

# Statement of Work for Services Provided by the Waste Sampling and Characterization Facility for the Effluent and Environmental Monitoring Program during Calendar Year 2010

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy  
under Contract DE-AC06-09RL14728



P.O. Box 650  
Richland, Washington 99352

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Mission Support Alliance

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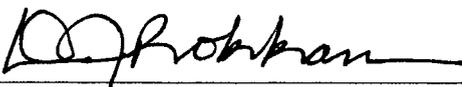
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**STATEMENT OF WORK FOR SERVICES PROVIDED BY  
THE WASTE SAMPLING AND CHARACTERIZATION FACILITY  
FOR THE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAM  
DURING CALENDAR YEAR 2010**

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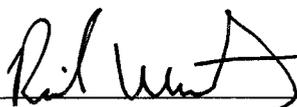
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**ACRONYMS**

ABCASH	Automated Bar Coding of All Samples at Hanford 2
CACN	Cost Account Charge Number
CAM	continuous air monitor
CFR	Code of Federal Regulations
CHPRC	CH2M HILL Plateau Remediation Company
CY	calendar year
DOE	U.S. Department of Energy
EDP code	Electronic Data Processing code
EEM	Effluent and Environmental Monitoring Program
EI	Environmental Integration
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
GEA	gamma-energy analysis
HEPA	high-efficiency particulate air [in relation to a filter]
HSER	Hanford Site Environmental Report
KBCP	K Basin Closure Project
LCS	laboratory control sample
MAPEP	(U.S. DOE) Mixed Analyte Performance Evaluation Program
MDA	minimum detectable activity
MDC	minimum detectable concentration
MSA	Mission Support Alliance, LLC
NESHAP	National Emission Standards for Hazardous Air Pollutants
PFP	Plutonium Finishing Plant
PNNL	Pacific Northwest National Laboratory
POC	point of contact
QAPP	quality assurance program plan
QA	quality assurance
QC	quality control
SOW	statement of work
WAC	Washington Administrative Code
WCH	Washington Closure Hanford, LLC
WPRS	Washington River Protection Solutions, LLC
WSCF	Waste Sampling and Characterization Facility

## **DEFINITION OF TERMS**

**Accuracy:** The degree of agreement of a measurement with a true or known value.

**Completeness:** A measure of the amount of valid data obtained compared to the amount expected under normal conditions.

**Precision:** A measure of the agreement among individual measurements of the same parameters under similar conditions.

**Turnaround time:** Elapsed time, in days, starting at the laboratory with the receipt of samples to be analyzed, along with all sampling information necessary for complete analysis, and ending when the results, generally expressed as a concentration, are electronically accessible.

**STATEMENT OF WORK PROVIDED BY  
THE WASTE SAMPLING AND CHARACTERIZATION FACILITY  
FOR THE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAM  
DURING CALENDAR YEAR 2010**

**1.0 SCOPE OF SERVICES**

This Mission Support Alliance, LLC (MSA) internal document represents a “statement of work” (SOW) in that it defines analytical services the Waste Sampling and Characterization Facility (WSCF) will provide the Effluent and Environmental Monitoring (EEM) Program throughout calendar year (CY) 2010. MSA Environmental Integration (EI) prepares and issues this annual document.

EI is responsible for managing data from the monitoring of radioactive liquid and gaseous effluents and of the environment in proximity to facilities that contain or may contain radioactive and hazardous materials. EI serves numerous projects and facilities, some of which are managed by other companies such as CH2M HILL Plateau Remediation Company (CHPRC), Washington Closure Hanford, LLC (WCH), and Washington River Protection Solutions, LLC (WRPS). Monitoring data are collected and evaluated to determine their compliance status with applicable federal and state regulations and permits. The data are eventually published in various reports, available to the public.

The appendix identifies samples that EI, with the assistance of personnel from projects and facilities, has estimated will be collected in CY 2010 for WSCF to analyze. As conditions in the field change, the actual numbers of samples may vary from the estimates. Analysis of effluent samples (i.e., samples of air emissions and liquid discharges to the environment) and environmental samples (i.e., samples of ambient air, soil, vegetation, liquid, and fauna) is required using standard laboratory procedures in accordance with requirements cited in Section 3.1. Should changes to this SOW be necessary during CY 2010, WSCF or EI may amend it at any time with a jointly approved change-request notice, available from WSCF.

**2.0 REGULATORY REPORTING REQUIREMENTS**

For EEM to fulfill its data review and regulatory reporting commitments, WSCF must meet the due dates specified in the SOW, and in particular the dates for analysis of year-end samples. The analytical data WSCF is to provide by those dates are essential for maintaining compliance with environmental reporting deadlines mandated by federal and state regulatory agencies and the U.S. Department of Energy (DOE). WSCF must inform EI of changes in this document to technical criteria, due dates, and pricing; depending on the nature of the changes, EI may seek approval authority for them. The key reports in which EEM data are published are described in the remainder of this section.

**2.1 RADIONUCLIDE AIR EMISSIONS REPORT FOR THE CLEAN AIR ACT**

This report documents radionuclide air emissions from the Hanford Site and the resulting highest effective dose equivalent to a member of the public. The report complies with the annual air emissions reporting requirements in 40 CFR 61, “National Emissions Standards for Hazardous Air Pollutants,” Subpart H, “National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities,” and in WAC 246-247, “Radiation Protection — Air Emissions.”

## **2.2 HANFORD SITE ENVIRONMENTAL REPORT**

Pacific Northwest National Laboratory (PNNL) annually compiles and publishes the *Hanford Site Environmental Report* (HSER) for DOE in compliance with DOE Manual 231.1-1A, *Environment, Safety and Health Reporting Manual*, and with DOE Order 450.1A, *Environmental Protection Program*. EI contributes the effluent, near-facility monitoring, and occasionally a portion of the quality assurance sections of this report.

## **2.3 ENVIRONMENTAL RELEASES REPORT**

The annual *Environmental Releases Report* complies primarily with the effluent monitoring requirements of DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, by summarizing the radioactive airborne and liquid effluent releases to the environment from facilities managed by MSA, CHPRC, WCH, and WPRS. This report also provides more detail on releases, which are summarized in the HSER, described above in Section 2.2.

## **2.4 HANFORD SITE NEAR-FACILITY ENVIRONMENTAL MONITORING DATA REPORT**

EI annually publishes the *Hanford Site Near-Facility Environmental Monitoring Data Report* as an appendix to the HSER (the respective document numbers for the calendar year 2008 reports are PNNL-18427, Appendix 2, and PNNL-18427). This monitoring report has a calendar-year summary of analysis results on samples collected from soil, vegetation, ambient air, and other media near Hanford facilities. This monitoring is performed in accordance with requirements in 40 CFR 61 Subpart H; WAC 246-247; DOE Manual 231.1-1A; DOE Order 450.1A, DOE Order 435.1, *Radioactive Waste Management*, and DOE Order 5400.5.

## **3.0 WASTE SAMPLING AND CHARACTERIZATION FACILITY SERVICES AND DATA QUALITY OBJECTIVES**

WSCF shall provide the following analytical services when analyzing low-level effluent and environmental samples.

### **3.1 SAMPLING AND ANALYSIS REQUIREMENTS**

Analytical services shall comply with the analysis requirements listed in Tables 1 through 3. Supporting services are defined in Table 4. Analyses shall be performed in accordance with applicable requirements in Appendix B; HNF-SD-CP-QAPP-017, *Waste Sampling and Characterization Facility Quality Assurance Program Plan*; MSC-23333, *Environmental Quality Assurance Program Plan*; and with procedures cited in Section 3.4. As much as is feasible, routine analytical results shall be reported via the Automated Bar Coding of All Samples at Hanford 2 (ABCASH) database system. Results shall be expressed in the same units as for the minimum detectable concentrations (MDCs) shown in Tables 1, 2, and 3.

The quantity of EEM samples projected for WSCF to receive in CY 2010, along with their respective analyses, are shown in Tables A-1 through A-5. Tables A-1 and A-3 list mainly particulate air samples, most of which first require alpha-beta analysis. Many of those samples will be subsequently composited for specific isotopic analysis. Within 14 days of their receipt at WSCF, all samples listed in Table A-3 and as noted in Table A-1 will be individually counted for gross alpha and gross beta but not sooner than 7 days from the date of sample collection to allow for the decay of short-lived naturally occurring radionuclides, such as radon. Project and Facility personnel with responsibility for effluent monitoring

(i.e., principally stack emission monitoring) are strongly encouraged to ensure that collected record samples are delivered to WSCF as soon as practical rather than waiting for the 7-day decay period to elapse; WSCF analytical personnel will ensure that the 7 days have elapsed for performing any analyses. Assuming timely delivery of the samples to WSCF, the maximum of 14 days allotted for alpha-beta analysis assures, under routine conditions, acceptably prompt availability of those data for trending purposes and that the samples will be ready for any composite-isotopic-analysis phase that may follow without undue delay. Composite analyses must be completed by the appropriate due dates in Sections 3.2, 3.3, and 3.8, as well as within the turnaround times in Table 1. Samples not analyzed shall be archived in accordance with retention dates specified in Section 3.8.

Table A-2 lists liquid samples. Tables A-4 and A-5 list soil and vegetation samples, respectively. Samples listed in those four tables shall be analyzed in adherence to due dates in Sections 3.3 and 3.8 and within the turnaround times in Tables 2 and 3.

Fauna samples (usually smaller mammals) are not listed in a table in the appendix because the number and type are not known in advance of each calendar year. These samples are usually collected on an opportunistic basis. Based on the historical collection of fauna samples, general expectations of the number and type each year have been developed. It is common that annually three to six mice and/or one or two rabbits will be collected for radioanalysis. These samples will be collected, handled, shipped, prepared for analysis, and disposed of in accordance with the terms of an existing WSCF contract and with applicable regulations and Hanford Site procedures.

