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SUPERCEDED

PLAN FOR MONITORING RADIONUCLIDE EMISSIONS OTHER THAN RADON AT WELDON SPRING SITE CRITICAL RECEPTORS

For the

Weldon Spring Site Remedial Action Project

Weldon Spring, Missouri

Prepared by MK-Ferguson Company and Jacobs Engineering Group

MAY 1990 REV. 0

U.S. Department Of Energy

Oak Ridge Operations Office

Weldon Spring Site Remedial Action Project

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Plan for Monitoring Radionuclide Emissions Other Than Radon at Weldon Spring Site Critical Receptors

May 1990

Revision 0

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Prepared for

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

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ABSTRACT

During the course of the Weldon Spring Site Remedial Action Project (WSSRAP) radionuclides may be emitted to the air. Emissions of radionuclides are regulated by the U.S. Environmental Protection Agency in 40 CFR 61. It is clear in 40 CFR 61 that, for sites being remediated according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), no monitoring or reporting of radon emissions is required prior to completion of temporary or permanent disposal sites, other than that already required under CERCLA. For radionuclides other than radon, however, it is not clear whether 40 CFR 61 requires sites being remediated according to CERCLA to implement additional monitoring and reporting prior to completion of disposal facilities. Because the U.S. Department of Energy is committed to protection of the public and environment, a plan has been formulated which defines how the WSSRAP will implement a monitoring program for radionuclides other than radon. This plan adheres to the specifications contained in 40 CFR 61.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 SITE HISTORY

The Weldon Spring Site is located in St. Charles County, Missouri, about 30 miles west of St. Louis on land formerly used by the Department of Army (DA) as a trinitrotoluene (TNT) and dinitrotoluene (DNT) ordnance works. The site consists of a 9-acre former limestone quarry; a 51-acre raffinate disposal area; and a 166-acre uranium feed materials plant. The feed materials plant was built in 1955-1957 by the Atomic Energy Commission (AEC), the predecessor to the U.S. Department of Energy (DOE), and operated by Mallinckrodt Chemical Works for the AEC from 1957 through 1966. The plant processed uranium ore concentrates and recycled scrap to pure uranium trioxide, uranium tetrafluoride, and uranium metal. Thorium ore concentrates were also processed. The raffinate residues from this processing were disposed of in four large open pits. During the plant's operational period, the buildings, the equipment, the immediate terrain, the process sewer system, and the drainage easement to the Missouri River became contaminated with uranium, thorium, and their decay products.

During the period 1943-1957, the DA disposed of rubble and soils contaminated with TNT and DNT in a former limestone quarry about 4 miles from the ordnance works. Later, from 1959 through 1966, the AEC disposed of building rubble and soils contaminated with thorium and uranium and their decay products in the same quarry. The quarry now contains about 95,000 cubic yards of contaminated materials, including quarry materials contaminated by this radioactive waste.

In 1967, the feed materials plant site was selected to be converted to a herbicide production facility. Except for the materials stored in the raffinate pits, the site was transferred back to the DA and renamed the Weldon Spring Chemical Plant (WSCP). The DA began a major effort to decontaminate three process buildings for herbicide production. The cleanup was not totally successful, and in 1969, reduced requirements for the herbicide and increased cleanup costs resulted in cancellation of the project. The 51 acres encompassing the Weldon Spring Raffinate Pits (WSRP) were transferred back to the AEC in 1971.

On November 27, 1984, the DOE was directed by the Office of Management and Budget to assume responsibility for the decontamination of the WSCP and to integrate work with other DOE remedial actions proposed for the Weldon Spring Quarry (WSQ), and the WSRP. In 1987 the WSQ was placed on the National Priorities List (NPL). The WSCP/WSRP were placed on the NPL in 1989. These NPL sites are being remediated according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Environmental Policy Act (NEPA).

During cleanup of the Weldon Spring Site (WSS) a temporary storage area (TSA) for wastes from the WSQ is proposed. In addition, the DOE-preferred alternative for all wastes at the WSQ and WSCP/WSRP is to build a permanent disposal site at the WSCP/WSRP.

1.2 REGULATIONS PERTAINING TO RADIOACTIVE EMISSIONS

Because of the radioactive materials present at the WSCP/WSRP and WSQ, radon is emitted to the atmosphere as are other radionuclides from the U-238, U-235, and Th-232 natural decay series. Atmospheric emissions of radon and radionuclides other than radon are regulated by the U.S. Environmental Protection Agency (EPA). The regulations are contained in 40 CFR 61 which was updated and became effective on December 15, 1989. It is clear in Section G of 40 CFR 61 that, for DOE facilities being remediated according to CERCLA, radon monitoring or reporting programs required through the CERCLA program are sufficient to protect the public health until temporary or permanent storage facilities for Ra-226-containing byproduct material are completed. Once all wastes have been placed and completely covered at the TSA, radon flux monitoring will be performed at the TSA. If a permanent disposal site is constructed at the WSCP/WSRP, radon flux monitoring will be performed after construction of the disposal site is completed. Radon flux monitoring will be performed according to 40 CFR 61, Appendix B, Method 115.

However, it is not clear in those sections of 40 CFR 61 that pertain to radionuclide emissions other than radon whether DOE sites being remediated according to CERCLA are required to monitor and report emissions prior to completion of temporary or permanent storage facilities.

1.3 MONITORING RADIONUCLIDE EMISSIONS OTHER THAN RADON

The DOE is currently determining through discussions with EPA whether the monitoring and reporting requirements for radionuclide emissions other than radon contained in 40 CFR 61, Subpart H apply to CERCLA sites prior to completion of permanent or temporary storage facilities. Regardless of whether 40 CFR 61, Subpart H applies to the WSS during remediation, the DOE is committed to protection of the public and environment. Therefore, a monitoring and quality assurance program sensitive enough to detect concentrations of radionuclides other than radon at levels specified in 40 CFR 61 will be initiated at the WSS.

