Appendix D

2008 National Emissions Standards for Hazardous Air Pollutants (NESHAP) Annual Report

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U.S. Department of Energy
Radionuclide Air Emissions Annual Report
(Under Subpart H of 40 Code of Federal Regulations Part 61)
Calendar Year 2008

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Acronyms

AMS	air monitoring station
°C	degrees Celsius
CFR	*Code of Federal Regulations*
cm	centimeter
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FCP	Fernald Closure Project
ft^3/min.	cubic feet per minute
km	kilometer
m^3/min.	cubic meters per minute
mrem	millirem
mSv	millisieverts
NESHAP	National Emission Standards for Hazardous Air Pollutants
OEPA	Ohio Environmental Protection Agency
pCi/m^3	picocuries per cubic meter
USC	*United States Code*

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Introduction

On May 23, 1997, the U.S. Department of Energy (DOE) Fernald Closure Project (FCP) submitted a written request to the U.S. Environmental Protection Agency (EPA) for approval to use an alternate approach for demonstrating compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H requirements (DOE 1997). The alternate approach uses environmental measurements of airborne radionuclide concentrations (as provided for under Title 40, *Code of Federal Regulations*, Part 61.93[b][5]), rather than air dispersion modeling, to demonstrate that radionuclide emissions resulting from operations at the former FCP were below the annual NESHAP Subpart H standard. The request for approval of the alternative approach was driven by the recognition that the dominant sources of radiological emissions at the Fernald site had changed as the mission of the site changed from uranium metal production (which ended in 1989) to environmental remediation (which ended in 2006 for all projects except aquifer restoration). During production, the primary emission sources from the facility were point sources (stacks and vents), and during environmental remediation the dominant sources were fugitive emissions from large-scale excavations, wind erosion from stockpiled materials, and decontamination and dismantling activities. Presently, the Fernald Preserve is a wildlife preserve, and the dominant emission source is soil.

Because there was a high degree of uncertainty associated with modeling fugitive emissions during the environmental remediation activities, environmental measurements were proposed as an alternative to provide a more accurate assessment of the site's emissions. On August 11, 1997, EPA granted approval to use environmental measurements as an alternative methodology for demonstrating NESHAP compliance (EPA 1997). The FCP began using environmental measurements for NESHAP compliance purposes in 1998.

Summary

For calendar year 2008, the maximum effective dose equivalent from emissions of radionuclides to the ambient air is estimated to be 0.017 millirem per year (0.00017 millisieverts per year [mSv/yr]) above background, which is in compliance with the Subpart H standard of less than 10 mrem/yr (0.1 mSv/yr) above background. This estimate is based on the Fernald Preserve's radiological air particulate monitoring program, which consists of five high-volume air monitoring stations operated at the Fernald Preserve boundary and one background location.

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D.1.0 Facility Information

D.1.1 Site Description

The Fernald Preserve is located on a 1,050-acre (425-hectare) area approximately 18 miles (29 kilometers [km]) northwest of downtown Cincinnati, Ohio, just north of the small farming community of Fernald, Ohio (Figure D−1). A former production area covered approximately 136 acres (55 hectares) in the center of the Fernald Preserve, which is located outside of the 500-year flood plain of the Great Miami River in an ancestral river valley known as the New Haven Trough. The area immediately surrounding the Fernald Preserve is rural in nature and characterized by the predominance of agriculture, with some light industry and private residences.

The climate is characterized as continental to subtropical, with average temperatures ranging from approximately 31 °F (–0.7 °C) in December to 76 °F (25 °C) in July. Average annual precipitation is approximately 40 inches (102 centimeters [cm]). Prevailing wind flow is from the southwest (Figure D−2).

For 37 years, the former Feed Materials Production Center produced uranium metal products for DOE and its predecessors. On July 10, 1989, uranium metal production was suspended and management responsibilities at the Fernald site were transferred from the Defense Programs to the U.S. Department of Energy (DOE) Office of Environmental Restoration and Waste Management.

Remedial action activities at the Fernald site were conducted under the Comprehensive Environmental Response, Compensation, and Liability Act. These activities included sample analysis; waste characterization; the management, treatment, storage, and disposal of hazardous, mixed, low-level and solid wastes; the decontamination and demolition of radioactively contaminated equipment and buildings, and clean-up of the contaminated soil and groundwater. The site also managed containerized thorium wastes and the K-65 Silos waste material, which contained radium. All remedial actions, with the exception of groundwater restoration, were completed in October 2006.