## 3.2 DUE DATES FOR ANALYSIS RESULTS

Due dates for analytical results of specified samples are identified in Sections 3.2.1 and 3.2.2. For “straggler” quarterly or year-end samples arriving at WSCF 15 or more days after the end of each quarter, WSCF shall attempt to perform the required analyses by the applicable due dates, provided preparation of an associated composite sample has not already begun. In any case, WSCF is not responsible should those due dates be missed owing to facilities having delivered their samples late. Occasionally, a still-missing or late-delivered fourth-quarter sample may have to be excluded from a fourth-quarter composite sample because inflexible annual reporting deadlines could be jeopardized if analyses are further delayed from waiting too long for overdue samples. WSCF shall inform EI of any samples identified as possibly missing for year-end analyses or that need to be excluded from those analyses before a final decision is made to proceed with the analyses.

When selecting samples for compositing, it is the usual practice of WSCF to choose samples with off-dates within the respective compositing period (i.e., quarter or half-year) and not crossing beyond it. The exception is for “end-of-the-year” stack samples. For example, for a fourth-quarter composite sample consisting of numerous biweekly samples, an individual sample with an on-date in, say, mid-December and an off-date of January 6 in the following year could be readily included. It’s also acceptable not to include in the last composite sample of the year those samples that have on-dates close to the end of December, for instance December 22 or later. Should WSCF have questions regarding the selection of samples to composite, conferring with EI is always welcomed.

### 3.2.1 Year-End Samples from Calendar Year 2009

**March 11, 2010**, is the due date for loading into ABCASH the analytical results for all air emission samples listed in Tables A-1 that have sampling on-dates within 2009 and are delivered to WSCF by January 19, 2010. Year-end samples typically have on-dates within the fourth quarter, but some may have earlier on-dates. (**Note:** It’s likely that a handful of year-end samples for CY 2009 will have off-dates in the first half of January 2010. For purposes of reporting CY 2009 sample results, WSCF should try to count those samples and, if possible and as applicable, incorporate them into respective fourth-

quarter, monthly, or semiannual composite samples; if questions arise on the handling of these types of samples, contact EI for assistance.)

**April 14, 2010**, is the due date for loading into ABCASH the analytical results for all environmental (i.e., ambient air, soil, liquid effluent, pond vegetation, and pond sediment) samples listed in Tables A-2, A-3, A-4, and A-5 that have sampling on-dates in 2009 and are delivered to WSCF by January 31, 2010.

### 3.2.2 Samples from First Three Quarters of Calendar Year 2010

All analytical results (i.e., gross alpha, gross beta, gamma-energy analysis [GEA], and isotopic) for stack air emission samples listed in Table A-1 collected during the first three quarters of 2010 shall be available in ABCASH by these dates:

**FIRST QUARTER..... June 30, 2010**

**SECOND QUARTER ..... September 30, 2010**

**THIRD QUARTER ..... January 3, 2011**

**NOTE:** Ambient air samples shall be combined into composite samples either quarterly or semiannually, as directed in Table A-3. Except for year-end samples discussed in Section 3.2.1, analytical results for those composite samples shall be reported within 90 days of receiving the samples and the supporting sampling information.

### 3.3 LABORATORY PROCEDURES

WSCF shall use laboratory analytical procedures cited in Appendix B and the HNF-SD-CP-QAPP-017. These procedures must be and/or are:

- In compliance with U.S. Environmental Protection Agency (EPA) Method 114, Section 4.0, “Quality Assurance Methods,” as found in 40 CFR Part 61, Appendix B (specifically, 4.4 and 4.5).
- In conformance with Chapter 6.0 of DOE-EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*.
- In compliance with the requirements specified in HNF-SD-CP-QAPP-017.
- Appropriate to the sample medium and size as well as the analysis criteria listed in Tables 1 through 3.
- Newly developed for special needs, such as destructive analysis of high-efficiency particulate air (HEPA) filters; before WSCF uses a new special-needs procedure within the scope of this document, the analysis requirements and methods must be agreed upon by all parties involved, including EI; the organization requiring a new procedure shall be responsible for development costs.

### 3.4 QUALITY CONTROL

WSCF shall assure the integrity and validity of analytical test results through implementation of its own quality control (QC) program, as defined in the current version of HNF-SD-CP-QAPP-017. Standard methods shall be used whenever possible. New methods that are developed or adapted shall be completely tested and documented.

WSCF shall perform calibration and quality control checks using methods consistent with HNF-SD-CP-QAPP-017. Upon request, WSCF shall provide data to EI to demonstrate adequate quality control,

including availability of precision and accuracy reports and the percent of completeness of samples acceptably analyzed. Auditable QC test results shall be provided within two weeks of having received a request for specific records, without additional charges.

WSCF shall participate in the Mixed Analyte Performance Evaluation Program (MAPEP), managed by DOE in Idaho Falls, and provide the results (electronic format [e.g., pdf] is preferred) to EI. Participation is required as mandated in a memorandum from DOE Headquarters (Grumbly 1994).

WSCF agrees to fulfill EI requests for copies of external and internal assessments, audits, and inspections of WSCF analytical activities, management and quality systems, records, etc.

### **3.4.1 Air Sample Analyses**

WSCF shall perform QC tests for accuracy and precision, with all test results documented. Analytical problems identified through analysis of QC samples shall be promptly corrected. Upon request from EI, QC test data reports shall be made available for review.

The requirements for precision, accuracy, and completeness are as follows:

- Precision requirements for radioisotopic measurements shall be met when samples fall within a relative percent difference of  $\pm 30\%$  for activities  $\geq 5$  times the minimum detectable activity (MDA) values in Tables 1 through 3 or when the analytical uncertainty is  $\leq 20\%$ .
- Accuracy requirements shall be met when 95% of the results from performance-check standards of the counting instruments fall within  $\pm 25\%$ .
- Completeness requirements shall be met when WSCF produces a minimum of 90% reportable data for requested analyses on all submitted EEM samples.

Splitting stack air sample filters is not feasible for making analytical replicates. The extremely low gross alpha and gross beta activities typically found on record stack sample filters result in high counting errors, which for purposes of precision would render large variances in filter recounts. However, split samples can be produced by collecting two essentially identical ambient air sample filters for sampling precision. This can be done by using two side-by-side air samplers operating identically throughout a sample collection period, usually at least two weeks in length. EI may submit such samples to WSCF without identifying their "split" nature.

- The requirements of this section also apply to air sample analyses that involve radiochemical separations. The data quality objectives for air samples requiring radiochemical separations shall be met when the objectives specified in Section 3.4.1 are met.

### **3.4.2 Water, Vegetation, Soil, and Fauna Sample Analyses**

WSCF shall perform QC tests for accuracy and precision, with all test results documented. Analytical problems identified through analysis of QC samples shall be promptly corrected. Upon request from EI, QC test data reports shall be made available for review.

WSCF shall prepare and analyze laboratory control samples (LCSs) as well as blank and duplicate samples to verify the accuracy and precision of all radiochemical methods. The total number of all QC samples shall be no less than 10% of all scheduled sample analyses. An LCS shall be included with each batch of samples processed and have, as is feasible, a comparable matrix of the actual samples being analyzed. The LCSs will have activity no greater than 20 times the MDA values in Tables 1 through 3.

The requirements for precision, accuracy, and completeness are as follows:

- Precision requirements shall be met when duplicate results fall within  $\pm 30\%$  relative percent difference for samples  $\geq 5$  times the MDA values in Tables 1 through 3 or when the analytical uncertainty is  $\leq 20\%$ .
- Accuracy requirements shall be met when 95% of the LCS results fall within  $\pm 25\%$ .
- Completeness requirements shall be met when WSCF produces a minimum of 90% reportable data for requested analyses on all submitted EEM samples.

### **3.5 RETENTION OF AND ACCESS TO RAW DATA AND RESULTS**

WSCF shall retain all raw data and analytical results for a minimum of five years, as specified by 40 CFR 61 Subpart H and in WAC 246-247. EI shall have access to all available raw data and results related to EEM samples. Upon request, WSCF shall provide analysis printouts.

Records of samples and analyses identified in this document that are generated and retained at WSCF shall be available for inspection within 24 hours of a request, typically made by a regulatory agency, assessor, or auditor.

### **3.6 ANALYTICAL ERROR AND MINIMUM DETECTABLE CONCENTRATIONS**

WSCF shall provide the overall analytical error associated with each analytical result. Total analytical error shall be calculated at the 95%-confidence interval.

For samples of at least nominal volume as specified in Tables 1 through 3, WSCF will not exceed the corresponding MDC values in those tables. However, WSCF will not be accountable for maintaining MDC limits when analyzing samples of less-than-nominal volumes. When sample sizes are of less than nominal volumes, EI may authorize WSCF to adjust the MDCs for such samples by multiplying the specified MDC by the ratio of the actual sample size and the respective nominal sample size.

### **3.7 ROUTINE ELECTRONIC TRANSFER OF ANALYTICAL DATA**

WSCF shall make analytical results available to EI via ABCASH; case-by-case exceptions may be allowed to provide data via means other than ABCASH. As previously stated, all **CY 2009** air emissions data shall be in ABCASH by **March 11, 2010**, and all environmental and liquid effluent data by **April 14, 2010**. Air emissions data are associated with the sampling and analysis schedule in Table A-1. Liquid effluent and environmental data are associated with the sampling and analysis schedules in Tables A-2 through A-5.

### **3.8 ARCHIVING OF SAMPLES**

Ambient air samples in the Nxxx series of Electronic Data Processing (EDP) codes (synonymous with "location codes") shall be stored at WSCF after gross alpha and gross beta counts on them have been completed. Those archived ambient air samples shall then be combined into composite samples and analyzed in accordance with analytical requirements in Table A-3.

All **CY 2010** air samples listed in Tables A-1 and A-3 shall be archived by WSCF until **December 31, 2011**, after which WSCF may dispose of them, but only after gaining approval from EI. The same archiving schedule applies to **CY 2010** stack continuous air monitor (CAM) samples, which serve as

backup samples to stack record samples. Stack CAM samples should arrive at WSCF in envelopes stamped "Archive Only" and are identified by EDP codes not listed in Table A-1. All **CY 2009** air samples listed in Tables A-1 and A-3 of HNF-EP-0835, Rev. 15, *Statement of Work for Services Provided by the Waste Sampling and Characterization Facility for the Effluent and Environmental Monitoring Program during Calendar Year 2009*, and stack CAM samples from **CY 2009** shall be archived at WSCF until **December 31, 2010**, after which WSCF may dispose of them, but only after receiving approval from EI.

