7078 G-000-106.64

FERNALD SITE ENVIRONMENTAL MONITORING PLAN

06/01/95

PL-1002, REV 2
FERMCO DOE-FN
125
MONITOR PLAN

7078

CONTROL NO NON-CONTROLLED COPY

PL-1002, REVISION No. 2

FERNALD SITE
ENVIRONMENTAL MONITORING PLAN

Effective Date: June 1, 1995

AUTHORIZED BY: Mark J Cherry
M. J. Cherry, Functional Area Manager

1-June-95
Date

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Fernald Environmental Restoration Management Corporation
P.O. Box 538704
Cincinnati, Ohio 45253-8704

000001

TABLE OF CONTENTS

1.0 OVERVIEW 1-1
- 1.1 General Requirements 1-1
- 1.2 Purpose and Scope 1-3
- 1.3 Environmental Monitoring and the SCQ 1-4
- 1.4 Environmental Monitoring Program Objectives 1-6
- 1.5 Organizational Responsibilities at the FEMP 1-6
- 1.6 FEMP Site Description 1-14

2.0 LIQUID EFFLUENT MONITORING 2-1
- 2.1 Performance Standards 2-1
- 2.2 Organizational Responsibilities 2-7
- 2.3 Identification of Discharge Sources 2-8
- 2.4 Evaluation of Discharged Contaminants and Water Quality Parameters . 2-11
- 2.5 Sampling and Monitoring Methods 2-16
- 2.6 Analytical Requirements 2-18
- 2.7 Non-Radiological Program Description 2-22
- 2.8 Quality Assurance 2-34

3.0 AIRBORNE EFFLUENT MONITORING 3-1
- 3.1 Performance Standards 3-1
- 3.2 Organizational Responsibilities 3-3
- 3.3 Basis for Airborne Effluent Monitoring 3-4
- 3.4 Identification of Discharge Sources 3-4
- 3.5 Stacks Requiring Monitoring 3-10
- 3.6 Evaluation of Discharged Contaminants 3-11
- 3.7 Sampling and Monitoring Methods 3-17
- 3.8 Analytical Requirements 3-25
- 3.9 Non-Radiological Airborne Effluent Monitoring 3-29
- 3.10 Quality Assurance 3-33

4.0 METEOROLOGICAL MONITORING 4-1
- 4.1 Meteorological Monitoring Program Scope 4-1
- 4.2 Organizational Responsibilities 4-2
- 4.3 Meteorological Monitoring Program Basis 4-3
- 4.4 Meteorological Modeling Methods 4-6
- 4.5 Meteorological Measurements 4-10
- 4.6 Quality Assurance 4-13

5.0 ENVIRONMENTAL SURVEILLANCE 5-1
- 5.1 Organizational Responsibilities 5-2
- 5.2 Basis for Environmental Surveillance Program 5-3

5.3 Criteria for Environmental Surveillance 5-6
5.4 Environmental Surveillance Sampling Design 5-10
5.5 Minimum Sampling Requirements 5-11
5.6 Media Specific Sampling Methods and Criteria 5-19
5.7 Quality Assurance 5-36

6.0 LABORATORY PROCEDURES 6-1
6.1 Introduction 6-1
6.2 Sample Identification and Tracking 6-2
6.3 Sample Handling 6-5
6.4 Preparation of Sample Mounts 6-9
6.5 Operation of Analytical Instrumentation 6-12
6.6 Validation of Laboratory Results 6-15
6.7 Reporting of Results 6-16
6.8 Quality Assurance 6-17
6.9 Control of Contract Laboratory Services 6-20

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT 7-1
7.1 Organizational Responsibilities 7-3
7.2 Variability of Effluent and Environmental Data 7-3
7.3 Data Management 7-4
7.4 Summarization of Data 7-6
7.5 Data Reporting 7-9
7.6 Comparisons to Standards, Control Data, and Historical Data 7-11
7.7 Quality Assurance 7-12

8.0 DOSE CALCULATIONS 8-1
8.1 General Requirements and Standards 8-1
8.2 Human Exposure Calculations - General Requirements and Methods 8-3
8.3 Quality Assurance 8-5

9.0 RECORDS AND REPORTS 9-1
9.1 Records 9-2
9.2 Reporting 9-3
9.3 Quality Assurance 9-3

10.0 QUALITY ASSURANCE 10-1
10.1 Introduction 10-1
10.2 Mandatory Quality Assurance Requirements 10-2
10.3 Elements of the QA Plans 10-4
10.4 QA Document Summary 10-13

11.0 REFERENCES 11-1

000003

LIST OF TABLES

Table 2-1: Target Analytes in FEMP Liquid Effluents 2-36
Table 2-2: Minimum Analytical Requirements of FEMP Liquid Effluents 2-37
Table 2-3: Laboratory Analyses NPDES Parameters 2-38
Table 2-4: NPDES-Related Standard Operating Procedures 2-40
Table 3-1: FEMP Radiological Point Sources 3-35
Table 3-2: FEMP Point Sources Requiring Continuous Monitoring 3-38
Table 3-3: Unmonitored FEMP Radiological Point Sources 3-39
Table 3-4: Minimum Analyses for Air Particulate Samples 3-41
Table 4-1: Classification of Atmospheric Stability Based on Vertical Temperature Gradient or Horizontal Wind Direction Fluctuation 4-16
Table 4-2: Instrumentation for the Primary Meterological Tower 4-16
Table 4-3: Instrument Performance Criteria 4-17
Table 5-1: Radiological Exposure Pathways of Potential Concern in Remedial Investigation Baseline Risk Assessments (Current Land Use Only) 5-39
Table 5-2: Minimum Analysis Regimen for Environmental Media Samples 5-40
Table 5-3: Sampling and Analysis Procedures 5-43
Table 5-4: Measured Radionuclides at AMS 9/9A 5-50
Table 5-5: Measured Radionuclides at AMS 8 5-51
Table 5-6: Measured radionuclides at MH-175 5-52
Table 5-7: Results of Air Sample Location Analysis 5-52
Table 9-1: Applicable Reporting Requirements 9-4

LIST OF FIGURES

Figure 2-1: Liquid wastewater flow
Figure 2-2: Controlled stormwater runoff
Figure 2-3: U-238 decay chain
Figure 2-4: U-235 decay chain
Figure 2-5: Th-232 decay chain
Figure 3-1: Coal-fired & natural gas boilers
Figure 5-1: Air pathways
Figure 5-2: Water pathways
Figure 5-3: Air locations
Figure 5-4: Groundwater well locations
Figure 5-5: TLD locations
Figure 5-6: Produce locations
Figure 5-7: Fish locations
Figure 5-8: Sediment locations
Figure 5-9: Surface water locations
Figure 5-10: Soil & grass locations
Figure 5-11: Radon locations

000005

1.0 OVERVIEW

1.1 General Requirements

U.S. Department of Energy (DOE) facilities that use, generate, release or manage significant pollutants or hazardous materials are required by DOE 5400.1[1] to develop and implement an Environmental Monitoring Plan (EMP) covering both radiological and nonradiological parameters. Each DOE site EMP must contain the design criteria and rationale for the routine effluent monitoring and environmental surveillance activities of the facility.

Safety must receive first consideration throughout all phases of work at the Fernald Environmental Management Project (FEMP). All employees, including subcontractors, must comply with Fernald Environmental Restoration Management Corporation's (FERMCO's) safety, health, and environmental regulations. All applicable safety, health, and environmental practices and policies shall be considered when planning work.

The Comprehensive Environmental Occupational Safety and Health Program specifies the Environmental Safety and Health (ES&H) policies that apply to all activities at the FEMP. These policies, addressing chemical, physical, and radiological hazards, are designed to ensure the protection of human health and the environment during FEMP activities.

The Comprehensive Environmental Occupational Safety and Health Program shall be rigorously executed to ensure that work is accomplished safely, without unnecessary delays, and in full compliance with health and safety requirements. Chemical Hygiene Plan and Chemical Awareness Hazardous Communication requirements found in the Comprehensive Environmental Occupational Safety and Health Program, as applicable to Environmental Monitoring Program activities, shall be followed.

1.0 OVERVIEW (cont.)

The Sitewide Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Quality Assurance Project Plan (SCQ) requirements must be integrated into all FEMP sampling and analysis programs, including those that are not driven by CERCLA requirements such as the Environmental Monitoring Program. SCQ requirements are incorporated or referenced throughout the EMP where applicable. Any applicable changes resulting from modification of the SCQ will be reflected in the EMP during the annual review of the EMP or as needed. The EMP complements the SCQ where appropriate and it does not intend to repeat information contained in the SCQ.

The DOE has provided guidance for the development of an EMP in the "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance" (DOE/EH-0173T).[2] The elements that are considered by DOE to be essential to a quality monitoring and surveillance program are denoted by *should** within this regulatory guide. A summary of each *should** requirement is presented in the Summary Section of DOE/EH-1073T (pp xi-xxvi).[2] DOE requirements for routine environmental surveillance and effluent monitoring at the FEMP are addressed within the body of this Plan in Sections 1.0 - 10.0. The essential elements are cross referenced in the Plan to the summary of *should** criteria contained within DOE/EH-0173T. The status of the implementation of this Plan at the FEMP has been reviewed and the results are presented in the "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix" (Attachment A).

The Matrix lists the *should** criteria presented in DOE/EH-0173T, as well as the Sections of the EMP where the *should** criteria are addressed. Furthermore, the Matrix references documentation that supports requirements assessed as complete, notes deficiencies, and identifies actions required to address deficiencies. In addition to the implementation status provided in the Matrix, a current description of the FEMP Environmental Monitoring Program is provided in

1.0 OVERVIEW (cont.)

Section 5.0 of this Plan which includes a list of FEMP implementing procedures in Table 5-3. Both Attachment A and Section 5.0 of this Plan will be updated as the EMP is implemented. All programmatic changes affecting the performance or quality of the Environmental Monitoring Program must be approved by the Head of the DOE Field Office, DOE-FN.

Each DOE facility is unique. Therefore, the need and levels of effort for monitoring programs shall be determined by the appropriate field organization on a case-by-case basis, consistent with regulatory requirements, DOE directives, and the degree of environmental assurance that activities at a site require.

1.2 Purpose and Scope

Environmental monitoring consists of two major activities, effluent monitoring and environmental surveillance. The purpose of the EMP is to establish standards of performance for how routine effluent monitoring and environmental surveillance sampling shall be conducted, to document the associated rationale and design criteria, and to address quality assurance and data verification requirements for the FEMP's routine environmental monitoring activities. It ensures that work performed under the Environmental Monitoring Program is of adequate quality to fulfill Environmental Monitoring Data Quality Objectives (DQOs).

The EMP provides the necessary elements and rationale for the FEMP to conduct environmental surveillance and effluent monitoring to demonstrate that radioactive and hazardous materials released at the FEMP are handled in such a way as to pose minimal risks to the environment and public health, and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or the public welfare. Data generated under the

1.0 OVERVIEW (cont.)

Environmental Monitoring Program are intended to fulfill the needs of the DOE, as well as the EPA, the Ohio EPA (OEPA), and the public.

1.3 Environmental Monitoring and the SCQ

The EMP will serve as the project-specific plan (PSP) for the routine effluent monitoring and environmental surveillance activities. Because the Environmental Monitoring Program is an ongoing program with a program plan (this EMP), it does not require the development of a formal PSP. Therefore, throughout the EMP, the SCQ's PSP requirements will be discussed or referenced where applicable.

The SCQ also defines PSPs as follows: PSPs are supplements to the SCQ and they serve as comprehensive work plans. The EMP, then, supplements the SCQ and serves as a comprehensive work plan which scope includes routine effluent monitoring and environmental surveillance activities. In addition the SCQ states that PSPs are combinations of a standard QA project plan and a CERCLA work plan. The EMP could be thought of as a combination of a standard QA plan and a work plan on how to conduct routine monitoring per DOE requirements and, from an Environmental Protection Agency (EPA) perspective, how to provide data comparability with the CERCLA effort.

The EMP addresses all the required PSP information, as applicable to the Environmental Monitoring Program. That is, the EMP directs the use of historical information and assessment of existing data relevant to the Environmental Monitoring Program with respect to Program development, modification, and implementation. During the EMP's development, such information was used. Identification of 1) sampling points and how they were chosen, 2) methods for collecting data, 3) analytical methods to be used and corresponding analytical

000009

1.0 OVERVIEW (cont.)

support levels, 4) field and laboratory QA/QC, and 5) data reduction and validation are required to be addressed in the EMP by DOE Order 5400.1 as well as the SCQ. These elements are also addressed in the EMP at the programmatic and implementing levels. Rationale and program design criteria must be documented in the EMP.

Also, the EMP directs the use of the process and implementing procedures that ensure precision, accuracy, completeness, and representativeness of the data and documentation thereof to ensure the generation of quality data. All EMP DQOs are established per the SCQ and kept in a centrally located document, separate from the SCQ. Therefore, DQOs will be incorporated into the EMP via reference.

The EMP provides for changes in the routine effluent monitoring and environmental surveillance program in response to evolving program needs as new projects are implemented at the FEMP. Program review and modification focuses on site specific and generic factors affecting the quality of the Environmental Monitoring Program.

The EMP requirements differ in some respects from those of the SCQ in a few areas. The SCQ requires additional QA/QC requirements for field and laboratory samples, including: the types and frequencies of required field and laboratory QA/QC samples, requirements for the use of FEMP specified analytical methods, and requirements for participating laboratories to generate and use control charts for various parameters. These SCQ requirements are incorporated in the EMP by reference.

1.0 OVERVIEW (cont.)

1.4 Environmental Monitoring Program Objectives

The Environmental Monitoring Program shall be capable of verifying and/or determining compliance with applicable environmental statutes, regulations, and standards. Monitoring activities shall provide the data necessary to characterize releases, determine performance of equipment, establish trends, support environmental management decisions, and demonstrate compliance with legal and regulatory requirements set forth in applicable environmental statutes, regulations, and standards. The Environmental Monitoring Program shall also be capable of detecting and quantifying unplanned releases.

To the extent that a regulation or permit allows for exemptions from required monitoring practices and procedures, DOE-FN shall obtain approval for any exemption from the appropriate regulatory agency. In those instances where an exemption from a DOE-imposed monitoring requirement is justifiable, approval may be granted by DOE-FN accordingly.

1.5 Organizational Responsibilities at the FEMP

On October 1, 1990, the FEMP was transferred from DOE's Office of Defense Program (DP-1) to the Office of Environmental Restoration and Waste Management (EM-1). The DOE Office of Environmental Restoration and Waste Management is the Program Secretarial Officer (PSO) for the Fernald Site Office. The Office of Environmental Restoration (EM-40) specifically will assume responsibility for all air and water quality improvements; Resource Conservation and Recovery Act (RCRA) compliance activities; waste management upgrades; continuity of operations; waste treatment and associated upgrades; all waste processing, storage, and disposal; waste minimization; and scrap metal management.[3] Responsibility for implementation of all

1.0 OVERVIEW (cont.)

applicable environmental laws and regulations, including the implementation of DOE 5400.1,[1] rests primarily with:

- the DOE Headquarters Office of Environmental Restoration,
- the Eastern Area Program Division/FEMP Program Branch,
- The DOE Ohio Field Office, and
- the DOE Field Office, Fernald (DOE-FN)

FERMCO is the prime contractor for the Fernald Environmental Restoration Management Contract (ERMC). The scope of work for the ERMC is to manage cleanup of the Fernald site safely, cost effectively, on a timely basis, and in compliance with regulations. FERMCO has the responsibility to ensure protection of the public health and the environment in accordance with direction from the DOE.

FERMCO will be flexible and quick to respond to regulatory changes, and to address technical issues that may arise as the cleanup progresses.[4] At the same time, FERMCO will maintain a disciplined approach and protect the integrity of compliance and performance baselines.

Near-term actions will be completed on the basis of a thorough review of both potential risks to human health and the environment from existing conditions and budget authorizations and priorities.

1.0 OVERVIEW (cont.)

The FEMP is administered in a safe and environmentally sound manner consistent with DOE Order 5400.1, "General Environmental Protection Program" and the regulations cited in the DOE Orders, with National Environmental Policy Act (NEPA) regulations 40 Code of Federal Regulations (CFR) 1500 through 1508, and with any other applicable state and federal environmental regulations.

Acceptance tests will be performed on suppliers and construction/subcontractors to assure that the design-imposed requirements for safety, health, and environmental impacts are satisfied.

Generally, seven key staff organizations - Administration, Public Affairs, Quality Assurance, Systems Integration and Assessment, Legal Affairs, an Ombudsman, and Audits - have been formed to see that policies and procedures are developed in line with DOE Orders and regulations, contract terms, and applicable laws. They will ensure that these policies and FERMCO objectives are appropriately communicated to employees and the public. They will work with line organizations to develop written policies and procedures, to understand and interpret regulations and laws, and to audit for compliance.

Specifically, Systems Integration and Assessment (SIA) and Administration develop policies, procedures, and practices to ensure that operations are consistent with DOE requirements and verify they are internally consistent. The ERMC activities must comply with DOE and EPA orders and regulations, and with written procedures. They will also coordinate occurrence reporting.

The primary responsibility of Environmental Programs is to manage environmental investigation and restoration. The organization consists of a group of integrated project task teams led by dedicated managers, flexibly staffed from the engineering, construction, environmental and

1.0 OVERVIEW (cont.)

support organizations, to promote coordination across CERCLA/RCRA Units (CRUs) and throughout the FEMP.

Regulatory interfaces are coordinated with Regulatory Programs (RP) through regulatory specialists assigned to the CRUs to ensure consistency and overall site objectives and NEPA-approved actions. The CRU Project Directors have the ultimate authority for the cost, schedule and technical performance of their CRUs, as established by the contractual commitments, and by DOE Direction and Orders (that include those directly associated with the EMP.)

The Regulatory Programs (RP) Division works with DOE to coordinate external interfaces with the public, the regulatory authorities, and the technical community to develop and maintain a strategic vision for completion, a regulatory consensus, a safe operating envelope, and opportunities for technology application. RP has the functional responsibility for sitewide Risk Assessments. They provide the Regulatory Specialists to the CRUs. RP processes and maintains all FEMP permits.

RP's primary responsibility is to manage an active outreach to, and continuing dialogue with, the regulators and the technical community, and to integrate these interface efforts with the activities of Environmental Projects. RP evaluates ongoing efforts and plans to include the EMP from a sitewide perspective to assess regulatory compliance and to ensure that the activities remain within a safe operating envelope. Their evaluations consider many inputs including the following:

1) Environmental requirements from Federal and State laws such as CERCLA, RCRA, Clean Air Act (CAA), Clean Water Act (CWA), and state requirements.

1.0 OVERVIEW (cont.)

2) Licenses and permits.

3) Safety requirements for worker and public protection which include radiological and environmental monitoring concerns as addressed in DOE Orders, regulations, and notices.

4) Health Risk Assessments to support remedial decision-making.

5) Safety and probabalistic risk assessments to support operating requirements and emergency plans.

6) Available improved and advantageous technologies.

RP establishes environmental and safety requirements and limits as they develop from analysis of proposed actions. The ES&H Division ensures that they are included in policies and procedures and implemented sitewide.

The Remediation Support Operation (RSO) Division supports the safe remediation and decontamination of the site through management of all waste materials, support to remediation contractors, and base activities including facilities operation and maintenance. A primary charter of this organization is to ensure that worker health and safety and environmental standards are never compromised. To ensure that individual facilities are in compliance with regulations and policies, and the work is conducted in these facilites within procedures and consistent with Conduct of Operations practices, each facility will be assigned to a facility or area landlord. All activities required by, or impinging on, that facility will be coordinated with and approved by the facility or area manager.