D.1.2 Source Descriptions

For calendar year (CY) 2008, wind erosion of soil is the only potential radionuclide emission source at the Fernald Preserve. The primary radioactive airborne contaminants at the Fernald Preserve consist of radium, thorium, and uranium isotopes that are present in soil at concentrations below the Operable Unit 5 final remediation levels. Additional radioactive isotopes in the soil consist of daughter products from the uranium (U-235 and U-238) and thorium decay chains.

D.1.3 Radiological Air Particulate Monitoring Program Description

The Fernald Preserve's radiological air monitoring program for CY 2008 is defined in Attachment D (Integrated Environmental Monitoring Plan) of the 2008 *Comprehensive Legacy Management and Institutional Controls Plan* (DOE 2008). The program design applicable to air monitoring, as approved by the U.S. Environmental Protection Agency (EPA), is summarized in the following subsections.

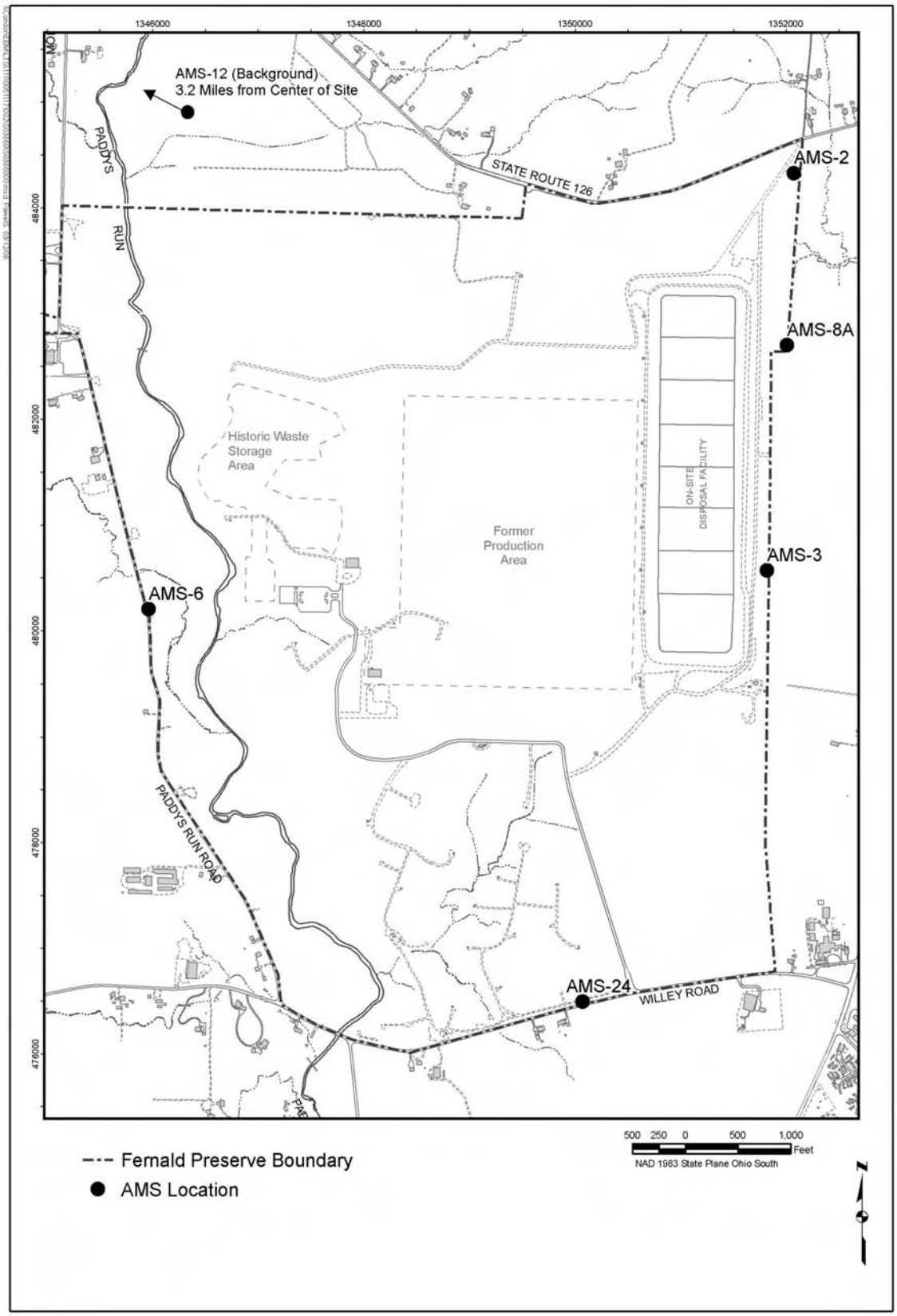

Figure D−1. Radiological Air Monitoring Locations

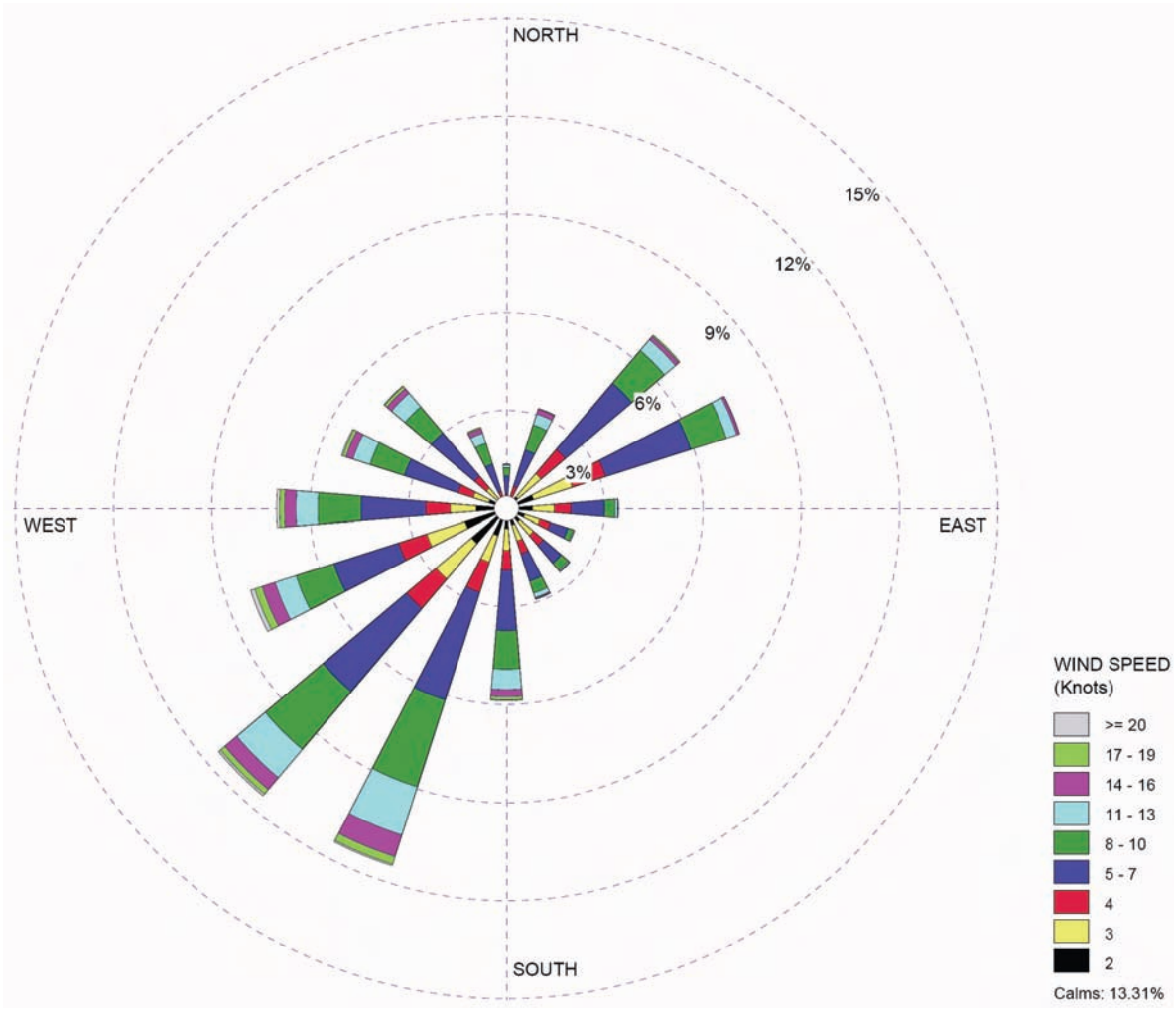

Figure D−2. Five-Year Average (2002–2006) Wind Rose, 33-ft (10-m) Height

D.1.3.1 Monitoring Equipment and Locations

Six high-volume air-monitoring stations (AMSs) (Figure D−1) draw air continuously through an 8-inch by 10-inch filter at a rate of 40 to 50 cubic feet per minute (ft^3/min) (1.13 to 1.42 cubic meters per minute [m^3/min]). Each AMS contains a flow-rate chart recorder and a hour-meter that provide a record of the monitor's operational run time over the sampling period. Additionally, each AMS is equipped with flow controllers that maintain a constant airflow through the monitor and automatically adjust blower/motor speed to correct for variations in line voltage, temperature, pressure, or filter loading.