All **CY 2010** samples listed in Tables A-2, A-4, and A-5 and all **CY 2010** fauna samples covered by this SOW and that have not been returned to the customer or shipper may be disposed of after **October 1, 2011**, but only after obtaining permission from EI. Also, all **CY 2009** samples listed in Tables A-2, A-4, and A-5 of HNF-EP-0835, Rev. 15, and all pre-**CY 2010** fauna samples that have not been returned to the customer or shipper may be disposed of after **October 1, 2010**, but only after obtaining permission from EI.

### **3.9 ANALYSIS COSTS**

Best-estimated costs for analyzing samples are shown in Tables 1 through 3. These prices contain additional fees associated with services specific to EEM, which are explained in Table 4. Unit prices, which do not contain company overhead adders, are evaluated annually and subject to change. The analysis costs in Tables 1 through 3 may fluctuate because of changes in work scope, material, and/or labor costs.

Table 1. Air Emission and Ambient Air Sample Analysis Criteria for the Waste Sampling and Characterization Facility.

Nominal Sample Volume	Type of Analysis	MDA, <sup>a</sup> μCi	MDC, <sup>b</sup> μCi/ml	Turn-around Time (Days)	Unit Price <sup>c</sup> (\$)
20,000 ft <sup>3</sup> (5.7 E+02 m <sup>3</sup> )	gross α <sup>d</sup>	1.1 E-07	2.0 E-16	14	140 (combined cost)
	gross β <sup>d</sup>	1.1 E-06	1.9 E-15	14	
	Ag zeolite <sup>e</sup>	1.9 E-05 (as <sup>106</sup> Ru)	3.4 E-14 (as <sup>106</sup> Ru)	30	248
262,000 ft <sup>3</sup> (7.4 E+03 m <sup>3</sup> )	<sup>90</sup> Sr	1.4 E-05	1.9 E-15	90	321
	gamma-energy analysis <sup>f</sup>	1.4 E-05 (as <sup>137</sup> Cs)	1.9 E-15 (as <sup>137</sup> Cs)	90	142
	isotopic U ( <sup>234</sup> U, <sup>235</sup> U, <sup>238</sup> U)	5.3 E-06	7.1 E-16	90	377
	isotopic Pu ( <sup>238</sup> Pu, <sup>239,240</sup> Pu) <sup>g</sup>	1.5 E-06	2.0 E-16	90	301
	<sup>241</sup> Pu	7.4 E-05	1.0 E-14	90	340
	<sup>241</sup> Am	1.4 E-06	1.9 E-16	90	301
	gross α composite	1.5 E-06	2.0 E-16	90	152 (combined cost)
	gross β composite	1.4 E-05	1.9 E-15	90	
22 ft <sup>3</sup> (6.2 E-01 m <sup>3</sup> )	tritium ( <sup>3</sup> H)	9.3 E-05	1.5 E-10	90	92

MDA = minimum detectable activity; MDC = minimum detectable concentration.

- <sup>a</sup> Actual MDAs derived from sample analyses shall be as low as reasonably achievable and shall not exceed the values specified in Table 1 provided the sample is of nominal volume or greater. The target MDAs in Table 1 are calculated by multiplying the MDCs in Table 1 by the nominal sample volumes, also listed in the table.
- <sup>b</sup> Actual MDCs derived from sample analysis shall be as low as reasonably attainable and shall not exceed the values specified in the Table 1 provided the sample is of nominal volume or greater. The target MDCs in Table 1 are 10% of the concentration values in Table 2 of 40 CFR 61, Appendix E.
- <sup>c</sup> These prices are approximate to the actual unit costs, which could be less because of cost reductions for large volumes of samples that EEM annually delivers to WSCF. The prices also encompass fees for additional services specific to EEM, detailed in Table 4.
- <sup>d</sup> When appropriate, gross alpha and gross beta emission release data are used in dose calculations to substitute for the presumed presence of the generally most abundant respective alpha- and beta-emitting radionuclides having the highest dose factors, which for alpha-emitters has usually been <sup>239/240</sup>Pu, but occasionally <sup>241</sup>Am, and for beta-emitters, <sup>90</sup>Sr, but occasionally <sup>137</sup>Cs.
- <sup>e</sup> Silver-zeolite analysis shall be designed at a minimum to identify <sup>106</sup>Ru, <sup>125</sup>Sb, and <sup>129</sup>I.
- <sup>f</sup> All positive gamma-energy analysis (GEA) results shall be reported, with the exception of short-lived progeny of <sup>222</sup>Rn and <sup>220</sup>Rn. At a minimum, GEA shall be designed to identify peaks of <sup>60</sup>Co, <sup>106</sup>Ru, <sup>125</sup>Sb, <sup>134</sup>Cs, <sup>137</sup>Cs, <sup>152</sup>Eu, <sup>154</sup>Eu, and <sup>155</sup>Eu. All positive gamma-energy analysis results shall be reported.
- <sup>g</sup> Isotopic Pu analysis shall be designed at a minimum to identify <sup>238</sup>Pu and <sup>239/240</sup>Pu.

Table 2. Groundwater Monitoring and Liquid Effluent Sample Analysis Criteria for the Waste Sampling and Characterization Facility.<sup>a</sup>

Nominal Sample Volume	Type of Analysis	MDC, <sup>b</sup> pCi/L <sup>c</sup>	Turn-around Time (Days)	Unit Price <sup>d</sup> (\$)
1.0 L	gross $\alpha^c$	3.0 E+00	45	137 (combined cost)
	gross $\beta^c$	4.0 E+00	45	
	$^3\text{H}$	4.0 E+02	45	122
	$^{90}\text{Sr}$	5.0 E+00	45	331
	gamma-energy analysis <sup>f</sup>	1.2 E+01 (as $^{137}\text{Cs}$ )	45	146
	isotopic U ( $^{234}\text{U}$ , $^{235}\text{U}$ , $^{238}\text{U}$ )	1.0 E+00	45	342
	isotopic Pu ( $^{238}\text{Pu}$ , $^{239/240}\text{Pu}$ )	1.0 E+00	45	342
	$^{241}\text{Am}$	1.0 E+00	45	342

MDC = minimum detectable concentration.

<sup>a</sup> Liquid effluent samples shall be analyzed unfiltered, whereas groundwater samples shall be filtered and only the filtrate analyzed.

<sup>b</sup> Actual MDCs derived from sample analyses shall be as low as reasonably attainable and shall not exceed the values specified in Table 2 provided the sample is of nominal volume or greater. MDC values in Table 2 are 4% of respective Derived Concentration Guidelines from DOE Order 5400.5.

<sup>c</sup> Unless other units of measure are indicated.

<sup>d</sup> These prices contain additional fees associated with services specific to the Effluent and Environmental Monitoring Program. Table 4 contains a detailed list of additional services factored into unit prices.

<sup>e</sup> Gross alpha and gross beta analyses conducted at WSCF are regarded as screening measurements. When appropriate, those measurements are substituted in dose calculations for the presumed presence of the generally most abundant respective alpha- and beta-emitting radionuclides having the highest dose factors, which for alpha-emitters is usually  $^{239/240}\text{Pu}$ , but occasionally  $^{241}\text{Am}$ , and for beta-emitters,  $^{90}\text{Sr}$ , but occasionally  $^{137}\text{Cs}$ .

<sup>f</sup> All positive gamma-energy analysis results shall be reported, with the exception of the short-lived progeny of  $^{220}\text{Rn}$  and  $^{222}\text{Rn}$ .

Table 3. Vegetation, Soil, and Fauna<sup>a</sup> Sample Analysis Criteria for the Waste Sampling and Characterization Facility.

Nominal Sample Weight	Type of Analysis	MDC, <sup>b</sup> pCi/g	Turnaround Time <sup>c</sup> (Days)	Unit Price (\$)
500 g (dry weight)	<sup>90</sup> Sr	0.5	45	305
	gamma-energy analysis <sup>d</sup>	0.02 (as <sup>137</sup> Cs)	45	142
	Isotopic U ( <sup>234</sup> U, <sup>235</sup> U, <sup>238</sup> U)	0.02	45	389
	Isotopic Pu ( <sup>238</sup> Pu, <sup>239/240</sup> Pu)	0.1	45	389
	<sup>241</sup> Pu	2.5	45	457
	<sup>241</sup> Am	0.06	45	523
	<sup>241</sup> Am– <sup>244</sup> Cm	0.1	45	566

MDC = minimum detectable concentration; g = grams; pCi/g = picocuries per gram.

<sup>a</sup> Fauna samples generally require destructive preparation prior to isotopic analysis. TestAmerica Laboratories, Inc., in Richland, WA, has been contracted to prepare fauna samples (averaging from 3 to 6 annually) to meet WSCF radiological acceptance criteria and analytical matrix requirements.

<sup>b</sup> Actual MDCs derived from sample analyses shall be as low as reasonably attainable and shall not exceed the values specified in Table 3 provided the sample is of nominal weight or greater (Note: the weight of vegetation samples is typically between 30 and 80 g and biota even less than that, which means the MDCs for these smaller samples will be correspondingly higher). Depending on the nature of a sample — a fauna sample, for example — and the activity within it, the MDC may unavoidably be higher than the Table 3 values.

<sup>c</sup> Shorter turnaround times are available for a higher price.

<sup>d</sup> All positive GEA results shall be reported, with the exception of short-lived progeny of <sup>222</sup>Rn and <sup>220</sup>Rn.

Table 4. Additional Services Factored into the Waste Sampling and Characterization Facility Sample Analysis Prices for the Effluent and Environmental Monitoring Program.