1.0 OVERVIEW (cont.)

The Quality Control Department of the Environmental Division is responsible for establishing, implementing, and maintaining QC programs for procurement; Title I, II, and III engineering activities associated with construction and remediation; waste package verifications; nondestructive examinations; internal and external laboratory qualifications; and data validation.

The Laboratory Service Department of the Environmental Division ensures development of analytical methodologies in both onsite and offsite laboratories in order to comply with the requirements of the SCQ. The department will interface with regulatory agencies such as DOE, USEPA, and OEPA on necessary matters relative to the conduct of chemical analytical measurements at the FEMP. The department will coordinate with other FERMCO Departments to ensure efficient conduct of operations relating to laboratory analysis. This will include those activities as related to the Environmental Monitoring Program.

The Project and Information Control (PIC) Division maintains all cost, schedule, and technical baselines. The Information Resources Management group of PCC provides for archival, indexing, retrieval and storage of site documents. The group also performs optical imaging of selected historical and site operating documents. The group has oversight responsibility to help ensure that sitewide records management procedures are being adhered to across the site.

The Communication Center of the Administration Division has the responsibility for monitoring of the site alarm systems involving fire, safety, environmental (to include those of the Environmental Monitoring Program), and security, and fulfill the function of the Emergency Operations Center (EOC) until the EOC is activated.

The Environmental Safety and Health (ES&H) Division manages all ES&H programs for FERMCO to facilitate safe operations, ensure compliance with all applicable regulations and

1.0 OVERVIEW (cont.)

permits and ensure that all activities are conducted within approved and analyzed conditions conducive to worker health and safety, environmental protection, and public health and safety. One of the ES&H Division's primary responsibilities is to ensure that proper ES&H programs, such as the Environmental Monitoring Program, systems, and procedures are in place so that all regulatory and DOE requirements are met. ES&H works closely with the Vice-President of Regulatory Programs (RP) to ensure site activities meet the regulatory requirements. The RP Division obtains required licenses and permits and provide ES&H with an acceptable and safe operating envelope so that effective ES&H policies, plans, and procedures can be developed, implemented, and enforced. RP as well as the QA organization provides oversight of ES&H to ensure that ES&H criteria are being appropriately interpreted and implemented.

The Environmental Protection Department of the ES&H Division ensures environmental compliance through rigorous effluent control and monitoring practices for the protection of the general public and the environment. Release of hazardous and radiological contamination will be reduced to As Low As Reasonably Achievable (ALARA). Contamination and hazardous emissions will be monitored to ensure that they remain well below regulatory limits during all site activities as defined in licenses, permits, and compliance documents.

The ES&H Assurance/Emergency Preparedness Department of the ES&H Division maintains a performance-based self-assessment program to ensure proactive ES&H oversight and compliance with all DOE Orders and established requirements. It also establishes the programmatic aspects of procedures, document control, and records management in accordance with DOE requirements; establishes a centralized, consistent, accurate, and flexible data repository for management reporting, analysis, and decision support systems; and establishes and maintains an emergency preparedness and management program in compliance with all applicable DOE Orders, Federal and State regulations.

1.0 OVERVIEW (cont.)

In addition to the organizational responsibilities described above, the responsibility for providing information necessary to keep the EMP current rests with each staff organization manager. The procedures that implement the requirements of this Plan are listed in Table 5-3.

During the implementation of the EMP requirements, department managers are responsible for sending documentation to the Manager of Environmental Monitoring and Surveillance showing that deficient items required by the EMP are complete. This will ensure that appropriate changes to the EMP are incorporated in a timely manner. Significant changes to the Program must be approved by DOE-FN and incorporated in the EMP before they can be implemented. All rationale related to Environmental Monitoring Program activities must be documented in the EMP per DOE requirement.

Changes in site specific or generic factors and remediation projects may affect the execution and/or performance of the Environmental Monitoring Program. Specifically, changes in the nature of current site operations with respect to the history and the extent of change to facility operations, changes of materials released in effluents and their potential hazards, changes in waste shipping and disposal practices, as well as changes in land usage may affect some or all aspects of the program.

Certain aspects of the Environmental Monitoring Program may be modified temporarily or for the long term due to site remedial and removal actions such as building demolition or waste pit remediation. For example, the following actions may be necessary as a result of evaluating specific removal and remedial action Work Plans impact on the adequacy of the routine Environmental Monitoring Program:

1.0 OVERVIEW (cont.)

- preliminary sampling to provide a basis for evaluation of sampling and design and statistical analysis options,

- verification of the efficiency, sensitivity, and adequacy of the sampling device or method over a range of conditions encountered,

- proportional sampling focusing on homogeneous subareas, and

- reevaluation of the selection of the "best" statistical method to provide the test of hypothesis.

Therefore, managers who have responsibilities under the Environmental Monitoring Program, as well as those who have responsibilities under Environmental Programs Organizations, shall consider how the removal and remedial actions that are planned may impact the adequacy of the way in which routine effluent monitoring and environmental surveillance activities driven by DOE Order 5400.1 are conducted at the site. This shall be accomplished primarily through interfacing with Regulatory Programs Division as discussed previously.

1.6 FEMP Site Description

To provide a perspective of the material presented in the EMP, Chapter One of the 1993 Site Environmental Report (SER)[5] contains the following introductory sections:

- The FEMP Mission: Changing from Production to Restoration - a historical overview of the site's former operations and its current cleanup mission leading to current site activities;

1.0 OVERVIEW (cont.)

- Environmental Program Information - a description of site activities aimed at monitoring and maintaining environmental quality;

- Local Geography - an introduction to the physical, ecological, and human characteristics of the area;

- Exposure Pathways to People - an examination of the physical and biological surroundings as possible routes for contaminants to reach local communities; and

- Environmental Standards and Guidelines - a description of the various standards with which the FEMP must comply to protect the local environment.

2.0 LIQUID EFFLUENT MONITORING

To assess the impact of liquid releases on members of the general public and the environment, the FEMP shall monitor liquid discharges from the facility. This involves both radiological and non-radiological discharges. This Section sets forth performance standards for compliance with applicable requirements contained in DOE Orders, the FEMP NPDES Permit, other CWA sampling and monitoring protocols, and the Sitewide CERCLA Quality Assurance Project Plan (SCQ). Sections 2.8 and 10.0 discuss and reference applicable SCQ requirements to be followed in the liquid effluent monitoring program. Section 5.0 provides a description of current FEMP liquid effluent monitoring practices. Attachment A, "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix," identifies the current status of compliance with applicable requirements and schedules for improving that status. Applicable DQOs are referenced in Attachment B.

As discussed in Section 1.1 of the EMP, applicable requirements set forth in the Comprehensive Environmental Occupational Safety and Health Program shall be followed. Any chemical handling shall be based on the Chemical Hygiene Plan.

2.1 Performance Standards

The FEMP shall monitor liquid effluent streams in compliance with applicable requirements of DOE Orders and other federal, state and local standards. These standards are summarized in Sections 2.1.1 through 2.1.5. Applicable SCQ requirements referenced in Section 2.8 and 10.0 of this Environmental Monitoring Plan also shall be followed.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.1.1 DOE Public Dose Limit - All Exposure Modes, All DOE Sources of Radiation

The exposure of members of the public to radiation sources as a consequence of all routine activities at a DOE site shall not cause, in a year, an effective dose equivalent (EDE) greater than 100 mrem. The EDE is the sum of exposures due to radiation sources external to the body during the year plus the committed effective dose equivalent from radionuclides taken into the body during the year.

2.1.2 Drinking Water Pathway Only, All DOE Sources of Radionuclides

Liquid effluents from DOE activities shall not cause private or public drinking water systems downstream of the facility discharge to exceed the drinking water radiological limits established in 40 CFR Part 141.[6] Specifically, such activities shall not cause:

- persons consuming water to receive a committed effective dose equivalent greater than 4 mrem in a year due to beta particle and photon radioactivity,
- the combined concentrations of ^{226}Ra and ^{228}Ra in drinking water to exceed 5 pCi/L,
- the concentration of gross alpha activity (including ^{226}Ra but excluding radon and uranium) in drinking water to exceed 15 pCi/L, or
- the concentration of ^{90}Sr in drinking water shall not exceed 8 pCi/L.

Direct consumption of surface water is not considered a pathway since surface water is not used as a source of drinking water in the FEMP vicinity.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.1.3 Radiological ALARA Considerations

In addition to the above requirements to limit dose to members of the general public, further controls are imposed on liquid effluents to protect resources such as land, surface water, groundwater, and related ecosystems from undue contamination. These controls include required actions based on Derived Concentration Guide (DCG) fractions; limits on the concentration of radioactive settleable solids in the effluents; and dose limits for native aquatic organisms.

2.1.3.1 Determination of Derived Concentration Guide (DCG) Fraction

The adequacy of liquid effluent discharge controls is evaluated, in part, by comparing the annual average concentrations of radioactive contaminants in liquid effluents at the location of discharge to the environment to derived concentration guides (DCGs) set forth in DOE 5400.5.[7] The criterion used in such comparisons is the DCG Fraction which is computed as follows:

$$DCG\ Fraction = \sum_{i=1}^{I} \frac{C_i}{DCG_i}$$

where:

C_i = annual average concentration of the ith radionuclide in the liquid effluent,

DCG_i = Derived Concentration Guide value of the ith radionuclide, and

I = total number of radionuclides in the liquid effluent.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.1.3.2 DCG Fraction Greater Than Or Equal To One

If the DCG Fraction for a discharge location is calculated to be greater than or equal to one, then a Best Available Technology (BAT) assessment shall be done to determine the benefits of applying BAT in reducing and maintaining the DCG Fraction to a value less than one. BAT selection shall be made from candidate alternative technologies which are identified by an evaluation process that includes factors related to technology, economics, and public policy considerations. Factors that are to be considered in selecting BAT, at a minimum, shall include:

- the age of equipment and facilities involved,
- the process employed,
- the engineering aspects of the application of various types of control techniques,
- process changes,
- the cost of achieving such effluent reduction,
- non-water quality environmental impact (including energy requirements),
- safety considerations, and
- public policy considerations.

2.0 LIQUID EFFLUENT MONITORING (cont.)

A plan and schedule to upgrade liquid effluent treatment systems, if justified by a BAT analysis, shall be submitted for approval to the responsible Operations Office Manager and updated annually, consistent with the provisions of DOE 5820.2A for preparing and updating Waste Management Plans.

NOTE: Because the FEMP is a CERCLA site for which remedial actions are being planned and implemented consistent with applicable statutory requirements and direction from U.S. EPA, requirements for a BAT analysis may be replaced or superseded by equivalent requirements for EE/CAs and/or feasibility studies mandated under CERCLA.

2.1.3.3 DCG Fraction Less Than One

If the DCG Fraction for a discharge location is less than one, then the conduct of facility operations and the performance of the effluent treatment system(s) associated with the affected discharge location are considered adequate.

2.1.3.4 Sedimentation

To prevent the buildup of radionuclide concentrations in sediments, liquid effluents containing radioactive material in the form of settleable solids shall not be released to natural waterways if the concentration of radioactive material in the solids present in the waste stream exceeds 5 pCi/g above the ambient background level of settleable solids for alpha emitting radionuclides, or 50 pCi/g above the ambient background level of settleable solids for beta-gamma emitting radionuclides (DOE/EH-0173T, Summary 2c).

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.1.3.5 Dose Limit for Native Aquatic Animal Organisms

To protect native animal aquatic organisms, the absorbed dose to these organisms shall not exceed 1 rad/day from exposure to radioactive materials discharged to natural waterways. Dose to aquatic organisms will be calculated per Section 8.0. Actual dose calculations will be performed after applicable environmental data have been validated, verified, and reviewed.

2.1.3.6 New Facilities and Modification to Existing Facilities

New facilities and modification to existing facilities shall be designed and constructed such that the DCG Fraction for each discharge location is maintained less than one. Preoperational assessments shall be made and the decision regarding potential liquid effluent releases shall be documented in the EMP. An acceptable form of this assessment is an Operational Readiness Review with an associated checklist as specified in Site Standard Operating Procedure (SSOP)-0100, "Readiness Review Process." However, the decision as to type and schedule of any new facility will be controlled by considerations related to the CERCLA remedial program at the FEMP.

2.1.4 National Pollutant Discharge Elimination System

Liquid effluents shall be monitored and managed in accordance with the National Pollutant Discharge Elimination System (NPDES) Permit[8] issued by the OEPA.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.1.5 Resource Conservation and Recovery Act

Wastes shall be monitored and managed in accordance with the regulations established under RCRA, 40 CFR Parts 260 through 280.[9]

2.1.6 Ohio Administrative Code Regulations

Wastes shall be monitored and managed in accordance with the regulations established under the Ohio Administrative Code (OAC).

2.2 Organizational Responsibilities

2.2.1 Effluent Monitoring and Control Section

The ES&H Effluent Monitoring and Control Section reviews discharge data for regulatory compliance and prepares discharge monitoring reports (DMRs). This section also is responsible for assuring continuing compliance with regulatory and DOE Order requirements for management of liquid effluent discharges, and for assuring that effluent discharges satisfy ALARA principles. DOE Order requirements for liquid effluents can be found in DOE 5400.5, Section II.3.

2.2.2 Permitting and Reporting Department

The Regulatory Programs (RP) Permitting and Reporting Department reviews and issues the DMRs to OEPA, and assures continuing awareness and adherence of FEMP activities with current and proposed federal, state and local regulations relating to liquid effluent discharges.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.2.3 Utilities Services Section

The Utilities Services Section is responsible for operating and maintaining the water treatment systems and obtaining liquid effluent samples. In addition, Utilities Services is responsible for calibrating effluent monitoring and sampling equipment in accordance with the quality assurance requirements set forth in Section 10.0 of this Plan.

2.2.4 Analytical Laboratory Services Department

The Analytical Laboratory Services Department is responsible for ensuring that the analyses specified in this Section of this Plan are performed on liquid effluent samples in accordance with Section 6.0 of this Plan.

2.2.5 Environmental Monitoring and Surveillance Section

The Environmental Monitoring and Surveillance (EMS) Section is responsible for generating summaries of liquid effluent data in accordance with Section 7.0 of this Plan, performing dose calculations for liquid pathways in accordance with Section 8.0 of this Plan, and generating the SER in accordance with Section 9.0 of this Plan. This section is also responsible for ensuring compliance with requirements for radon and meterological monitoring.

2.3 Identification of Discharge Sources

A discharge point is any discernable, confined, and discrete conveyance, including but not limited to any stack, duct, vent, pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, or vessel from which any water is discharged to the atmosphere or waters accessible

2.0 LIQUID EFFLUENT MONITORING (cont.)

to the general public. Figure 2-1 depicts the origin, flow, and treatment of water that ultimately leads to liquid effluent discharges from the FEMP.

All process wastewater is treated in various process facilities throughout the site to reduce the amounts of chemical and radioactive contaminants. Normally, this water is routed through the General Sump. At the General Sump, the flows are segregated based on the presence of contamination. Non-contaminated streams are routed directly to Manhole-175 (Outfall 4001). Contaminated streams are routed to Plant 8, then to the Biodenitrification (BDN) Facility where they are treated to reduce nitrate. This water is then routed to Outfall 4001 where it flows by gravity through a buried pipeline to the Great Miami River.

Stormwater runoff from the majority of the former Production Area and waste pit areas is controlled prior to discharge. These areas are shown in Figure 2-2. Runoff from the waste pit areas is collected in the clearwell and the stormwater runoff collection system; then it is pumped to the Biodenitrification Surge Lagoon (BSL). Stormwater from the former Production Area converges at the Storm Sewer Lift Station (SSLS), and flows via gravity to the Stormwater Retention Basin (SWRB). The purpose of the SWRB is to retain the stormwater long enough to allow suspended solids to settle. After settling (usually after a minimum of 24 hours), the water is pumped to the SWRB Valve House (SP3) for discharge to the Great Miami River (the river) via Manhole 176B. There may be times when rainfall is so heavy or frequent that the holding and pump discharge capacity of the SWRB is exceeded. In this event, excess stormwater overflows to the Storm Sewer Outfall Ditch (SSOD) at Outfall 4002. The SSOD empties into Paddys Run which ultimately flows into the Great Miami River.

The Waste Pit Area Runoff Control Project provides a system for the collection and treatment of potentially contaminated stormwater from the perimeter of the waste pit area to prevent it

2.0 LIQUID EFFLUENT MONITORING (cont.)

from reaching Paddys Run Creek. The project provides runoff control, as well as a collection system, designated to collect stormwater runoff from the waste pit perimeter area and pump it to the BSL for processing through the BDN system.

The Collect Uncontrolled Production Area Stormwater Runoff Project provides a system to redirect additional contaminated surface runoff into the Storm Sewer System for discharge to the SWRB.

When the Advanced Wastewater Treatment (AWWT) Facility is completed and placed into operation, it will treat up to 44.1 ℓ/sec (700 gpm) of stormwater from the SWRB and 25.2 ℓ/sec (400 gpm) of process waters for additional solids and radionuclide removal. The stormwater collected at the BSL will be part of the 25.2 ℓ/sec (400 gallons per minute) process stream. The AWWT Facility is currently scheduled for completion in early 1995.

Outfall 4001 and 4002 are the final monitoring locations for liquid effluent discharged from the FEMP to the Great Miami River and to Paddys Run respectively. A single effluent monitoring station is proposed to satisfy all FEMP monitoring and sampling requirements, including NPDES requirements, for effluent discharge through the outfall pipeline beginning at Manhole 176B. The location of this station will be downstream of Manhole 176B, at the Parshall Flume Chamber, which has been constructed under the South Plume Removal Action.

The Parshall Flume Chamber consists of a concrete structure housing a flow measuring device, known as a Parshall Flume, that has been previously constructed within the outfall pipeline. Sampling and monitoring equipment (*e.g.*, probes, indicators, transmitters, recorders) are proposed to be installed to enable the Parshall Flume Chamber to become an effluent monitoring

station. It is proposed that a building be constructed over the Chamber to house the sampling equipment and monitoring equipment.

2.4 Evaluation of Discharged Contaminants and Water Quality Parameters

2.4.1 Radiological Contaminants

Based on the former operational processes described in Chapter 1 of the 1993 Site Environmental Report,[5] the primary radionuclides of interest at the FEMP (*i.e.*, those posing the greatest health risk) are ^{238}U, ^{235}U, ^{234}U, ^{232}Th, and ^{226}Ra. Since chemical processing of uranium bearing materials is no longer performed, the short-lived decay products of the uranium isotopes will become more prominent as they grow into equilibrium. Because thorium has been stored onsite since 1979 without any chemical processing, its short lived decay products are nearly at equilibrium activities at the present time.

Data on annual liquid effluent releases can be found in the Site Environmental Reports.[5, 10-14]

2.4.1.1 Radionuclides Associated with the ^{238}U Decay Chain

Daughter radionuclides associated with the ^{238}U decay chain are shown in Figure 2-3. The significance of the radionuclides in this decay chain is evaluated below:

- Since ^{234}Th is a beta emitter, it has not been included among the thorium isotopes that were quantified by alpha spectroscopy. However, ^{234}Th cannot be ignored as a possible contaminant in FEMP liquid effluent.

2.0 LIQUID EFFLUENT MONITORING (cont.)

- ^{234m}Pa is currently in equilibrium with its predecessors. Since it is a beta emitter with no significant photon emissions, and its half-life is approximately one minute, there is no practical means of specifically analyzing for this radionuclide. Therefore, it is not considered a target analyte for liquid effluent radiochemical analyses.

- ^{234}Pa is produced by internal transition from ^{234m}Pa with a branching ratio of 0.0016, which means that under equilibrium conditions, the ratio of ^{234}Pa to any of its predecessors will never exceed 0.0016. For this reason, ^{234}Pa is not considered a target analyte for liquid effluent radiochemical analyses.

