

5.0 Air Pathway

This chapter describes the air pathway monitoring program used to track and evaluate airborne emissions from the Fernald site. It includes a discussion of radiological air particulates, radon, and direct radiation. In addition, this chapter provides a summary of radiological emissions from stacks and vents, as well as non-radiological emissions associated with the combustion of fossil fuel.

Results in Brief: 2004 Air Pathway

Radiological Air Particulates — Data collected from fenceline air monitoring stations show that average concentrations for each radionuclide monitored were less than 1 percent of the corresponding DOE-derived concentration guide.

Radon — There were no exceedances of the DOE standard (3 pCi/L annual average above background) at the site fenceline and off-property locations. The maximum annual average concentration at the FCP fenceline measured by continuous radon monitors was 0.3 pCi/L above background.

Direct Radiation — Direct radiation measurements at the site fenceline and the K-65 Silos boundary were similar to those in 2003. This was attributed to the continuing operation of the Radon Control System (RCS).

Air pathway monitoring focuses on airborne pollutants that may be carried from the site as a particle or gas, and how these pollutants are distributed in the environment. The physical form and chemical composition of pollutants influence how they are dispersed in the environment and how they may deliver radiation doses. For example, fine particles and gases remain suspended, while larger, heavier particles tend to settle and deposit on the ground. Chemical properties determine whether the pollutant will dissolve in water, be absorbed by plants and animals, or settle in sediment and soil.

Monitoring the air pathway is critical to ensuring the continued protection of the public and the environment during the remediation process because airborne contaminants can potentially migrate beyond the Fernald site. The site's air

monitoring approach (presented in the IEMP) provides an ongoing assessment of the collective emissions originating from remediation activities. The results of this assessment are used to provide feedback to remediation project organizations regarding the site-wide effectiveness of project-specific emission controls relative to DOE, EPA, and OEPA standards. In response to this feedback, project organizations modify or maintain emission controls.

5.1 Remediation Activities Affecting the Air Pathway

When the mission of the Fernald site changed from production to remediation, work activities also changed. This change in work scope altered the characteristics of sources that emit pollutants in the environment via the air pathway. During the production years, the primary emission sources were point sources (i.e., stacks and vents) from process facilities. Today the dominant emission sources are associated with remediation activities in the form of fugitive emissions (i.e., excavation, hauling and processing of waste and contaminated soil, demolition of production facilities, and general construction activities supporting the remediation process), and the storage of radon-generating waste materials.

The following primary emission sources were active during 2004:

- Decontamination and demolition activities, most notably Plant 2/3, Pilot Plant (Building 54A), and the Pilot Plant Warehouse (Operable Unit 3)
- Excavation of the waste pits and the associated waste processing and rail car load-out operations at the Waste Pits Project (Operable Unit 1)
- Excavation of contaminated soil and debris (Operable Unit 5)

- Construction activities associated with the on-site disposal facility including excavation, screening, and hauling activities in the on-site disposal facility borrow area (Operable Unit 2)
- Transportation and placement of contaminated material in the on-site disposal facility and interim storage at the on-site material transfer area (Operable Unit 2)
- Radon Control System (RCS) and Silos 1 and 2 Waste Retrieval operations (Operable Unit 4).

Each project is responsible for designing and implementing engineered and administrative controls for each remediation activity. The fugitive emissions control policy mandates that fugitive emissions be visually monitored and controls be implemented as necessary. The following types of controls are used to keep point source and fugitive emissions to a minimum.

- **Engineered Controls** – Typical engineered controls include physical barriers, wetting agents, filtration, fixatives, sealants, dust suppressants and control, collection, and treatment systems. Engineered designs help reduce point source and fugitive emissions by using the best available technology. The selection of the best available technology for controlling project emissions is conducted during the design process and frequently includes the evaluation of several treatment alternatives.
- **Administrative Controls** – Typical administrative controls include management and control procedures; record keeping; periodic assessments; and established speed limits, control zones, and construction zones.

5.2 Air Monitoring Program Summary for 2004

The site's air monitoring program, as defined in the IEMP, is comprised of three distinct components:

- Radiological air particulate monitoring
- Radon monitoring
- Direct radiation monitoring.

Each component of the air monitoring program is designed to address a unique aspect of air pathway monitoring, and as such, reflects distinct sampling methodologies and analytical procedures. The key elements of the air monitoring program design are:

- **Sampling** – Sample locations, frequency, and the constituents were selected to address DOE and EPA requirements for assessing radiological emissions from the Fernald site. Key considerations in the design of the sampling program included prevailing wind directions, location of potential sources of emissions, and the location of off-property receptors. The IEMP program includes monitoring radiological air particulates at 18 locations, radon measurements at 32 locations, and direct radiation at 37 locations on and off the property.
- **Data Evaluation** – The data evaluation process focuses on tracking and trending data against historical ranges and DOE, EPA, and OEPA standards. Each section in this chapter presents an evaluation of data and a comparison to applicable standards and guidelines.
- **Reporting** – All data are reported through the IEMP program and annual site environmental reports.

5.3 Radiological Air Particulate Sampling Results

As described in the IEMP, Revision 3, a network of 18 high-volume air particulate monitoring stations is used to measure the collective contributions from all fugitive and point source particulate emissions from the site. The current monitoring network includes 16 monitoring locations on the fenceline and one background location. In addition, one thorium monitor was operated on the western fenceline. Figure 5-1 provides the locations of the IEMP air monitoring stations.

The sampling and analysis program for the 16 fenceline and background locations consists of biweekly total uranium and total particulate analyses, and monthly composites (eight times per year) for isotopic thorium analyses, in addition to a quarterly composite sample. The quarterly composite sample is analyzed for the expected major contributors (i.e., uranium, thorium, and radium) to the radiological air inhalation dose at the site's boundary. The thorium monitor includes biweekly particulate and monthly isotopic thorium analyses. Analytical data from this program are used to assess the effectiveness of the emission control practices throughout the year to ensure particulate emissions remain below health protective standards.

The radiological air particulate monitoring program is designed to demonstrate compliance with the following:

- NESHAP Subpart H requirements which stipulate that radionuclide emissions (not including radon) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 millirem (mrem) in a year above background levels. This dose is reported in the annual NESHAP Subpart H compliance report and is included as Appendix D of this report.
- DOE Order 5400.5, Radiation Protection of the Public and the Environment (DOE 1993), guidelines for concentrations of radionuclides in air emissions. These guidelines, referred to as derived concentration guide values, are concentrations of radionuclides that, under conditions of continuous exposure for one year by one exposure mode (e.g., inhalation or ingestion), would result in a dose of 100 mrem to the public. These derived concentration guide values are not limits, but serve as reference values to assist in evaluating the radiological air particulate data.