Sample Category	Additional Services Provided
Air Samples	Entering sample collection data into ABCASH, for facilities not equipped with bar-coding equipment.
	Sorting effluent samples into two groups: (1) samples to be analyzed and (2) samples to be archived.
	Storing effluent and environmental samples units that require composite analyses.
	Storing samples from minor emission units that require quarterly analysis.
	Archiving effluent samples and backup effluent samples from minor emission units that do not get analyzed.
	Notifying effluent and environmental monitoring point of contact (POC) of problematic sampling information.
	Assembly and preparation of samples for composite analysis.
	Preparation and analysis of QC samples (e.g., control standards, blanks, duplicates, matrix spikes, etc.).
	Downloading all air sample results into ABCASH.
	Disposal of samples and wastes from chemical processing.
Liquid Samples	Assembly and preparation of samples for composite analysis, which includes verifying receipt of all samples for composite, calculating effluent stream volumes, and determining aliquot sizes for composite.
	Preparation and analysis of QC samples (e.g., control standards, blanks, duplicates, matrix spikes, etc.).
	Archiving samples until composite analysis is performed.
	Archiving unused samples until EEM Program reports are issued.
	Disposal of samples and wastes from chemical processing.
Miscellaneous	Support EEM when it is audited, assessed, or inspected on areas related to WSCF.
	Participate in prescribed laboratory intercomparison programs.
	Provide laboratory intercomparison results to MSA EI POC.
	Develop and implement new analytical methods or modify existing methods when indicated by circumstances such as regulator concerns or improvements in laboratory techniques or changing environmental and/or operational conditions that affect routine samples (Note: Development costs of new procedures requested by Facilities or Projects are the responsibility of the requestor).
	Perform rush and emergency sample analyses.

#### 4.0 REFERENCES

(NOTE: All referenced documents are for the most current revision.)

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," Title 40, *Code of Federal Regulations*, Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities."

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," Title 40, *Code of Federal Regulations*, Part 61, Appendix B, "Test Methods."

DOE Manual 231.1-1A, *Environment, Safety and Health Reporting Manual*, U.S. Department of Energy, Washington, D.C.

DOE Order 435.1, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

DOE Order 450.1A, *Environmental Protection Program*, U.S. Department of Energy, Washington, D.C.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, U.S. Department of Energy, Washington, D.C.

DOE/EH-0173T, 1991, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy, Washington D.C.

Grumbly, Thomas P, 1994, Letter: "Participation in the Mixed Analyte Performance Evaluation Program," U.S. Department of Energy, Washington, D.C.

HNF-SD-CP-QAPP-017, *Waste Sampling and Characterization Facility Quality Assurance Program Plan*, Fluor Hanford, Inc., Richland, Washington.

MSC-23333, *Environmental Quality Assurance Program Plan*, Mission Support Alliance, LLC, Richland, Washington.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code*, Olympia, Washington.

**APPENDIX A**

**ANALYTICAL REQUIREMENTS AND PROCESSES FOR  
EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAM SAMPLES  
DURING CALENDAR YEAR 2010**

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**EXPLANATORY NOTES FOR TABLES A-1 THROUGH A-5****Time Period per Sample**

- A = annually (i.e., a sample collected once a year, generally resulting in one gross alpha-gross beta and/or isotopic analysis a year)
- BE = biennial (i.e., a sample collected once every two years, generally resulting in one gross alpha-gross beta and/or isotopic analysis a year)
- BW = biweekly (i.e., a two-week sampling period, generally resulting in from 4 to 26 samples collected each year, with each sample receiving gross alpha-gross beta analysis as well as possibly 4 composite isotopic analyses a year depending on specifications in table)
- M = monthly (i.e., a sample is collected once a month, generally resulting in the number and types of analyses specified for that sampling location)
- Q = quarterly (i.e., a sample is collected once a quarter, resulting in the number and type of analyses specified for that sampling location) identified with 4 gross alpha-gross beta and/or composite isotopic analyses a year depending on specifications in table)
- V = variable (i.e., the number of samples to be collected cannot be firmly estimated because of the uncertain future needs of the project but approximate numbers of samples and analyses are nonetheless shown in the table).
- W = weekly (i.e., the number of samples to be collected cannot be firmly estimated because of the uncertain future needs of the project but approximate numbers of samples and analyses are nonetheless shown in the table).

**Table A-1 Notes**

In the column labeled “Time Period per Sample,” the time periods listed (e.g., BW, M, A) represent the typical sampling durations for the stack sample locations. For instance, a sampling location associated with an “M” will almost always have 12, or close to 12, monthly samples collected a year. On the other hand, locations marked “BW” will have 4 samples or alternately about 26 samples collected a year, with the difference in total samples contingent on how facility management has chosen to meet its annual monitoring requirements. For Tank Farm minor stacks, 26 samples are generally collected annually but only four samples analyzed, which comfortably fulfills the Air Operating Permit monitoring requirement of a 4-week sample per year, on which only gross alpha and gross beta activities are measured.

As a general rule, WSCF is requested to analyze gross alpha and gross beta on the first “acceptable” sample collected within each quarter of the year. An acceptable sample is one that meets all minimum sampling criteria: the sample has both on and off dates and times and an adequate sample volume. For the sample volume to be considered adequate, it should be at least 20,000 cubic feet. If each available individual sample from a given quarter has less than this volume, WSCF should contact EI for assistance in selecting a sample to count, which would usually be the sample with the largest sample volume. In such cases, WSCF radiochemistry technical staff will select an appropriate method to determine gross alpha and gross beta.

The **boldface characters** in the column labeled “Stack or Emission Point ID” represent “major” stacks, whereas characters not in boldface represent “minor” stacks. In general, only 4 samples individually counted for gross alpha and gross beta are required to meet monitoring requirements for periodic confirmatory measurements to confirm that concentrations of radionuclide emissions from these stacks are low. Several minor stacks have more onerous monitoring requirements, as reflected by the number of samples collected and additional analytical requirements shown in Table A-1. Stack samples that are not analyzed shall be archived in accordance with time provisions in Section 3.8. If questions arise on sample selection, WSCF should contact EI.

Table A-1. Air Emissions Samples and Analyses for Calendar Year 2010. (3 sheets)

Facility or Project	Stack or Emission Point ID <sup>a</sup>	EDP Code (aka location code)	Time Period Per Sample	Analysis and Number of Samples Projected for Analysis							CACN	
				Particulate Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic Pu	<sup>241</sup> Pu	<sup>241</sup> Am	Tritium ( <sup>3</sup> H)		Ag-Zeolite
K Basin Closure Project	105-KW	Y234 <sup>b</sup>	BW	26	4	4	4	4	4	4		
		Y235 <sup>b</sup>	BW	26	4	4	4	4	4	4		
		Y236 <sup>b</sup>	BW	26	4	4	4	4	4	4		
105-KW Sparger Vent	Y249 <sup>c</sup>	A	1	1	1	1	1	1	1	1		
	Y201	M	12	4	4	4	4	4	4	4		
PUREX	291-A-1	A006	M	12	4	4	4	4	4	4		12
		A007	M									
B Plant	296-B-1	B001	M	12	4	4	4	4	4	4		
WESF	296-B-10	B748	BW	26	4	4	4	4	4	4		
		E060	BW	4								
East Tanks Farms	296-A-18	E061	BW	4								
	296-A-19	E197	BW	4								
	296-A-20	E272	BW	4								
	296-A-28	E903	BW	4								
	296-A-30	E013	BW	26								
	296-A-40	E015	BW	4								
	296-A-41	E147	BW	26	4	4	4	4	4	4		
	296-A-42	E148	V	4								
	296-A-43	E920	BW	13	4	4	4	4	4	4		
	296-A-44	E922	BW	13	4	4	4	4	4	4		
	296-A-45	E924	BW	13	4	4	4	4	4	4		
	296-A-46	E926	BW	13	4	4	4	4	4	4		
	296-A-47	E047	BW	4								
	296-P-45	E096	BW	17	4	4	4	4	4	4		
296-P-47	E098	BW	17	4	4	4	4	4	4			

Table A-1. Air Emissions Samples and Analyses for Calendar Year 2010. (3 sheets)

Facility or Project	Stack or Emission Point ID <sup>a</sup>	EDP Code (aka location code)	Time Period Per Sample	Analysis and Number of Samples Projected for Analysis							CACN	
				Particulate Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic Pu	<sup>241</sup> Pu	<sup>241</sup> Am	Tritium ( <sup>3</sup> H)		Ag-Zeolite
242-A Evaporator	296-A-21	E645	BW	4								
	296-A-22	E643	BW	26	4	4	4		4			
	296-E-1	E036	Q	4								
CSB	<b>296-H-212</b>	C601	M	12	4	4	4	4	4	4		
	<b>296-P-31</b>	E209	M	12			4	4	4	4		
222-S Lab	296-S-16	S264	BW	4								
	<b>296-S-21</b>	S289	BW	26	4	4	4	4	4	4		
	291-S-1	S006	M	1								
S Plant	291-U-1	U771	M	12	4	4	4	4	4	4		
T Plant	<b>291-T-1</b>	T785	M	26	4	4	4	4	4	4		
	296-T-7	T154 <sup>d</sup>	M	4	4							
	296-P-22	W191	BW	4								
West Tank Farms	296-P-23	W190	V	8	2	2	2	2	2	2		
	296-P-44	E046	M	6	1	1	1	1	1	1		
	296-S-18	W096	V	2								
	296-S-25	W145	V	8	2	2	2	2	2	2		
	<b>296-W-4</b>	W123	BW	26	4	4	4	4	4	4	4	
WSCF	696-W-1	W010 <sup>e</sup>	M	4								
	696-W-2	W011 <sup>e</sup>	M	4								
PFP	<b>291-Z-1</b>	Z810	BW	26			4	4	4	4		
	296-Z-5	Z913	BW	4								
	296-Z-6	Z802	BW	4								
	<b>296-Z-7</b>	Z818	BW	26			4	4	4	4		
	296-Z-15	Z915	A	1								

Table A-1. Air Emissions Samples and Analyses for Calendar Year 2010. (3 sheets)

Facility or Project	Stack or Emission Point ID <sup>a</sup>	EDP Code (aka location code)	Time Period Per Sample	Analysis and Number of Samples Projected for Analysis							CACN	
				Particulate Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic Pu	<sup>241</sup> Pu	<sup>241</sup> Am	Tritium ( <sup>3</sup> H)		Ag-Zeolite
340 Facility	340-NT-EX	F002	BW	4								
	340-DECON	F009	BW	4								
324 Building	<b>EP-324-01-S</b>	F025	M	12	4	4	4	4	4			121857
FFTF	437-MN&ST	F014	W	4								400100
	437-1-61	F019	W	4								
<b>Totals</b>				<b>687</b>	<b>94</b>	<b>90</b>	<b>94</b>	<b>41</b>	<b>94</b>	<b>0</b>	<b>0</b>	

<sup>a</sup> A stack or emission point ID in boldface indicates it is a major stack or emission point, meaning the dose potential of its annual emissions exceeds 0.1 mrem/yr effective dose equivalent (EDE); conversely, all stacks or emission points in regular face are minor, meaning the dose potential of each is equal to or less than 0.1 mrem/yr EDE.