- ^{234}U is nearly in equilibrium with ^{238}U since it was separated along with the ^{238}U as part of past chemical processes. This fact is supported by data which indicate ^{234}U to ^{238}U dischage ratios of 0.65 to 0.86 from 1988 to 1993. Thus, ^{234}U is considered a target analyte in effluents.

- There will be no significant in-growth of ^{230}Th due to the long half-life of ^{234}U. However, ^{230}Th and ^{226}Ra were separated from uranium in past chemical processes at the FEMP. Because of their long half-lives, they could be present in process residues and general site contamination. This is supported by the fact that ^{230}Th has been quantified in liquid effluents every year since 1988. Thus, ^{230}Th is considered a target analyte in liquid effluents. The analyses of liquid effluents have not identified ^{226}Ra since 1988; however, due to the known inventory of this radionuclide onsite, it cannot be dismissed as a potential contaminant in liquid effluents.

- Any in-growth of ^{226}Ra daughters will not be significant for residues and contamination that are open to the atmosphere because the emanation of gaseous ^{222}Rn will disrupt the

decay chain. This is supported by the fact that analyses of liquid effluents have not detected ^{210}Pb since 1988. Any contained materials bearing ^{226}Ra would also contain its daughters through ^{210}Pb, but the fact that such materials are confined makes these daughter products unlikely contaminants in liquid effluents. For these reasons, the ^{226}Ra daughters are not considered target analytes for liquid effluent radiochemical analyses.

2.4.1.2 Radionuclides Associated with the ^{235}U Decay Chain

Radionuclides associated with the ^{235}U decay chain are shown in Figure 2-4. The significance of radionuclides in this decay chain are evaluated below:

- ^{231}Th is already in equilibrium with ^{235}U at the site. Since ^{231}Th is a beta emitter it has not been quantified with other thorium isotopes because they were quantified by alpha spectroscopy. For these reasons, ^{231}Th cannot be dismissed as a potential contaminant in liquid effluents.

- There will be no significant in-growth of ^{231}Pa and ^{227}Ac due to their long half-lives. However, ^{231}Pa and ^{227}Ac were separated from uranium as a result of past chemical processes. Because of their long half-lives, they could be present in process residues and general site contamination. Specific analyses have not been performed for ^{231}Pa in the past. Routine analyses for ^{227}Ac have not detected this radionuclide since 1988. In addition, specific analyses for alpha-emitting thorium isotopes have not detected ^{227}Th since 1988.

2.0 LIQUID EFFLUENT MONITORING (cont.)

Based on these facts, it is reasonable to infer that site concentrations of ^{231}Pa, ^{227}Ac, ^{227}Th, and radionuclides following ^{227}Th in the decay chain, are not significant enough to warrant making them target analytes in radiochemical analyses of liquid effluents.

2.4.1.3 Radionuclides Associated with the ^{232}Th Decay Chain

Radionuclides associated with the ^{232}Th decay chain are shown in Figure 2-5. The significance of radionuclides in this decay chain are evaluated below:

- Due to the long storage period onsite since chemical separation processes were performed, the decay chain through ^{224}Ra is nearly in equilibrium. Routine analyses for alpha emitting radium isotopes have not detected ^{224}Ra since 1988. Based on this observation, ^{232}Th daughters are not considered target analytes in radiochemical analyses of liquid effluents.

- Any in-growth of ^{224}Ra daughters will not be significant for residues and contamination that are open to the atmosphere because the emanation of gaseous thoron (^{220}Rn) will disrupt the decay chain. Any contained materials bearing ^{224}Ra would also contain its daughters through ^{208}Pb; however, the fact that such materials are confined makes these daughter products unlikely contaminants in liquid effluents. For these reasons, the ^{224}Ra daughters are not considered target analytes for liquid effluent radiochemical analyses.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.4.1.4 Radionuclides Associated with Other Decay Chains and Sources

Because some reprocessed uranium was handled in past FEMP operations, trace quantities of fission products, ^{236}U, and transuranics are present onsite. The significance of these radionuclides is evaluated below:

- Gamma emitting fission products such as ^{137}Cs and ^{106}Ru have not been quantified in liquid effluents since 1988. Since both ^{137}Cs and ^{106}Ru are high yield fission products, their absence in liquid effluents makes it highly improbable that other fission products are present to any significant degree in process residues and site contamination. Therefore, there are no specific gamma emitting fission products that are considered target analytes for liquid effluent radiochemical analyses.

- The fission products ^{90}Sr and ^{99}Tc were quantified in liquid effluents in 1988. However, the levels at which they were quantified were small fractions of their respective DCGs. The complex chemistry associated with isotopic strontium and technetium analyses is not justified by the observed concentrations of these radionuclides in effluents. Therefore these radionuclides are not considered target analytes for liquid effluent radiochemical analyses.

- ^{236}U has been quantified in liquid effluents since 1988. Therefore it is considered a target analyte for liquid effluent radiochemical analyses.

- The transuranics $^{239/240}Pu$ were quantified in liquid effluents in 1989. However, the levels at which these radionuclides were quantified was a small fraction of their DCGs. ^{238}Pu has not been quantified in liquid effluents since 1988. The complex chemistry associated

with isotopic neptunium and plutonium analyses is not justified by the observed concentrations of these radionuclides in effluents. Therefore, the neptunium and plutonium isotopes are not considered target analytes for liquid effluent radiochemical analyses.

Based on the foregoing evaluation, target analytes for radiochemical analyses of liquid effluents at the FEMP are given in Table 2-1.

2.4.2 Current and Potential Non-Radiological Contaminants

Non-radiological contaminants are driven by the inventory of materials incident to past operations, current remediation activities, as well as current water treatment capabilities. The current National Pollutant Discharge Elimination System (NPDES) Permit[8] issued by the OEPA delineates the pollutants of concern at all FEMP liquid effluent discharge locations. Included in this Plan is a discussion of these requirements. The requirements are applied in accordance with 40 CFR 421.323 and 40 CFR 471.72, which regulate the FEMP as a uranium manufacturing and forming plant, as well as OEPA's evaluation conducted during the permitting process. Refer to Section 2.7 of this Plan for additional information.

2.5 Sampling and Monitoring Methods

2.5.1 Radiological

The most abundant radionuclides reported in the FEMP liquid effluents are ^{238}U, ^{234}U, and ^{234}Th. The data in Table 2-1 show that alpha is the principal radioactive emission associated with ^{238}U and ^{234}U, while beta is the principal emission from ^{234}Th. None of these radionuclides emit

2.0 LIQUID EFFLUENT MONITORING (cont.)

photons suitable for reliable gamma measurement. Currently available continuous monitoring instruments for radioactive contaminants in liquid effluent streams are designed to detect photon emissions from such contaminants. Because the radioactive target analytes in the FEMP liquid effluent streams are not prolific photon emitters, the use of such equipment for continuous monitoring would not be appropriate and is therefore not required. It follows that no radioactivity alarm levels for continuous liquid monitors need to be specified.

In lieu of continuous monitoring equipment, continuous flow proportional sampling equipment shall be utilized at all normal liquid effluent discharge locations (*i.e.*, Outfall 4001) to obtain representative samples for analysis. These sampling systems shall be calibrated prior to being placed in service; following initial installation, maintenance, or modifications that could affect system performance; and at least annually thereafter during periods of routine system operation. Calibration frequency should be consistent with vendor specifications for sampling equipment systems. System operability checks shall be performed at least weekly to verify that a catastrophic failure has not occurred. Procedures shall exist that prescribe how calibrations and operability checks are to be performed. The methods employed for conducting these activities shall be consistent with manufacturers' instructions and specifications. In addition, the accuracy of effluent flow and sample flow measurements shall be documented in these procedures. A list of available implementing procedures is found in Table 5-3. Currently the Maintenance Management and Inventory Control System (MMICS) is being used to track calibration and maintenance activities. Procedures are currently being developed to address these requirements.

The continued suitability of installed sampling equipment shall be evaluated at least annually. Procedures shall exist that prescribe the evaluation criteria and their application. These procedures shall address environmental conditions such as weather protection and the potential

for a buildup of contaminants or materials that could impair or otherwise invalidate system operation.

Procedures shall exist that prescribe alternative sampling methods to be employed when sampling systems are out of service.

Additional sampling and analysis requirements from the SCQ, as applicable to the Liquid Effluent Monitoring Program, are discussed and referenced in Section 2.8 and Section 10.0 of this Plan.

2.5.2 Non-Radiological

The sampling requirements for non-radiological contaminants of concern are prescribed by the current NPDES Permit[8] issued by the OEPA. Procedures shall exist for implementing the sampling and monitoring requirements established by the permit. Refer to Section 2.7 for additional information.

2.6 Analytical Requirements

2.6.1 Radiological

In general, the chemistry required to obtain isotope-specific results for some target analytes is too complex and expensive to be performed very frequently. However, some form of analysis needs to be performed frequently to allow for proper management of liquid effluent discharges.

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-2 summarizes the minimum analysis regimen for samples obtained from each effluent discharge location. All analytical methods utilized shall comply with the requirements of Section 6.0 of this Plan. The basis for this regimen is discussed below.

2.6.1.1 Total Gross Alpha/Beta Analyses

Gross alpha/beta analyses are relatively inexpensive and quick to perform, and they are thorough because they encompass both target analytes as well as unanticipated analytes such as transuranics and fission products. For these reasons, gross analyses are ideally suited for providing timely feedback on effluent treatment controls. Procedures shall be maintained to direct the computation and use of gross analyses action levels. Gross analyses with established action levels are used to determine trends in effluent activity. This is particularly useful in the overall monitoring of nontarget radionuclides that are not routinely analyzed in FEMP effluents.

The gross analysis procedures will require the review and comparison of weekly and quarterly composite data. Responses will be identified when action levels are exceeded. An evaluation of gross data may indicate that changes in specific isotopic analyses regimens are required. Factors influencing data interpretation are background activity, the impact of half life with respect to the comparison of sample results collected at relatively different frequencies, and the significance of specific radionuclide concentrations versus relative activities.

2.6.1.2 Isotope Specific Analyses

These analyses are intended to provide the information necessary for assessing and reporting the dose impact on the general public from liquid effluents. The analysis methods employed shall

2.0 LIQUID EFFLUENT MONITORING (cont.)

be capable of quantifying the target analytes as well as any unsolicited analytes that are identified in the sample.

Since all the target analytes are either long-lived or are in equilibrium within their decay chain, the quarterly analysis frequency does not have an adverse impact on required MDAs. Less frequent analyses (*e.g.*, semi-annual or annual) create an unacceptable time delay between analysis and increase the possibility that a condition of non-compliance will go undetected for a significant portion of a calendar year. More frequent analyses (*e.g.*, monthly or weekly) are too expensive for actinides due to the cost of performing these analyses. When complemented with weekly gross analyses, the quarterly analysis frequency is considered the best compromise between timely, and accurate analytical results and cost.

Procedures shall exist that prescribe the methods for obtaining isotopic analytical results. This does not imply that all radionuclides must be measured directly. The calculation of analytical results based on decay equilibrium considerations is acceptable when direct measurement techniques are not well established or are too costly.

2.6.1.3 Minimum Detectable Activity (MDA)

The MDAs specified in Table 2-1 are based on 1% of the analyte's DCG. For gross analyses, the MDA is based on the most conservative analyte that has routinely comprised a large percentage of the total radioactivity discharged. Inspection of prior release data resulted in the choice of ^{234}U as the basis for the gross alpha MDA and ^{234}Th for the gross beta MDA. The MDAs for the gross analyses of suspended solids are based on 1% of the concentration limits established for controlling sedimentation of radioactive materials in environmental waters (see Section 2.1.3.4). The 1% criterion was selected because it represents a small fraction of

applicable dose and concentration performance standards. Thus if analytes are routinely not detected at their respective MDAs, it is highly unlikely the performance standards will be exceeded unknowingly.

The practice of assuming that all gross activity is due to the most conservative radionuclide does not reflect actual conditions at the FEMP. However, this practice is conservative and is used solely for the purpose of determining a performance criterion for laboratory analysis.

2.6.1.4 Overall Uncertainty in Measurements

The overall uncertainty in an analytical result is a combination of random (*e.g.*, counting) and systematic (*e.g.*, sampling) errors. Theoretically, the MDA is the smallest amount of a radionuclide in a sample that will be detected with a β probability of non-detection (Type II error) while accepting an α probability of erroneously detecting that radionuclide in an appropriate blank sample (Type I error). The α and β probabilities are both set at 0.05.[15] The formula to be used for calculating MDA for purposes of demonstrating that the MDAs specified in this Plan are being met can be found in Section 7.0. The uncertainty in analytical results due to random error decreases as the concentration of the analyte of interest in the sample increases. At sufficiently high analyte concentrations, the contribution of random error to the overall uncertainty in the analysis is so small that the overall uncertainty becomes dominated by systematic error. The objective of the uncertainty specifications in Table 2-2 is to establish a reasonable upper bound for systematic error so that analytical results remain meaningful with regard to stated sampling objectives. For this reason, the specifications for overall uncertainty are quoted for analyte concentrations at 10 times their MDA in order to minimize the effect of random error on the measurement. Analyte concentrations at ten times the MDA are readily quantified making verification of this specification a reasonable task.

2.0 LIQUID EFFLUENT MONITORING (cont.)

Additional sampling and analysis requirements from the SCQ, as applicable to the Liquid Effluent Monitoring Program, are discussed and referenced in Section 2.8 and Section 10.0 of this Plan.

2.6.2 Non-Radiological

For a discussion of non-radiological analytical parameters, refer to Section 2.7.3.

2.7 Non-Radiological Program Description

2.7.1 NPDES Requirements

The primary regulatory driver for discharges of pollutants to the Nation's waters is the Clean Water Act (CWA) NPDES permit system. This system establishes effluent limits for pollutants from both industrial and municipal point source discharges. As mandated by the CWA, the OEPA has adopted its own NPDES program, under which all non-radiological discharges from the FEMP are regulated.

OEPA issued FEMP NPDES Permit 1IOOOOO4*BD on February 12, 1990. On July 15, 1991 the NPDES permit was amended (NPDES Permit #1I000004*CD) to remove the effluent limit and monitoring requirement for fluoride at the Biodenitrification Effluent Treatment System (BDN,ETS; Outfall 4605). On May 20, 1993, the permit was further modified (NPDES Permit #1I000004*DD) to (1) eliminate effluent limits and monitoring requirements for silver, cyanide, and lead at Outfall 4001; (2) eliminate effluent limits for fluoride, chromium, copper, and nickel and reduce the required monitoring frequency for these parameters from once per week to once per month at the Sewage Treatment Plant (STP); (3) eliminate effluent limits and monitoring

000042

2.0 LIQUID EFFLUENT MONITORING (cont.)

requirements for hexavalent chromium and pH at the General Sump; (4) eliminate all effluent limits and monitoring requriements at the Storm Sewer Lift Station and the Stormwater Retention Basin discharge to Outfall 4001; (5) add a monitoring requirement for sewage sludge removed from the STP digester and filtered through Plant 8, including annual monitoring requirements for cadmium, chromium, copper, lead, nickel, zinc, and mercury and a monthly monitoring requirement for sludge wieght (dry tons) after filtration; (6) replace continuous pH monitoring requirements and associated limits at internal outfalls with daily grab samples for pH; and (7) change the type of sample for hexavalent chromium and fecal coliform from 24-hour compiste samples to grab samples. The current NPDES permit is in effect until February 9, 1995.

The FEMP NPDES Permit currently covers seven discharge points, five of which are internal monitoring points and two of which are direct discharges to receiving surface waters. These discharge points are shown in Figure 2-6. The permitted discharges are as follows:

Sampling Station	Description of Location
1I000004001	Manhole 175, final effluent before Great Miami River.
1I000004002	Spillway from Stormwater Retention Basin to Paddys Run.
1I000004601	Sewage Treatment Plant effluent, after disinfection, prior to mixing with other wastestreams discharged via Manhole-175 and final Outfall (001).
1I000004602	General Sump, effluent directed to Manhole-175 then discharged.
1I000004603	Clearwell effluent pumped to the BSL and then to 4605, Manhole-175 and discharged. (**NOTE:** The discharge of Clearwell effluent directly to Manhole-175 is prohibited.)
1I000004605	Effluent from Biodenitrification after settling and/or biological treatment discharged via Manhole-175.
1I000004589	Sewage Treatment Plant sludge disposed of through Plant 8 sump operations.

2.0 LIQUID EFFLUENT MONITORING (cont.)

All monitoring, sampling, testing, and reporting requirements for complying with the discharge limitations at these discharge points are detailed in the NPDES permit.

2.7.2 FEMP NPDES Monitoring Stations

This section briefly describes each monitoring station and its associated effluent limitations and monitoring requirements. NPDES monitoring stations are as follows:

***4001 - Manhole 175, Effluent to Great Miami River**

Discharges to Manhole 175 include effluent from the Sewage Treatment Plant, General Sump, Biodenitrification Effluent Treatment System, the Storm Sewer Lift Station and the Stormwater Retention Basin. NPDES samples are collected using an automatic sampler located at Outfall 4001. Flows are recorded on a continuous basis using a 6-inch parshall flume and are recorded on charts located at Outfall 4001. NPDES parameters, their corresponding effluent limitations/loading rates, and monitoring requirements for discharge point *4001 are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
mg/ℓ	Dissolved Oxygen	—	(5.0 Min.)	—	—	1/Week	Grab
mg/ℓ	Total suspended solids (TSS)	30	45	99	149	1/Week	24 Hr. Comp.
mg/ℓ	Oil and grease, Total	15	15	50	50	1/Week	Grab
mg/ℓ	Nitrogen, Ammonia (NH_3)	—	—	—	—	1/Week	24 Hr. Comp.
mg/ℓ	Nitrogen, Nitrate (NO_3)	—	—	—	—	1/Week	24 Hr. Comp.
mg/ℓ	Fluoride, Total (F)	—	—	—	—	1/Week	24 Hr. Comp.
μg/ℓ	Chromium, Total (Cr)	—	—	—	—	1/Week	24 Hr. Comp.
μg/ℓ	Copper, Total (Cu)	23	94	0.077	0.310	1/Week	24 Hr. Comp.
μg/ℓ	Nickel, Total (Ni)	--	--	--	--	1/Week	24 Hr. Comp.
μg/ℓ	Chromium, Hexavalent (Cr_{+6})	--	--	--	--	1/Week	Grab
mgd	Flow Rate	--	--	--	--	Daily	24 Hr. Total

2.0 LIQUID EFFLUENT MONITORING (cont.)

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
mg/ℓ	BOD, carb.	20	30	66	99	1/Week	24 Hr. Comp.

• Loadings based on flow rate of 0.872 mgd and reported in kg/day
pH monitored on continuous basis, acceptable range 6.5 S.U. to 9.0 S.U.

*4002 - Spillway Stormwater Retention Basin to Paddys Run

Discharges from point *4002 consist of overflow stormwater from the Stormwater Retention Basin (SWRB). The spillway discharges to the storm sewer outfall ditch (SSOD) and then to Paddys Run and is monitored only during flow conditions. No overflows from the spillway have occurred since May 1990. Samples are manually collected and manually composited. NPDES parameters, their corresponding effluent limitations/loading rates, and monitoring requirements for discharge point *4002 are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
mg/ℓ	TSS	—	100	—	—	Daily	Composite
mg/ℓ	Oil and grease, Total	--	15	--	--	Daily	Grab
mg/ℓ	Nitrogen, Ammonia (NH_3)	--	--	--	--	Daily	Composite
mg/ℓ	Nitrogen, Nitrate (NO_3)	—	—	—	—	Daily	Composite
mg/ℓ	Fluoride, Total (F)	—	—	—	—	Daily	Composite
µg/ℓ	Chromium, Total (Cr)	—	3986	—	—	Daily	Composite
µg/ℓ	Copper, Total (Cu)	—	45	—	—	Daily	Composite
µg/ℓ	Nickel, Total (Ni)	--	3137	--	--	Daily	Composite
µg/ℓ	Silver, Total (Ag)	--	11.6	--	--	Daily	Composite
µg/ℓ	Chromium, Hexavalent (Cr_{+6})	--	19	--	--	Daily	Grab
mgd	Flow Rate	--	--	--	--	Daily	24 Hr. Total estimate

2.0 LIQUID EFFLUENT MONITORING (cont.)

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type

* Loadings are based on flow rate of 0.125 mgd and reported in kg/day
pH monitored daily by grab method, acceptable range 6.5 S.U. to 9.0 S.U.