The six AMSs are divided among boundary and background monitoring locations. Five monitors are located on the Fernald Preserve boundary, and one monitor collects background data at a location approximately 3.2 miles (5.2 km) from the center of the Fernald Preserve.

The EPA criteria for locating air monitors (40 CFR 58, Appendix E) were considered when selecting the initial 16 boundary locations. Reduction of the initial 16 locations to the present five stations was discussed with and approved by the EPA (DOE 2006a, DOE 2006b).

D.1.3.2 Analytical Regime and Sampling Frequency

The analytical regime and sampling frequency for this program were designed to collect defensible data, account for the major dose sources and demonstrate compliance with NESHAP Subpart H, as defined in 40 CFR 61.93(b)(5)(ii).

- Filters were exchanged monthly throughout the year and were analyzed for total uranium and total particulates to document emissions originating from wind erosion of soil at the Fernald Preserve. (NOTE: uranium results for July are unavailable, as the analytical laboratory inadvertently disposed of the samples after measuring total particulate.)
- A portion of each monthly filter was retained and used to form a quarterly composite sample. (NOTE: the third quarter composite consisted of samples from August and September, as the laboratory inadvertently disposed of the July samples.) The composite samples were analyzed for radium-226, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238. Results from the quarterly composite samples are used to track compliance with the NESHAP Subpart H standard for the calendar year.
- The isotope list for the quarterly results used for NESHAP compliance is based on:
  - — Radionuclides that were stored in large quantities at the Fernald site and were handled or processed during the remediation effort (all noted isotopes).
  - — Radionuclides that were the major contributors to dose based on environmental and stack filter measurements (uranium-234, uranium-235 and uranium-238).