<sup>b</sup> K Basin Closure Project (KBCP) may inform WSCF that certain quarterly isotopic analyses will not be needed; this notification must be done in a timely manner before WSCF begins composite sample preparations. The reason KBCP would do this is when an exhaustor has not run for a particular quarter. (Note: The current KBCP policy with respect to the collection of point source emission samples at the K Basins is to exchange the filters and send them to WSCF for gross alpha and gross beta counts even when an exhaustor and/or sampler has not run during the respective sampling period.)

The following list associates K Basin EDP codes with respective exhaust points:

- Y234 = RV-11
- Y235 = RV-10
- Y236 = RV-6 & -7

<sup>c</sup> This sample is not the standard 47-mm Versapor 3000 particulate air filter but a small HEPA filter, the analysis of which is handled under an active Letter of Instruction between WSCF and KBCP.

<sup>d</sup> These monthly samples are not to be analyzed individually for gross alpha and gross beta but instead composited quarterly. Each composite sample will first have GEA performed on it before it is prepared for gross alpha and gross beta analysis using the WSCF AB-32 method, for which additional costs may be assessed.

<sup>e</sup> A sample of at least a 2-week duration (i.e., ≥ 336 hours) from each quarter is to be analyzed for gross alpha and gross beta.

Table A-2. Liquid Effluent Samples and Analyses for Calendar Year 2010.

Facility	Stream Code	EDP Code (aka location code)	Time Period per Sample	Analysis and Number of Samples Projected for Analysis				CACN
				Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic Pu	
100-K	1908-K	Y130	M	12	12	12	12	400100
100-K	1908-K	Y132	BW	26				400100
<b>Totals</b>				<b>38</b>	<b>12</b>	<b>12</b>	<b>12</b>	

Table A-3. Near-Facility Monitoring Air Samples and Analyses for Calendar Year 2010. (4 sheets)

Operating Area or Facility	EDP Code (aka location code)	Time Period per Sample	Analysis and Number of Samples Projected for Analysis							CACN	
			Particulate Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	<sup>241</sup> Am		Tritium ( <sup>3</sup> H)
100-D FR	N467	BW	26	2	2	2	2	2	2		
	N468	BW	26	2	2	2	2	2	2		
	N514	BW	26	2	2	2	2	2	2		
	N515	BW	26	2	2	2	2	2	2		
100-F FR	TBD	BW	17	2	2	2	2	2			
	TBD	BW	17	2	2	2	2	2			
	TBD	BW	17	2	2	2	2	2			
100-H FR	N508	BW	26	2	2	2	2	2		2	
	N509	BW	26	2	2	2	2	2		2	
	N510	BW	26	2	2	2	2	2		2	
	N574	BW	26	2	2	2	2	2		2	
100-K	N401	BW	26	2	2	2	2	2		2	
	N402	BW	26	2	2	2	2	2		2	
	N403	BW	26	2	2	2	2	2		2	
	N404	BW	26	2	2	2	2	2		2	
	N476	BW	26	2	2	2	2	2		2	
	N477	BW	26	2	2	2	2	2		2	
	N478	BW	26	2	2	2	2	2		2	
N479	BW	26	2	2	2	2	2		2		
118-K-1	N534	BW	26	2	2	2	2	2			
	N535	BW	26	2	2	2	2	2			
100-N D4	N102	BW	26	2	2	2	2	2		2	
	N103	BW	26	2	2	2	2	2		2	
	N106	BW	26	2	2	2	2	2		2	

Table A-3. Near-Facility Monitoring Air Samples and Analyses for Calendar Year 2010. (4 sheets)

Operating Area or Facility	EDP Code (aka location code)	Time Period per Sample	Analysis and Number of Samples Projected for Analysis						CACN		
			Particulate Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu		<sup>241</sup> Am	Tritium ( <sup>3</sup> H)
200 East Area	N019	BW	26	2	2	2	2	2			
	N158	BW	26	2	2	2	2	2			
	N498	BW	26	2	2	2	2	2			
	N499	BW	26	2	2	2	2	2			
	N532	BW	26	2	2	2	2	2			
	N957	BW	26	2	2	2	2	2			
	N559	BW	26	2	2	2	2	2			
	N967	BW	26	2	2	2	2	2			
	N968	BW	26	2	2	2	2	2			
	N969	BW	26	2	2	2	2	2			
	N970	BW	26	2	2	2	2	2			
	N972	BW	26	2	2	2	2	2			
	N973	BW	26	2	2	2	2	2			
	N976	BW	26	2	2	2	2	2			
	N977	BW	26	2	2	2	2	2			
	N978	BW	26	2	2	2	2	2			
	N984	BW	26	2	2	2	2	2			
	N985	BW	26	2	2	2	2	2			
N999	BW	26	2	2	2	2	2				
CSB	N480	BW	26	2	2	2	2	2	2	2	
	N481	BW	26	2	2	2	2	2	2	2	
BC Controlled Area	N572	BW	26	2	2	2	2	2			
	N573	BW	26	2	2	2	2	2			
200-N	N563	BW	26	2	2	2	2	2			
	N564	BW	26	2	2	2	2	2			
	N565	BW	26	2	2	2	2	2			
	N566	BW	26	2	2	2	2	2			

Table A-3. Near-Facility Monitoring Air Samples and Analyses for Calendar Year 2010. (4 sheets)

Operating Area or Facility	EDP Code (aka location code)	Time Period per Sample	Analysis and Number of Samples Projected for Analysis							CACN	
			Particulate Gross Alpha and Gross Beta	GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	<sup>241</sup> Am		Tritium ( <sup>3</sup> H)
200 West Area	N155	BW	26	2	2	2	2	2			
	N161	BW	26	2	2	2	2	2			
	N165	BW	26	2	2	2	2	2	2	2	
	N168	BW	26	2	2	2	2	2			
	N200	BW	26	2	2	2	2	2			
	N304	BW	26	2	2	2	2	2			
	N411	BW	26	2	2	2	2	2			
	N433	BW	26	2	2	2	2	2			
	N441	BW	26	2	2	2	2	2			
	N442	BW	26	2	2	2	2	2			
	N449	BW	26	2	2	2	2	2			
	N454	BW	26	2	2	2	2	2			
	N455	BW	26	2	2	2	2	2			
	N456	BW	26	2	2	2	2	2			
	N457	BW	26	2	2	2	2	2			
	N554	BW	26	2	2	2	2	2			
	N555	BW	26	2	2	2	2	2			
	N956	BW	26	2	2	2	2	2			
	N963	BW	26	2	2	2	2	2			
	N964	BW	26	2	2	2	2	2			
N965	BW	26	2	2	2	2	2				
N966	BW	26	2	2	2	2	2				
N974	BW	26	2	2	2	2	2				
N975	BW	26	2	2	2	2	2				
N987	BW	26	2	2	2	2	2				
N994	BW	26	2	2	2	2	2				

Table A-3. Near-Facility Monitoring Air Samples and Analyses for Calendar Year 2010. (4 sheets)

Operating Area or Facility	EDP Code (aka location code)	Time Period per Sample	Analysis and Number of Samples Projected for Analysis							CACN	
			Particulate Gross Alpha and Gross Beta	Quarterly or Semiannual Particulate Composite							Tritium ( <sup>3</sup> H)
				GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	<sup>241</sup> Am		
U Ancillary D&D	N550	BW	26	2	2	2	2			400100	
	N551	BW	26	2	2	2	2				
TEDF	N130	BW	26	2	2	2	2			400100	
Wye	N981	BW	26	2	2	2	2				
300-FE-2 FR	N527	BW	20	2	2	2	2				
618-10	N548	BW	20	2		2	2			121857	
	N549	BW	20	2		2	2				
	N579	BW	20	2		2	2				
	N580	BW	20	2		2	2				
300 Area D4	N557	BW	26	4	4	4	4			400100	
QA	N950	BW	26	2	2	2	2				
ERDF	N482	BW	26	2	2	2	2			121857	
	N517	BW	26	2	2	2	2				
	N518	BW	26	2	2	2	2				
<b>Totals</b>			<b>2,309</b>	<b>174</b>	<b>176</b>	<b>174</b>	<b>174</b>	<b>22</b>	<b>44</b>	<b>0</b>	

Table A-4. Near-Facility Monitoring Soil Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
100-H FR	D152	V	1	1	1	1		121857
	D176	V	1	1	1	1		
	D177	V	1	1	1	1		
	D178	V	1	1	1	1		
200 East Area	D053	BE						400100
	D054	BE	1	1	1	1		
	D055	BE						
	D056	BE	1	1	1	1		
	D057	BE						
	D058	BE	1	1	1	1		
	D059	BE						
	D060	BE	1	1	1	1		
	D061	BE						
	D062	BE	1	1	1	1		
	D063	BE						
	D064	BE	1	1	1	1		
	D065	BE						
	D066	BE	1	1	1	1		
D067	BE							
D068	BE	1	1	1	1			
D069	BE							
D070	BE	1	1	1	1			
D071	BE							
D072	BE	1	1	1	1			
D073	BE							
D074	BE	1	1	1	1			
D075	BE							
D076	BE	1	1	1	1			