Results of the monitoring will be reported in annual site environmental reports. These reports are intended to allow EPA oversight of radionuclide emissions during remediation according to CERCLA/NEPA. The monitoring, reporting, and quality assurance program is discussed below.

2 METHODS OF EMISSION EVALUATION

The national emission standard for radionuclides other than radon is set so that no member of the general public receives an effective dose equivalent greater than 0.10 mSv (10 mrem) per year. 40 CFR 61 Subpart H requires that radionuclide emissions other than radon be measured and effective dose equivalents estimated by computer models. If the emission monitoring and modeling specified in Subpart H is impractical, alternate procedures may be acceptable. As an alternate to modeling dose equivalents, air concentrations can be monitored at critical receptors.

After evaluating the methods of assessing effective dose equivalents from radionuclides other than radon, it was determined that monitoring air concentrations at critical receptors was the most accurate means of assessing effective dose equivalents to maximally exposed individuals. This plan describes how the Weldon Spring Site Remedial Action Project will use monitoring results to estimate effective dose equivalents to members of the public resulting from emissions of radionuclides other than radon.

3 SCOPE

This plan discusses the monitoring, reporting, and quality assurance program requirements that will be used to estimate and document the effective dose equivalent from airborne emissions of radionuclides other than radon at locations of highest potential offsite exposure. The monitoring plan, including rationale for the monitoring program as well as sampler location, description, analytical methods, and frequency is discussed in Section 4. This monitoring program meets the specifications in 40 CFR 61, Subpart H. Also contained in Section 4 is a description of the annual reporting system.

Section 5 contains the quality assurance plan. This plan meets the requirements of 40 CFR 61, Appendix B.

4 PLAN

The Weldon Spring Site (WSS) is currently being remediated according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Environmental Policy Act (NEPA). It no longer operates as a uranium and thorium processing plant and has been in mothball status since about 1966. Therefore, radionuclides are no longer emitted from the types of sources (i.e. stacks, vents, or pipes) described in 40 CFR 61, Subpart H.

Airborne emissions of radionuclides at the WSS result from wind dispersal of surface soils or dust and dirt within deteriorating buildings and from fugitive dust generated during remedial actions. Monitoring these types of emission sources is not practical because of the inability to adequately characterize the emission inventory. The amount of entrainment can be estimated from fugitive dust emission factors developed by the U.S. Environmental Protection Agency (EPA) for various materials handling activities, but it is generally recognized that those estimates contain gross uncertainties. Measurement of the entrainment and emissions inventory is also extremely difficult and results are uncertain at best, because the emissions are highly variable both over time and location. Accurate measurements of area or volumetric fugitive emissions can only be made with complete knowledge of the micro-meteorology in and around the source and the use of many (usually greater than 10) concentration or measurement locations. Therefore, modeling of downwind dispersion and subsequent dose calculations using either assumed or measured emission rates leads to extremely uncertain results. The most accurate method of dose calculation at nearby receptor points is through the use of actual concentration measurements at these locations.

An assessment of the effective dose equivalents at critical receptors will be documented by environmental measurements of radionuclide air concentrations. Critical receptors are defined as those locations at which individuals abide or reside where the highest potential offsite concentrations of radionuclides other than radon are likely to occur during remediation of the Weldon Spring Site (WSS). The proposed monitoring and sample analysis plan is presented in Section 4.1. Section 4.2 describes how the monitoring meets the specifications in 40 CFR 61.

4.1 MONITORING PLAN

This section describes sampler locations, discusses rationale for selecting critical receptor locations, establishes occupancy times at critical receptor locations, describes the samplers, presents sampling frequency, and presents sample analytical techniques. Also included in Section 4.1.4 is a discussion of how the monitoring results will be reported.

4.1.1 Sampler Locations

The WSS includes the Weldon Spring Raffinate Pits (WSRP), the Weldon Spring Chemical Plant (WSCP), and the Weldon Spring Quarry (WSQ). Eleven air particulate samplers are in use at the WSS. Five samplers are located on the WSCP/WSRP perimeter. Four are located offsite, one of which measures background air. Two are at the WSQ perimeter. Sampler locations with respect to the WSCP/WSRP and WSQ are shown on Figures 4-1 through 4-3.

Sampler location AP-4007 at the Busch Wildlife Area office measures background concentrations for the WSS. This station is located 1.1 km (0.7 mile) from the WSCP perimeter. The forested and gently rolling terrain between the WSCP and this sampling