*4601 - Sewage Treatment Plant Effluent

The Sewage Treatment Plant (STP) discharges treated effluent to Outfall 4001 via internal discharge point *4601. Discharges consist of sanitary wastewater generated from onsite restrooms, locker rooms, and laundry facilities. NPDES samples are collected using an automatic sampler located in the building adjacent to the contact basin at the wastewater treatment plant. Flows are recorded using a V-notch weir and are recorded on charts at the STP. NPDES parameters, their corresponding effluent limitations/loadings, and required monitoring for discharge point *4601 are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
mg/ℓ	BOD, 5 day	20	40	9.5	19	1/Week	24-hr. Composite
mg/ℓ	TSS	20	40	9.5	19	1/Week	24-hr. Composite
mg/ℓ	Nitrogen, Ammonia (NH_3)	--	--	--	--	1/Week	24-hr. Composite
mg/ℓ	Fluoride, Total (F)	—	—	—	—	1/Month	24-hr. Composite
µg/ℓ	Chromium, Total (Cr)	—	--	—	—	1/Month	24-hr. Composite
µg/ℓ	Copper, Total (Cu)	—	--	—	—	1/Month	24-hr. Composite
µg/ℓ	Nickel, Total (Ni)	--	--	--	--	1/Month	24-hr. Composite
#/100 mℓ	Fecal Coliform (Summer only)	1000	2000	--	--	1/Week	Grab
mgd	Flow Rate	--	--	--	--	Daily	24 Hr. Total

* Loadings are based on flow rate of 0.125 mgd and reported in kg/day
pH monitored daily by grab sample.

2.0 LIQUID EFFLUENT MONITORING (cont.)

*4602 - General Sump Effluent

The focal point of all wastewater treatment on site is the General Sump. The General Sump receives uranium and non-uranium contaminated wastewater. For uranium contaminated wastewaters, the General Sump acts primarily as a transfer facility; providing initial treatment and then routing the wastewater to the necessary treatment systems in Plant 8 or the BDN facility. Non-uranium contaminated wastewater received at the General Sump consists primarily of decant from the lime sludge ponds and coal pile runoff basins; boiler plant blowdown; and wastestreams associated with the on site production of potable water. These wastewaters receive elementary treatment consisting of pH adjustment and sedimentation of solids by the addition of polymer. Non-contaminated wastewater from the General Sump is discharged to Outfall 4001 via internal monitoring point *4602. NPDES parameters, their corresponding effluent limitations/loading rates, and required monitoring for discharge point *4602 are describe as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
µg/ℓ	Chromium, Total (Cr)	41	54	0.010	0.013	1/Week	24-hr. Composite
µg/ℓ	Copper, Total (Cu)	66	111	0.016	0.027	1/Week	24-hr. Composite
µg/ℓ	Nickel, Total (Ni)	91	165	0.022	0.040	1/Week	24-hr. Composite
mgd	Flow Rate	--	--	--	--	Daily	24 Hr. Total

* Loadings are based on flow rate of 0.064 mgd and reported in kg/day

*4603 - Clearwell Effluent

The Clearwell collects stormwater runoff from the waste pit storage area and discharges directly to the biosurge lagoon. From the biosurge lagoon water is pumped to the Biodenitrification Facility for additional treatment.

2.0 LIQUID EFFLUENT MONITORING (cont.)

No samples are collected from the Clearwell. The Clearwell is required to be discharged directly to Biosurge Lagoon as of August 4, 1990.

*4605 - Biodenitrification Effluent Treatment System Effluent

The Biodenitrification (BDN) facility is utilized to biologically denitrify high nitrate laden wastewaters. The Biosurge lagoon serves as an equalization basin for BDN Tower feed. Water from the Biosurge Lagoon is pumped through the BDN Towers and then to the BDN Effluent Treatment System (BDN-ETS), prior to being discharged to Outfall 4001 via internal monitoring point *4605. Flows are recorded by an in-line magmeter at the BDN-ETS chlorine contact tank and are recorded on log sheets in the BDN control room. NPDES samples are collected by an automatic sampler located at the BDN-ETS. NPDES parameters, their corresponding effluent limitations, and monitoring requirements are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
mg/ℓ	BOD, 5 day	30	45	26	38	1/Week	24-hr. Composite
mg/ℓ	TSS	30	45	26	38	1/Week	24-hr. Composite
mg/ℓ	Nitrogen, Ammonia (NH_3)	--	--	--	--	1/Week	24-hr. Composite
mg/ℓ	Nitrogen, Nitrate (NO_3)	72.7	145	62	124	1/Week	24-hr. Composite
μg/ℓ	Chromium, Total (Cr)	12	27	0.0101	0.0226	1/Week	24-hr. Composite
μg/ℓ	Copper, Total (Cu)	45	90	0.0387	0.0770	1/Week	24-hr. Composite
μg/ℓ	Nickel, Total (Ni)	29	42	0.0251	0.0361	1/Week	24-hr. Composite
μg/ℓ	Chromium, Hexavalent (Cr_{+6})	--	--	--	--	1/Week	24-hr. Composite
mgd	Flow Rate	--	--	--	--	Daily	24 Hr. Total

• Loadings are based on flow rate of 0.2252 mgd and reported in kg/day
pH monitored daily by grab sample.

*4589 - STP Sludge Monitoring

Sludge is withdrawn periodically from the anaerobic digester at the Sewage Treatment Plant (STP) and transported to Plant 8. The sludge is dewatered, drummed, and stored awaiting final

2.0 LIQUID EFFLUENT MONITORING (cont.)

disposal. Samples are manually collected and manually composited. NPDES parameters and monitoring requirements for Discharge point *4589 are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings*			
Units	Parameter	30 day	Daily	30 day	Daily	Measurement Frequency	Sample Type
mg/ℓ	Cadmium (Cd)	--	--	--	--	1/Year	Grab
mg/ℓ	Chromium (Cr)	--	--	--	--	1/Year	Grab
µg/ℓ	Copper, Total (Cu)	--	--	--	--	1/Year	Grab
µg/ℓ	Lead (Pb)	--	--	--	--	1/Year	Grab
µg/ℓ	Nickel, Total (Ni)	--	--	--	--	1/Year	Grab
µg/ℓ	Zinc (Zn)	--	--	--	--	1/Year	Grab
µg/ℓ	Mercury (Hg)	--	--	--	--	1/Year	Grab
mgd	Sludge Weight (Dry Tons, Total)	--	--	--	--	1/Month	Total

2.7.3 Analytical Requirements

The on site laboratories involved in conducting NPDES laboratory testing include the Water Treatment Plant Lab, the Analytical Laboratory Bioassay Section, the Analytical Laboratory Inorganic and Special Analyses Section, and the Quality Control Lab. Table 2-3 details the testing responsibilities for each lab.

Methods of analysis are regulated by 40 CFR Part 136. Tables 1A & 1B under Part 136.3 of this regulation cite the test procedures and references for biological and inorganic parameters. 40 CFR Part 136 - Appendix B establishes procedures for determining the Method Detection Limit.

The NPDES permit requires that test procedures for the permitted parameters conform to 40 CFR Part 136 unless otherwise approved. Application for alternative test procedures can be

2.0 LIQUID EFFLUENT MONITORING (cont.)

made to the Regional Administrator under 40 CFR 136.4. The permit also requires that periodic calibration and maintenance be performed on all monitoring and analytical instrumentation to ensure accuracy of the measurements. In addition, the permit requires recording of certain information including the date the analyses were performed, the person who did the analysis, the techniques used, and the results. All analytical records, original instrumentation recordings, and calibration and maintenance records must be retained for a minimum period of three years.

A list of all acceptable reference material is included in 40 CFR Part 136.3 (b). The primary references used at the FEMP are "Methods for Chemical Analysis of Water & Wastes, U.S. EPA 600/4-79-020", and "Standard Methods for the Examination of Water and Wastewater."

All analytical procedures used in the FEMP laboratories were developed from specific methods detailed in these references. The method reference for each analyte is identified in Table 2-3. All laboratory procedures must be referenced in the SCQ.

Samples are received at the sample receiving laboratory where they are logged in and the Chain of Custody Record is initiated. The samples are then disseminated to the appropriate laboratory rooms for analysis. Upon receipt at the laboratory room, samples are registered in a lab sample log book. Chain of Custody Records are covered under SSOP-0018, "Processing the Site-Wide Analysis Request/Custody Record for Sample Control."

NPDES analyses are run according to site standard operating procedures (SSOPs). Copies of SSOPs for each analysis are contained in the Procedure Section of the individual laboratory conducting the NPDES testing. Table 2-4 lists site SSOPs for the various laboratory analyses.

000050

2.0 LIQUID EFFLUENT MONITORING (cont.)

Results of the NPDES laboratory analyses are entered into the Fernald Analytical Computerized Tracking System (FACTS). Work cards are prepared which include the date and time of analysis, the person performing the analysis, the raw data, calculations, and results. These cards are cross checked by an individual who did not perform the analysis to ensure that the calculations are correct. After the work cards have been verified the sample data is entered into the FACTS system and are rechecked to ensure they have been entered accurately.

2.7.4 Lower Limit of Detection for NPDES Parameters

The lower limits of detection for NPDES Parameters are summarized in the table below.

Lower Limits of Detection for NPDES Parameters

Parameter	Lower Limit of Detection
TSS	2.0 mg/ℓ
Oil and Grease, Total	5.0 mg/ℓ
Nitrogen, Ammonia (NH_3)	0.1 mg/ℓ
Nitrogen, Nitrate (NO_3)	0.1 mg/ℓ
Fluoride, Total (F)	0.1 mg/ℓ
Chromium, Total (Cr)	6 μg/ℓ
Copper, Total (Cu)	14 μg/ℓ
Nickel, Total (Ni)	17 μg/ℓ
Chromium, Hexavalent (Cr_{+6})	6 μg/ℓ
BOD	NA

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.7.5 Overall Accuracy and Percent Confidence Levels for NPDES Parameters

FEMP NPDES permit Quality Control sample results for matrix spikes must be within the 99% confidence interval.

2.7.6 NPDES Reporting Requirements

All NPDES monitoring data are reported to OEPA on a monthly basis in the Discharge Monitoring Report (DMR). The DMR consists of NPDES data which is compiled on OEPA Form 4500, signed, and submitted to OEPA by the 15th of each month. Regulatory requirements for reporting monitoring data are codified at 40 CFR Part 122.41, Subpart C, (1) and are detailed in the NPDES Permit Part III, 4, A & B. Signatory requirements are detailed in Permit Part III, 28.

2.7.7 FEMP Stormwater Permit Application

As of October 1, 1992, all facilities which discharge stormwater associated with industrial activities are required to apply for a stormwater permit. The FEMP submitted this application on September 29, 1992. The outfalls covered under this permit application drain areas outside the FEMP production area. These areas are primarily associated with waste storage and construction staging activities. The outfalls are briefly described as follows:

STRM 001: This outfall drains from the Stormsewer Outfall Ditch (SSOD) into Paddys Run. This outfall receives runoff from the Sewage Treatment Plant, North and South access roads, and the active fly ash pile. The SSOD also receives any overflow from the Stormwater Retention Basin (permitted outfall 1I000004002). The outfall is south of the Stormwater

000052

2.0 LIQUID EFFLUENT MONITORING (cont.)

Retention basin in the Pilot Plant Drainage Ditch. The monitoring point is located within the stream bed.

STRM 002: This outfall contains runoff from the inactive fly ash pile. This outfall is downstream of the old flyash pile in a deeply wooded location. The monitoring point is located within the stream bed.

STRM 003: This outfall contains runoff from the construction staging areas and non-contaminated runoff from waste pit area which will remain after the completion of the Waste Pit Area Runoff Control Project. It is located in an unnamed tributary of Paddys Run immediately south of the K-65 silos. The monitoring point is located at the downstream side of a new culvert installed as part of the Waste Pit Area Stormwater Runoff Control Removal Action.

STRM 004: This outfall contains runoff from the fire training facility and waste storage areas on the north side of the process area not currently collected by the process area storm sewer system.

At present it is difficult to predict the extent of additional monitoring requirements resulting from the stormwater permit application. It is anticipated that the FEMP will be required to monitor some or all of the discharge points on at least an annual basis.

Additional sampling and analysis quality assurance requirements from the SCQ, as applicable to the Liquid Effluent Monitoring Program, are discussed and referenced in Section 2.8 and Section 10.0 of this Plan.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.7.8 FEMP NPDES Renewal Application

In order to continue discharging under an expiring or expired NPDES permit, permittees must submit a complete Renewal Application at least 180 days prior to permit expiration. The FEMP submitted a renewal application for its NPDES permit on July 12, 1994. This renewal application provided data on two outfalls to receiving streams: (1) Manhole-176B, which includes the south groundwater plume contribution; and (2) the spillway from the SWRB to Paddys Run via the SSOD.

The extent of the new monitoring requirements and effluent limits will be determined through the NPDES Permit issuance process.

2.8 Quality Assurance

As they apply to liquid effluent monitoring, the quality assurance program provisions of Section 10.0 shall be followed. Specific quality assurance requirements for the FEMP's liquid effluent monitoring program are contained in the FEMP's Quality Assurance Program Description[16] and the SCQ.[17]

SCQ requirements shall be followed as they apply to the Environmental Monitoring Program at the FEMP. Section 10.0 of the EMP discusses and references additional SCQ requirements that apply to Liquid Effluent Monitoring activities in general: Section 2.0, "Project Description;" Section 3.0, "Project Organization;" Section 4.0, "Quality Assurance Objectives;" Section 5.0, "Field Activities;" Section 6.0, "Sampling Requirements;" Section 7.0, "Sample Custody;" Section 8.0, "Calibration Procedures and Frequency;" Section 9.0, "Analytical Procedures;" Section 10.0, "Internal Quality Control Checks and Frequency;" Section 11.0, "Data Reduction,

000054

2.0 LIQUID EFFLUENT MONITORING (cont.)

Validation, and Reporting;" Section 12.0, "Performance Assessment and System Audits;" Section 13.0, "Preventative Maintenance;" Section 14.0, "Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness;" Section 15.0, "Corrective Actions;" and Section 16.0, "Quality Assurance Reports to Management." These requirements must be followed and incorporated in the Liquid Effluent Monitoring Program at the implementing level.

In addition, DOE is required to participate in a Quality Assurance Program based on the authority of Section 308(a) of the CWA. Under this program, EPA annually sends the FEMP control samples which are to be analyzed for NPDES parameters. The accuracy of the FEMP laboratories with respect to NPDES parameters can be determined by comparing the known concentrations of analytes in the EPA control samples to the results that the FEMP Laboratories have determined for these control samples.

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-1: Target Analytes in FEMP Liquid Effluents

Radio-nuclide	Alphas		Betas			Gamma Rays	
	MeV	% Yield	Avg MeV	Max MeV	% Yield	MeV	% Yield
^{226}Ra	4.602 4.785	5.55 94.55					
^{230}Th	4.621 4.688	23.40 76.30				0.012	8.43
^{231}Th			0.055 0.079 0.080 0.085	0.206 0.287 0.288 0.305	15.00 9.00 41.00 35.00	0.013 0.026	70.78 14.65
^{232}Th	3.953 4.010	23.00 77.00				0.012	8.39
^{234}Th			0.025 0.025 0.051	0.096 0.096 0.189	6.80 18.50 82.50	0.013	9.57
^{234}U	4.724 4.776	27.40 72.40				0.013	10.50
^{235}U	4.217 4.364 4.370 4.396 4.598	5.70 11.00 6.00 55.00 5.00				0.013 0.144 0.184	30.91 10.50 54.00
^{236}U	4.445 4.494	26.00 74.00				0.013	9.98
^{238}U	4.147 4.196	23.00 77.00				0.013	8.83

000056

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-2: Minimum Analytical Requirements of FEMP Liquid Effluents

Description of Analysis	Minimum Frequency	Target Analytes	Required MDA	Max. Uncertainty at 10 × MDA
Total Gross Alpha	Weekly Composites	*	1.0×10^2 pCi/ℓ	± 50%
Total Gross Beta	Weekly Composites	*	1.0×10^2 pCi/ℓ	± 50%
Gamma Spectrometry	Quarterly Composites	^{228}Ac	6.0×10^2 pCi/ℓ	± 50%
Isotopic Radium	Quarterly Composites	^{224}Ra	4.0×10^0 pCi/ℓ	± 50%
		^{226}Ra	1.0×10^0 pCi/ℓ	
		^{228}Ra	1.0×10^0 pCi/ℓ	
Isotopic Thorium	Quarterly Composites	^{228}Th	4.0×10^0 pCi/ℓ	± 50%
		^{230}Th	3.0×10^0 pCi/ℓ	
		^{231}Th	1.0×10^3 pCi/ℓ	
		^{232}Th	5.0×10^{-1} pCi/ℓ	
		^{234}Th	1.0×10^2 pCi/ℓ	
Isotopic Uranium	Quarterly Composites	^{234}U	5.0×10^0 pCi/ℓ	± 50%
		^{235}U	6.0×10^0 pCi ℓ	
		^{236}U	5.0×10^0 pCi/ℓ	
		^{238}U	6.0×10^0 pCi/ℓ	

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-3: Laboratory Analyses NPDES Parameters

Parameter	Sample Hold Time	Sample Preservation	Laboratory	Technique Used	Method Number	Reference
Dissolved Oxygen (DO)	Analyze immediately	None	WTP	Probe	43-M-1002	Standard methods
Total Suspended Solids (TSS)	7 days	Cool 4°C	ALS Inorg.	Gravimetric	Method 9094	USEPA Method No. 160.2
Oil & Grease	28 days	Cool 4°C; H_2SO_4 to pH<2	ALS Inorg.	Gravimetric	Method 1001	USEPA Method No. 413.1
Ammonia-Nitrogen (NH_3)	28 days	Cool 4°C; H_2SO_4 to pH<2	ALS Inorg.	Electrode	Method 3001	USEPA Method No. 350.2
Nitrate-Nitrogen (NO_3)	48 hours	Cool 4°C; H_2SO_4 to pH<2	ALS Inorg.	Brucine sulfate	Method 3051	USEPA Method No. 352.1
Fecal Coliform	6 hours	Cool 4°C; 0.008% $Na_2S_2O_3$	WTP	Membrane filter	43-M-1005	Standard Methods
CBOD 5-day	set up immediately	Cool 4°C	WTP	Electrode	43-M-1000	Standard Methods
BOD 5-day	set up immediately	Cool 4°C	WTP	Electrode	43-M-1000	Standard Methods
Chromium - Total (Cr)	6 months	Cool 4°C; HNO_3 to pH<2	ALS Inorg. AA/ICP	Inductively coupled plasma	Method 9043	USEPA Method No. 218.2
Chromium - Dissolved Hexavalent (Cr^{+6})	24 hours	Cool 4°C	ALS Inorg. AA/ICP	Graphite furnace; AA unit	Method 1026	USEPA Method No. 218.5
Copper - Total (Cu)	6 months	Cool 4°C; HNO_3 to pH<2	ALS Inorg. AA/ICP	Inductively coupled plasma	Method 9043	USEPA Method No. 230.2

000058

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-3: Laboratory Analyses NPDES Parameters