Table A-4. Near-Facility Monitoring Soil Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
200 West Area (cont)	D008	BE	1	1	1	1		
	D009	BE						
	D010	BE	1	1	1	1		
	D011	BE						
	D012	BE	1	1	1	1		
	D013	BE						
	D014	BE	1	1	1	1		
	D015	BE						
	D016	BE	1	1	1	1		
	D017	BE						
	D018	BE	1	1	1	1		
	D019	BE						
	D020	BE	1	1	1	1		
	D021	BE						
	D022	BE	1	1	1	1		
	D023	BE						
	D024	BE	1	1	1	1		
	D025	BE						
	D026	BE	1	1	1	1		
	D027	BE						
	D028	BE	1	1	1	1		
	D029	BE						
	D030	BE	1	1	1	1		
	D031	BE						
	D032	BE	1	1	1	1		
	D033	BE						
	D034	BE	1	1	1	1		
	D035	BE						
	D036	BE	1	1	1	1		

Table A-4. Near-Facility Monitoring Soil Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN		
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu		<sup>241</sup> Am	
200 West Area (cont)	D037	BE								
	D038	BE	1	1	1	1				
	D039	BE								
	D040	BE	1	1	1	1				
	D041	BE								
	D042	BE	1	1	1	1				
	D043	BE								
	D044	BE	1	1	1	1				
	D045	BE								
	D046	BE	1	1	1	1				
	D047	BE								
	D048	BE	1	1	1	1				
	D049	BE								
	D050	BE	1	1	1	1				
	D051	BE								
D052	BE	1	1	1	1					
D111	BE									
D141	BE									
D142	BE	1	1	1	1					
300 Area	D116	A	1	1	1	1				
	D117	A	1	1	1	1				
	D118	A	1	1	1	1				
	D119	A	1	1	1	1				
	D120	A	1	1	1	1				
	D121	A	1	1	1	1				
	D122	A	1	1	1	1				
	D123	A	1	1	1	1				
	D124	A	1	1	1	1				
	D125	A	1	1	1	1				
	400100									

Table A-4. Near-Facility Monitoring Soil Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
300 Area (cont)	D126	A	1	1	1	1		
	D127	A	1	1	1	1		
	D128	A	1	1	1	1		
	D129	A	1	1	1	1		
	D131	A	1	1	1	1		
	D132	A	1	1	1	1		
	D139	A	1	1	1	1		
	D140	A	1	1	1	1		
	D130	A	1	1	1	1		
	D081	BE						
D082	BE	1	1	1	1			
D083	BE							
D084	BE	1	1	1	1			
D085	BE							
D086	BE	1	1	1	1			
D087	BE							
D088	BE	1	1	1	1			
D089	BE							
D090	BE	1	1	1	1			
D091	BE							
D092	BE	1	1	1	1			
D093	BE							
D094	BE	1	1	1	1			
D113	BE							
D114	BE	1	1	1	1			
D115	BE							
400 Area								400100
600 Area								

Table A-4. Near-Facility Monitoring Soil Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
ERDF	D146	A	1	1	1	1		121857
<b>Totals</b>			<b>83</b>	<b>83</b>	<b>83</b>	<b>83</b>	<b>0</b>	<b>0</b>

Table A-5. Near-Facility Monitoring Vegetation Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
100-N D4	Y718	A	1	1	1	1		121857
	Y719	A	1	1	1	1		
	Y724	A	1	1	1	1		
200 East Area	V053	BE						400100
	V054	BE	1	1	1	1		
	V055	BE						
	V056	BE	1	1	1	1		
	V057	BE						
	V058	BE	1	1	1	1		
	V059	BE						
	V060	BE	1	1	1	1		
	V061	BE						
	V062	BE	1	1	1	1		
	V063	BE						
	V064	BE	1	1	1	1		
	V065	BE						
	V066	BE	1	1	1	1		
V067	BE							
V068	BE	1	1	1	1			
V069	BE							
V070	BE	1	1	1	1			
V071	BE							
V072	BE	1	1	1	1			
V073	BE							
V074	BE	1	1	1	1			

Table A-5. Near-Facility Monitoring Vegetation Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN	
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu		<sup>241</sup> Am
200 East Area (cont)	V075	BE							
	V076	BE	1	1	1	1			
	V077	BE							
	V078	BE	1	1	1	1			
	V079	BE							
	V080	BE	1	1	1	1			
	V142	BE	1	1	1	1			
	V001	BE							
200 West Area	V002	BE	1	1	1	1			
	V003	BE							
	V004	BE	1	1	1	1			
	V005	BE							
	V006	BE	1	1	1	1			
	V007	BE							
	V008	BE	1	1	1	1			
	V009	BE							
	V010	BE	1	1	1	1			
	V011	BE							
	V012	BE	1	1	1	1			
	V013	BE							
V014	BE	1	1	1	1				
V015	BE								
V016	BE	1	1	1	1				
V017	BE								
V018	BE	1	1	1	1				
V019	BE								
V020	BE	1	1	1	1				

Table A-5. Near-Facility Monitoring Vegetation Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN	
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu		<sup>241</sup> Am
200 West Area (cont)	V021	BE							
	V022	BE	1	1	1	1			
	V023	BE							
	V024	BE	1	1	1	1			
	V025	BE							
	V026	BE	1	1	1	1			
	V027	BE							
	V028	BE	1	1	1	1			
	V029	BE							
	V030	BE	1	1	1	1			
	V031	BE							
	V032	BE	1	1	1	1			
	V033	BE							
	V034	BE	1	1	1	1			
	V035	BE							
	V036	BE	1	1	1	1			
	V037	BE							
V038	BE	1	1	1	1				
V039	BE								
V040	BE	1	1	1	1				
V041	BE								
V042	BE	1	1	1	1				
V043	BE								
V044	BE	1	1	1	1				
V045	BE								
V046	BE	1	1	1	1				
V047	BE								

Table A-5. Near-Facility Monitoring Vegetation Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
200 West Area (cont)	V048	BE	1	1	1	1		
	V049	BE						
	V050	BE	1	1	1	1		
	V051	BE						
	V052	BE	1	1	1	1		
	V112	BE	1	1	1	1		
300 Area	V116	A	1	1	1	1		
	V117	A	1	1	1	1		
	V118	A	1	1	1	1		
	V119	A	1	1	1	1		
	V120	A	1	1	1	1		
	V121	A	1	1	1	1		
	V122	A	1	1	1	1		
	V123	A	1	1	1	1		
	V124	A	1	1	1	1		
	V125	A	1	1	1	1		
	V126	A	1	1	1	1		
	V127	A	1	1	1	1		
400 Area	V128	A	1	1	1	1		
	V129	A	1	1	1	1		
	V131	A	1	1	1	1		
	V132	A	1	1	1	1		
	V138	A	1	1	1	1		
	V130	A	1	1	1	1		

Table A-5. Near-Facility Monitoring Vegetation Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
600 Area	V081	BE						400100
	V082	BE	1	1	1	1		
	V083	BE						
	V084	BE	1	1	1	1		
	V085	BE						
	V086	BE	1	1	1	1		
	V087	BE						
	V088	BE	1	1	1	1		
	V089	BE						
	V090	BE	1	1	1	1		
	V091	BE						
	V092	BE	1	1	1	1		
	V093	BE						
	V094	BE	1	1	1	1		
	V095	BE						
	V096	BE	1	1	1	1		
	V097	BE						
V098	BE	1	1	1	1			
V099	BE							
V100	BE	1	1	1	1			
V101	BE							
V102	BE	1	1	1	1			
V103	BE							
V104	BE	1	1	1	1			
V105	BE							
V106	BE	1	1	1	1			
V107	BE							

Table A-5. Near-Facility Monitoring Vegetation Samples and Analyses for Calendar Year 2010. (6 sheets)

Operating Area	EDP Code (aka location code)	Sampling Frequency	Analysis and Number of Samples Projected for Analysis					CACN
			GEA	<sup>90</sup> Sr	Isotopic U	Isotopic Pu	<sup>241</sup> Pu	
600 Area (cont)	V108	BE	1	1	1	1		
	V109	BE						
	V110	BE	1	1	1	1		400100
	V114	BE	1	1	1	1		
<b>Totals</b>			<b>79</b>	<b>79</b>	<b>79</b>	<b>79</b>	<b>0</b>	<b>0</b>

**APPENDIX B**

**METHOD 114 POINT-BY-POINT COMPARISON  
WITH ANALYTICAL METHODS USED AT THE WASTE SAMPLING  
AND CHARACTERIZATION FACILITY**

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**APPENDIX B****METHOD 114 POINT-BY-POINT COMPARISON  
WITH ANALYTICAL METHODS USED AT THE WASTE SAMPLING  
AND CHARACTERIZATION FACILITY**

In this appendix, emissions monitoring practices and analytical methods at the Waste Sampling and Characterization Facility (WSCF) have been evaluated to determine their state of compliance with the radionuclide emission requirements defined in 40 CFR 61, Subpart H, specifically Method 114 of Appendix B.

Radioactive constituents in air emissions from emission points (e.g., stacks) at the Hanford Site are well characterized. The characterizations are in complete agreement with the nature of the operations carried out in respective facilities that generate radioactive air emissions. The laboratory ordinarily receives biweekly, monthly, or quarterly stack air filter samples, depending on the respective NESHAP category of stack; that is, major or minor and unique mandatory monitoring requirements imposed on each stack. The filters used for sampling are usually 47 millimeters in diameter and composed of acrylic copolymer on a nonwoven backing. Before analysis is performed, samples are held for seven days from the date of collection to allow the nearly complete decay of radon and its daughter products, which can be present on the filters.

After the seven-day decay period, gross alpha and gross beta activities on the air particulate samples are determined. Those counts are performed to make a quick evaluation of activity levels in the stack air streams. Soon after the filters are counted, radiological control, effluent monitoring, and facility effluent personnel can access the analysis data via ABCASH. Hard copies of data reports can also be requested.