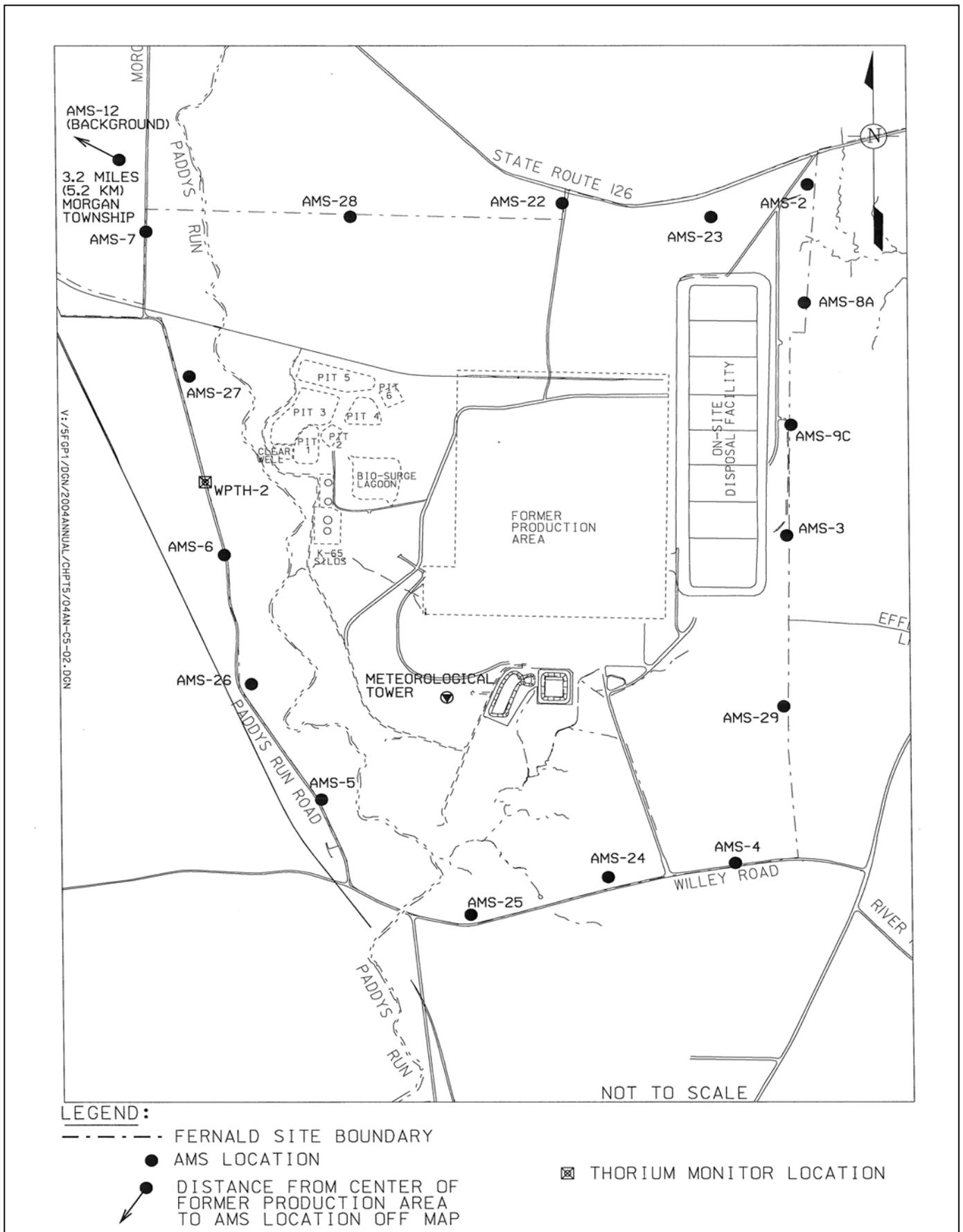


Figure 5-1. Radiological Air Monitoring Locations

Table 5-1 presents a summary of the minimum, maximum, and average concentrations for total uranium, thorium-230, and total particulate in 2003 and 2004 based on the biweekly and monthly sample results used for monitoring air emission trends. For 2004, the annual average concentrations of total uranium at all fenceline air monitoring stations were less than 1 percent of the DOE derived concentration guide (DCG) value (0.1 picoCuries per cubic meter [pCi/m³]). In 2004, total uranium at all air monitoring locations ranged from non-detectable at the background monitor to 1.3E-02 pCi/m³ at AMS-23.

TABLE 5-1
SUMMARY OF BIWEEKLY TOTAL URANIUM, TOTAL PARTICULATE,
AND MONTHLY THORIUM-230 CONCENTRATIONS IN AIR

Location	2004 Total Uranium (pCi/m ³)	2003 Total Uranium (pCi/m ³)	2004 Total Particulate (µg/m ³)	2003 Total Particulate (µg/m ³)	2004 Thorium-230 (pCi/m ³)	2003 Thorium-230 (pCi/m ³)
Fenceline Locations						
Minimum	1.3E-006	3.3E-06	8	5	1.9E-006	0.0E+00
Maximum	1.3E-002	2.3E-03	102	124	4.2E-004	2.1E-04
Average	2.5E-004	1.7E-04	35	34	4.6E-005	6.0E-05
Background Locations						
Minimum	0.0E+000	3.2E-06	6	14	0.0E+000	0.0E+00
Maximum	1.1E-004	4.0E-05	42	48	2.7E-005	3.6E-05
Average	1.6E-005	1.4E-05	26	25	1.1E-005	1.2E-05

Biweekly thorium monitoring at the fenceline provides timely feedback on project engineered and administrative controls that are implemented to control fugitive emissions, primarily at the Waste Pits Project. The fenceline concentrations of thorium-230 (the primary thorium isotope of concern in the waste pit material being excavated) ranged from less-than-detectable to 4.2E-04 pCi/m³, which was detected at the WPTH-2 project monitor.

In addition to the total uranium and isotopic thorium analyses, total particulate measurements are also obtained from each filter every two weeks as summarized in Table 5-1. Total particulate concentrations at the fenceline ranged from 8 micrograms per cubic meter (µg/m³) to a maximum of 102 µg/m³ at AMS-3. There are no general or site-specific regulatory limits associated with total particulate measurements used in the data evaluation process.

Total particulate, total uranium, and thorium-230 data were collectively evaluated to identify any increasing trends that may be related to remediation activities. Several temporary increases of these three constituents were observed at various monitoring locations; however, the short-lived increases did not pose a potential exceedance of the NESHAP dose limit of 10 mrem or DOE guidelines. The majority of increases in total uranium and thorium-230 concentrations were detected in the northeast quadrant of the site. Figures 5-2 and 5-3 show total uranium and thorium-230 concentrations, respectively, at the selected fenceline locations (AMS-22, AMS-23, and AMS-8A). These temporary increases were due to the remediation activities associated with the Waste Pits Project, on-site disposal facility and its associated material transfer area, and decontamination and demolition activities. The radiological air particulate data are discussed with remediation project personnel to ensure that emission controls are operating as expected and to consider actions as necessary. Appendix C, Attachment C.1, of this report provides graphical displays of the 2004 total uranium, thorium-230, and total particulate data.

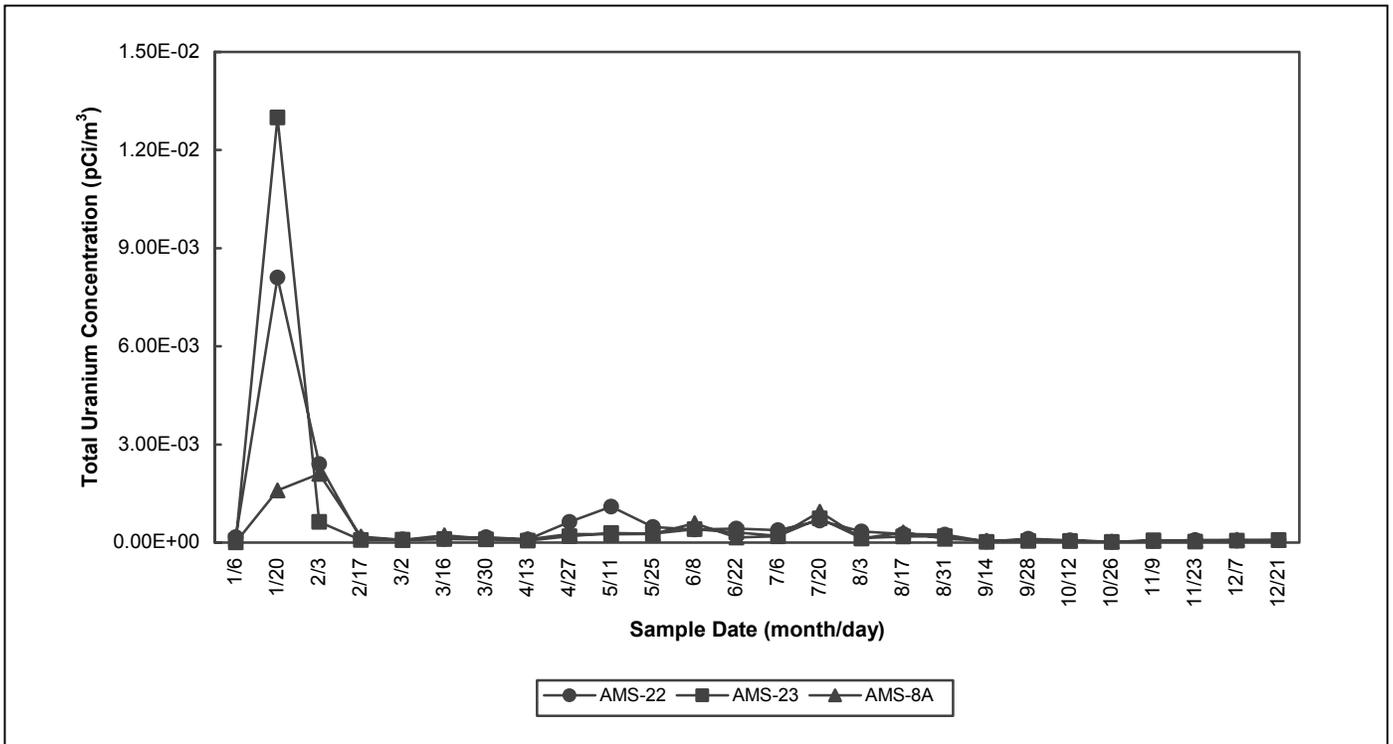


Figure 5-2. 2004 Total Uranium Concentrations in Air at Selected East Fenceline Monitors (AMS-3, AMS-8A, and AMS-9C)