Parameter	Sample Hold Time	Sample Preservation	Laboratory	Technique Used	Method Number	Reference
Cyanide - Total (CN)	14 days	Cool 4°C; NaOH to pH > 12; 0-.6 g ascorbic acid	Contract lab		NA	USEPA SW-846 Method No. 9010
Fluoride - Total (F)	28 days	None	ALS Inorg.	Ion selective electrode	Method 9145	USEPA Method No. 340.2
Lead - Total (Pb)	6 months	Cool 4°C; HNO_3 to pH < 2	ALS Inorg. AA/ICP	Graphite furnace; AA unit	Method 9079	USEPA Method No. 239.2
Nickel - Total (Ni)	6 months	Cool 4°C; HNO_3 to pH < 2	ALS Inorg. AA/ICP	Inductively coupled plasma	Method 9043	USEPA Method No. 249.2
Silver - Total (Ag)	6 months	Cool 4°C; HNO_3 to pH < 2	ALS Inorg. AA/ICP	Inductively coupled plasma	Method 9043	USEPA Method No. 272.2

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-4: NPDES-Related Standard Operating Procedures

SOP#	SOP Title	Department
Anl-01-0017	Preparation of Reagents and Standards	Analytical
Anl-01-0038	Handling and Storing Chemicals	Analytical
Anl-01-0045	Removal of Non-Radioactive Laboratory Liquid and Solid Waste Chemicals from Individual Laboratories for Disposal	Analytical
SSOP-0018	Processing the Site-Wide Analysis Request/Custody Record for Sample Control	Analytical
Anl-01-0053	Managing Hazardous Waste Satellite Accumulation Areas in Analytical Laboratories	Analytical
SAM-SS-001	Receiving and Delivering NPDES Samples	Analytical
Anl-10-0034	Preparation, Documentation, and Delivery of Quality Control Samples	Water Plant
SOP 43-C-301	Water Treatment Plant Operation	Water Plant
SOP 43-C-305	Water Plant Laboratory Procedures	Water Plant
SOP 43-C-306	Storm Sewer Lift Station	Water Plant
SOP 43-C-308	Responding to Excursions of Storm Sewer Water Quality	Water Plant
SOP 43-C-313	SRB/ESB Sludge Removal	Water Plant
SOP 43-C-314	Stormwater Retention/Emergency Spill Containment Sampling	Water Plant
SOP 43-C-315	Biodenitrification Facility Routine Checks	BDN
SOP 43-C-318	Surge Lagoon Underdrain System	BDN
SOP 43-C-319	Surge Lagoon Inspection	BDN
SOP 43-C-320	Biodenitrification Facility Operation	BDN
SOP 43-C-324	Sampling FMPC Water Supplies	Water Plant
SOP 43-C-325	Biodenitrification High Nitrate Tank	BDN
SOP 43-C-326	Stormwater Retention Basin Control System Operation	Water Plant
SOP 43-C-327	Effluent Treatment System Operation	BDN
SOP 43-C-501	Sanitary Sweaage Treatment Plant	Water Plant
SOP 43-C-701	General Sump Operation	General Sump

000060

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-4: NPDES-Related Standard Operating Procedures

SOP#	SOP Title	Department
Method 43-M-1000	Biochemical Oxygen Demand (BOD)	Water Plant
Method 43-M-1001	Dissolved Oxygen (DO), Azide Modification of Winkler Method	Water Plant
Method 43-M-1002	Dissolved Oxygen (DO), Membrane Electrode Method	Water Plant
Method 43-M-1005	Fecal Coliform Testing of Water by Membrane Filter Method	Water Plant
SOP EC-4-004	National Pollutant Dischage Elimination System	Regulatory Programs