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, generally, biweekly gross alpha and gross beta measurements of stack emissions is made, assuming in most cases that the most limiting alpha-emitting particulate radionuclide is  $^{239/240}\text{Pu}$  and the most limiting beta-emitting particulate radionuclide is  $^{90}\text{Sr}$ .

To ensure compliance with the dose standard is maintained, WSCF, as directed, performs specific radionuclide analyses on composites of filters collected generally during a single calendar quarter. Those analyses include gamma-energy analysis (GEA), specific analysis for Pu and Am isotopes, and specific analysis for Sr isotopes. Currently, sampling for  $^{129}\text{I}$  is conducted on emissions from the PUREX main stack. Silver-zeolite cartridges are used to collect those samples. The cartridges are sent to WSCF for analysis, which includes gamma-energy analysis.

GEA would be the first analysis performed on a composite sample. GEA determines the activities of the gamma emitters, particularly  $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{154}\text{Eu}$ ,  $^{106}\text{Ru}$ ,  $^{125}\text{Sb}$  and any other positive gamma peaks, except radon and thoron daughters. After GEA is complete, the composite of air filters is ashed, dissolved, leached, appropriately treated, and mounted for analysis of individual alpha emitters and beta emitters, depending on the analyses requested.

For compliance purposes, analyses performed at WSCF are compared in a point-by-point fashion with the analytical requirements in Method 114 of Appendix B of Subpart H of 40 CFR 61. The point-by-point comparison of verbatim Method 114 requirements and the WSCF determination of compliance with those requirements, shown as "response" statements, follows from here.

## METHOD 114 — TEST METHODS FOR MEASURING RADIONUCLIDE EMISSIONS FROM STATIONARY SOURCES

### 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” is 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:* No response required. [Note: Responses are in boldface text.]**

### 2. *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.

***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 N13.1-1999 (section 6.6.2 Filter media) shall be followed in using filter media to collect particulates (incorporated by reference-see §61.18 of this part).

***Response:* WSCF uses such a filter medium (i.e., a Versapor 3000 [Note: Versapor is a trademark name of the Pall Corporation, Ann Arbor, Michigan], or equivalent, filter) to collect samples from its two minor stacks.**

#### 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.

**Response: Not applicable to WSCF.**

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.

**Response: Not applicable to WSCF.**

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 sorbers may include charcoal or metal zeolite.

**Response: Not applicable to WSCF.**

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.

**Response: Not applicable to WSCF.**

### 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. 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:* This method involves dissolution, chemical separation, followed by alpha spectrometry. This method meets all the requirements of the EPA-suggested method. This method is used for analyzing  $^{241}\text{Am}$ ,  $^{238}\text{Pu}$ , and  $^{239,240}\text{Pu}$  collected on air filter samples. The activities of these isotopes are determined by direct comparison with the recoveries of certified  $^{243}\text{Am}$  and  $^{236}\text{Pu}$  or  $^{242}\text{Pu}$  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 an 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 gross alpha emitter activity of the separated element is not used because more than one alpha might 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 [“full width, half max” or better]), ASTM-D-3084(16).

**Response: This is not done at WSCF. However, this method is used by the 222-S Laboratory Complex counting room for emergency air samples (i.e., samples in “red-bordered” envelopes, marked as such for special processing and handling). The 222-S Laboratory Complex counting room works to its own procedures for gross alpha counts and for alpha spectrometry. The sample is counted on the alpha counter of known efficiency to obtain the gross 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 gross 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 determinations 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. The WSCF method meets all of the requirements stated in the EPA-suggested method.**

### 3.1.5 Method A-5, Chemical Determination of Uranium

*Principle:* 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 absorbance 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-E-318(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 ( $^{234}\text{U}$ ,  $^{235}\text{U}$  and  $^{238}\text{U}$ ) are required, the filter sample undergoes dissolution, followed by column separation, and the mount gets counted by AEA.**

### 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 correlated 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  $^{222}\text{Rn}$  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 than 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  $^{90}\text{Sr}/^{90}\text{Y}$  in air filter samples meets the requirements for dissolution of filters of the Versapor type, chemical separation by Sr-spec resins, and gross beta counting.**

### 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 that uses a pulse-height discriminator to separate alpha and beta activity. Gross-beta determination by the laboratory 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  $^{147}\text{Pm}$  or  $^3\text{H}$ .**

## 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 (MCA). Samples collected in silver-zeolite cartridges are counted on a n-type high-purity Ge detector (very useful for low-energy gamma rays and x-rays). The WSCF method uses gamma-ray**

**spectroscopy with high-resolution germanium detectors that meet all the requirements of 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 at WSCF.**

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 at WSCF.**

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 above 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 with 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 an MCA are used for alpha counting of air filters at WSCF. WSCF equipment meets 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 anthracene 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 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. The charged pair is collected by an applied electrical field. A very stable low noise preamplifier amplifies the pulses of electrical charge resulting from the gamma photon interactions. Multi-channel 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 (aka closed-end HPGe coaxial) detectors connected to computer controlled MCAs are used for air filter analysis. WSCF equipment exceeds 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 that emits various gamma rays ranging from 59 to 1,850 keV is used, employing vendor-supplied calibration software to construct efficiency-versus-energy calibration curves for different geometrical configurations used in gamma analysis. The calibration procedure for gamma-ray spectrometer meets EPA criteria for gamma-ray spectroscopic analysis.**

**For calibration of beta detectors for  $^{90}\text{Sr}/^{90}\text{Y}$  analysis, a procedure is used that 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 calibration follows laboratory procedures. For gross alpha and gross beta measurements, WSCF instruments are calibrated separately with vendor-supplied certified filter standards made with NIST-traceable alpha-emitting  $^{241}\text{Am}$  and beta-emitting  $^{137}\text{Cs}$  standards, respectively, fabricated into the filter sample counting geometry.**

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

The reasons for choosing the <sup>241</sup>Am standard for alpha calibration are as follows:

- <sup>241</sup>Am is one of the alpha emitters commonly found in stack air samples.
- Alpha counting efficiency for <sup>241</sup>Am is usually the same for other alpha emitters also found in the air stack samples.
- The <sup>241</sup>Am standard 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 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 have 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:** Air samples from stacks are well characterized. Some of the radionuclides identified (e.g., <sup>241</sup>Am, <sup>238</sup>Pu, <sup>239,240</sup>Pu, <sup>90</sup>Sr, and <sup>137</sup>Cs) are listed in Table 1 of Method 114 and are analyzed according to the approved methods given in Table 1. Other radionuclides (<sup>129</sup>I, <sup>106</sup>Ru, <sup>125</sup>Sb) not listed in Table 1 are analyzed depending on the type of radiation, as 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 [from 40 CFR 61]. 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.

Table 1\_List of Approved Methods for Specific Radionuclides

Radionuclide	Approved methods of analysis
Am-241.....	A-1, A-2, A-3, A-4
Ar-41.....	B-1, B-2, G-1, G-2, G-3, G-4
Ba-140.....	G-1, G-2, G-3, G-4
Br-82.....	G-1, G-2, G-3, G-4
C-11.....	B-1, B-2, G-1, G-2, G-3, G-4
Ca-45.....	B-3, B-4, B-5
Ce-144.....	G-1, G-2, G-3, G-4
Cm-244.....	A-1, A-2, A-3, A-4
Co-60.....	G-1, G-2, G-3, G-4
Cr-51.....	G-1, G-2, G-3, G-4
Cs-134.....	G-1, G-2, G-3, G-4
Cs-137.....	G-1, G-2, G-3, G-4
Fe-55.....	B-5, G-1
Fe-59.....	G-1, G-2, G-3, G-4

Ga-67 .....	G-1, G-2, G-3, G-4
H-3 (H[INF]2[INF]0) .....	B-5
H-3 (gas).....	B-1
I-123 .....	G-1, G-2, G-3, G-4
I-125 .....	G-1
I-131 .....	G-1, G-2, G-3, G-4
In-113m.....	G-1, G-2, G-3, G-4
Ir-192.....	G-1, G-2, G-3, G-4
Kr-85 .....	B-1, B-2, B-5, G-1, G-2, G-3, G-4
Kr-87 .....	B-1, B-2, G-1, G-2, G-3, G-4
Kr-88 .....	B-1, B-2, G-1, G-2, G-3, G-4
Mn-54.....	G-1, G-2, G-3, G-4
Mo-99.....	G-1, G-2, G-3, G-4
N-13.....	B-1, B-2, G-1, G-2, G-3, G-4
O-15.....	B-1, B-2, G-1, G-2, G-3, G-4
P-32 .....	B-3, B-4, B-5
Pm-147 .....	B-3, B-4, B-5
Po-210 .....	A-1, A-2, A-3, A-4
Pu-238 .....	A-1, A-2, A-3, A-4
Pu-239 .....	A-1, A-2, A-3, A-4
Pu-240 .....	A-1, A-2, A-3, A-4
Ra-226.....	A-1, A-2, G-1, G-2
S-35 .....	B-5
Se-75 .....	G-1, G-2, G-3, G-4
Sr-90.....	B-3, B-4, B-5
Tc-99 .....	B-3, B-4, B-5
Te-201 .....	G-1, G-2, G-3, G-4
Uranium (total alpha) .....	A-1, A-2, A-3, A-4
Uranium (Isotopic) .....	A-1, A-3
Uranium (Natural) .....	A-5
Xe-133.....	G-1
Yb-169.....	G-1, G-2, G-3, G-4
Zn-65 .....	G-1, G-2, G-3, G-4

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**Response:** This is not applicable because the air effluents from the main stacks are well characterized. However, gross alpha and gross beta analyses of air samples are routinely 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 gross beta analysis results are compared for compliance to those listed in the appendix of DOE Order 5400.5.