  - — Radionuclides in waste and contaminated soil that were the major contributors to dose during remedial actions (uranium-234, uranium-235, uranium-238, thorium-228, and thorium-230).

Uranium-238, thorium-232, and uranium-235 are the parent nuclides in the uranium, thorium, and actinide decay chains, respectively. Presently, the only applicable source for the isotopes is the certified soil that has been restored to isotope concentrations less than the final remediation levels in the *Final Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996). The uranium and thorium isotopes received and processed during the production history of the Fernald site were separated from their decay chain progeny at the site in the early years, and in later years the separation occurred prior to shipment to the site. As a result of the separation and purification of uranium and thorium products, all decay chain progeny are not in equilibrium with the parent activity, but short half-life progeny are expected to be in equilibrium with the parent. Because some of the short-lived progeny are difficult to quantify using standard radiochemistry analytical techniques, in part due to the limited sample volume and low nuclide concentrations in the quarterly composite samples, they can be considered to be present in equilibrium with their parent or immediately preceding long-lived daughter (i.e., thorium-234 with uranium-238; radium-228 and actinium-228 with thorium-232; radium-224 with thorium-228; and thorium-231 with uranium-235). The progeny nuclides noted above are used in the dose assessment.

Net air concentrations for measured isotopes are summarized in Table D−1, For the boundary monitors, the net air concentration is defined as the analytical result minus the blank and background values. The net air concentration at the background location is the analytical result minus the blank.