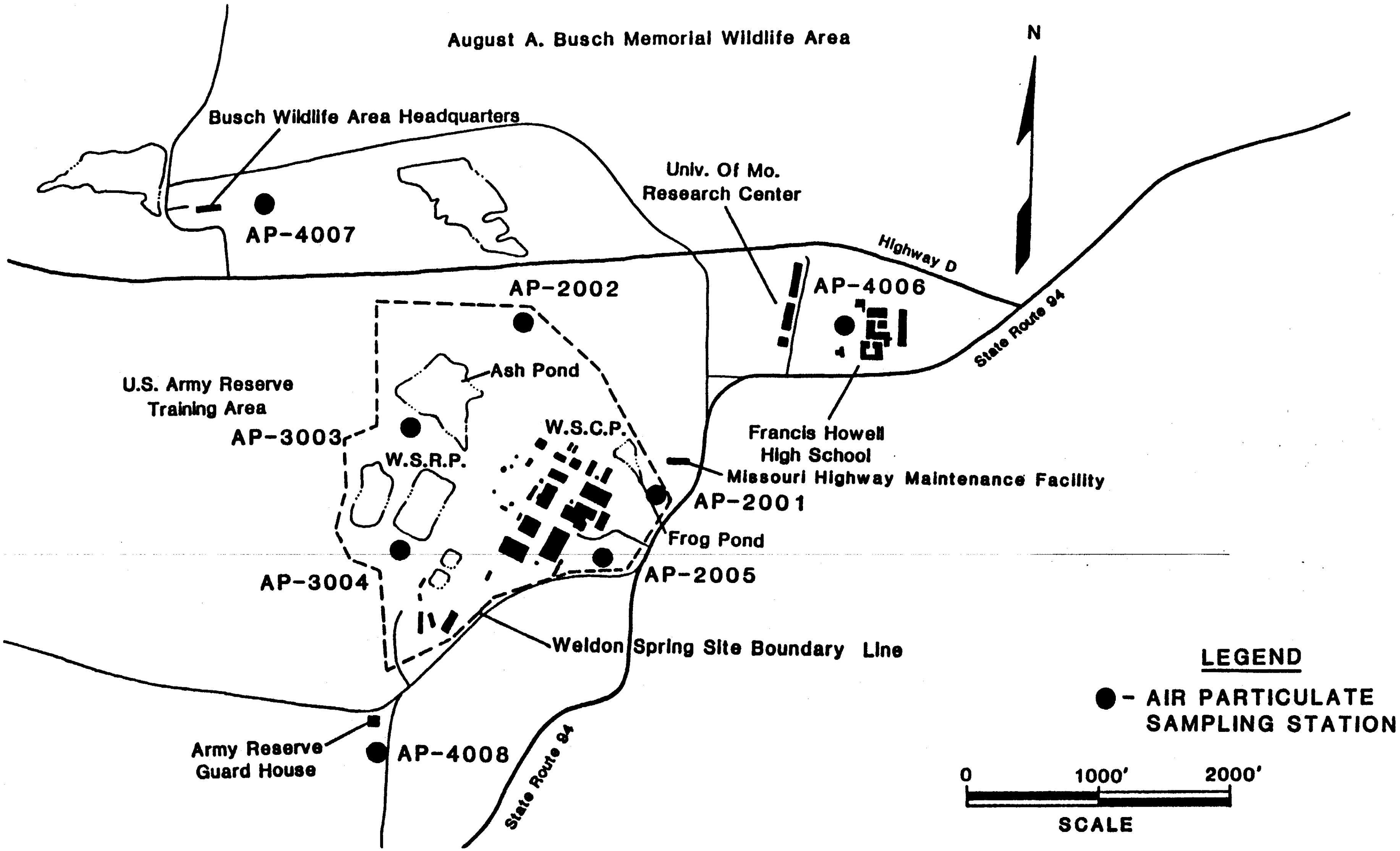


FIGURE 4-1

AIR SAMPLER LOCATIONS SURROUNDING THE WSCP/WSRP

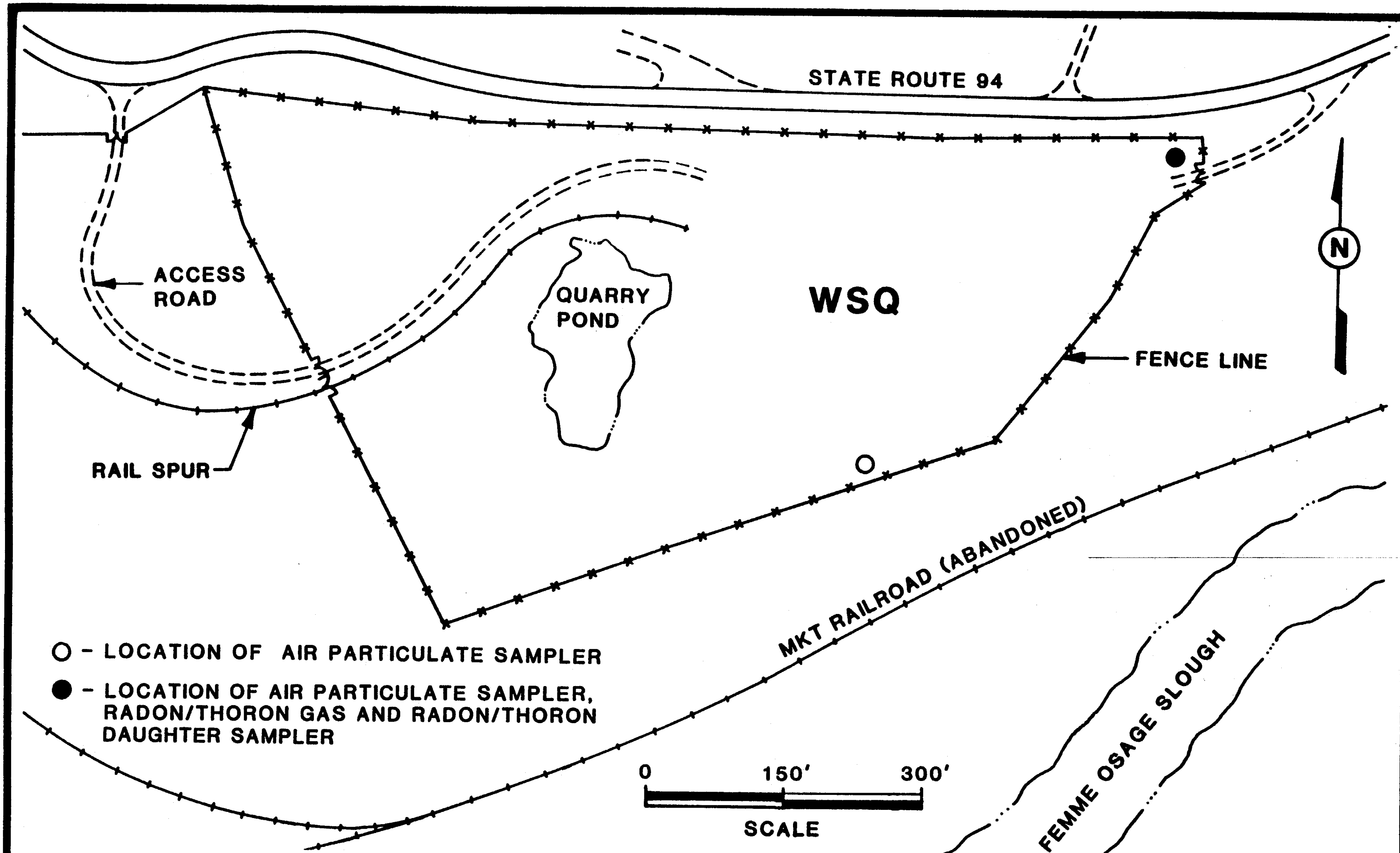
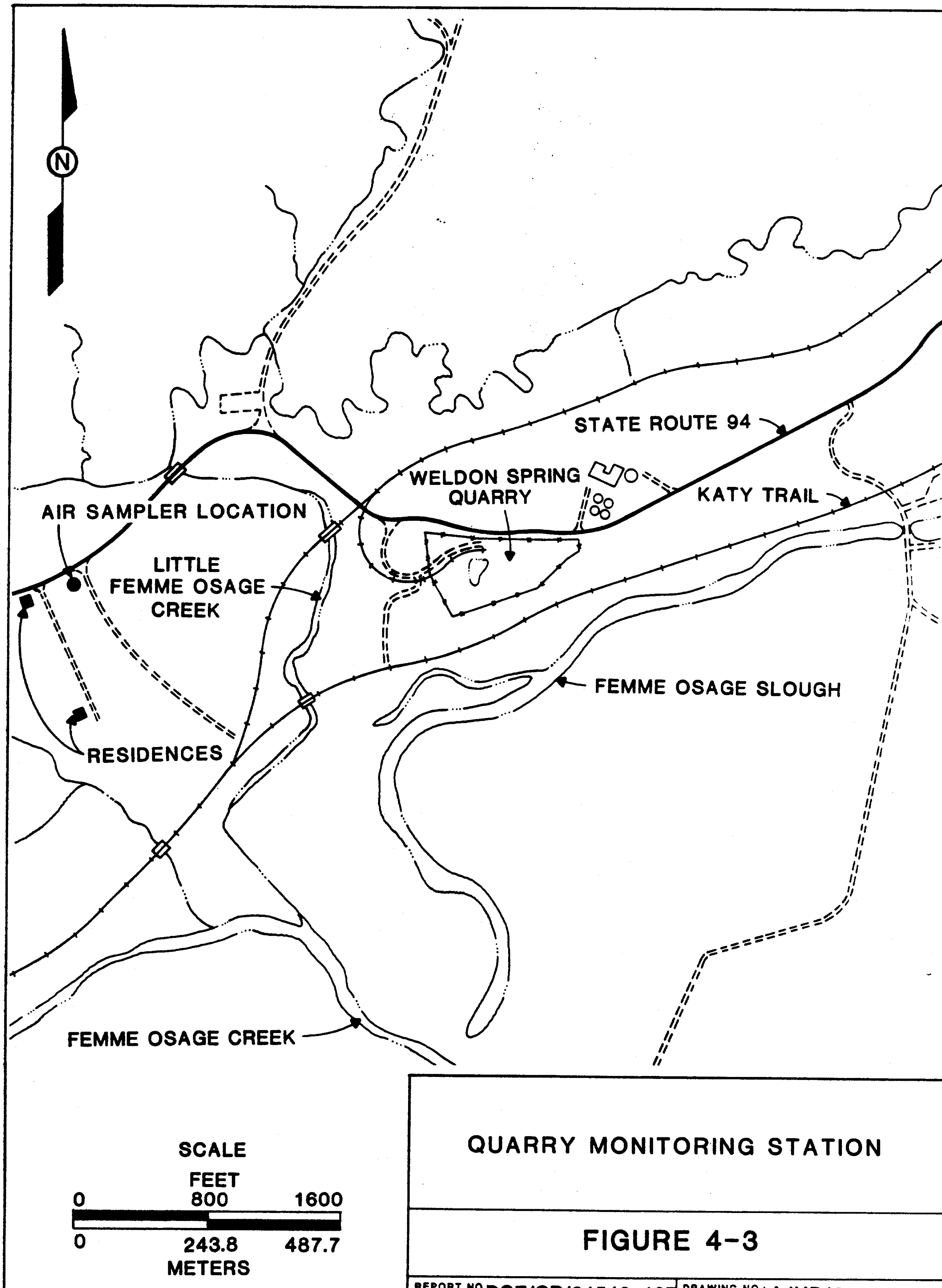


FIGURE 4-2

WSQ AIR MONITORING LOCATIONS



QUARRY MONITORING STATION

FIGURE 4-3

REPORT NO. DOE/OR/21548-127		DRAWING NO.: A/VP/012/0590	
ORIGINATOR: SG	DRAWN BY: GLN	DATE: 5/90	

station provides a significant physical barrier to airborne particulates originating from the site.

As shown in Figure 4-1, sampler stations AP-2001, AP-4006, AP-4008, and AP-2005 are strategically located to measure radioactive air particulate concentrations around the WSCP/WSRP at the point where a maximally exposed individual resides or abides. Station AP-2001 is at the common boundary of the WSCP and Missouri Highway Maintenance Facility. Station AP-4006 is located at the Francis Howell High School. Station AP-4008 is on the Weldon Spring Army Reserve Training Area. Station AP-2005 is located between the WSCP and the Weldon Spring Site Remedial Action Project (WSSRAP) Administration Building.