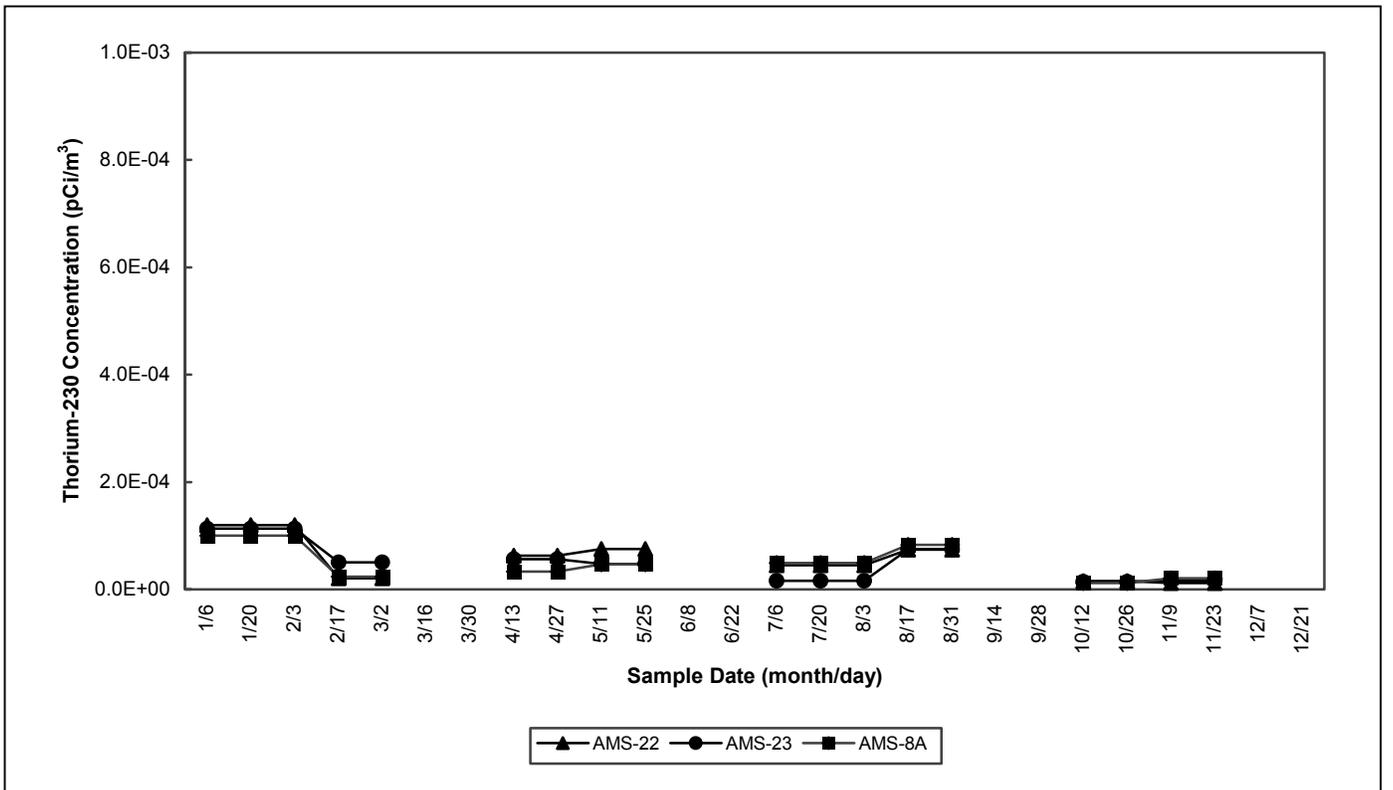


Figure 5-3. 2004 Thorium-230 Concentrations in Air at Selected East Fenceline Monitors (AMS-3, AMS-8A, and AMS-9C)

Quarterly composite air filter samples were formed from the biweekly samples at each IEMP air monitoring station during 2004 to determine the radiological air inhalation dose for each location. The samples were analyzed for isotopes of radium, thorium, and uranium. The quarterly results were used to track compliance with the NESHAP 10-mrem dose limit throughout the year and to demonstrate compliance with the limit at the end of 2004. The maximum dose associated with the quarterly composite results for 2004 was 0.65 mrem (compared to the 10-mrem limit) and occurred at AMS-23. The composite results from the fenceline monitors show that, on average, thorium isotopes contribute 54 percent of the dose from 2004 airborne emissions. Isotopes of uranium and radium account for 42 and 1.5 percent of the dose, respectively. The higher percentage of dose from thorium isotopes is a result of thorium-230 becoming the major dose contributor through fugitive emissions from Waste Pits Project operations. Thorium-230 became the major dose contributor beginning in 2000 with the commencement of Waste Pits Project excavation activities. Given the methods required to excavate, transport, and process waste pit material, fugitive emissions were expected to increase the average concentration of thorium-230 at the fenceline. Although the project used several environmental compliance-based dust abatement practices and controls, some fugitive emissions were expected from the project based on the large-scale waste handling operations. Chapter 6 and Appendix D of this report provide more detailed information on the dose associated with the composite results.

The annual average radionuclide concentrations at each air monitoring station, as determined from the quarterly composite results, were compared to the DOE-derived concentration guide values. At each monitoring station, the annual average radionuclide concentrations were below 1 percent of the corresponding DOE-derived concentration guide values.

The WPTH-2 fenceline monitor was installed in late 1998 on the west property boundary to specifically monitor thorium emissions from the Waste Pits Project. Measured airborne concentrations of thorium-228 and thorium-232 were comparable to background concentrations throughout 2004. These fenceline data reflect that, in comparison to thorium-230, the concentrations of thorium-228 and thorium-232 in the waste pit material were relatively low in 2004. Appendix C, Attachment C.1, of this report provides graphical displays of the isotopic thorium data from the WPTH-2 monitor.

5.4 Radon Monitoring

Radon-222 (referred to in this section as radon) is a naturally occurring radioactive gas. It is produced by radioactive decay of radium-226, which can be found in varying concentrations in the earth's crust. Radon is also chemically inert, and tends to diffuse from the earth's crust to the atmosphere. The concentration of radon in the environment is dynamic and exhibits daily, seasonal, and annual variability.

Many factors influence the concentration of radon in the environment, including the distribution of radium-226 in the ground, porosity of the soil, weather conditions, etc. For instance, radon diffusion from the ground is minimized by the presence of precipitation and snow cover. Alternatively, elevated temperatures and the absence of precipitation can produce cracks in the ground and changes in porosity that increase the rate at which radon escapes. A summary of meteorological data from 2004 is presented in Figures 1-7 through 1-10 in Chapter 1, and Appendix C, Attachment C.4, of this report.

Environmental radon concentrations are also influenced by atmospheric conditions. During periods of calm winds and temperature inversions (when the air near the earth's surface is cooler than the air above it), air is held near the earth's surface, minimizing the mixing of air. Consequently, radon's movement is limited vertically and concentrations tend to increase near the ground.