2.0 LIQUID EFFLUENT MONITORING (cont.)

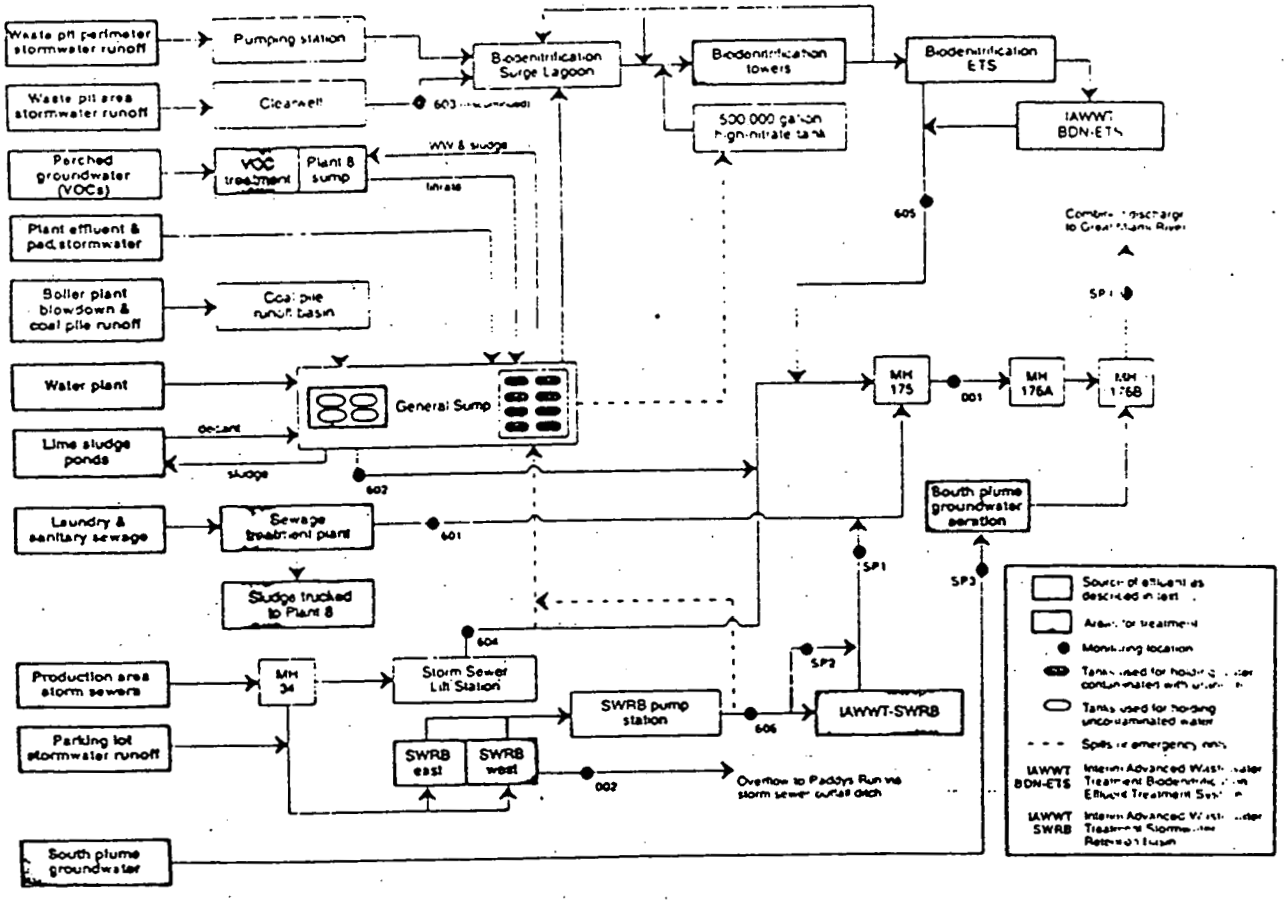


Figure 2-1: Fernald Site Effluent Flow Diagram

2.0 LIQUID EFFLUENT MONITORING (cont.)

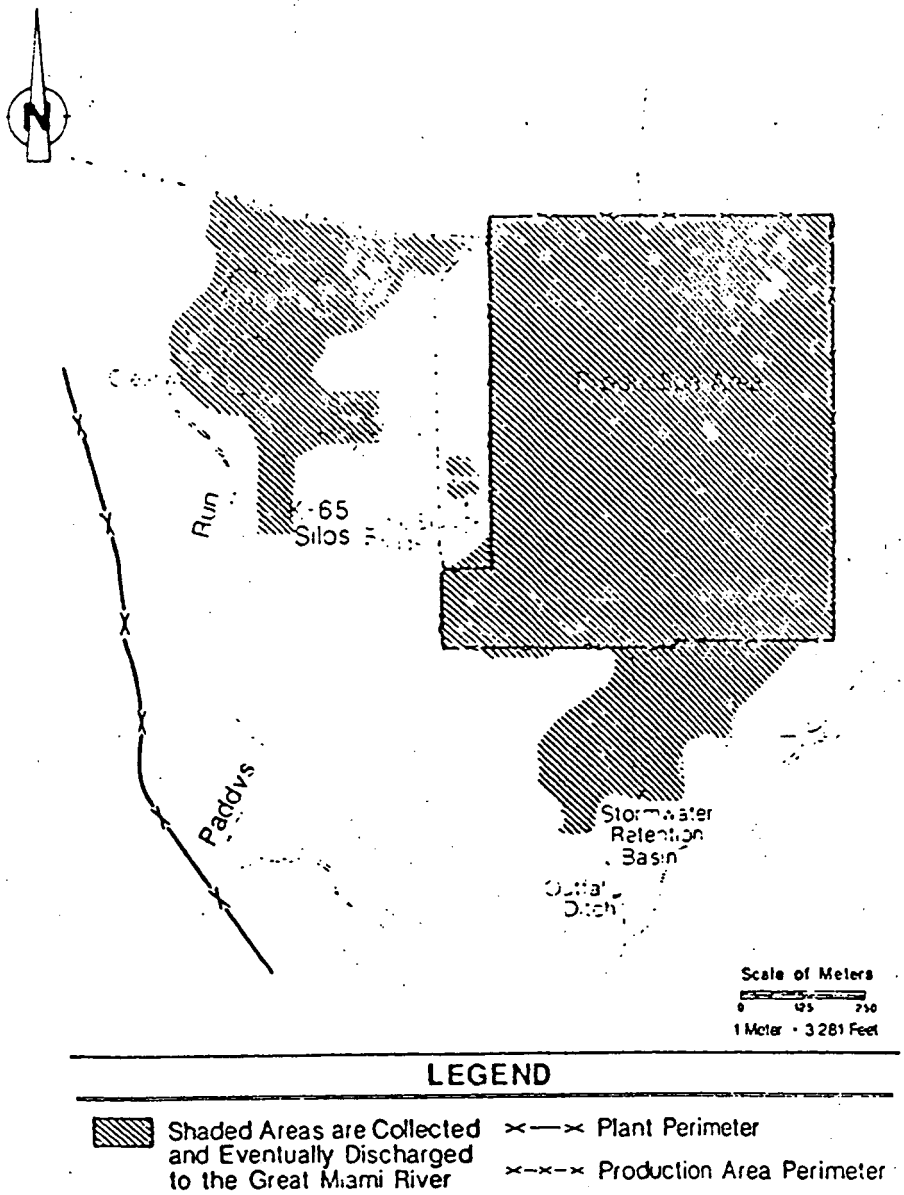


Figure 2-2: Areas of Controlled Stormwater Runoff

2.0 LIQUID EFFLUENT MONITORING (cont.)

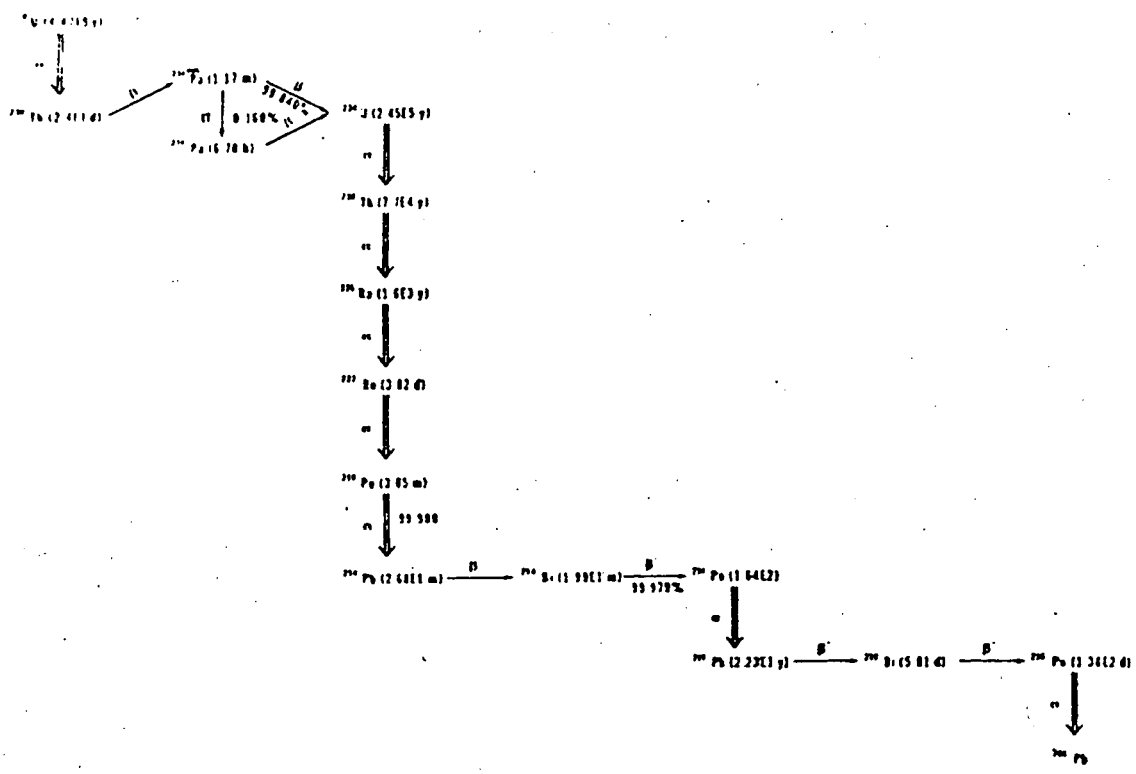


Figure 2-3: ^{238}U Decay Chain

2.0 LIQUID EFFLUENT MONITORING (cont.)

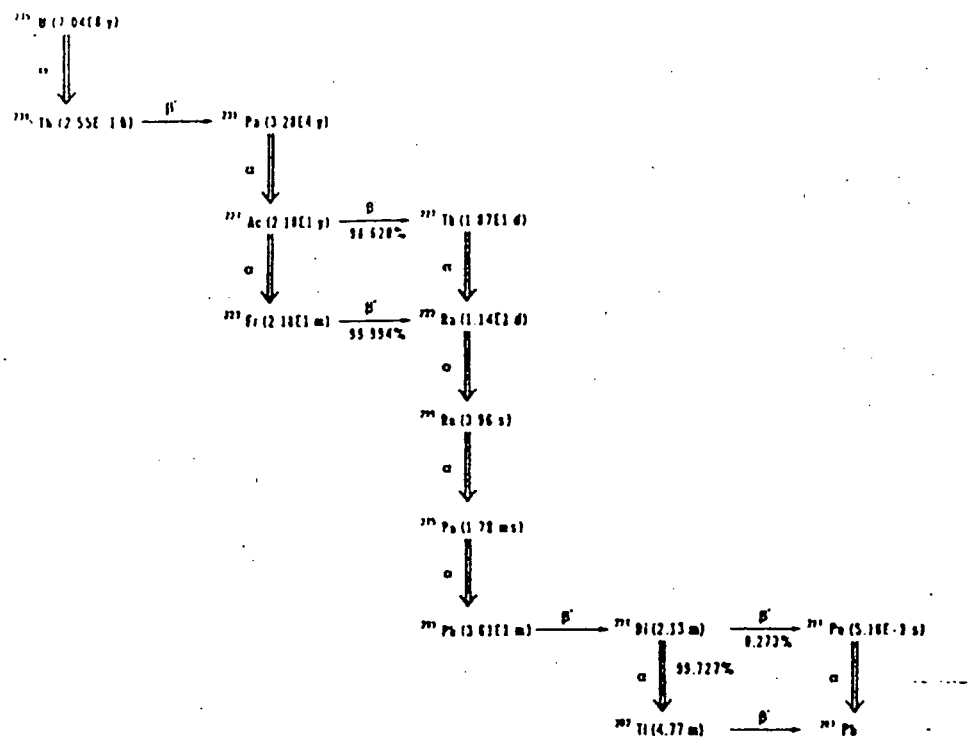


Figure 2-4: ^{235}U Decay Chain

2.0 LIQUID EFFLUENT MONITORING (cont.)

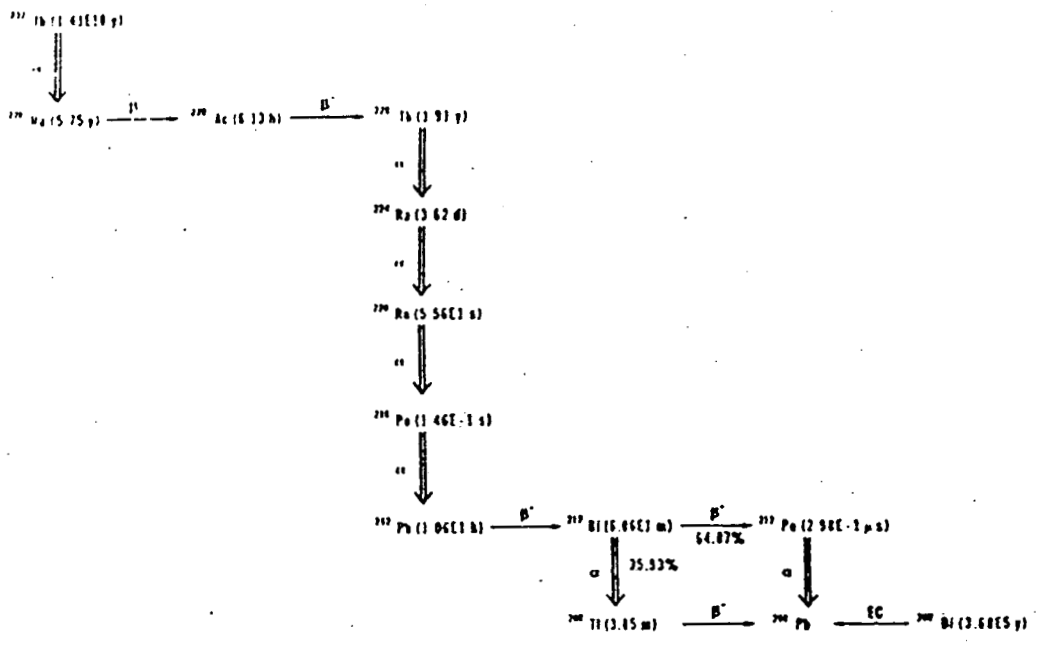


Figure 2-5: ^{232}Th Decay Chain

000066

2.0 LIQUID EFFLUENT MONITORING (cont.)

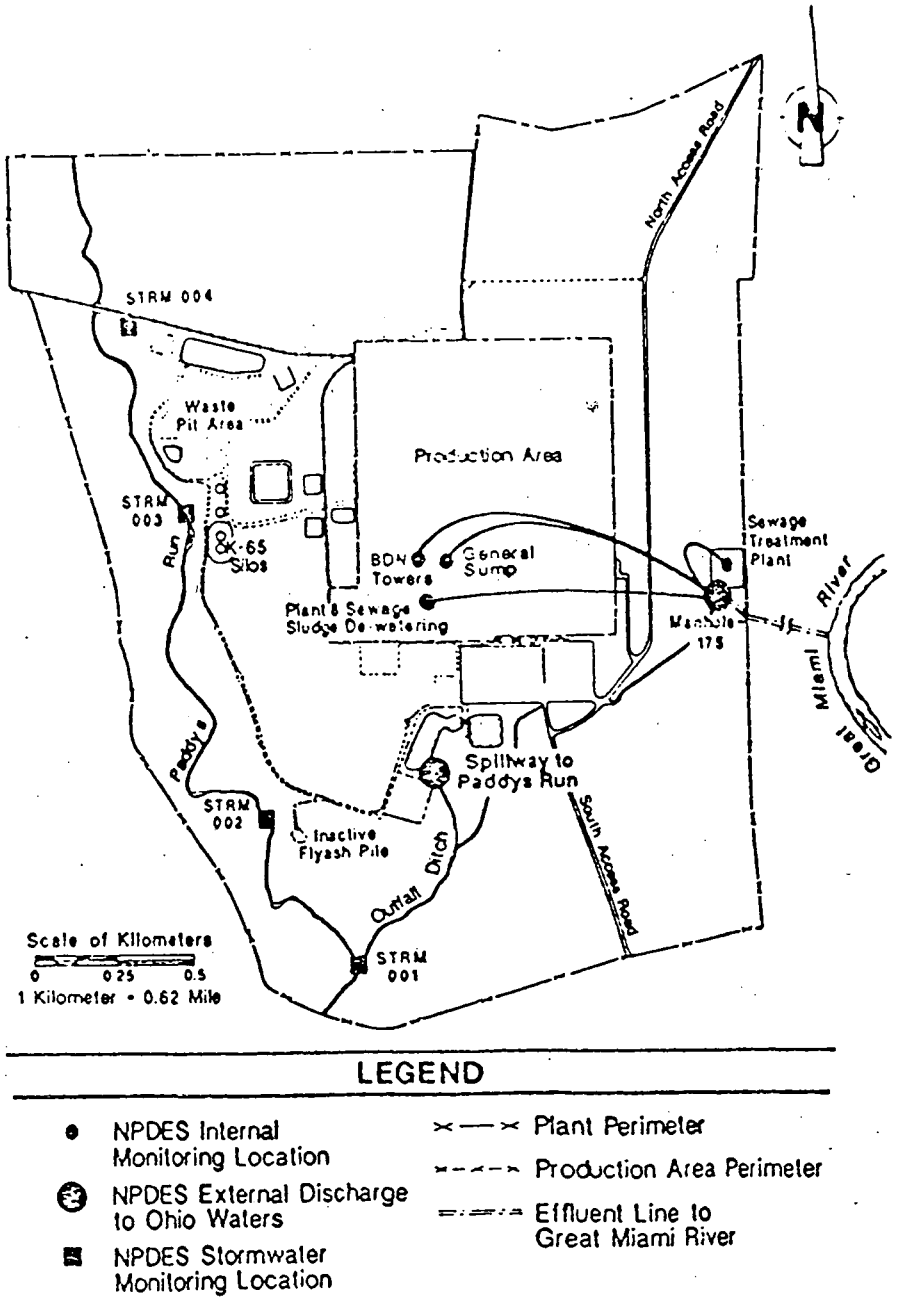


Figure 2-6: NPDES Effluent and Stormwater Monitoring Locations

3.0 AIRBORNE EFFLUENT MONITORING

To assess the impact of atmospheric releases on members of the general public and the environment, the FEMP shall monitor airborne discharges from the facility. This involves the monitoring of both radiological and non-radiological discharges, as discussed in this Section. Sections 3.1 through 3.7 address radiological airborne effluent monitoring activities; Section 3.9 covers non-radiological airborne effluent monitoring.

The analytical requirements of Section 3.8 and the quality assurance requirements of Section 3.10 apply to all airborne effluent monitoring. Section 10.0 discusses quality assurance and references SCQ requirements that shall be followed in the airborne effluent monitoring program. The current implementation plan and schedule are presented in Attachment, A, "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix."

As discussed in Section 1.1 of the EMP, applicable requirements set forth in the Comprehensive Environmental Occupational Safety and Health Program shall be followed. Any chemical handling shall be based on the Chemical Hygiene Plan.

3.1 Performance Standards

Radiological airborne effluent monitoring methods shall be sufficient to show compliance with the following limits and guidelines from the specified paragraphs of DOE Order 5400.5 (DOE/EH-0173T Summary 3e):

- The exposure of members of the public to radiation sources as a consequence of all routine activities at the FEMP shall not cause, in a year, an effective dose equivalent greater than 100 mrem [paragraph II.1a]. The annual effective dose equivalent is defined

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

as the sum of penetrating external exposure for the year plus the committed effective dose equivalent for intakes experienced during the year [paragraph II.1a(1)].

The limit includes doses from remedial actions and naturally occurring radionuclides released by DOE processes and operations. 40 CFR 61 Subpart H[18] requirements have been interpreted to exclude radon and its decay products.

- The exposure of members of the public to radioactive materials released to the atmosphere as a consequence of all routine activities at the FEMP site shall not cause, in a year, an effective dose equivalent greater than 10 mrem [paragraph II.1b]. Because this guideline implements the U.S. EPA regulations of 40 CFR 61 Subpart H, radon and its decay products are excepted.

- Concentrations of Radon (^{222}Rn) due to onsite interim storage facilities shall not exceed the following:[19]

  1. An annual average concentration of 30 pCi/ℓ over the facility,
  2. An annual average concentration of 3 pCi/ℓ at or above any location beyond the site boundary,
  3. 100 pCi/ℓ at any given point, and
  4. Flux rates from the storage of radon producing wastes shall not exceed 20 pCi/m^2-sec.

Note: The ^{222}Rn flux from the FEMP K-65 silos 1 and 2 is presently estimated to exceed the 20 pCi/m^2-sec flux rate standard. The required reduction in flux rate will be attained by implementing planned CERCLA removal and remedial actions. It is DOE's position that the

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

standard does not apply until completion of the final remedial action. EPA has disagreed with this position. The Federal Facilities Agreement (FFA) signed by USEPA on November 14, 1991 does not resolve the DOE/USEPA disagreement as to the time frame for demonstrating compliance. However, USEPA has agreed to initiate no enforcement action relating to the FEMP's inability to satisfy the ^{222}Rn standard prior to final remedial action so long as DOE remains in compliance with the provisions of the FFA.

3.2 Organizational Responsibilities

The airborne effluent monitoring responsibilities at the FEMP are divided among the following divisions:

- The Environmental Safety and Health (ES&H) Division has the overall responsibility of assuring that the programs and projects required to achieve and maintain compliance with the Clean Air Act (CAA) are identified, developed and pursued to timely completion. ES&H is responsible for collecting samples of airborne particulate matter from monitors and samplers located within buildings, stacks, and at the site boundary including directing their analysis. The sections within ES&H that perform these tasks are Dosimetry, Radiological Control, the Clean Air Program, and Environmental Monitoring. In addition, the Radiological Instrumentation Section of ES&H is responsible for the calibration of various components of the stack monitors and radiation detectors.

- The Remediation Support Operation (RSO) Division performs routine inspections of stack monitors and coordinates preventative maintenance activities of some of the monitor components. Some of the departments with responsibilities to support airborne sampling are RSO Maintenance and RSO Operations.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- The Environmental Division performs or coordinates analysis of samples collected for airborne particulate matter. The department with this responsibility is Analytical Laboratory Services.

- The Regulatory Programs (RP) Division assesses on-going and proposed activities to determine the impact of requirements of the CAA emission standards and the DOE As Low As Reasonably Achievable (ALARA) policy. It also maintains accurate, up-to-date permits and emission data for sources releasing contaminants into the atmosphere. The department within this division with these responsibilities is Air/Water Quality Support (AWQS).

3.3 Basis for Airborne Effluent Monitoring

A review of environmental monitoring results from 1989 through 1993 indicates that the airborne emissions (both estimated and measured) from the FEMP have decreased since production operations ceased in 1989. Although emissions have dropped significantly during this period, the potential for significant emissions (those capable of contributing a dose of 0.1 mrem/year or greater) still exists, and emissions may increase over present levels as onsite remediation activities (*i.e.*, building demolition, waste pit excavation, waste solidification/vitrification, safe shutdown activities, etc.) increase.

3.4 Identification of Discharge Sources

Although FEMP production activities were discontinued in mid-1989, the site still has five classes of possible emission sources:

000071

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- exhaust from processing equipment,
- general building ventilation,
- releases during demolition and clean-up activities (fugitive emissions),
- radon emissions from waste storage facilities, and
- mist drift from the cooling tower.

The five classes of airborne effluent emission sources are described in the following Sections.

3.4.1 Exhaust from Processing Equipment

There has been a major decrease in the airborne emissions from processing equipment at the FEMP since the facility discontinued production. As of January 1995, the FEMP had 102 active Permits to Operate air emission sources. However, virtually none of the equipment covered by these permits is in operation, nor is significant operation foreseen in the future.

Processing equipment to support remediation will exhaust discharges through stacks or vents distributed throughout the site. Some of the stacks will be equipped with air pollution control equipment, primarily HEPA filtration devices (HFDs), while others might have no specific effluent controls other than the ability to turn off the processing equipment to stop the release.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.4.2 General Building Ventilation

Each building in the former Production Area has one or more roof-top vents or short stacks for discharging its ventilation air. Since manufacturing processes are not active within these buildings, significant contamination is not entering the ventilation air, and therefore is not being discharged to the atmosphere. ES&H monitors these buildings. When fans are turned on due to warm weather and when the monitors in the buildings indicate measurable airborne activity, estimates are made of the amount of emissions from those ventilators.

3.4.3 Fugitive Dust Emission

Fugitive dust is particulate material that does not pass through a stack, vent, or other functionally equivalent opening. The particulate material is released to the atmosphere at the point of generation, at or near ground level. Other than installing soil or water covers on piles, ponds, or pits, diffuse fugitive dust sources are not amenable to effluent controls.

Historically, fugitive emissions at the FEMP have resulted from several mechanisms, such as wind erosion, vehicle movement, and loading of material into and out of waste storage areas. At present, particulate resuspension by wind erosion is the most important of these sources: since vehicle movement and loading of material into and out of the waste storage areas are both at a minimum, these two mechanisms do not significantly contribute to the total FEMP emissions.[20]

For remedial action purposes, the facility is divided into five CRUs, each of which has been evaluated for possible fugitive emissions:

000073

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- CRU 1 consists of Waste Pits 1 through 6, the Burn Pit and the Clearwell located within the Waste Storage Area. Waste Pits 1, 2, and 3 have negligible wind erosion of their soil caps due to a cover of vegetation.[21] However, there are areas of Waste Pits 1, 2, and 3 that are not covered by vegetation. Green salts have been observed in these areas. Waste Pit 4 is covered by dirt and is topped with a Nypon cover; therefore, this pit also contributes negligible wind erosion of soil. At present Waste Pits 5 and 6 are normally kept covered with water, as a result of the completion of their respective Removal Actions. The Burn Pit was back filled with dirt; most of the area is covered in vegetation. The Clearwell is a surface impoundment which normally contains substantial amounts of water; there is no significant potential for the clearwell to contribute any fugitive emissions as a result of wind erosion.

- CRU 2 consists of the Sanitary Landfill, the North and South Lime Sludge Ponds, the Flyash Disposal Areas, and the South Field Area — collectively known as the Solid Waste Units. The South Lime Sludge Pond, the Sanitary Landfill, and the South Field Area have negligible wind erosion because their soil is covered by vegetation. The North Lime Sludge Pond is active but has negligible wind erosion potential because its contents are a slurry; even if it is allowed to dry out, the pond will have low erosion potential because of the aggregation of the sludge particles with time and the high moisture content.[22] The ash in the Inactive Fly Ash Disposal Area and the Active Fly Ash Pile can be eroded by wind. Removal Action #10 was completed to eliminate fugitive emissions from the active pile.

- CRU 3 consists of the former Production Area and several miscellaneous Suspect Areas. Inhalation by offsite residents of fugitive emissions from CRU 3 is not considered a

credible potential exposure pathway.[23] Buildings and grass-covered areas within CRU 3 significantly reduce the resuspension of contaminants into the air.

- CRU 4 consists of the K-65 Silos, Metal Oxide Silo, and Silo 4. These are all closed structures surrounded by vegetation-covered ground so that fugitive dust from this unit is negligible.[24]

- CRU 5 consists of Environmental Media and other areas that were not considered in the other units. The surface soil contamination in CRU 5 is largely due to airborne emissions from the former production activities and past incinerator operations at the sewage treatment plant. The resuspension of contaminated surface soil is not considered a significant potential human exposure pathway: the average measured contaminant concentrations of the surface soil in CRU 5 are comparable to background concentrations or detection limits, and vegetation cover over the surface soils mitigates the potential for resuspension of dust.[25]

3.4.4 Radon Emissions from Waste Storage Facilities

Radon emissions from waste storage facilites (silos, pits, warehouses, etc.) comprise the fourth class of airborne emission sources at the FEMP. The construction of each storage facility is such that radon generated in the waste material is capable of escaping to the atmosphere. Sitewide radon emissions are dominated by emissions from the K-65 silos; however, the waste pits, storage warehouses, and building/areas on site also contribute to radon emissions. The radon monitoring program is described in Section 5 of this Plan.

For remedial action purposes, the five CRUs have been evaluated for possible radon emissions:

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- Waste Pits 1 through 6 (in CRU1) are potential sources of radon emissions. Waste pits 5 and 6 are covered with water and radon emissions are considered negligible. Radon flux measurements were performed on Waste Pits 1-4, and all four pits had flux rates less than 20 pCi/m^2-sec. Kiln drying of pit wastes may occur during 1005, as well as the Dewatering, Excavation, and Evaluation Program (DEEP), which includes excavation of pit materials. Radon monitoring will be performed as needed to support these activities.

- Buildings 64, 65, 66, and 67 (in CRU3) store radium-bearing wastes. The perimeters of the controlled areas of these buildings are monitored for radon with alpha track-etch detectors.

- The K-65 silos 1 and 2 (in CRU4) are continuously monitored as described in Section 5.6.11. Construction of the Vitrification Plant should be completed in 1995. Continuous radon monitors will be needed to adequately monitor this facility when silo wastes are being treated.

CRU2 and CRU5 have no known or suspected radon emission sources.

3.4.5 Mist Drift from the Cooling Tower

Various processes at the FEMP used and recycled cooling water to the tower. This is believed to have led to contamination of the recirculating water and the piping system. On returning to the tower, the water stream cascades down the tower fill. Contact with the air transfers the heat to the air. At the same time, some of the water is removed in the form of mist. Uranium is assumed to only be emitted in this mist, in the same concentration it is found in the water

stream. Based on the estimated flow through the tower, the concentration of uranium in the recycle stream, and the drift loss factor for this design of cooling tower, the emission loss may be estimated for any given operating period.

3.4.6 Summary

Because fugitive dust emissions from Waste Pits 5 and 6 are now well controlled by water cover, the principal source of radioactive airborne emissions from the FEMP is currently the K-65 Silos (due to their radon-emitting ore residues). To the extent that currently inactive processing equipment may be operated to clean them or to process site wastes, processing equipment exhaust and building ventilation may produce significant emissions; however, their present offsite radiological impact is minimal.

3.5 Stacks Requiring Monitoring

Table 3-1 provides a list of all the FEMP stacks requiring some form of monitoring or periodic sampling. This list identifies only those point source emissions which may be activated during the next year.

3.5.1 Required Frequency of Monitoring

Regulations on radionuclide point sources (*i.e.*, stacks and vents) require continuous monitoring on any source with the potential to deliver an effective dose equivalent (EDE) of 0.1 mrem/year or greater to any member of the public (40 CFR 61, Subpart H). Table 3-2 lists the FEMP stacks requiring continuous monitoring, based on modeling of sources using USEPA-approved computer codes and process knowledge.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

40 CFR 61 Subpart H requires periodic confirmatory measurements of un-monitored point sources with potential to deliver an effective dose equivalent dose of less than 0.1 mrem/year. Based on the status of buildings and equipment, the stacks identified in Table 3-3 are required to be monitored periodically.

Although no specific frequency is specified for periodic confirmatory measurements on some of these stacks and vents, it is the FEMP's intent to test each applicable stack or vent per the guidance contained in DOE Orders.

3.6 Evaluation of Discharged Contaminants

Determination of airborne effluent monitoring needs depends not only on the characteristics of the release points just described, but it also depends on which radionuclides contribute significantly to the exposures of members of the public. The following subsections evaluate the radionuclides available for discharge.

3.6.1 Radionuclides Available for Discharge

Chapter 1 of the 1993 SER discusses past operations at the FEMP for the purposes of determining what radionuclides are important in liquid effluent accounting. The primary radionuclides of interest at the FEMP are ^{238}U, ^{235}U, ^{234}U, ^{232}Th, and ^{226}Ra. These radionuclides should certainly be target analytes for airborne effluent-related samples. The following paragraphs assess the necessity and practicality of analyzing for their respective daughter products. All references to detection of radionuclides in airborne effluents are based on releases reported in the Site Environmental Reports.[5, 10-14]

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.6.1.1 Radionuclides Associated with the ^{238}U Decay Chain

Daughter radionuclides associated with the ^{238}U decay chain are shown in Figure 2-3. Their respective applicability to airborne effluent accountability is evaluated as follows:

- ^{234}Th is assumed to be in equilibrium with ^{238}U, and therefore is considered a potential contaminant in airborne effluents. It was reported as having been released every year from 1988-1993. It is a target analyte for airborne effluent accounting.

- ^{234m}Pa is currently in equilibrium with its predecessors. Since it is a beta emitter with no significant photon emissions, and its half-life is approximately one minute, there is no practical means of analyzing for this radionuclide specifically. Therefore, it is not considered a target analyte for airborne effluent accounting.

- ^{234}Pa is a low-probability daughter of ^{234m}Pa, with correspondingly low activity relative to other members of the decay chain. For this reason, ^{234}Pa is not considered a target analyte for airborne effluent accounting.

- ^{234}U is nearly in equilibrium with ^{238}U since it had equal activity in the feed materials and was separated along with the ^{238}U in the past chemical processes. Thus, ^{234}U is considered a target analyte for airborne effluent accounting.

- There has been no significant in-growth of ^{230}Th and ^{226}Ra from ^{234}U at the FEMP due to its long half-life. However, ^{230}Th and ^{226}Ra were both separated from uranium in past FEMP chemical processes. They are present in process residues and general site

000079

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

contamination, and both nuclides were reported as having been released every year from 1988-1993. Thus they are considered target analytes for airborne effluent accounting.

- ^{222}Rn and daughters are governed by different limits than the above-listed radionuclides (see Section 3.1). Because of the large potential source of radon and daughters from the K-65 silos, methods are being used to determine their concentration in air over the site and beyond the facility fence. ^{222}Rn is a target analyte per 40 CFR 61, Subpart Q.

3.6.1.2 Radionuclides Associated with the ^{235}U Decay Chain

Radionuclides associated with the ^{235}U decay chain are shown above in Figure 2–4. Their respective applicability to airborne effluent accountability is evaluated as follows:

- ^{231}Th is already in equilibrium with ^{235}U at the site and is in principle detectable by gamma spectroscopy. For these reasons, it is a target analyte for airborne effluent accounting.

- There has been no significant in-growth of ^{231}Pa and the later daughters from ^{231}Th at the FEMP, due to the long half-life of ^{231}Pa. However, ^{231}Pa and ^{227}Ac were separated from uranium as a result of past chemical processes. Because of their long half-lives, they could be present in process residues and general site contamination. Specific analyses for both nuclides have not been performed in the past.

  However, specific analyses for alpha-emitting thorium isotopes did not detect ^{227}Th in 1988, 1989, 1990 or 1991. Based on these facts, it is reasonable to infer that site concentrations of ^{231}Pa, ^{227}Ac, ^{227}Th, and radionuclides following ^{227}Th in the decay chain

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

are not high enough to warrant making them target analytes in radiochemical analyses for airborne effluent accounting.