Located 0.8 km (0.5 mi) west of the quarry is a residence. This residence is within 150 meters (0.1 mi) and directly in line with the quarry monitoring station (Figure 4-3).

These sites were selected as critical receptor locations because they are located within 1.0 km (0.62 mile) of the WSS where members of the public may spend at least eight hours per day for a significant fraction of a year. Other facilities (for example the St. Charles County Water Treatment Plant and the Weldon Spring Heights Subdivision) are located near the WSS; however, no other facility is closer than 2.5 km (1.6 mile) from the WSS. Because of this greater distance these facilities were not considered critical receptors.

At the one critical receptor that is a residence, occupancy will be assumed to be continuous. The number of individuals at the other receptors and typical occupancy patterns are discussed below.

There are nine workers at the highway maintenance facility. A typical worker is at the facility less than 40 hours per week, 50 weeks per year.

There are approximately 1,800 students, faculty and staff members at the high school. Faculty and staff generally spend more time at the school than do students. A typical employee spends 45 hours per week, 50 weeks per year at the school. One janitor lives on the school grounds. Occupancy for this person will be assumed to be continuous.

A remedial investigation is being conducted at the Army Reserve Training area. Subcontract workers perform site characterization tasks intermittently. One employee of the Department of the Army works at most 40 hours a week, 50 weeks per year at the office on the Army Reserve property.

Currently there are approximately 110 workers at the WSSRAP Administration Building. Workers typically spend less than 50 hours per week, for 50 weeks per year, at the facility.

4.1.2 Sampler Description and Sampling Frequency

Air particulate samplers are low volume, self adjusting carbon-vaned, oil-less air pumps at the three quarry locations, and low volume, self-adjusting, twin diaphragm, oil-less air pumps at the five WSCP/WSRP site perimeter locations and at the other three offsite locations. Each sampler is mounted in a weather-protective housing with a 110-volt outlet and a thermostat-controlled fan for cooling. Each sampler will have a timer to document the operational periods. Samplers also have a flow meter and vacuum gages to automatically maintain constant flow.

Air filters are mounted approximately 1 meter (3 feet) above ground surface. The sampling head is on the side of the protective housing opposite the cooling fan exhaust. This prevents the cooling fan exhaust from disturbing the air being drawn through the filter.

All air samplers will run continuously at a flow rate of approximately 40 liters per minute. Samples are collected on 47 millimeter diameter 0.8 micron pore size mixed ester cellulose filter paper. Filters are exchanged weekly.

4.1.3 Sample Analysis

Air samples obtained at the common perimeter of the WSCP and the highway department, the high school, the Army training area, near the WSSRAP Administration Building, by the nearest WSQ resident, and at the Busch Wildlife Area Headquarters will be used to assess effective dose equivalents to a maximally exposed individual. Other sampling locations do not represent potential locations for maximum public exposure because public occupancy times at these locations is negligible.

Each filter, representative of approximately 403,200 liters of air (40 liters per minute times 10,080 minutes per week) will be analyzed for gross alpha concentration. Following gross alpha analysis filters will be cut into three equal sections, with each section placed in an individual envelope. The filters will be cut in thirds for quality assurance. This will allow an evaluation of analytical precision. Three pieces are used because, if an error caused a difference in analytical results between two filter portions, the third portion will allow a determination of which result was erroneous.

In January of each year the three sections of 52 weekly filters will form three composite samples for each of the five critical receptor locations and the Busch Wildlife Area background station. The 18 composite samples (filter thirds from six sampler locations) will be analyzed for isotopic thorium, isotopic uranium, Ra-228, and Ra-226. Analysis for this suite of radionuclides allows a determination of the concentration of all radionuclides at the Weldon Spring Site which could contribute more than 10 percent of the total effective dose equivalent. Radon and daughters are not included because they are not regulated by 40 CFR 61, Subpart H.

Yearly analyses of the filters is considered acceptable because it meets the intent of 40 CFR 61. The primary method given in 40 CFR 61 of determining effective dose equivalents is through computer modeling. The computer modeling exercise is to be performed and reported annually. Monitoring of airborne concentrations is also allowable. Therefore, a yearly determination of the airborne concentrations and associated effective dose equivalent at critical receptors meets the specifications of 40 CFR 61.

4.1.4 <u>Reports</u>

Reports of environmental monitoring for radionuclide emissions other than radon have been made for calendar years 1986 through 1988 in Annual Environmental Monitoring Reports (DOE, 1986; DOE, 1987a; DOE, 1988). These monitoring reports were transmitted to EPA Region VII. Although the monitoring at critical receptor locations was not sensitive enough to distinguish an annual effective dose equivalent of 0.10 mSv (10 mrem) above natural background, results for years 1986 through 1988 detected no significant difference at the 95 percent confidence level between gross alpha concentrations at critical receptors and the background monitoring station. This was as expected because no significant activities occurred at the WSS during these years that generated airborne radionuclide emissions.

Beginning with air samples collected during calendar year 1990, results of the monitoring performed as specified in Section 4.1 of this plan and an assessment of the effective dose equivalent at critical receptor locations will be reported in the 1990 Annual Site Environmental Report. These annual reports meet the requirements of 40 CFR 61 because the WSS is being remediated according to CERCLA. This allows EPA oversight which is sufficient to protect the public health by providing EPA Regional Office VII with all the information it needs to assess potential impacts on public health as a result of remediating the WSS.

4.2 COMPARISON TO 40 CFR 61 SPECIFICATIONS

In order to satisfy the sensitivity requirements of 40 CFR 61 through environmental monitoring the following must be met:

1. The air at the point of measurement must be continuously sampled for collection of radionuclides.

2. Those radionuclides released from the facility that are major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurement program.