#### 4. *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: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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

**Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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.

**Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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

**Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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.

**Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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:**

- **Gross alpha and gross beta activities are determined on generally biweekly samples. The calibration procedure is documented. 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 separately ( $^{147}\text{Pm}$  for low-energy beta,  $^{60}\text{Co}$  for mid-energy beta,  $^{137}\text{Cs}$  for high-energy beta, and  $^{241}\text{Am}$  for alpha activity). When a batch of air filter samples is run, all the performance standards are also run with the sample. To verify that the counting system is working properly, the standard values from analysis should fall within the administrative limits set according to the statement of work and WSCF procedures. Note that the results for  $^{147}\text{Pm}$  and  $^{60}\text{Co}$  are used for informational purposes only.**
- **The WSCF method for analyzing alpha emitters ( $^{241}\text{Am}$ ,  $^{238}\text{Pu}$ , and  $^{239/240}\text{Pu}$ ) involves various steps for dissolution, chemical separation, and final alpha spectrometry. The analysis of specific alpha emitters is usually done on only quarterly composites of typically biweekly air filters. A pulser check is performed daily at a specified energy level within the range of 4 to 6 MeV on each alpha chamber of the AEA system. This check is intended to get a quick evaluation of the energy calibration and resolution of the alpha detector. Efficiency calibration of the AEA is performed according to WSCF procedure. The chemical yield used to correct the**

analyte activity is determined by using radioactive tracers ( $^{243}\text{Am}$  and  $^{242}\text{Pu}$  or  $^{236}\text{Pu}$ ). Also, direct comparison of the sample response with the tracer response ( $^{243}\text{Am}$  and  $^{236}\text{Pu}$  or  $^{242}\text{Pu}$ ) can be made to determine the activities of the radionuclides  $^{241}\text{Am}$  and  $^{238,239/240}\text{Pu}$  present in the sample. For routine operation, AEA system performance is checked once every week using a mixed alpha source standard. The FWHM, peak centroid, and activity are monitored using statistical or fixed limits. Counting frequency of performance check standards is performed according to WSCF procedure. 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 laboratory method for determining  $^{90}\text{Sr}/^{90}\text{Y}$ -beta activity consists of a dissolution step and chemical separation, followed by total-beta counting. Analysis is usually done on only quarterly composites of typically biweekly air filters per collection point. A calibration procedure for window-type gas-flow proportional counters is used in conjunction with a procedure for mother/daughter cases (e.g.,  $^{90}\text{Sr}/^{90}\text{Y}$  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 ( $^{60}\text{Co}$  and  $^{137}\text{Cs}$  for beta activity) with each batch of samples. The complete procedure for the  $^{90}\text{Sr}/^{90}\text{Y}$  analysis in the sample is carried out with a method standard (several filter papers spiked with  $^{90}\text{Sr}$ ,  $^{241}\text{Am}$ ,  $^{239}\text{Pu}$ ) on a batch basis. This checks the overall method performance. The chemical yield is determined by using the appropriate radioactive tracers ( $^{85}\text{Sr}$ ) or stable Sr carrier.
- For analysis of gamma emitters  $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ ,  $^{106}\text{Ru}$ ,  $^{60}\text{Co}$ ,  $^{152}\text{Eu}$ ,  $^{154}\text{Eu}$ ,  $^{155}\text{Eu}$ ,  $^{125}\text{Sb}$ , and any other positive gamma peak except radon and thoron daughters, a WSCF procedure is followed. Analysis is done on quarterly composites of typically biweekly air filter samples. Analysis of volatile radionuclides ( $^{129}\text{I}$ ,  $^{106}\text{Ru}$ ,  $^{125}\text{Sb}$ ) collected monthly on silver zeolite cartridges are performed to procedure. Calibration of the gamma ray spectrometer is done with the procedure documented 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  $^{241}\text{Am}$  for low energy,  $^{137}\text{Cs}$  for mid energy, and  $^{60}\text{Co}$  for high energy. The analytical results on each of these radionuclides should fall within the administratively limits set according to the laboratory QA plan or appropriate description-of-services document. 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, the adjustment is followed by analysis of a performance check standard at a scientist's discretion. For a major shift in the calibration, the system is thoroughly calibrated for both energy and efficiency.
- The content of the WSCF procedures, test plans, supporting documents, and drawings provides a sufficient level of detail to allow trained personnel to safely produce quality results. 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 peer and technical reviewers. While authors are responsible for the specific content of their procedures, authors address the following:

**Summary** - MANDATORY. A short description or abstract of the procedure is provided containing enough information to distinguish this procedure from other procedures.

**Applications** - MANDATORY. The scope and purpose of the specific procedure is defined. This section could be combined with the following element under the title “Applications and Limitations.”

**Limitations** - MANDATORY. A brief description of those areas in which the procedure is not applicable. A statement of accuracy and precision is given where appropriate.

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

**Approval Designator** - MANDATORY. Approval designators are identified for each procedure with a brief basis of determination statement.

The procedures usually are 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.

**Safety** - MANDATORY. The procedure must identify applicable safety hazards.

**Reagents** - If the procedure requires analytical reagents, a list of reagents is provided. Material safety data sheets (MSDS) are available. Reagent makeup, storage container requirements, unique storage needs, shelf-life requirements, special labeling, and special preparation steps are included when applicable. Reagent preparation described fully in other current documentation could be included by reference.

**Equipment** - Special equipment needs are 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 is referenced or described in this section.

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

**Calculations** - Calculations required to complete the work are described. Examples with sample values can be included. All combined factors are described fully and units noted.

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

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

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

**The mandatory topics are addressed WSCF analytical procedures. However, the laboratories have operational, 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.

**Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

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

**Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.**

4.4 The objectives of the quality assurance program shall be documented and 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.

**Response: Refer to Section 3.4 of the main body of this document, HNF-EP-0835, Rev. 16.**

**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 (RSD) or relative percent difference (RPD). The RSD is used when at least three replicate measurements are performed on a given technique. The RSD is computed using the following equation:**

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

**The RPD is used when two measurements exist. The RPD is computed using the following equation:**

**$RPD = (x_1 - x_2) * 100 / \bar{x}$ , where  $x_1, x_2$  are observed values and  $\bar{x}$  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 (U.S. DOE Mixed Analyte Performance Evaluation Program) might be used to provide the percent recovery (P). However, this can be superseded by the customer's requirements as stated in a description-of-services document or 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 reported data compared to the amount of data requested, as defined in a description-of-services document or a statement of work (i.e., HNF-PRO-0835).**

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.

**Response: 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 could affect the quality of the AMS. Where possible, the QC options presented are used. Each analytical batch has 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 stack sample collection point produces only one record sample filter that is sent to the laboratory for analysis; no replicate samples are available, although ambient air samples can be "duplicated" to yield essentially a replicate or split sample. 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  $^{243}\text{Am}$ ,  $^{242}\text{Pu}$  ( or  $^{236}\text{Pu}$ ) and  $^{85}\text{Sr}$  are used in the analysis of  $^{241}\text{Am}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ , and  $^{90}\text{Sr}$ , respectively, in the quarterly composites of 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 would be homogeneous. Because of this, no sampling procedure, such as splitting, can be assured of producing two representative portions. Splitting the sample in effect dilutes the sample, which would adversely affect 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 (i.e., planchets) are used to check the background of the counting instrument.**

**The parameters used in a 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 might 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 annual statement of work the Effluent and Environmental Monitoring Program has with WSCF.**

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 Laboratory Information Management System (LIMS) such as Multi-LIMS and Omni-LIMS. These charts are updated and evaluated regularly.

The WSCF Radiochemistry Laboratory Quality Control Program also includes participation in the U.S. DOE Mixed Analyte Performance Evaluation Program.

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.

*Response:* These samples come from fixed sample points and are analyzed according to an established description-of-services document that is reviewed and revised annually.

When barcoding of samples is performed, traceability begins with the ABCASH database issuance of a unique sample identifier (in this format: Sxxxxxx) for the customer. With this number, the database references the sample point and the 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, through shipping, 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, such as Omni-LIMS or equivalent, where another unique identifier is issued (WYYFxxxxxxx). For each sample covered by the description-of-services document, the Omni-LIMS or equivalent has the associated required analysis protocols and analytes. The database generates a worklist that lists each sample by both laboratory and customer identification, and the required analyses. The results of the initial analyses are transferred electronically from the instrument to the Omni-LIMS or equivalent 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 Omni-LIMS or equivalent, and again, after validation, the results are sent electronically to the customer's database (i.e., Environmental Release Summary [ERS]) database via ABCASH.

4.7 Regular maintenance, calibrations and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table 2: Maintenance, Calibration and Field Check Requirements.

Table 2 – Maintenance, Calibration, and Field Check Requirements

Sampling System Components	Frequency of Activity
Cleaning of thermal anemometer.	As required by application
Inspect pitot tubes for contaminant deposits.	At least annually.
Inspect pitot tube systems for leaks.	At least annually.
Inspect sharp-edged nozzles for damage.	At least annually or after maintenance that could cause damage.
Check nozzles for alignment, presence of deposits, or other potentially degrading factors.	Annually.
Check transport lines of HEPA-filtered applications to determine if cleaning is required.	Annually.

Clean transport lines.	Visible deposits for HEPA-filtered applications. Surface density of 1 g/cm <sup>2</sup> for other applications.
Inspect or test the sample system for leaks.	At least annually.
Check mass flow meters of sampling systems with a secondary or transfer standard.	At least quarterly.
Check sampling flow rate through critical flow venturis.	At the start of each sampling period.
Inspect rotameters of sampling systems for presence of foreign matter.	At the start of each sampling period.
Check response of stack flow rate systems.	At least quarterly.
Calibration of flow meters of sampling systems.	At least annually.
Calibration of effluent flow measurement devices.	At least annually.
Calibration of timing devices.	At least annually.

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***Response: Not applicable.***

4.8 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: Laboratory and data quality personnel perform internal audits on laboratory analytical activities. Those 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 personnel.***

4.9 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.

***Response: WSCF follows the corrective action system defined in HNF-SD-CP-QAPP-017 and in MSC-PRO-052, Corrective Action Management.***

4.10 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.

***Response: Not applicable to this point-by-point comparison focused on WSCF analytical methods.***

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

***Response: Refer to HNF-SD-CP-QAPP-017, MSC-23333, and to Section 3.4 of this document, HNF-EP-0835, Rev. 16.***

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