Table D–1. CY 2008 Net Air Concentrations

	Radium (pCi/m^3)	Thorium (pCi/m^3)			Uranium (pCi/m^3)		
Location	226	228	230	232	234	235/236	238
Boundary[a]							
AMS-2	0	0	0	0	2.00E-07	0	8.00E-07
AMS-3	0	2.10E-06	0	0	1.00E-07	0	2.10E-06
AMS-6	0	0	0	0	0	0	9.00E-07
AMS-8A	2.00E-06	0	8.00E-07	0	2.20E-06	5.90E-07	3.80E-06
AMS-24	0	0	0	0	0	0	1.00E-07
Background							
AMS-12	4.60E-05	7.90E-06	4.90E-06	3.10E-06	5.40E-06	0	4.50E-06

[a]For boundary monitors, net = total - blank - background (0 if net is negative)

D.1.3.3 Air Emission Data Reporting

All monitoring data are provided to the EPA and OEPA electronically on the Office of Legacy Management's Fernald Preserve website: http://www.lm.doe.gov/land/sites/oh/fernald/fernalddata.htm.

D.2.0 Air Emissions Data

D.2.1 Air Monitoring Data Completeness Status

During CY 2008, there was one minor issue with the data quality of the quarterly composite results. Many of the reported thorium and uranium isotopes had a detection limit slightly above the contract specified detection limit of 1 pCi/L. Although most isotope results were above the slightly higher detection limits, one thorium-228 result and several uranium-235 results were slightly above 1 pCi/L, but less than the reported detection limit. As results below the detection limit are set to zero for the NESHAP analysis, the failure of the lab to meet the 1-pCi/L detection limit for the few noted isotopes resulted in a small amount of activity being omitted from the NESHAP calculations. However, this is not a significant issue, as the calculated particulate dose of 0.017 mrem/yr is nearly three orders of magnitude below the 10-mrem/yr NESHAP standard.

All blank filter results were below nuclide detection limits, with the exception of thorium-228 for the first quarter. The first-quarter blank indicated 2.8 pCi/L for thorium-228, and this value was subtracted from all first-quarter thorium-228 results prior to performing the NESHAP calculations. Additional corrections to the analytical results were unnecessary.

Finally, as noted above, the laboratory lost the July samples after measuring particulate mass, and the third-quarter results represent a 2-month composite (August and September).

D.2.2 Air Monitoring Station Operational Performance

During CY 2008, operational run times for five of the AMSs exceeded 94 percent, and AMS-24 exceeded 87 percent (Table D−2). In general, interruptions in monitor operations during CY 2008 were the result of short-term power failures and/or equipment failures.

D.3.0 Dose Assessment

Based on the sum of the quarterly net measured concentrations (i.e., net concentration equals boundary concentration minus background concentration) and annual air volumes, the annual net average concentration for each radionuclide is calculated and then divided by the corresponding value listed in Subpart H of 40 CFR 61, Appendix E, Table 2 to form a radionuclide-specific compliance ratio. For each boundary monitor, the sum of the radionuclide compliance ratios is calculated (Table D−3; Annual Total column) to evaluate compliance with NESHAP requirements. In accordance with 40 CFR 61.107, compliance with the NESHAP standard is demonstrated when the sum of the ratios is less than 1.

Table D−2. CY 2008 Operational Summary for Air Particulate Monitoring Stations

Location	Number of Samples	Sample Start Date	Last Sample Collection Date	Operating Time (hours)	Percent of Operation
Boundary					
AMS-2	12	03-Jan-08	05-Jan-09	8696	98.5
AMS-3	12	03-Jan-08	05-Jan-09	8342	94.5
AMS-6	12	03-Jan-08	05-Jan-09	8615	97.5
AMS-8A	12	03-Jan-08	05-Jan-09	8758	99.2
AMS-24	12	03-Jan-08	05-Jan-09	7712	87.3
Background					
AMS-12	12	03-Jan-08	05-Jan-09	8810	99.8