3. Radionuclide concentrations which would cause an effective dose equivalent of 10% of the standard must be readily detectable and distinguishable from background.

4. Net measured radionuclide concentrations must be compared to the concentration levels in Table 2,

Appendix E of 40 CFR 61. In the case of multiple radionuclides being released from a facility, it must be demonstrated that the value for all radionuclides is less than the concentration level in Table 2, and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than 1.

5. A quality assurance program must be conducted that meets the performance requirements described in Appendix B, Method 114 of 40 CFR 61.

This subsection describes how the monitoring program at the WSS will satisfy items 1 through 4. Item 5 is addressed in Section 5.

Items 1 and 2 have been addressed previously. Samplers will run continuously and all major contributors to effective dose equivalent will be collected and measured.

Regarding Item 3, the sampling protocol at the critical receptor locations will be followed at the background monitoring station. Assuming typical Th-232 soil concentrations of 40 Bq/kg (1 pCi/g) and a typical rural airborne dust loading of 16 $\mu g/m^3$ (EPA, 1980), airborne Th-232 concentrations in background air would be 6×10^{-13} MBq/m^3 (2×10^{-17} Ci/m^3). (Th-232 was chosen for this example because it is the greatest contributor to effective dose equivalent.) Assuming continuous inhalation at 20 m^3/day (Cember, 1983) for 365 days/year and using a committed effective dose equivalent conversion factor of 4.43×10^{-4} Sv/Bq (EPA, 1988), a committed effective dose equivalent of 2×10^{-3} mSv (0.2 mrem) is predicted. Since the committed effective dose equivalent for Th-232 is received over a 50-year period the effective dose equivalent received in any single year would be at least a factor of ten lower. For these

TABLE 4-1 Sensitivity Analysis

Radionuclide	Required Sensitivity MBq/m³	(Ci/m³)		Ratio
U-238	3.1E-10	(8.3E-15)		0.018
U-234	2.9E-10	(7.7E-15)		0.020
Th-230	1.3E-10	(3.4E-15)		0.044
Ra-226	1.2E-10	(3.3E-15)		0.045
Th-232	2.3E-11	(6.2E-16)		0.242
Th-228	1.2E-10	(3.1E-15)		0.048
Ra-228	2.2E-10	(5.9E-15)		0.025
			SUM	0.442

reasons the annual effective dose equivalents for each radionuclide in background air is much less than 1 x 10^{-2} mSv (1 mrem). Monitoring results which attain the sensitivity requirements of Item 4 would, therefore, be readily detectable and distinguishable above background.

The sensitivity of the monitoring method meets the criteria in Item 4. A radiochemical detection limit for each radionuclide of 40 mBq (1 pCi) can be attained (Horton, 1990). By dividing this detection level by the 700 m³ drawn through the filter thirds in each composite sample, an airborne concentration of 5.28 x 10^{-12} MBq/m³ (1.5 x 10^{-16} Ci/m³) can be detected. Listed in Table 4-1 are the radionuclides for which monitoring will be performed, the analytical sensitivity specified in Table 2, Appendix E of 40 CFR 61, and the ratio of achievable sensitivity to the required sensitivity. Since the ratio of the sensitivities for each radionuclide is less than 1.0 and the sum of the ratios is less than 1.0, the proposed analytical method meets the requirements of 40 CFR 61.

5 QUALITY ASSURANCE

This section discusses the quality assurance program that will be conducted to ensure that emission measurements are representative and are of known precision and accuracy. Also included are administrative controls to assure prompt response when measurements indicate unexpectedly large emissions. In addition to complying with all requirements contained in this section, this monitoring program will also comply with the Weldon Spring Site Quality Assurance Program Plan (QAPP) (DOE, 1987b).

5.1 ORGANIZATIONAL STRUCTURE

The responsibility for implementing the emission monitoring program lies within the Environmental, Safety and Health (ES&H) Department. As such, the ES&H Manager has overall responsibility. Actual sampling protocol will be carried out within the Radiation Protection Group under the guidance of the Radiation Protection Manager. Audits will be conducted by the Quality Assurance Department which reports directly to the MK-Ferguson Company Quality Assurance Director. Any corrective actions which require modifications in the way remedial actions are performed at the Weldon Spring Site (WSS) are the responsibility of the Operations Department Manager. The lines of responsibility are shown in Figure 5-1.

5.2 SAMPLE COLLECTION AND ANALYSIS PROCEDURES

Project procedures exist for all phases of sample collection and analysis except for the method of dividing individual filters in thirds and the means of compositing samples. This procedure is currently being drafted and will be forwarded upon completion.