3.6.1.3 Radionuclides Associated with the ^{232}Th Decay Chain

Radionuclides associated with the ^{232}Th decay chain are shown above in Figure 2-5. Their respective applicability to airborne effluent accountability is evaluated as follows:

- Due to the long storage period onsite since chemical separation processes were performed, the ^{232}Th decay chain through ^{224}Ra should be nearly in equilibrium. This is consistent with the fact that ^{232}Th and ^{228}Th were reported as having been released in roughly the same amounts during the years 1988 through 1993. Although routine analyses for alpha-emitting radium isotopes did not detect ^{234}Ra in any of these years, it nevertheless is concluded that all ^{232}Th daughters through ^{224}Ra should be considered target analytes in radiochemical analyses for airborne effluent accounting.

- ^{220}Rn and later daughters in air on the FEMP site during the period of continuing DOE control are not governed by limits under DOE 5400.5 (see Section 3.1). Furthermore, because of the 55-second half-life of ^{220}Rn, it is much less likely than ^{222}Rn to escape from the equipment or residues in which it may be contained. ^{220}Rn and daughters are not considered target analytes for airborne effluent accounting.

000081

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.6.1.4 Radionuclides Associated with Other Decay Chains and Sources

Because some reprocessed uranium was handled in past FEMP operations, trace quantities of fission products, ^{236}U, and transuranics are present onsite. Their respective applicability to airborne effluent accountability is evaluated as follows:

- The fission products ^{90}Sr and ^{99}Tc were reported in airborne effluents in 1988-1993. However, the levels at which they were quantified were small fractions of the activities of uranium and thorium isotopes; considering their much lower committed effective dose equivalent per unit activity inhaled or ingested, they contribute even less to dose than they do to total activity. Because of the complex chemistry required for analyses of these isotopes and their small contribution to total dose, these radionuclide are not considered target analytes for airborne effluent accounting.

- ^{137}Cs and ^{106}Ru were reported in 1988-1993, although their respective activities also made them negligible contributors to dose. However, the analysis is relatively inexpensive and simple, and detection of fission products may occur in the process of performing gamma spectroscopy for measurement of more significant radionuclides. Therefore, although these radionuclides are not considered target analytes for airborne effluent accounting, they should be reported if detected during analyses for other radionuclides.

- ^{236}U was reported in 1988-1993. Therefore, it is considered a target analyte for airborne effluent accounting.

- Isotopes of neptunium and plutonium were reported in airborne effluents in 1988-1993 but the activities at which these radionuclides were quantified were 1% or less of the

levels reported for uranium isotopes. The dose impact per unit activity of transuranics is similar to that of the uranium isotopes, so their overall contribution to dose is insignificant. Because of the complex chemistry required for analysis of these isotopes and their small contributors to total dose, these radionuclides are not considered target analytes for airborne effluent accounting.

Based on the foregoing evaluation, target analytes for airborne effluent accounting at the FEMP are summarized as follows:

- The basic target analytes listed in Table 2-1 for liquid effluents are also applicable to airborne effluent accounting.

- In addition, any gamma-emitting fission products incidentally detected in analyses of airborne samples will be reported.

- ^{222}Rn must be measured in ambient air on the FEMP site and beyond the facility fence.

3.6.2 Dose Impacts of Airborne Discharges in the Remediation Mode

Since the FEMP ceased production operations in mid-1989, the total activity of radiological airborne effluents has decreased markedly. Data for the most recent published SERs indicate a low aggregate dose impact from the FEMP's point and diffuse sources. Environmental data from 1989 indicate a 5.2 mrem annual effective dose equivalent (EDE) to the maximally-exposed member of the public, due to all airborne releases of non-radon radionuclides. This annual EDE due to airborne releases from the FEMP has decreased since then to 0.6 mrem/year in 1990, 0.3 mrem/year in 1991, 0.2 mrem/year in 1992, and less than 0.1 mrem/year in 1993. Diffuse

sources, which are not readily amenable to controls or to monitoring at the point of emission, dominate these totals.

Radon exposures at the site fenceline have also been estimated on an annual basis. Using the dose calculation method that was used for the Site Environmental Reports for 1989 through 1992, the dose due to radon has been at or below the natural radon background dose rate of 200 mrem per year every year since 1989. The dose calculation method has been revised beginning with 1993 data, using a more conservative method used by the National Council on Radiation Protection (NCRP).[26] This new method is expected to provide higher radon dose estimates than have been determined in previous years. For 1993, the new method y ielded a radon dose estimate of 454 mrem. The old method (used through 1992) would have yielded a radon dose estimate of 189 mrem, comparable with previous years' estimates.

3.7 Sampling and Monitoring Methods

The description of airborne radiological effluent release points and contaminants in Sections 3.3 through 3.6 are sufficient to support a determination of the sampling and analysis requirements for discharges from the FEMP. Section 3.7 establishes the requirements for obtaining samples of airborne effluent-related materials, and Section 3.8 establishes the requirements for analysis of such samples. Section 3.9 addresses non-radiological airborne effluent monitoring and permit requirements. Refer to Section 3.10 and Section 10.0 of this Plan for additional SCQ sampling and analysis requirements. These requirements shall be followed as they apply to the routine Airborne Effluent Monitoring Program. These requirements shall be incorporated and referenced in Section, Department, or Division implementing procedures as applicable.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.7.1 Point Source Continuous Monitoring for Current Site Conditions

A point source is the single defined point (origin) of an airborne release such as a stack or vent. The dose impact of each individual point source (and of all point sources in aggregate) may be an area of concern with the FEMP operating normally in the remediation mode. Because of the relatively low level of activity at the FEMP since production was stopped in 1989, the annual effective dose equivalent of point release sources is substantially below 2 mrem[27] (20% of the 10 mrem standard) (DOE/EH-0173T Summary 3l). Table 3-1 identifies those point sources which may be operated over the next few years. However, the dose may increase once remedial activites at the site are well underway. At that time the dose impact of each individual point source (and of all point sources in aggregate) may be substantial.

The FEMP may install continuous airborne effluent monitors on selected release points as a conservative practice, as required by NESHAP Subpart H,[25] or based on the criteria stated in Section 3.5.2 and the SCQ.

Installation of additional continous monitors may be required in the future as new or modified facilities are constructed. Any continuous airborne effluent monitors installed for any reason (to include those sources identified in Table 3-1) shall satisfy all applicable criteria of DOE/EH-0173T regarding sampling systems, monitor design, alarm setpoints, and system sensitivity and accuracy (DOE/EH-0173T Summary 3f, 3g, 3j, 3k, 3m, and 3n).

3.7.2 Assessment of Modified Facilities with Potential Airborne Effluent Release Sources

A pre-operational assessment shall be made and the decision shall be documented in the EMP for the following types of facilities containing potential airborne effluent release sources:

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- new facilities,
- facilities restarted after a prolonged shutdown, and
- facilities that have been modified in a manner that could affect effluent release quantity or quality, or the sensitivity of monitoring or surveillance systems.

An acceptable form for this assessment is a Operational Readiness Review with an associated checklist as specified in SSOP-0100, "Readiness Review Process."

For point sources, pertinent system characteristics in such new or modified facilities shall be documented. These system characteristics shall include the following:

- exhaust handling system and other pertinent structural information,
- process-emission control systems, and
- sampling and measurement systems.

The final products of each such assessment shall be determinations of the types and quantities of airborne emissions to be expected from the facility, and of the associated airborne emission monitoring needs (DOE/EH-0173T Summary 3d). The criteria for monitoring techniques established in Section 3.0 of DOE/EH-0173T shall be used to determine the airborne emission monitoring needs, given the source characteristics (DOE/EH-0173T Summary 3c). The criteria includes applicable SCQ requirements. Any individual identified source with a potential to cause an annual effective dose equivalent exceeding 0.1 mrem to a member of the public shall be

continuously monitored or sampled in accordance with the requirements of Sections 3.5.1 and 3.5.2 of this Plan (DOE/EH-0173T Summary 3b).

In addition, if such assessments should lead to the conclusion that the effective annual dose equivalent from inhalation of particulates released from all the point sources at the FEMP exceeds 2 mrem, then a particle size analysis of each point source emission to exceed 0.1 mrem shall be conducted at least annually (DOE/EH-0173T Summary 5f).

A diffuse or area source is a source (or sources) of radioactive contaminants (emissions) released into the atmosphere that has no well defined point of origin or release (*i.e.*, a non-point source). Such sources are also known as area sources. For diffuse sources, an annual inventory shall be made. All diffuse sources with potential to cause an annual effective dose equivalent exceeding 0.1 mrem to a member of the public shall be identified, documented, and assessed (DOE/EH-0173T Summary 3i).

For all types of sources, any changes to the effluent monitoring program caused by facility modifications or identification of new sources shall be reflected in revisions to the Plan.

3.7.3 Routine Emissions Monitoring

3.7.3.1 Ambient Air Measurements

The following factors support the determination that ambient air monitoring is the most appropriate and cost-effective method to account for airborne emissions of non-radon radionuclides from the FEMP:

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- The annual effective dose equivalent due to all FEMP point and diffuse airborne emission sources is very low, less than 0.1 mrem (Section 3.6.2).

- There are a large number of potential point sources contributing to this low dose (Section 3.4).

- Sources for which monitors have not been required or which cannot be readily monitored (*e.g.*, cooling towers, waste pits) are now the predominant emissions sources for the site.

- The emissions from the diffuse sources that dominate the total dose must be estimated by calculation rather than being measured directly. These estimates in the past have been excessively conservative in predicting offsite concentrations at the very low levels that actually result from FEMP emissions.

However, DOE and EPA approval are necessary in order to use ambient air monitoring average concentrations to demonstrate NESHAP Subpart H compliance. The site is developing a request to obtain DOE and EPA approval for the use of ambient air monitors to demonstrate NESHAP Subpart H compliance. The request will include the detailed description of sampling and analytical methodology, and describes ways the 40 CFR 61.93(B)(5) criteria will be met.

The impact of airborne radiological effluents discharged by the FEMP shall be accounted for by either direct air effluent monitoring or engineering calculation. The FEMP currently uses the effluent based code, CAP-88-PC, to determine source-based impacts. High volume ambient air monitoring for non-radon radionuclides is preferred for NESHAP Subpart H compliance as discussed previously.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

This Plan and the SCQ (from a EPA QA perspective) direct the collection, processing, and overall management of samples collected at proposed critical receptor sites. Both Plan documents must be compatible with the Final Request before the decision is made concerning whether the FEMP will use ambient air monitoring data to demonstrate NESHAP Subpart H compliance.

Ambient air radionuclide concentrations obtained by measurement and/or by radionuclide accounting may be entered in a variation of the CAP-88-PC code to determine air pathway dose estimates. The resultant concentrations can be compared with the concentrations obtained by the use of the same model using measured and calculated emissions. The evaluation can be made to determine the accuracy of the measured and calculated emissions. When the dose estimates are similar, then one can conclude that a reasonably accurate estimate was made for unmeasured, unmonitored airborne emissions.

Currently the FEMP accounts for the impacts of airborne radiological effluents discharged by the facility through either direct effluent monitoring or a combination of direct monitoring and engineering calculation estimates of effluent concentrations when direct monitoring of some source terms is not possible.

The predominant air effluent sources at the FEMP are diffuse and fugitive emissions. The comparisons above are not required by NESHAP Subpart H, but are desirable because their interpretation may provide the facility with a better understanding of its non-point source emissions.

Pathway dose estimates based on the summation of all source terms that cover all pathways and each significant pathway, are also calculated according to Section 8.0 of this Plan. These

pathway dose estimates will not distinguish the radionuclide concentrations from a single year with those from the cumulative period of facility history.

The air pathway dose calculations directed by Section 8.0 of this Plan shall be made for estimating the dose due to inhalation and from past and current emissions that may have accumulated in the food chain. The corresponding air pathway dose estimates may be compared with the CAP-88 effluent based and ambient air based dose estimates (when available).

The air pathway dose estimates among the effluent based CAP-88-PC model, the version of CAP-88 used to calculate dose from the ambient air monitoring (when available), and the environmental surveillance based dose calculations (Section 8.0), may be useful in future evaluations. Basically, the site is using three different methods for calculating dose at certain receptors and comparing them. This comparison can be looked at as a verification or confirmation of different methods.

3.7.3.2 Concentrations of ^{222}Rn

The ^{222}Rn discharged from the FEMP includes not only that which is discharged through the cracks and leaks through the sounding ports and man-ways on the K-65 Silos, but also that which seeps directly into the soil through cracks in the buried portions of the silos. Silo 3 is a source of ^{222}Rn since the radon flux from the Silo was calculated to be approximately 20 pCi/m^2-sec. The Waste Pits are also considered a source of ^{222}Rn since the radon flux measurements from Waste Pits 1, 2, and 3 averaged to 9.1, 6.4, and 2.6 pCi/m^2-sec, respectively. To ensure that all radon discharges are properly accounted for, the most appropriate method is to measure directly the concentrations of ^{222}Rn in the air at points immediately adjacent to the silos and other identified or potential sources of radon, and at points on the FEMP facility fenceline. The

ambient radon measurement program established in Section 5.6.11 of this Plan shall be used for this purpose. The program includes additional SCQ sampling and analysis requirements. The concentrations measured by this program shall be compared directly to the ^{222}Rn concentration guidelines listed in Section 3.1 of this Plan for the purpose of determining FEMP compliance with those guidelines.

3.7.4 Monitoring Airborne Emissions in Abnormal Circumstances

Two principal types of abnormal conditions must be accounted for in planning methods for airborne emissions monitoring: loss of emission controls, and occurrence of accidents.

- In the event that there is a general loss of emission controls at the facility, the emissions would continue to be monitored by the ambient air monitors located at and beyond the facility fence (DOE/EH-0173T Summary 3a). Since the FEMP is no longer a production site, the majority of the facility airborne emissions are not from sources that have emission controls; therefore the loss of emission controls would not have a great impact on monitoring activities.

- In the event of an accident at the FEMP, two sources of data will be available for assessing the magnitude and impact of any release. First, the ambient air monitors located at and beyond the facility fence should continue to operate. Second, special field sampling programs governed by the site's Emergency Plan[28] and specific site procedures for emergency response would come into effect. The combination of the two sources of data would be sufficient for monitoring releases due to any credible accident at the FEMP (DOE/EH-0173T Summary 3h).

In addition, procedure EM-RM-004, "Reporting Airborne Emissions and Releases," establishes the method and frequency guidelines for reporting significant increases or decreases in airborne emissions and radon concentrations as measured by the fenceline ambient air monitoring stations and real-time radon monitors.

3.8 Analytical Requirements

3.8.1 Radiological Analyses

Table 3-4, Minimum Analysis Regimen for Air Particulate Samples, summarizes the minimum analyses regimen for stack monitoring. Several other radionuclides (trace fission products, transuranics, and other non-target analytes) may be analyzed in order to address community concerns about FEMP emissions. All analytical methods used shall comply with the requirements of the SCQ and 40 CFR 61, Appendix B.

3.8.1.1 Radionuclide Detection Limits

Detection limits for stack monitoring are derived from the requirements to continuously monitor stacks with the potential to deliver an EDE of greater than 0.1 mrem/year to offsite. From this requirement it follows that, at a minimum, the detection limits must be at a level to identify a concentration that would lead to 0.1 mrem/year. The potential that more than one radionuclide is likely to contribute dose suggests that a lower detection limit is needed in order to quantify multiple radionuclides and their contribution to dose. However, the dispersion and dilution that will take place between the point of release and the nearest member of the public allows for a higher detection limit to be acceptable. After considering these factors, detection levels were selected using a stack release concentration that would lead to an EDE of 0.1 mrem/year. This

is considered a conservative assumption because the amount of dispersion and dilution which will occur between the point of release and a member of the public located at the FEMP boundary, will result in a dose far below the 0.1 mrem level for a stack exit concentration that corresponds to an EDE of 0.1 mrem/year.

3.8.1.2 Frequency of Filter Change

There are no regulatory drivers for determining the frequency of filter changes in a continuously monitored stack. The nature of the operation and processes within a building, the effectiveness of the effluent treatment system, loading of the stack filter, and the analytical methods used to analyze the filter all play a role in determining the frequency of filter change. Since each of these factors (and others) varies over a range for each stack or building vent at the FEMP, no set frequency of filter change has been designated. The current approach is to exchange filters on a monthly basis, but as experience and data from stack monitoring accumulate, a more definitive filter change schedule may develop. The justification for each point source's filter change frequency will be documented in the FEMP's 40 CFR 61 Subpart H files.

3.8.1.3 Pulse Laser Phosphorimetry - Total Uranium/Alpha Spectrometry

In general, the chemistry required to obtain isotopic specific results for the target analytes listed in Table 3-4, Minimum Analysis Regimen for Air Particulate Samples, is too complex and expensive to be performed very frequently. Additionally for the past 5 years, there has not been enough sample on stack filters to analyze for isotopics. This is due to the change of the site's mission from production to remediation. On the other hand, some form of analysis must be performed to allow for proper management of airborne effluent discharges.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

An evaluation of each known point source will be conducted to determine the appropriate screening method. The site will use either pulse laser phosphorimetry or alpha spectrometry as a screening method for the determination of stack activity depending on the findings of the source evaluation. Screening of each stack will be done on a monthly basis to allow for proper management of airborne effluent discharges. Pulse laser phosphorimetry and alpha spectrometry are relatively quick to perform, and they are thorough because they encompass both target analytes and unanticipated analytes such as transuranics and fission products. For these reasons, pulse laser phosphorimetry and alpha spectrometry analyses are ideally suited for providing timely feedback on effluent treatment controls. Procedures shall be maintained, compliant with the SCQ, to direct the computation and use of pulse laser phosphorimetry and alpha spectrometry action levels. If screening action levels are exceeded, then isotopic analyses will be performed and process operations will be examined. Monthly filters will be composited.

3.8.1.4 Radionuclide-Specific Analyses

In addition to monthly screening and subsequent isotopic analyses as needed, isotopic analyses will be performed annually on the annual composite filters for each stack. These analyses are intended to provide information necessary for assessing and reporting the dose impact on the general public from airborne effluent. The analysis methods employed shall be capable of quantifying the target analytes as well as any non-target analytes that are identified in the sample. In the case where a relatively long-lived parent is easier to measure than the target analyte daughter, the secular equilibrium assumption may be used to quantify the target daughter analyte when it does not have the potential to provide a 0.1 mrem dose to the public. Table 3-4, Minimum Analysis Regimen for Air Particulate Samples, provides the minimum analysis regimen for the radionuclide target analytes. ^{228}Ac will be assumed to be in equilibrium with

^{228}Ra. ^{224}Ra will be assumed to be in equilibrium with ^{228}Th. ^{231}Th will be assumed to be in equilibrium with ^{235}U. ^{234}Th will be assumed to be in equilibrium with ^{238}U.

Since all the target analytes are either long-lived or are in equilibrium with their decay chain, the annual analysis frequency does not have an adverse impact on required Minimum Detectable Activities (MDAs). Performing analyses of actinides more frequently than annually is considered unnecessary, especially when complemented by monthly activity screening using either pulse laser phosphorimetry or gamma spectrometry.

Because of the low total level of airborne emissions from the site, there recently has been insufficient sample available to analyze each stack monitoring filter. Where the size of the stack monitoring sample is judged insufficient for an inorganic or radiochemical determination, the filter will be composited. If any annual composite of filters for a point source is insufficient for complete analysis, then only the radionuclide believed to be in the highest concentration will be analyzed for. If this is not possible, then the best estimates based on production knowledge, past site-specific data, and site mission will be made to perform the site compliance demonstration.