Waste material that produces radon is stored at the Fernald site. This waste was generated from uranium extraction processes performed decades ago and contains radium-226. This material is contained in K-65 Silos 1 and 2, and Silo 3 (part of the Operable Unit 4 remediation) and the waste pits (currently being remediated per the Operable Unit 1 Record of Decision).

DOE Order 5400.5 provides radiological protection requirements; and guidelines for cleanup of residual radioactive material, for management of resulting wastes and residues, and for the release of radiological property. Radon limits at interim storage facilities (such as at the Fernald site) are also defined under DOE Order 5400.5 and must not exceed:

- 100 pCi/L at any given location and any given time
- Annual average concentration of 30 pCi/L (above background) over the facility
- Annual average concentration of 3 pCi/L (above background) at and beyond the facility fence line.

Figure 5-4 illustrates the continuous radon monitoring network used in 2004 for determining compliance with the above limits. The continuous monitoring network provides frequent feedback to remediation projects, regulatory agencies, and stakeholders on trends in ambient radon concentrations, while providing sufficient radon monitoring to ensure compliance with DOE Order 5400.5 requirements. Access to real-time radon monitoring data is available at the Public Environmental Information Center.

In general, monitoring locations were selected near radon-emitting sources, at the property fenceline, and a background location. The FFA identifies additional environmental radon monitoring locations, as well as continuous measurement of radon concentrations in the headspace of the K-65 Silos. DOE guidance and EPA air monitor siting criteria were considered when selecting monitoring locations.

5.4.1 Continuous Radon Monitors

Continuous radon monitors use scintillation cells to continuously monitor environmental radon concentrations based on an hourly average. Radon gas in ambient air diffuses into the scintillation cell through a foam barrier without the aid of a pump (this technique is called passive sampling). Inside the cell, radon decays into more radioactive material (progeny products), which gives off alpha particles. The alpha particles interact with the scintillation material inside the cell, producing light pulses. The light pulses are amplified and counted. The number of light pulses counted is proportional to the radon concentration inside the cell.

Continuous monitors reveal important information regarding the dynamics of radon concentrations at different times during the day, and at various locations on and off site. These monitors allow for timely review of radon concentrations, which may indicate concentrations are significantly changing from day to day and week to week. However, the use of these monitors is restricted by certain conditions. For example, potential monitoring sites are limited by the availability of electricity.

Table 5-2 provides monthly average radon concentration data from the continuous radon monitors for 2004. The data are used to track radon concentrations throughout the year to ensure the DOE limits are not exceeded. In addition to the summary data presented here, Appendix C, Attachment C.2, of this report provides graphical displays of monthly average radon concentrations from continuous radon monitors during 2003 and 2004.

Results from the fenceline monitoring locations indicate radon levels for 2004 were within historical ranges and well below the DOE limit of 3 pCi/L above background. The maximum annual average site fenceline net radon concentration for 2004 was 0.3 pCi/L, which is below the proposed 10 CFR 834 site boundary limit of 0.5 pCi/L above background. The annual average radon concentration at the background monitoring location was 0.3 pCi/L. A review of site fenceline data suggests that during 2004, Waste Pits Project operations did not significantly impact the radon concentrations at the site fenceline (refer to Table 5-2).

TABLE 5-2
CONTINUOUS ENVIRONMENTAL RADON MONITORING MONTHLY AVERAGE CONCENTRATIONS^a

Location ^b	2004 Summary Results ^c (Instrument Background Corrected) (pCi/L)			2003 Summary Results ^c (Instrument Background Corrected) (pCi/L)		
	Min.	Max.	Avg.	Min.	Max.	Avg.
Fenceline						
AMS-02	0.2	1.3	0.5	0.1	0.6	0.3
AMS-03	0.2	1.3	0.5	0.1	0.5	0.3
AMS-04	0.2	0.7	0.3	0.2	0.6	0.4
AMS-05	0.1	1.2	0.6	0.2	0.9	0.4
AMS-06	0.2	0.6	0.3	0.3	0.8	0.5
AMS-07	0.3	1.3	0.6	0.3	0.9	0.6
AMS-08A	0.2	1.0	0.5	0.2	0.4	0.3
AMS-09C	0.2	0.9	0.5	0.2	0.5	0.4
AMS-22	0.1	0.5	0.3	0.1	0.4	0.2
AMS-23	0.2	0.5	0.3	0.2	0.4	0.3
AMS-24	0.3	1.4	0.6	0.3	0.7	0.5
AMS-25	0.2	0.9	0.4	0.2	0.6	0.3
AMS-26	0.2	0.6	0.3	0.2	0.6	0.4
AMS-27	0.3	0.9	0.5	0.2	0.8	0.5
AMS-28	0.2	0.7	0.4	0.3	0.9	0.5
AMS-29	0.2	0.5	0.3	0.2	0.5	0.4
Background						
AMS-12	0.2	0.6	0.3	0.2	0.4	0.3
On Site						
KNE-B	0.3	0.8	0.4	0.4	2.9	1.1
KNO	0.3	1.1	0.6	0.4	3.1	1.0
KNW-A	0.3	1.2	0.6	0.4	1.4	0.7
KSE	0.2	0.8	0.4	0.3	4.0	1.0
KSO	0.3	0.8	0.5	0.3	0.8	0.6
KSW-A	0.3	1.2	0.7	0.4	1.5	0.9
KTOP	0.3	1.5	0.8	0.4	12	3.3
LP2	0.3	0.7	0.4	0.4	0.9	0.7
Pilot Plant Warehouse ^d	0.2	0.4	0.3	0.2	0.8	0.4
PR-1	0.2	1.1	0.5	0.3	0.8	0.5
Rally Point 4	0.2	0.6	0.3	0.3	0.7	0.5
Surge Lagoon	0.3	0.8	0.4	0.2	0.8	0.5
T117A	0.2	0.7	0.4	0.2	0.5	0.4
T28A	0.2	0.7	0.4	0.2	0.9	0.6
WP-17A	0.3	1.1	0.5	0.1	0.8	0.4

^aMonthly average radon concentrations are calculated from the daily average concentrations.

^bRefer to Figure 5-4 for sample locations.

^cInstrument background changes as monitors are replaced.

^dPilot Plant Warehouse monitor removed from service in May 2004.

In accordance with the FFA, radon concentrations within the headspace of K-65 Silos 1 and 2 are continuously monitored to assess the effectiveness of control measures in reducing radon emissions. From 1993 to 2002, there was a gradual upward trend in silo headspace radon concentrations. The increases in the headspace concentration were attributable to degradation of the 1991 application of bentonite clay to the surface of the K-65 Silo residues. In December 2002, the headspace radon concentrations were temporarily lowered through the initial short-term test of the RCS. During 2003 and 2004, the RCS operated continuously with the exception of short-term shut-downs for maintenance activities. Due to the operation of the RCS, radon headspace concentrations indicated a sharp drop, which has lasted through 2004. Appendix C, Attachment C.2, of this report provides a graphical display of monthly average radon concentrations from continuous radon monitors for 2003 and 2004.

During 2004 as well as in 2003, there were no exceedance events related to the 100-pCi/L DOE limit measured on site, as compared with 10 recorded in 2002. The decrease in the exceedance events is attributable to the operation of the K-65 Silos RCS.

Long-term comparisons are performed on average radon concentrations recorded at the K-65 Silos exclusion fence locations. Historical alpha track-etch and continuous alpha scintillation detector data were used for this comparison (refer to Figure 5-5). The average concentrations adjacent to the K-65 Silos remain below the levels observed prior to the addition of bentonite to the K-65 Silos in 1991.

Long-term comparisons are also performed on average radon concentrations at western property fenceline locations and background locations as a basis for comparison to the 3-pCi/L annual average limit. In 2004, a marginal difference in radon concentrations was observed between background and western property fenceline monitoring locations (refer to Figure 5-6). The on-property monitoring locations also recorded radon levels well below the applicable DOE annual average limit of 30 pCi/L.

5.5 Monitoring for Direct Radiation

Direct radiation (e.g., X rays, gamma rays, energetic beta particles, and neutrons) originates from sources such as cosmic radiation, naturally occurring radionuclides in soil, as well as radioactive materials at the Fernald site. The largest source of direct radiation is the material stored in K-65 Silos 1 and 2. Gamma rays and X rays are the dominant types of radiation emitted from the silos. Energetic beta particles, alpha particles, and neutrons are not a significant component of direct radiation at the Fernald site because uranium, thorium, and their decay products do not emit these types of radiation at levels that create a public exposure concern.