Table D−3. 2008 Annual NESHAP Compliance Ratios

Location	Ac-228[a]	Ra-224[a]	Ra-226	Ra-228[a]	Th-228	Th-230	Th-231[a]	Th-232	Th-234[a]	U-234	U-235/6	U-238	Annual Total	Annual Dose[b] (mrem/yr)
Boundary[c]														
AMS-2	0	0	0	0	0	0	0	0	3.6E-07	2.6E-05	0	9.6E-05	1.2E-04	1.2E-03
AMS-3	0	1.4E-05	0	0	6.8E-04	0	0	0	9.5E-07	1.3E-05	0	2.5E-04	9.6E-04	9.6E-03
AMS-6	0	0	0	0	0	0	0	0	4.1E-07	0	0	1.1E-04	1.1E-04	1.1E-03
AMS-8A	0	0	6.1E-04	0	0	2.4E-04	2.0E-09	0	1.7E-06	2.9E-04	8.0E-05	4.6E-04	1.7E-03	1.7E-02
AMS-24	0	0	0	0	0	0	0	0	4.5E-08	0	0	1.2E-05	1.2E-05	1.2E-04
Background														
AMS-12	8.4E-07	5.3E-05	1.4E-02	5.3E-04	2.5E-03	1.4E-03	0	5.0E-03	2.0E-06	7.0E-04	0	5.4E-04	2.5E-02	2.5E-01

[a] Ratio determined by assuming nuclide is in secular equilibrium with the parent nuclide.
[b] Annual dose is based on the NESHAP standard of 10 mrem/yr multiplied by the annual total.
[c] For boundary monitors, net = total - blank - background (0 if net is negative)

Based on the NESHAP approach for demonstrating compliance, the 40 CFR 61, Appendix E, Table 2 values represent the annual average radionuclide concentrations that correspond to a 10 mrem/yr effective dose equivalent. It follows that a fraction of the 40 CFR 61, Appendix E, Table 2 values would correspond to an equivalent fraction of a 10 mrem/yr effective dose equivalent. Therefore, the sum of ratios for each monitor is converted to a dose by multiplying

the sum by 10 mrem/yr (Table D−3; Annual Dose column). The maximum value for the sum of the ratios (0.0017) is observed at AMS-8A, and this converts to a maximum effective dose equivalent of 0.017 mrem/yr (0.00017 mSv/yr) at the Fernald Preserve boundary.

Because the nearest downwind resident is located approximately 2,000 feet (606 meters) east-northeast from AMS-8A, the dose received by this receptor would be lower than 0.017 mrem/yr (0.00017 mSv/yr) because particulate dose decreases with distance.

D.4.0 Compliance Assessment

For CY 2008, the maximum effective dose equivalent from emissions of radionuclides to the ambient air, based on samples collected at the Fernald Preserve boundary, is estimated to be 0.017 mrem/yr (0.00017 mSv/yr), which is in compliance with the Subpart H standard of less than 10 mrem/yr (0.1 mSv/yr).

D.5.0 Additional Information

D.5.1 Meteorological Data

Refer to Figure D−2 for the wind rose data.

D.5.2 Construction/Modifications at the Fernald Preserve

In CY 2008, there were no project changes that resulted in a need to apply to the EPA for approval (under 40 CFR 61.96) to modify the monitoring network for source emissions.

D.6.0 References

DOE (U.S. Department of Energy), 1996. *Final Record of Decision for Remedial Actions at Operable Unit 5*, 7478 U-007-501.4, prepared by S.M. Stoller Corporation for DOE, Fernald Area Office, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 1997. "Application for Approval to Use Environmental Measurements to Demonstrate Compliance with the National Emission Standards for Hazardous Air Pollutants Subpart H," letter #DOE-0980-97, Johnny Reising to James Saric and Michael Murphy, May 23.

DOE (U.S. Department of Energy), 2006a. "Approval for removing Phase 1 – TLD, Radon and Particulate Monitors (AMS-04, AMS-05, AMS-07, AMS-23, AMS-25 and AMS-28)," received at weekly conference call on April 11.

DOE (U.S. Department of Energy), 2006b. "Phase II Site Boundary Air Monitor Reductions," approval letter received from EPA on November 29.

DOE (U.S. Department of Energy), 2008. *Comprehensive Legacy Management and Institutional Controls Plan*, LMS/FER/S03496, Revision 2, prepared by S.M. Stoller Corporation for DOE, Fernald Area Office, Cincinnati, Ohio, May.

EPA (U.S. Environmental Protection Agency), 1997. "Application for Approval to Use Environmental Measurements to Demonstrate Compliance with the National Emission Standards for Hazardous Air Pollutants Subpart H," letter from Jack Barnett to Johnny Reising, August 11.