FIGURE 5-1 Lines of Authority

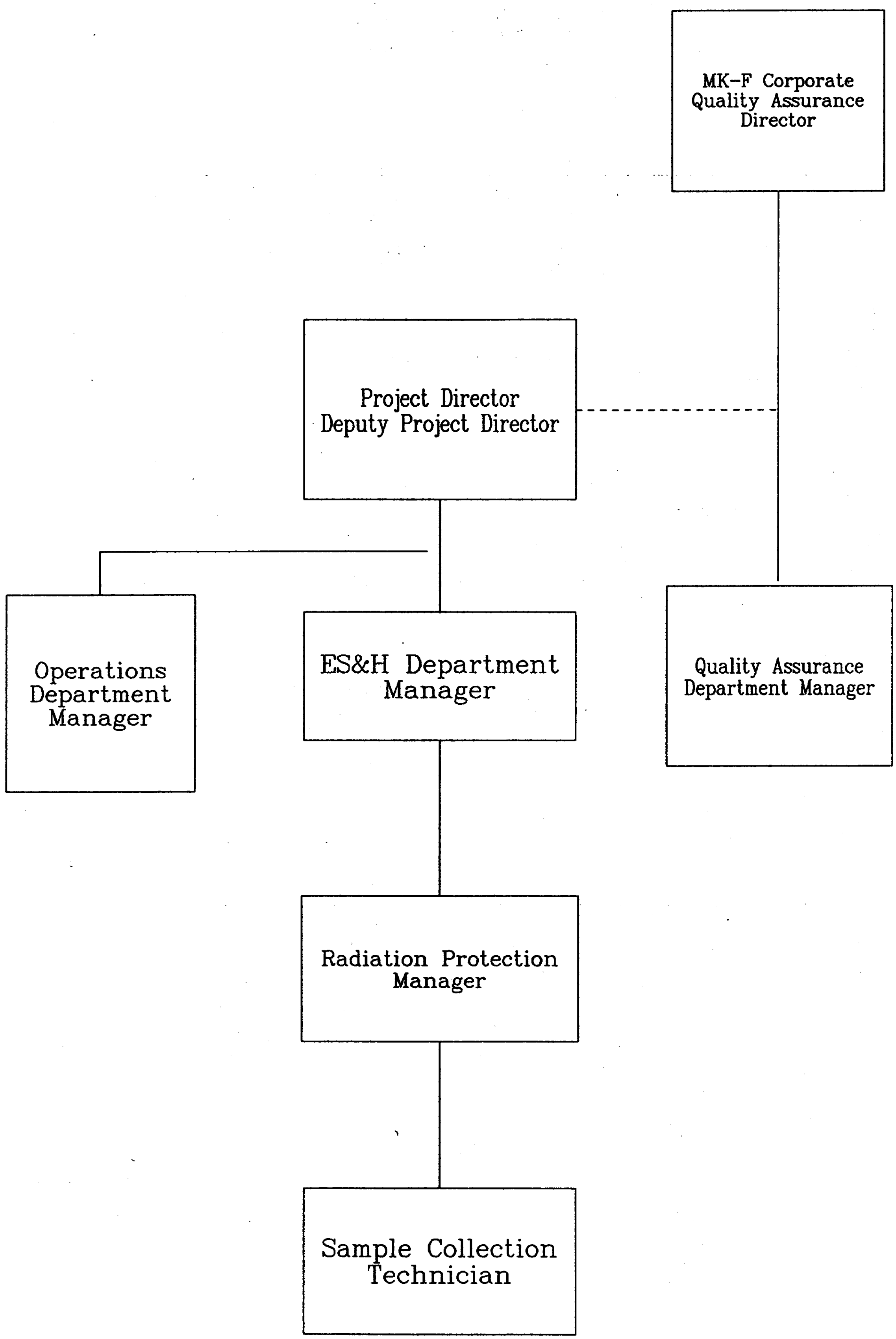


Table 5-1 presents a list of procedures and aspects of the sampling program which they govern. Each procedure is attached to this plan for reference.

Actual radioanalytical procedures are not performed at the site but at a subcontractor laboratory. The radioanalytical procedures used are specified in Table 5-2.

TABLE 5-1 Sampling Procedures

Procedure Number	Title	Sampling Program Aspects
ES&H 2.6.4	Ludlum Model 2000 Scaler and Model 43-10 Detector: Gross Alpha Measurement Operator and Calibration	Gross alpha analysis of air filters. Detector calibration, operational check, and usage.
ES&H 4.1.2	Chain-of-Custody	Chain-of-Custody for samples sent for radiochemical analysis
ES&H 4.6.4	Constant Flow Air Sampler Operation	Air filter change outs, filter handling, air sampler calibration and operation.

TABLE 5-2 Radioanalytical Procedures

Nuclide	Method
U-238	EPA-908
U-234	EPA-908
Th-232	EERF[a]-06
Th-230	EERF-06
Th-228	EERF-06
Ra-228	EPA-903.1
Ra-226	EPA-904

(a) Eastern Environmental Radiation Facility

5.3 ADMINISTRATIVE CONTROLS

Assurance that increased radionuclide emissions due to unplanned or unforeseen circumstances can be detected and controlled is achieved through weekly gross alpha analyses of each filter. Isotopes of thorium are the alpha-emitters at the WSS that have the highest potential to cause radiation dose at critical receptor locations. Isotopes of thorium are most prevalent in the quarry and in the raffinate pits. For other site areas such as Weldon Spring Chemical Plant (WSCP) buildings, uranium is the primary contaminant. At the quarry, Th-230 comprises, on average, 33 percent of the total alpha activity contributed by those radionuclides that will be measured at critical receptor locations. At the raffinate pits, Th-230 comprises, on average, 87 percent of the total alpha activity contributed by those radionuclides that will be measured at critical receptor locations. Clearly, Th-230 has the highest potential to cause a radiation dose at critical receptor locations.

If the potential for a person to receive a yearly effective dose in excess of 0.10 mSv (10 mrem) can be detected on a weekly basis, sufficient control over radionuclide emissions can be attained. This is achieved if a dose equivalent rate of 0.002 mSv (0.2 mrem) per week can be detected. Given a typical weekly occupancy time of five 8-hour days for persons closest to the site where the highest potential airborne concentrations are expected to occur, a quantity of air inhaled during eight hours at work of 10 m^3 (Cember, 1983), and a Th-230 committed effective dose equivalent conversion factor of 8.8×10^{-5} Sv/Bq (EPA, 1989), a dose equivalent of 0.002 mSv/week (0.2 mrem/week) corresponds to an airborne concentration of 4.4×10^{-10} MBq/m^3 (1.2×10^{-14} Ci/m^3).