Direct radiation levels at and around the Fernald site were continuously measured at 37 locations with thermoluminescent dosimeters (TLDs) during 2004. TLDs absorb and store the energy of direct radiation within the thermoluminescent material. By heating the thermoluminescent material under controlled conditions in a laboratory, the stored energy is released as light, measured, and correlated to the amount of direct radiation. During 2004 and previous years, this process of reading the TLDs was performed at the onsite dosimetry laboratory. For 2005, this process will be outsourced. TLD location 32 was established to measure possible affects from the irradiation process, a quality control process of exposing the TLDs to a know radiation source to verify an accurate correlation. Therefore, with the outsourcing of the TLD reading process and completion of the irradiation process, TLD 32 was removed from service at the end of 2004. Figure 5-7 identifies the TLD monitoring locations. These monitoring locations were selected based on the need to monitor the K-65 Silos, the fenceline, and background locations. Table 5-3 provides summary level information pertaining to direct radiation measurements for 2004 and 2003.

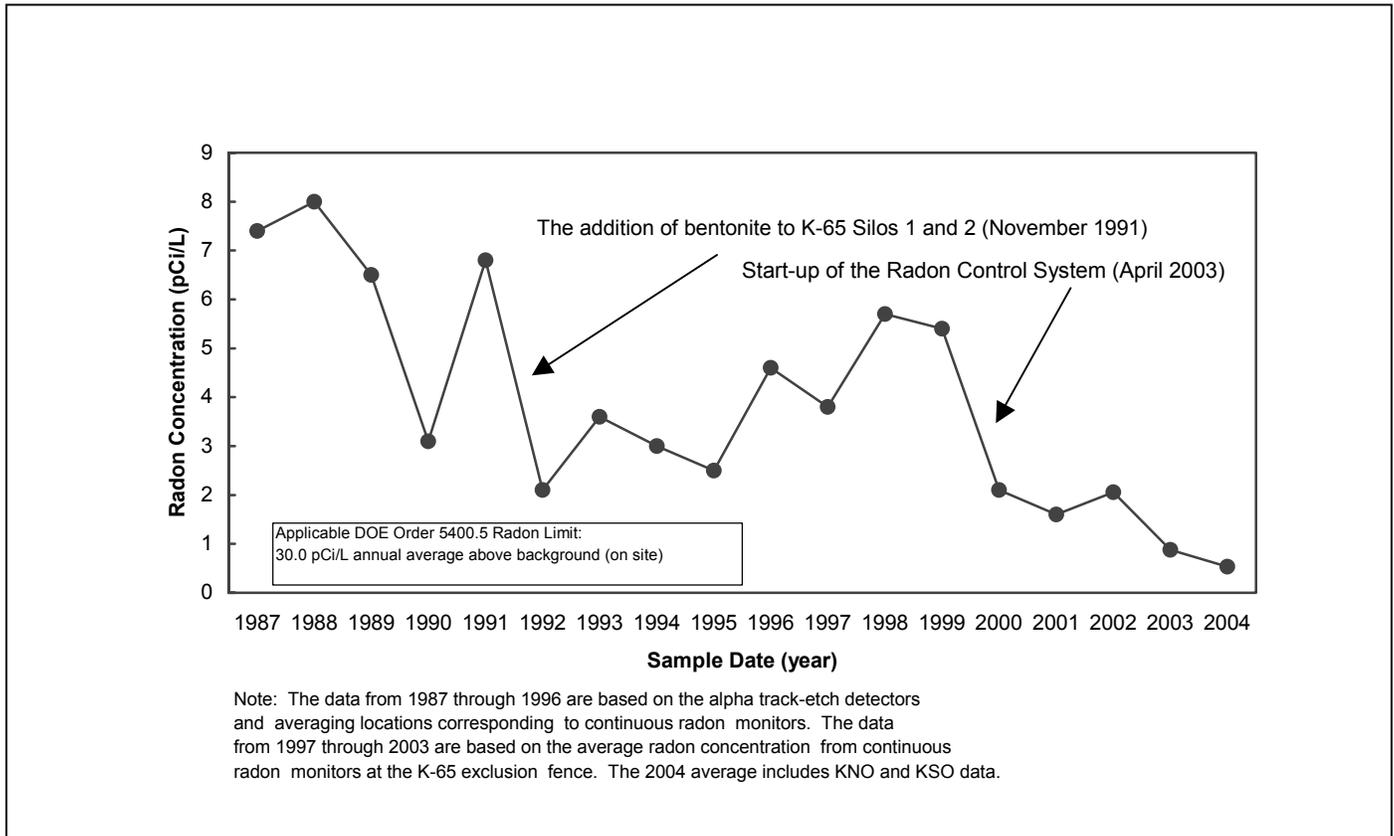


Figure 5-5. Annual Average Radon Concentrations at K-65 Silos Exclusion Fence, 1987-2004

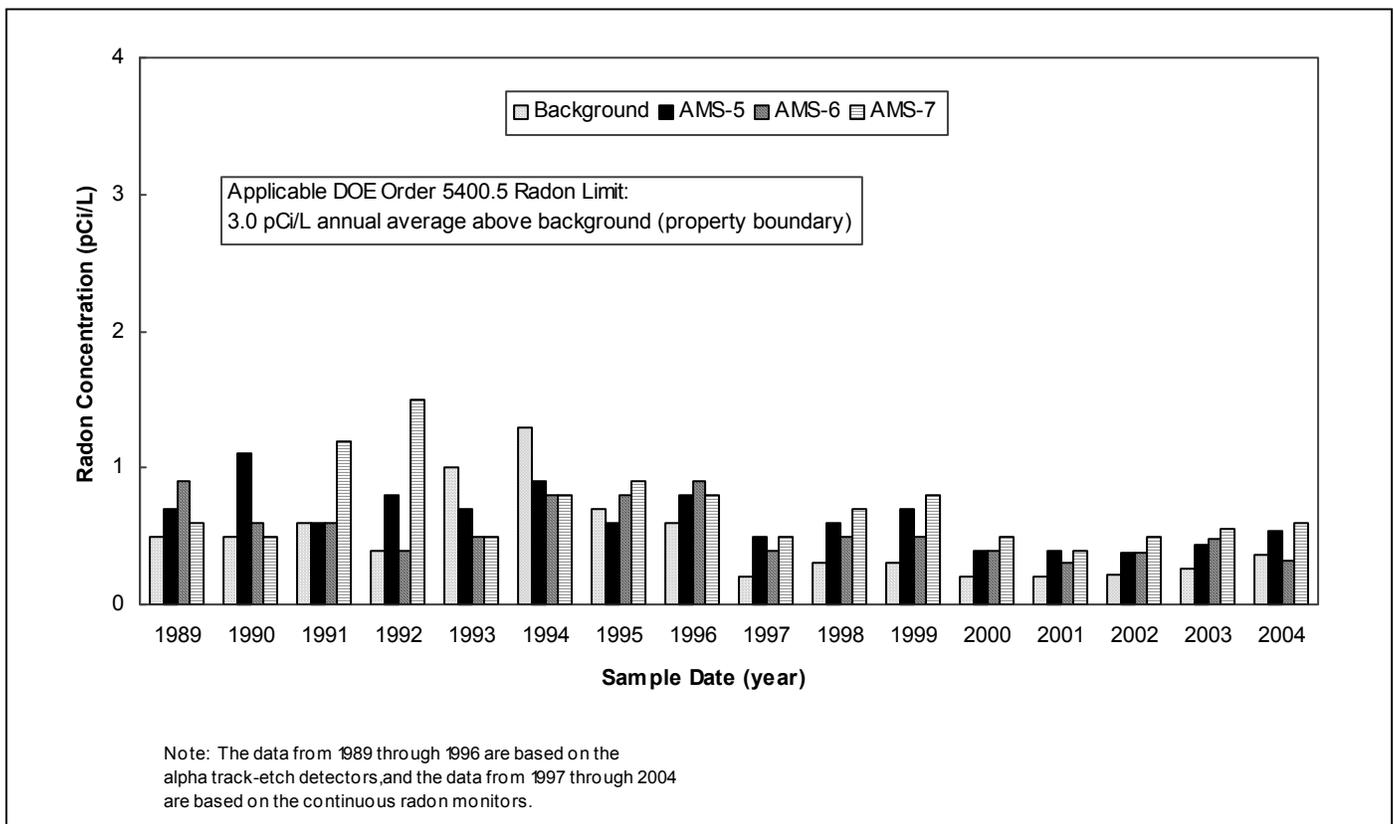


Figure 5-6. Annual Average Radon Concentrations at Selected Radon Locations, 1989-2004

