.

Response: **Refer to Appendix A.**

3.3 Methods for Non-Gaseous Beta Emitting Radionuclides.

Response: **Refer to Appendix A.**

3.4 Gamma Emitting Radionuclides

Response: **Refer to Appendix A.**

3.5 Counting Methods. All of the methods with the exception of Method A-5 involve counting the radiation emitted by the radionuclide. Counting methods applicable to the measurement of alpha, beta and gamma radiations are listed below. The equipment needed and the counting principles involved are described in detail in ASTM-3648(8).

Response: **Refer to Appendix A.**

3.6 Radiochemical Methods for Selected Radionuclides. Methods for a selected list of radionuclides are listed in Table 1. The radionuclides listed are those which are most commonly used and which hove the greatest potential for causing doses to members of the public. For radionuclides not listed in Table 1, methods based on any of the applicable "principles of measurement" described in section 3.1 through 3.4 may be used.

Response: **Refer to Appendix A.**

3.7 Applicability of Gross Alpha and Beta Measurements to Unidentified Mixtures of Radionuclides. Gross alpha and beta measurements may be used as a screening measurement as a part of an emission measurement program to identify the need to do specific radionuclide analyses or to confirm or verify that unexpected radionuclides are not being released in significant quantities.

Gross alpha (Method A-4) or gross beta (Methods B-2 or B-4) measurements may also be used for the purpose of comparing the measured concentrations in the effluent stream with the limiting "Concentration Levels for Environmental Compliance" in Table 2 of Appendix E. For unidentified mixtures, the measured concentration value shall be compared with the lowest environmental concentration limit for any radionuclide which is not known to be absent from the effluent stream.

Response: **Refer to Appendix A.**

4.0 *Quality Assurance Methods*

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall assure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to assure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

4.1 The organizational structure, functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

Response: **Refer to main text.**

4.2 Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

Response: **HNF-IP-0718, Part 1.5 (Area Radiation Monitor Alarm Response, Rev. 0), and 1.6 (Automated Personnel Monitor Alarm Response, Rev. 0). This practice establishes requirements and provides guidance for responding to alarms that are the responsibility of health physics.**

This practice does not apply to alarms intentionally activated according to approved procedures, (e.g., functional test, source test). Facility specific procedures or desk instructions based on those procedures may be provided by the health physics managers to address alarm systems specific to each facility.

Refer to HNF-PRO-388, Rev. 0. "Radiological Problem Reporting Program". The purpose of the Radiological Problem Report program is to provide a documented record of observed radiological problems, a mechanism for reporting these problems to management for action, a capability to track and monitor the progress of the planned corrective actions, and a database for assessing trends in radiological program performance and needed actions.

Refer to HNF-IP-0718, Part 1, Section 1.3, Rev. 0. General Emergency Radiological Recovery Checklist" An emergency is a sudden, unexpected event that requires immediate response to mitigate impacts to people, property, or the environment. When radioactive material is involved, health physics plays a major role in

evaluating, controlling, and recovering from the event. To be able to perform this function health physics personnel receive training to respond to a variety of emergency situations. The health physics procedures are written to provide guidelines to respond to emergencies. Together, the training and written procedure detail the health physics Emergency Response Program.

Emergency Response- Health physics personnel are, in many situations, the first to respond to a radiological emergency. The ability to assess and evaluate the situation and take immediate steps to minimize the effects of the event is crucial for controlling the emergency. Health physics personnel must use their training and experience to make good decisions during the initial response to an emergency.

An emergency response may be initiated by personnel observing the event, alarms, the Patrol Operation Center, or the Emergency Control Center(s). For a planned response, health physics personnel shall be in teams of at least two. Out of necessity (e.g., backshift response), one member could be an operations person or other emergency service person such as fire or patrol. A rapid response is required; however, no undue risks should be taken nor should personnel safety be compromised. The type of emergency determines the level of planning for health physics response. For example, a small radioactive spill requires little planning for the initial response. However, when an emergency causes a facility evacuation, preplanning (e.g., stay time, entry route, etc.), and approval of the building/facility emergency director is necessary for a re-entry.

4.3 The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

4.3.1 Identification of sampling sites and number of sampling points, including the rational for site selection.

Response: **The top of the EP-327-01-S stack is 41.25 feet above ground level. The record sampling port is located at a height of 34.5 feet above-ground. The sample port nozzle tip is over 7 diameters downstream of the last disturbance and over 1 stack diameter upstream of the last major disturbance.**

The site was chosen to provide representative sampling of the effluent and to comply with ANSI N13.1. The sample port was chosen to minimize the length of sample line in accordance with ANSI N13.1.

4.3.2 A description of the sampling probes and representativeness of the samples.

Response: **The sampling probe for the record sampler consists of 6 nozzles branching from a single delivery line and is made entirely of 316 stainless steel tubing (Air Monitor Corporation drawing 04181000). Probe nozzles are placed at centers of equal area annuli. At the inlet, each port is tapered to a knife-edge with a 60-degree angle. The six-point probe located over 7 stack diameters downstream of the last major flow disturbance, which exceeds the ANSI standard**

and is believed to achieve representative sampling. Sample flow rates are checked daily to ensure near isokinesis of ±10%.

4.3.3 A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

Response: **This requirement is not applicable because monitoring is not used to demonstrate compliance for this emission unit.**

4.3.4 A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

Response: **The sample is removed continuously from the effluent stream by the probe described in Section 4.3.2. The sample then flows through the sample line and the particulates are collected on a sample filter. The sample filters are replaced bi-weekly, and evaluated for gross alpha and gross beta activities by laboratory analysis. The filter media is then composited for quarterly analysis of specific radionuclide concentrations.**

4.3.5 A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

Response: **The frequency of sampling is detailed in HNF-EP-0835-3.**

4.3.6 A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

Response: **The sample flow rate is measured by a rotameter and corrected by a vacuum gage. It is calibrated annually and regulated by a flow control valve by a flow control valve located downstream of the sample collection filter. Sample flow rates are reviewed daily and adjusted as needed, to ensure near isokinesis (±10%).**

4.3.7 A description of effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

Response: **Flow measurements are accomplished annually following Battelle AIR BALANCE-4 and preventive maintenance 55411 (soon to be replaced by Procedure 7-GN-166 in combination with a facility preventive maintenance procedure) using a standard pitot tube traverse. There are 2 ports spaced 90° apart located just below the sampling probe location on the stack. These measurements are taken at equal annular traverse points. The calibration procedures and frequencies for stack flow measurement devices are covered in 7-GN-166. Frequency of measurement is at least annual.**

4.4 The objectives of the quality assurance program shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data including a description of the procedures used to assess these parameters.

Response: **Refer to main text.**

4.5 The quality control program shall be established to evaluate and track the quality of the emission measurement data against preset criteria. The program should include, where applicable, a system of replicates; spiked samples; split samples; blanks; and control charts. The number and frequency of such quality control checks shall be identified.

Response: **Refer to Appendix A.**

4.6 A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sampling collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain integrity of the samples during collection, storage, and analysis.

Response: **Refer to Appendix A.**

4.7 Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

Response: **Refer to main text.**

4.8 A corrective action program shall be established including criteria for when corrective actions will be taken and who is responsible for taking the corrective action.

Response: **Refer to main text.**

4.9 Periodic reports to responsible management shall be prepared on the performance of the emission measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

Response: **Refer to main text.**

4.10 The quality assurance program should be documented in a quality assurance project plan which should address each of the above requirements.

Response: **Refer to main text.**

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