A natural background gross alpha concentration of $2 \times 10^{-10} \pm 1.2 \times 10^{-10}$ MBq/m^3 at two standard deviations ($5 \times 10^{-15} \pm 3.26 \times 10^{-15}$ Ci/m^3) has been documented at the site (DOE, 1988). It can be seen that a committed effective dose equivalent rate due entirely to Th-230 of 0.002 mSv/week (0.2 mrem/week) can be resolved above natural background gross alpha concentrations. In fact, an effective dose equivalent rate much lower than 0.002 mSv/week (0.2 mrem/week) can be resolved above natural background gross alpha concentrations.

The wastes at the WSS contain a mixture of alpha emitters. Although some of the detected alpha activity will be due to Th-232 and Th-228, which have a higher potential to cause internal dose, a larger percentage of alpha emitters with lower internal dose delivery potential will also be present. This is based on measured radionuclide concentrations in waste materials. In addition, a Th-230 concentration of 4.4×10^{-10} MBq/m^3 (1.2×10^{-14} Ci/m^3) would result in a committed effective dose equivalent of 0.002 mSv/week (0.2 mrem/week). The effective dose equivalent would be much less because the dose equivalent from inhalation of Th-230 in any given year is spread out over a period of more than 10 years.

To ensure that remedial actions do not result in unplanned or unforeseen airborne radionuclide concentrations at critical receptor locations, a "sliding weekly average" gross alpha concentration will be computed for each critical receptor monitoring station. The sliding weekly average gross alpha concentration will be computed by summing all weekly gross alpha concentrations and dividing by the number of weeks of sampling during a calendar year. As successive weekly samples are analyzed, the results will be used to recompute the sliding weekly average concentration. If a sliding weekly average gross alpha concentration at critical receptor locations in excess of natural background is detected with 95 percent confidence, site operations which may have caused the elevated concentration will be evaluated to determine whether all reasonably achievable dust control measures have been implemented.

A weekly sampling frequency is adequate to control radiation exposures because the 0.10 mSv (10 mrem) level specified in 40 CFR 61 is a long-term standard (i.e. yearly). A response time of one week to control unplanned or unforeseen emissions will be adequate to maintain control over emissions.

5.4 QUALITY CONTROL

The quality control program will include spikes, duplicates, blanks, and control charts. This program is designed to meet the requirements of 40 CFR 61, Appendix B.

With each group of filters sent for radiochemical analysis, two filters will be spiked with known activities of Th-230 and two filters will be spiked with known activities of natural uranium (U-238, U-235, and U-234 in natural activity ratios).

Since each filter composite collected at critical receptor locations is cut into thirds, these filter thirds will serve as duplicates. Five percent of all gross alpha analyses are repeated to verify detector performance.

Field blanks are used each week when air filters are exchanged. These will be composited and analyzed radiochemically following analysis for gross alpha activity. In addition, each week an unused filter is analyzed for gross alpha activity. These filters will be composited and analyzed radiochemically.

Control charts are maintained to verify gross alpha detector performance. A control chart is generated to track daily detector background and daily certified standard source checks. Daily background and source counts must fall within three standard deviations of values posted when the detectors undergo semiannual calibration (MKF and JEG, 1989).

In addition to the system of spikes, duplicates, blanks, and control charts the radioanalytical analyses will be evaluated for internal consistency. At the WSS, U-238 and U-234 are in secular equilibrium. Uranium concentrations on air filters should also be in equilibrium. When radioanalytical results are provided, the degree of equilibrium will be evaluated. In most cases, Th-228 and Ra-228 are also in equilibrium. Equality between these radionuclides will also be evaluated.

5.5 DATA QUALITY OBJECTIVES

Accuracy and precision of radiochemical analyses will be measured at the 85 percent confidence level. Accuracy, as determined with the results of spiked samples, will be considered acceptable if analytical results of spiked samples are within ±50 percent of known values for 85 percent of all samples. Precision will be determined by averaging the results of the three duplicate analyses. Precision will be considered acceptable if the standard deviation of duplicate analyses is within ±50 percent of the average for 85 percent of the duplicate data sets. Analytical precision will also be calculated for U-238/U-234 for each composite sample. Precision will be considered acceptable if the standard deviation of the U-238/U-234 results for each composite sample are within ± 50 percent of the average for 85 percent of all samples.

Accuracy and precision of gross alpha analyses will be measured at the 95 percent confidence level. Accuracy, as determined by the daily source counts, will be considered acceptable if 95 percent of all daily values fall within three standard deviations of the certified standard source. Precision, as determined by the results of duplicate analyses, will be considered acceptable if 95 percent of the duplicate counts are within three standard deviations of the original count.

5.6 AUDITS

Internal audits will be conducted yearly by the WSSRAP Quality Assurance Department in accordance with the WSSRAP QAPP. The primary purpose of the audits will be to assure that sample collection, sample compositing, gross alpha analyses, and sample chain of custody are performed according to standard operating procedures. The internal audits will also ensure conformance with this overall "Plan for Monitoring Radionuclide Emissions Other Than Radon at Weldon Spring Site Critical Receptors."

External audits of the radioanalytical laboratory will also be performed annually by the WSSRAP Quality Assurance Department. These audits will ensure conformance of the radioanalytical laboratory to standard operating procedures.

5.7 CORRECTIVE ACTIONS

If data quality objectives are not met, the Radiation Protection Manager will provide a report evaluating the reasons for noncompliance and providing a statement of required corrective actions. The Environmental Safety and Health Manager will ensure the appropriateness of the recommended corrective actions and ensure that corrective actions are implemented in a timely manner.

If results of gross alpha analyses indicate detectable emissions of radioactive particulates at critical receptor locations the Radiation Protection Manager shall inform the Operations Department Manager. The Operations Department Manager will be responsible for ensuring that emissions are controlled to a level which is as low as reasonably achievable.

5.8 REPORTS

Emissions measurement program results including assessment of data quality, results of internal audits and corrective actions, if any, shall be prepared annually.

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