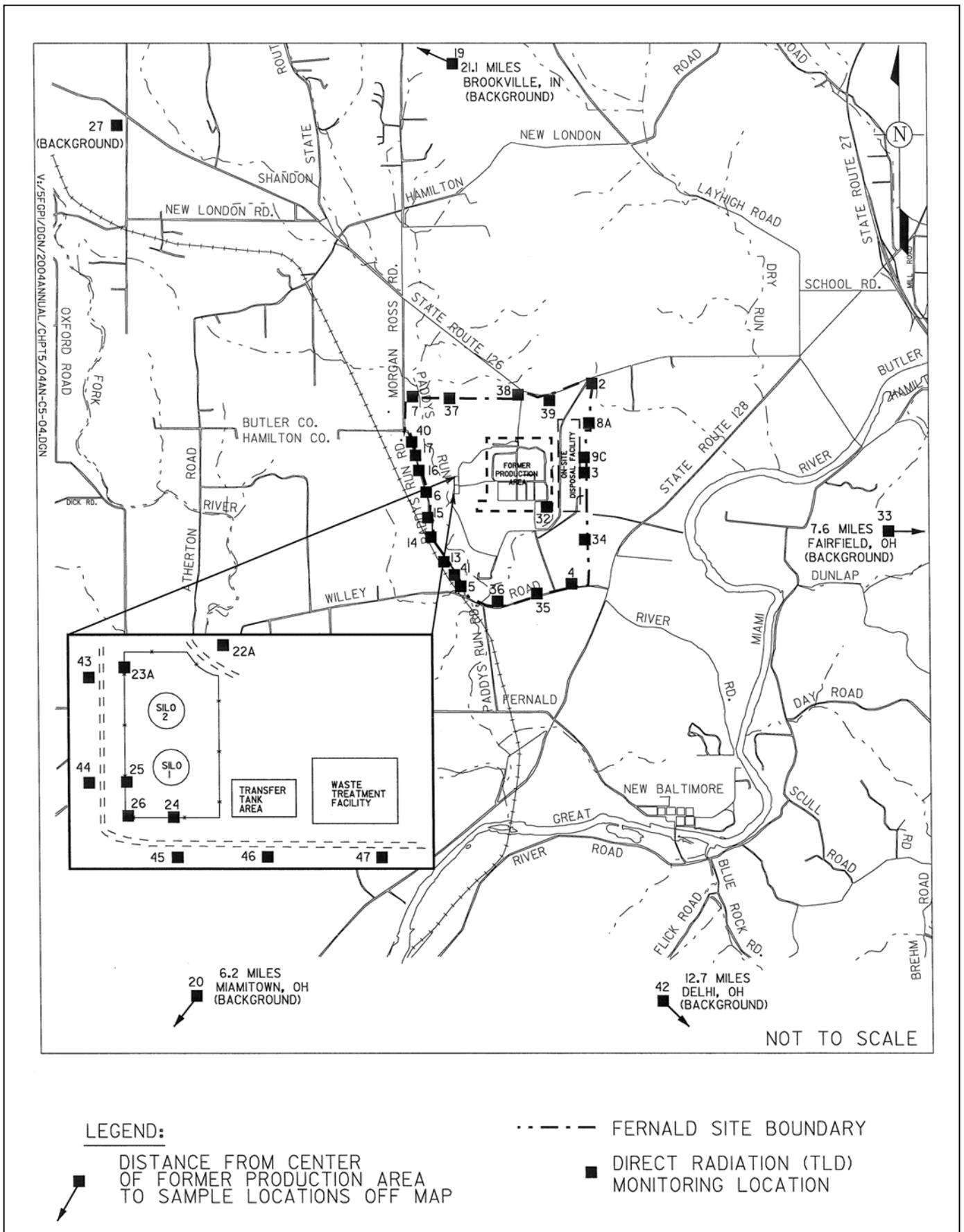


Figure 5-7. Direct Radiation (TLD) Monitoring Locations

**TABLE 5-3
DIRECT RADIATION (THERMOLUMINESCENT DOSIMETER) MEASUREMENT SUMMARY**

TLD Location	Direct Radiation (mrem)	
	Summary of 2004 Results	Summary of 2003 Results
Fenceline (21 locations)		
Minimum	64	64
Maximum	81	76
On Site (11 locations)		
Minimum (Health and Safety Bldg.)	52	56
Maximum (K-65 Silo area)	216	445
Background (5 locations)		
Minimum	63	61
Maximum	75	71

All monitoring results from TLDs for 2004 were within historical or expected ranges. From 1993 to 2001, there was a gradual upward trend in direct radiation measurements in the immediate area of the K-65 Silos, which stabilized in 2002 (refer to Figure 5-8). During 2003, there was a significant decrease in the direct radiation levels, followed by a continuing decrease in 2004. This was attributed to a reduction of the radon concentrations and associated decay products within the K-65 Silos' headspace. This reduction was accomplished through operations of the Silos Project RCS. Furthermore, a slight upward trend was noted at the end of 2004. This was most likely due to initiation of pumping operations to transfer K-65 Silo materials to the Transfer Tank Area.

The increasing trend in direct radiation levels at the site's western fenceline (1998 through 2001) also stabilized in 2002. During 2003, there was a significant decrease, particularly at TLD location 6, which is closest to the K-65 Silos, followed by a continuing decrease in 2004 (refer to Figure 5-9). These changes at the fenceline are also attributable to the reduction of radon concentrations and associated decay products within the K-65 Silos' headspace by the operation of the RCS. Similar to the direct radiation levels in the immediate area of the K-65 Silos, the radiation levels along the site's western fenceline also indicated a slight upward trend at the end of 2004 due to Transfer Tank Area pumping operations.

Historically, the maximum net radiation levels were measured at the site's western fenceline; for 2004, the maximum radiation level was monitored in the northeast quadrant of the site. This is reflective of the changing conditions at the Fernald site and is a result of decreasing radiation levels near the silos headspace (site's western fenceline). Chapter 6 provides more information on the dose associated with the direct radiation results. Detailed results of direct radiation measurements for 2004 and 2003 are provided in Appendix C, Attachment C.3, of this report.

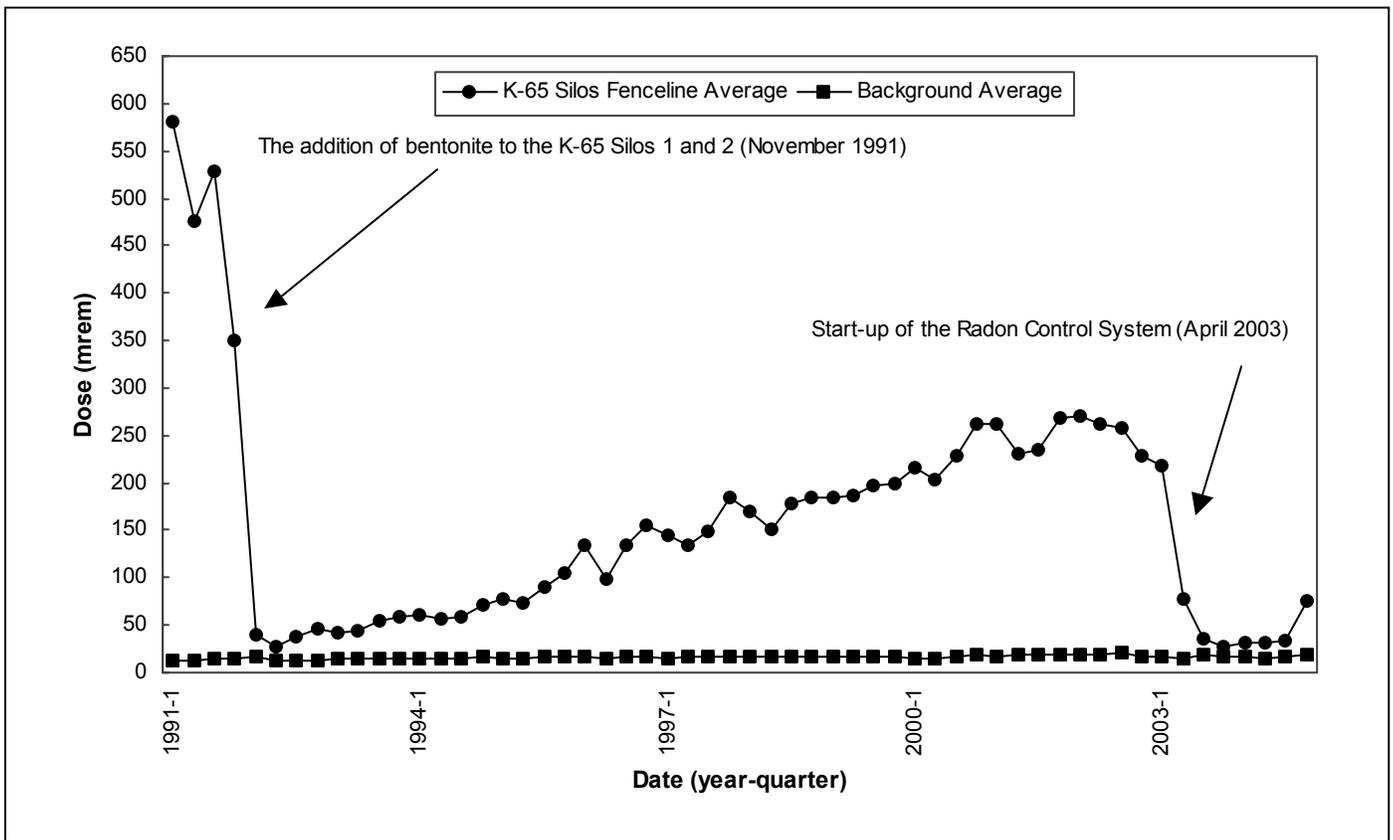


Figure 5-8. Direct Radiation (TLD) Measurements at K-65 Silos Boundary, 1991-2004 (K-65 Silos Fenceline Average vs. Background Average)

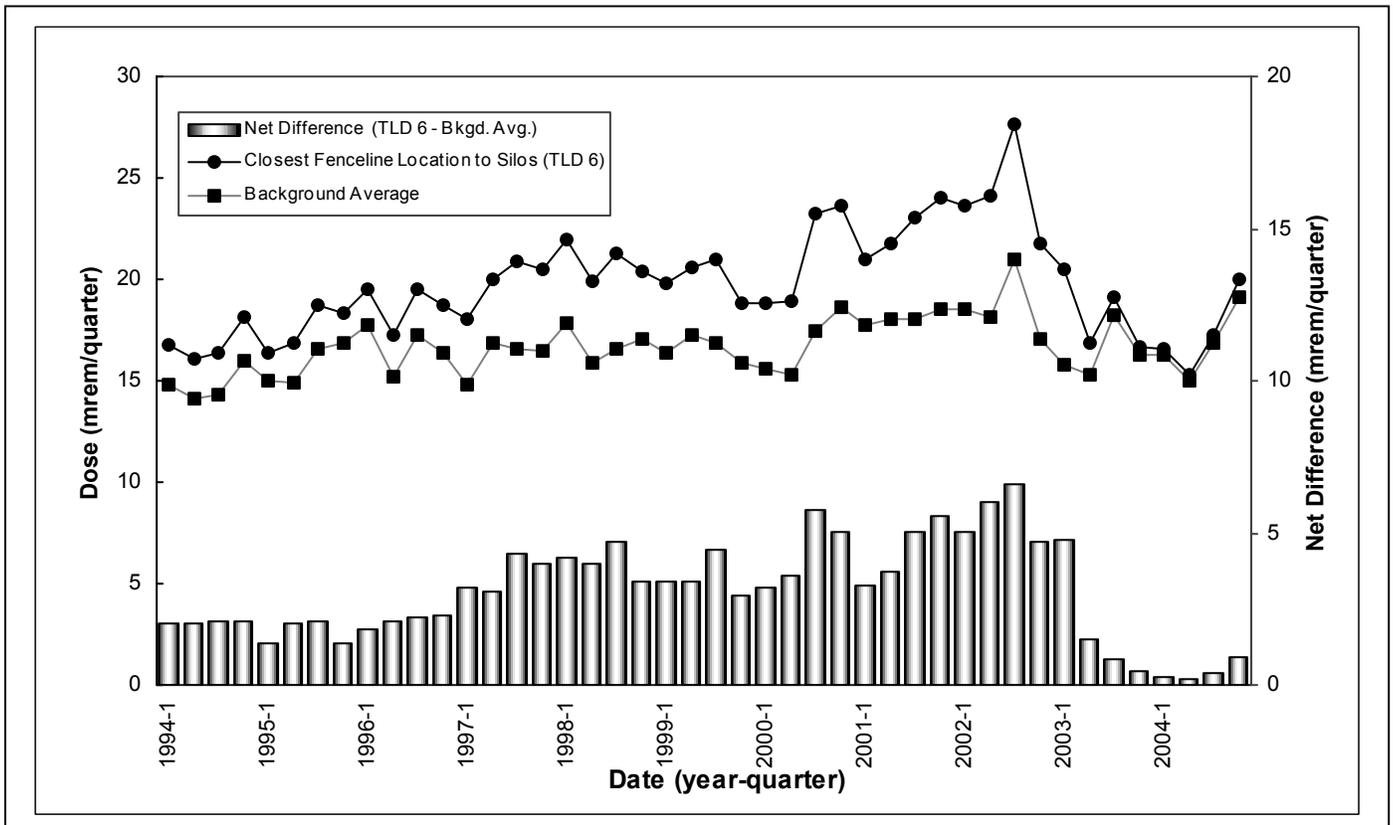


Figure 5-9. Direct Radiation (TLD) Measurements, 1994-2004 (Location 6 vs. Background Average)

5.6 Stack Monitoring for Radionuclide Emissions

During 2004, there were three stacks (or vents) that were monitored for radionuclide emissions as part of the requirements under the NESHAP Subpart H. The locations of the three stacks are shown in Figure 5-10. Stack sampling systems typically consist of a continuously operating pump that draws a representative volume of air from the stack through a filter or, in the case of radon monitoring, through a detector. Periodically, the filter is exchanged and analyzed for radiological contaminants that have the potential to be released during remediation activities or processes.

The Waste Pits Project dryer stack particulate filters were analyzed for isotopes of uranium, thorium, and radium. The results confirmed that Waste Pits Project stack particulate emissions were very low and not the primary source of thorium-230 concentrations at the site fence line. The stack also contained a continuous radon monitor (for radon-220 and radon-222). The maximum hourly release rate of radon (radon-220 and radon-222) during 2004 was 5,019 microCuries per hour ($\mu\text{Ci/hr}$), which is below the estimated maximum hourly release rate of 13,000 $\mu\text{Ci/hr}$ (DOE 1998a) for radon-222. Note there were no exceedances in 2004 of the 13,000 $\mu\text{Ci/hr}$ value. The total annual release of radon through the stack was estimated to be 7,390,000 microCuries (μCi). The Waste Pits Project dryer stack was removed from service in October 2004, at the completion of dryer operations.

In 2004, the Waste Pits Project pugmill ventilation stack (PVS) particulate filters were analyzed for isotopes of uranium, thorium, and radium. The results confirmed that Waste Pits Project PVS particulate emissions were very low and not the primary source of thorium-230 concentrations at the site fence line. The Waste Pits Project pugmill stack was also removed from service in October 2004.

In 2004, the Silos Project RCS stack particulate filters were analyzed for total particulates, isotopes of uranium, thorium, radium, and polonium, in addition to radon monitoring. The results confirm that the Silos RCS stack particulate and radon emissions were very low. The maximum instantaneous measurement of radon being released from the stack was 1,039 μCi , and the total annual release of radon through the stack was estimated to be 14,900,000 μCi .

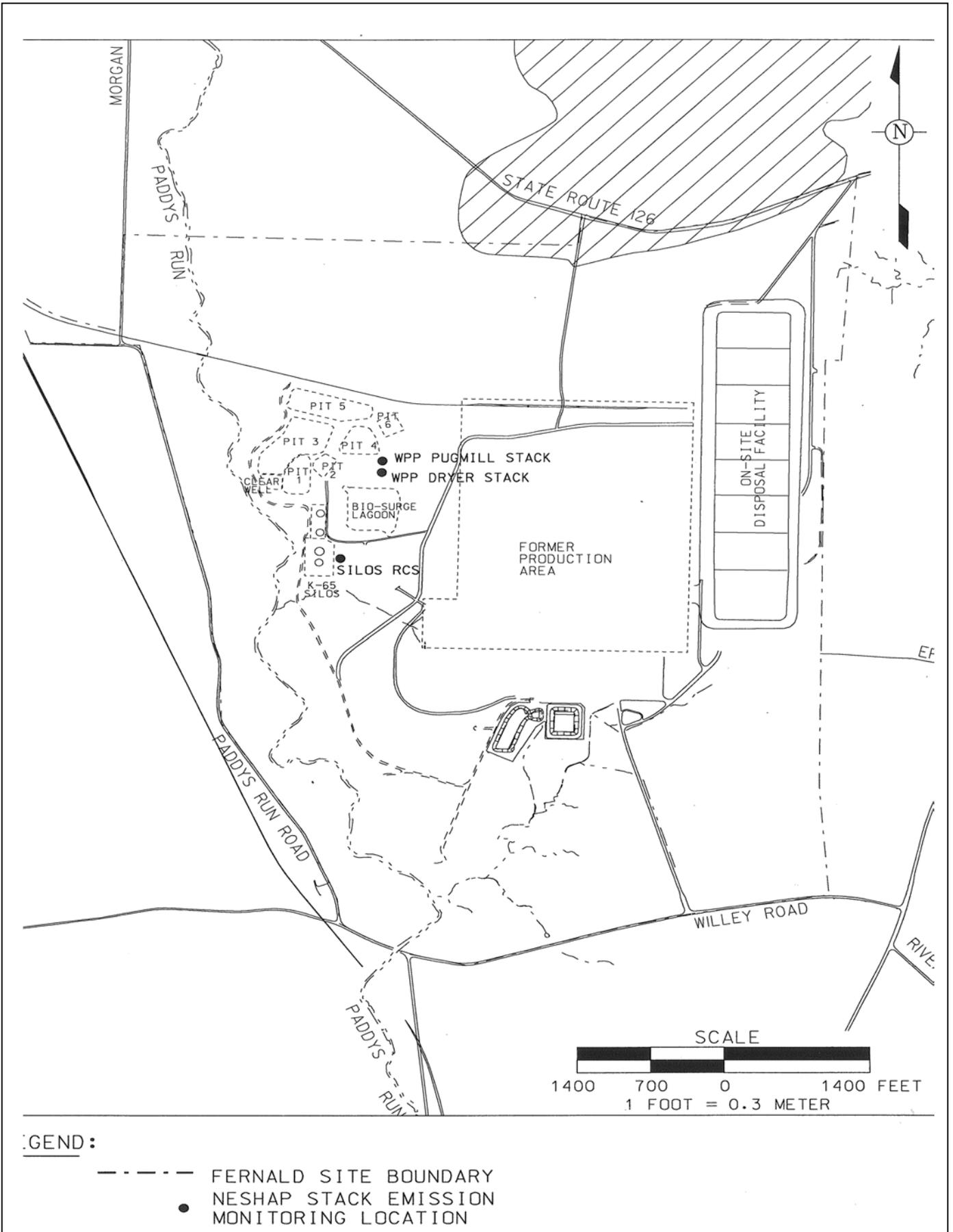


Figure 5-10. NESHA Stack Emission Monitoring Locations

Table 5-4 presents the 2004 stack results for total particulates, radionuclides, and radon measurements. Typically, post-production era (i.e., 1990 and later) monitoring data have shown stack emissions of radionuclides to be very low or not detectable. The use of high-efficiency particulate air (HEPA) filtration systems in many remediation activities and processes effectively controls stack emissions and limits the release of airborne contaminants. In summary, the 2004 stack emissions are consistent with the low stack emission data for the post-production period.

**TABLE 5-4
2004 NESHAP STACK EMISSIONS**

Radionuclide (Unit)	Waste Pits Project Dryer Stack^{a,b}	Waste Pits Project PVS Stack^{a,b}	Silos RCS Stack^{a,c}
Total Uranium (lbs/yr)			
Uranium-238 (lbs/yr)	5.6E-05	1.1E-03	3.8E-05
Uranium-235/236 (lbs/yr)	3.4E-07	5.9E-06	5.2E-06
Uranium-234 (lbs/yr)	1.1E-09	1.8E-08	3.5E-09
Thorium-232 (lbs/yr)	1.3E-05	1.9E-04	1.6E-04
Thorium-230 (lbs/yr)	1.1E-09	3.2E-08	3.9E-09
Thorium-228 (lbs/yr)	1.5E-15	2.2E-14	2.0E-14
Thorium-227 (lbs/yr)	NS	NS	ND
Radium-226 (lbs/yr)	2.2E-13	8.1E-12	1.5E-11
Polonium-210 (lbs/yr)	NS	NS	1.0E-14
Total Particulates (lbs/yr)	NS	NS	1.1E-01
Total Radon (mCi/yr)	7,390	NS	14,900

^aIncludes probe rinse results.

^bNS = not sampled

ND = not detectable

5.7 Monitoring for Non-radiological Pollutants

The FCP continued to operate the Waste Pits Project gas-fired dryers and other minor gas-fired sources during 2004. The estimated emissions from these combined operations were based on emission factors from the AP-42 technical reference document (Compilation of Air Pollution Emission Factors, Volume 1, Stationary Point and Area Sources, [EPA 1995]). The sulfur dioxide emissions were estimated to be 155 pounds (70 kg). Nitrogen oxide emissions for 2004 were estimated to be 12,900 pounds (5,857 kg). Carbon monoxide emissions were estimated to be 21,672 pounds (9,839 kg). The estimate for particulate as PM10 (particles with an aerodynamic diameter less than or equal to a nominal 10 micron) was 1,961 pounds (890 kg). Non-methane total organic compound emissions for 2004 were estimated to be 2,245 pounds (1,019 kg). There are no regulatory limits associated with non-radiological pollutants; however, each source is required to employ the best available technology to limit emissions. In order to meet the best available technology requirement, burners designed to lower emissions of nitrogen oxides are used in the dryers.

Table 5-5 provides a comprehensive list of 2004 emissions from the Waste Pits Project dryers and other minor gas-fired sources.

TABLE 5-5
CHEMICAL EMISSIONS FROM WASTE PITS PROJECT DRYERS OR GAS-FIRED SOURCES

Chemical Name	Emissions (lb/kg)	Sources of Emissions	Basis of Estimate^a
Particulates	1,961/890	Fossil Fuel Combustion	AP-42 Emission Factors
Sulfur Dioxide	155/70	Fossil Fuel Combustion	AP-42 Emission Factors
Nitrogen Oxide	12,900/5,857	Fossil Fuel Combustion	AP-42 Emission Factors
Carbon Monoxide	21,672/9,839	Fossil Fuel Combustion	AP-42 Emission Factors
Non-Methane Total Organic Compounds	2,245/1,019	Fossil Fuel Combustion	AP-42 Emission Factors

^aCompilation of Air Pollution Emission Factors, Volume 1; Stationary Point and Area Sources (Section 1.3, Fuel Oil Combustion, Final Section, Supplement E, September 1998; and Section 1.4, Natural Gas Combustion, Final Section, Supplement D, July 1998).