3.8.1.5 Overall Uncertainty in Measurements

The overall uncertainty in an analytical result is a combination of random (*e.g.*, counting) and systematic (*e.g.*, sampling) errors. Theoretically, the MDA is the level at which the uncertainty due to random error in an analytical result is $\pm 100\%$ for at least 95% of all sample analyses performed where the analyte of interest is not present in the sample. The uncertainty in analytical results due to random error decreases as the concentration of the analyte of interest in the sample increases. At sufficiently high analyte concentrations, the contribution of random error to the overall uncertainty in the analysis is so small that the overall uncertainty becomes

dominated by systematic error. The objective of the uncertainty specifications of ±50% for each analyte in Table 3-4 is to establish a reasonable upper bound for systematic error so that analytical results remain meaningful with regard to the stated sampling objectives. For this reason, the specifications for overall uncertainty are quoted for analyte concentrations at 10 times their MDA in order to minimize the effect of random error on the measurement. Analyte concentrations at ten times the MDA are readily quantified, making verification of this requirement a reasonable task. The formula that shall be used to calculate MDAs is found in Section 7.0.

3.8.2 Non-Radiological

The analytical requirements for non-radiological contaminants and air quality parameters for FEMP point sources are prescribed by their respective Permits to Operate. Procedures shall exist for implementing the analytical requirements established by the permits.

3.9 Non-Radiological Airborne Effluent Monitoring

Non-radiological air emission monitoring shall be in accordance with the requirements of applicable federal, state, and local regulations established under the CAA (42 U.S.C. 7401, *et seq.*). Section 118 of the Act specifically addresses the control of airborne pollution. Where applicable, the FEMP shall comply with the monitoring requirements of Title 40 CFR 53, which includes monitoring of fossil fuel combustion sources, and associated test methods.

Non-radiological emissions from the FEMP include sulfur dioxide (SO_2), nitrogen oxides (NO_X), airborne dust (total suspended particulate), carbon monoxide and volatile organic compounds (VOCs). The primary FEMP emission source of SO_2, NO_X, and airborne dust materials is the

coal-fired boiler plant, but airborne effluents from all sources at the FEMP are subject to standards adopted by the OEPA.

Monitoring of all sources shall conform to the U.S. EPA Prevention of Significant Deterioration (PSD) regulations, which include quality assurance and accuracy requirements for monitoring.[29]

Specific performance standards for emissions from the FEMP boiler plant are as follows:

- SO_2 emissions shall not exceed 0.6 kg (1.33 lbs) per million BTU input for each coal-fired boiler at the FEMP. SO_2 emissions are calculated according to the methods and procedures in Ohio Administrative Code rules.[30] Such calculations show that, to ensure that the FEMP does not exceed the limit on SO_2 emissions, the plant shall burn coal that contains less than 0.85% sulfur.

- Emissions shall be monitored continuously for opacity. The results of the opacity measurements shall be reported to the Department of Environmental Services Air Quality Program (DOESAQP) on a quarterly basis.

Note: The State of Ohio has not established NO_X emission limits for industrial process sources in the region of the state that includes the FEMP.

3.9.1 Non-Radiological Emissions Points

The sources of the largest non-radiological emissions from the FEMP are the coal-fired boiler plant and the natural gas fired boilers used to supplement or substitute for the coal-fired boilers. Figure 3-1 shows the current locations of the boilers. Emissions from these sources include

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

SO_2, NO_X, airborne dust (total suspended particulates), CO, and non-methane volatile organic compounds. Only for SO_2 and particulates has the State of Ohio set limits for the FEMP.

Radionuclide sources are also particulate emission sources but the particulate emission levels are small compared to those from the operation of the boilers. However, air permits for these sources do establish requirements for monitoring particulate emissions.

According to the 1990 CAA Amendments (CAAA), effective July 1, 1992 it shall be unlawful for any person in the course of maintaining, servicing, repairing or disposing of an appliance or industrial process refrigeration, to knowingly release or dispose of any Class I or Class II (halocarbon) substances used as a refrigerant in such appliance (or industrial process refrigeration) in a manner which permits such substance to enter the environment. Deminimus releases associated with good faith attempts to capture and recycle or safely dispose of Class I and Class II substances are allowed according to the 1990 CAAA. Halogen compounds (CFCs) emitted from routine maintenance and operation of stationary halocarbon sources (air conditioners, refrigerators) and mobile sources (FEMP trucks, cars, etc.) do not require monitoring but emissions of them must be quantified, reduced and phased out at the FEMP.

3.9.2 Procedures and Equipment Used to Monitor Effluent Emissions

SO_2 emissions shall not exceed 0.6 kg (1.33 lbs) per million BTU input for each coal-fired boiler at the FEMP. SO_2 emissions from the gas fired boilers are considered zero so the emission requirement is not applicable. To monitor the levels of SO_2 emitted from the coal-fired boilers, the FEMP is required to sample incoming shipments of coal to determine its sulfur content and heat content. The sulfur content of the coal can not exceed 0.85%. (The FEMP has requested

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

from the State of Ohio permission to perform the analysis on coal on an as used basis instead of an as received basis.)

Coal is sampled per FEMP SSOP 43-C-410, "Receipt, Sampling, and Storing Coal." The sampled coal is analyzed at an offsite laboratory for the following analyses: moisture (method D3173-73), ash (method D3174-82), BTU (method D2015-77), sulfur (method D3177-575), volatile (method D-3175-77), and fixed carbon (calculated).

SO_2 emissions are calculated using a formula from section 3745-18-03 of the Ohio administrative code. The formula utilizes the laboratory measured heat and sulfur content of the coal to determine SO_2 emission rates to the environment. Coal analysis and tonnage used is reported quarterly to the DOESAQP.

Particulate boiler emissions are calculated using emission factors. The emission factors are derived from results of source tests performed on the boilers in 1988 using manual US EPA techniques found in 40 CFR Part 60. Electrostatic precipitators are used to control particulate emissions from the coal fired boilers. Opacity (a measure of particulate emissions) is continuously monitored in the boiler discharge stacks. Records of the results of these measurements are retained and results reported to DOESAQP.

Particulates from radiological sources are either continuously measured per American National Standards Institute (ANSI)-13.1 - 1969 or estimated. The FEMP attempts to develop emission estimates using factors developed for US EPA models or from periodic testing of the sources using the applicable test methods from 40 CFR Part 60.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Halocarbon emissions are determined by how much CFCs the site has been unable to recover, recycle, or reclaim from the stationary or mobile sources at the FEMP during routine maintenance activities. The procedures used for recovering, recycling or reclaiming CFCs from the stationary or mobile sources at the FEMP thereby controlling CFC emissions are found in site procedure, "Freon Management," SSOP-0069.

3.9.3 Repeatability and Reproducibility

The analytical methods were developed to ensure analysis of coal composition and properties are accurate and precise. Each analytical method has repeatable and reproducible limits associated with it. For moisture analysis, repeatability for coal containing less than 5% moisture is not more than 0.2% and is 0.3% for coal containing greater than 5% moisture. Reproducibility for coal containing less than 5% moisture is not more than 0.3% and is 0.5% for coal containing more than 5% moisture. For ash analysis, repeatability is 0.3% and reproducibility is 1.0%. For BTU analysis, repeatability is 50 BTU/lbs (dry weight) and reproducibility is 100 BTU/lbs (dry weight). For sulfur analysis, repeatability is 0.05% and reproducibility is 0.15% for samples containing less than 2% sulfur and is 0.25% for samples containing greater than 2% sulfur. For volatile analysis, repeatability is 0.10% and reproducibility is 2.0%.

3.10 Quality Assurance

The general quality assurance program provisions discussed in Section 10.0 shall be followed as they apply to the monitoring of all airborne emissions from the FEMP (DOE/EH-0173T Summary 3o). The FEMP QAPD describes the overall Quality Assurance Program for the FEMP. The Radionuclide Air Emissions Quality Assurance Project Plan[31] states how the facility

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

policies will be implemented to achieve or exceed the required quality involved in monitoring stacks and vents at the FEMP.

SCQ requirements shall be followed as they apply to the Environmental Monitoring Program at the FEMP. Section 6.0 of the SCQ, "Sampling Requirements," addresses gaseous matrix samples. CAA Monitoring and Radon Sampling are included in the Gaseous Matrix Samples Subsection. Section 10.0 of the EMP, "Quality Assurance," requires that SCQ requirements be followed. It discusses and references additional SCQ requirements that apply to Airborne Effluent Monitoring activities in general: Section 2.0, "Project Description;" Section 3.0, "Project Organization;" Section 4.0, "Quality Assurance Objectives;" Section 5.0, "Field Activities;" Section 6.0, "Sampling Requirements;" Section 7.0, "Sample Custody;" Section 8.0, "Calibration Procedures and Frequency;" Section 9.0, "Analytical Procedures;" Section 10.0, "Internal Quality Control Checks and Frequency;" Section 11.0, "Data Reduction, Validation, and Reporting;" Section 12.0, "Performance Assessment and System Audits;" Section 13.0, "Preventative Maintenance;" Section 14.0, "Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness;" Section 15.0, "Corrective Actions;" and Section 16.0, "Quality Assurance Reports to Management." These requirements must be followed and incorporated in the Airborne Effluent Monitoring Program at the implementing level.

000101

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-1: FEMP Radiological Point Sources

FEMP Emission Point #	OEPA Stack Monitoring Source Description	OEPA Permit PTO #	Requirements (assume NESHAP-driven unless otherwise noted)
X001-01	Plant 1 Ore Silo general ventilation	NA	CERCLA work plan, continuous SPS(2)
X001-02	Plant 1 Ore Silo reduction building ventilation system	NA	CERCLA work plan, continuous SPS(2)
EP8-013	East Oliver filter	P239	Periodic
EP8-014	West Eimco filter	P240	Periodic
EP8-015	East Eimco filter	P248	Periodic
X002-02	MAWS area exhaust system	NA	Continuous - MPIS(1)
X002-01	MAWS melter offgas system	NA	Continuous - MPIS(1)
EP11-002	Contaminated clothing dryers	)274	Continuous - SPS(2) (per OEPA permit)
EP15-001	Laboratory MEPA/HEPA exhaust system	TBD	Continuous-MPIS(1)
EP15-002	Lab general exhaust system	TBD	Periodic
EP15-003	Lab general exhaust system	TBD	Periodic
EP15-004	Lab perchloric hood	TBD	(3)
EP15-005	Lab perchloric hood	TBD	(3)
EP15-006	Lab perchloric hood	TBD	(3)
EP15-007	Lab perchloric hood	TBD	(3)
EP15-008	Lab perchloric hood	TBD	(3)
EP15-009	Lab perchloric hood	TBD	(3)
EP15-010	Lab perchloric hood	TBD	(3)
EP15-011	Lab perchloric hood	TBD	(3)
EP15-012	Lab perchloric hood	TBD	(3)
EP15-013	Lab perchloric hood	TBD	(3)
EP15-014	Lab perchloric hood	TBD	(3)

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-1: FEMP Radiological Point Sources

FEMP Emission Point #	OEPA Stack Monitoring Source Description	OEPA Permit PTO #	Requirements (assume NESHAP-driven unless otherwise noted)
EP15-015	Lab perchloric hood	TBD	(3)
EPIS-TBD	Fume hoods S-43	TBD	Periodic
EPN-20-002	Water plant laboratory exhaust hoods	TBD	Periodic
EPN-20-003	Water plant laboratory exhaust hoods	TBD	Periodic
EP8-TBD	Trash compactor/baler	P227	OEPA, air monitoring
EP42-001	Respirator cleaning trailer exhaust system	TBD	Periodic
EP65-TBD	Thorium repacking general exhaust system	NA	Periodic
EP78-001	New Decon. Building cartridge/MEPA/HEPA	P261, P263, P264	Continuous - MPIS(1)
53-006	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-007	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-008	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-011	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-013	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-014	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic

000103

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-1: FEMP Radiological Point Sources

FEMP Emission Point #	OEPA Stack Monitoring Source Description	OEPA Permit PTO #	Requirements (assume NESHAP-driven unless otherwise noted)

(1) - Multipoint continuous isokinetic sampler.
(2) Single point continuous sampler.
(3) It is uncertain if point source can be tested safely due to location (roof, etc.).
TBD - to be determined.
NA - Not applicable, CERCLA action - no OEPA permit required.
Periodic - stacks will be tested per 40 CFR 61.93(B)(4)(i) requirements.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-2: FEMP Point Sources Requiring Continuous Monitoring

FEMP Emission Point #	OEPA Stack Monitoring Source Description	OEPA Permit PTO #	Requirements (assume NESHAP-driven unless otherwise noted)
X001-01	Plant 1 Ore Silo general ventilation	NA	CERCLA work plan, continuous SPS(2)
X001-02	Plant 1 Ore Silo reduction building ventilation system	NA	CERCLA work plan, continuous SPS(2)
X002-02	MAWS area exhaust system	NA	Continuous - MPIS(1)
X002-01	MAWS melter offgas system	NA	Continuous - MPIS(1)
EP11-002	Contaminated clothing dryers	P274	Continuous - SPS(2) (per OEPA permit)
EP78-001	New Decon. Building cartridge/MEPA/HEPA	P261, P263, P264	Continuous - MPIS(1)
EP8-TBD	Contaminated trash compactor	P227	Area monitoring per OEPA permit

(1) - Multipoint continuous isokinetic sampler.
(2) - Single point continuous sampler.
NA - Not applicable, CERCLA action - no OEPA permit required.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-3: Unmonitored FEMP Radiological Point Sources

FEMP Emission Point #	OEPA Stack Monitoring Source Description	OEPA Permit PTO #	Requirements (assume NESHAP-driven unless otherwise noted)
EP8-013	East Oliver filter	P239	Periodic
EP8-014	West Eimco filter	P240	Periodic
EP8-015	East Eimco filter	P248	Periodic
EP15-002	Lab general exhaust system	TBD	Periodic
EP15-003	Lab general exhaust system	TBD	Periodic
EP15-004	Lab perchloric hood	TBD	(1)
EP15-005	Lab perchloric hood	TBD	(1)
EP15-006	Lab perchloric hood	TBD	(1)
EP15-007	Lab perchloric hood	TBD	(1)
EP15-008	Lab perchloric hood	TBD	(1)
EP15-009	Lab perchloric hood	TBD	(1)
EP15-010	Lab perchloric hood	TBD	(1)
EP15-011	Lab perchloric hood	TBD	(1)
EP15-012	Lab perchloric hood	TBD	(1)
EP15-013	Lab perchloric hood	TBD	(1)
EP15-014	Lab perchloric hood	TBD	(1)
EP15-015	Lab perchloric hood	TBD	(1)
EPIS-TBD	Fume hoods S-43	TBD	Periodic
EPN20-002	Water plant laboratory exhaust hoods	TBD	Periodic
EPN20-003	Water plant laboratory exhaust hoods	TBD	Periodic
EP8-TBD	Trash compactor/baler	P227	OEPA, air monitoring
EP42-001	Respirator cleaning trailer exhaust system	TBD	Periodic

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-3: Unmonitored FEMP Radiological Point Sources

FEMP Emission Point #	OEPA Stack Monitoring Source Description	OEPA Permit PTO #	Requirements (assume NESHAP-driven unless otherwise noted)
53-006	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-007	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-008	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-011	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-013	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
53-014	Bioassay and Low-Level Environmental Analysis Laboratory	TBD	Periodic
EP65-TBD	Thorium repacking general exhaust system	NA	Periodic

(1) - It is uncertain if this point source can be periodically tested safely due to location of sourece(i.e., roof, etc.)
TBD - to be determined.
NA - Not applicable, CERCLA action - no OEPA permit required.
Periodic - stacks will be tested per 40 CFR 61.93(B)(4)(i) requirements.

000107

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3-4: Minimum Analyses for Air Particulate Samples

Radionuclide	Required Detection Limit (pCi/mℓ)*
^{226}Ra	4.0×10^{-9}
^{228}Ra	4.0×10^{-9}
^{228}Th	4.0×10^{-9}
^{230}Th	4.0×10^{-9}
^{232}Th	4.0×10^{-9}
^{234}U	4.0×10^{-9}
$^{235/236}U$	4.0×10^{-9}
^{238}U	4.0×10^{-9}
^{228}Ac	**
^{224}Ra	**
^{231}Th	**
^{234}Th	**

* - required detection limits are based on the capabilities of the onsite laboratory to measure a 10 pCi quantity of radionuclides in a typical stack filter, assuming a sample flow fate of 2 cfm over a 30-day sampling period. Detection limits may be adjusted in sampling or laboratory conditions vary.
** - These radionuclide concentrations will be estimated assuming they are in equilibrium with their parent radionuclide. Therefore no detection limits are required.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

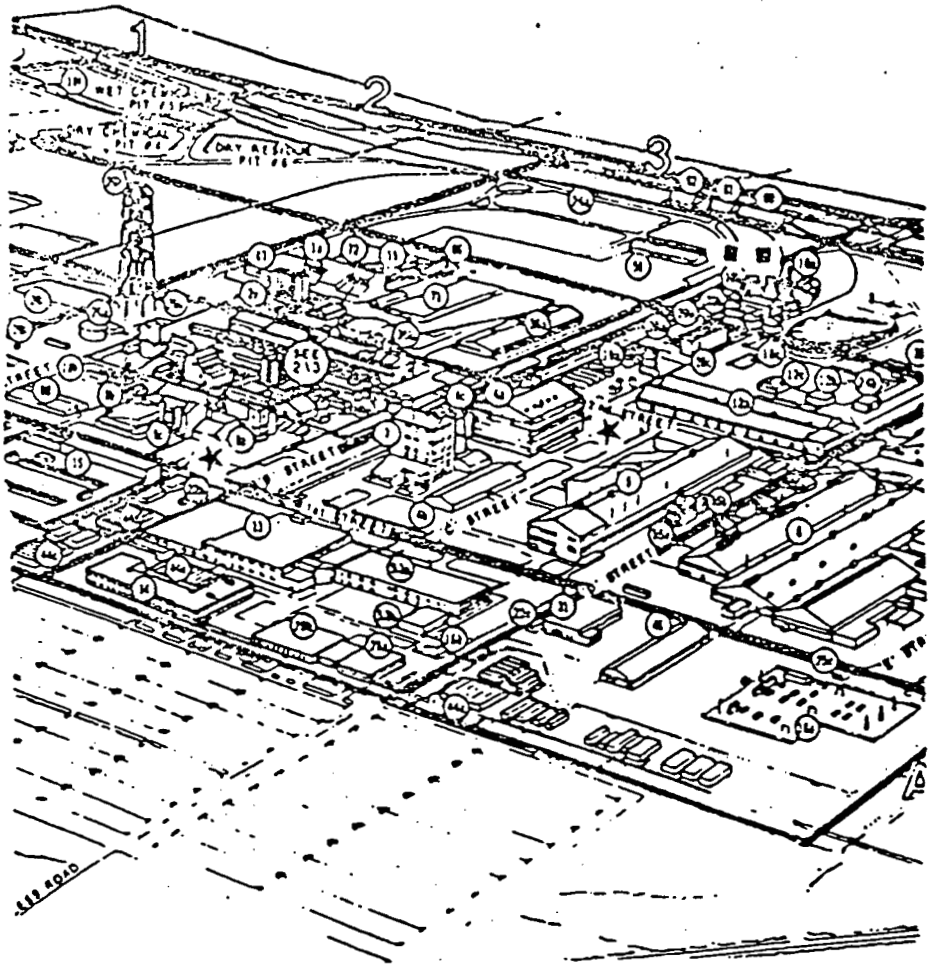


Figure 3-1: Locations for Coal-Fired and Natural Gas Fired Boilers

Coal Fired Boilers ■ Natural Gas Fired Boilers ★
Building Legend found in 1993 SER, Figure 3

4.0 METEOROLOGICAL MONITORING

4.1 Meteorological Monitoring Program Scope

For the purpose of determining offsite impacts of airborne releases, the FEMP conducts meteorological monitoring to characterize atmospheric dispersion and transport conditions. The meteorological monitoring program of the FEMP shall be sufficient to support the following:

- The design and conduct of routine environmental monitoring and surveillance activities.
- The performance of offsite impact assessments, including specifically the following:

  (1) Assessments of *projected* impacts of new or modified facilities or operations. For example, this is part of the permitting process for specific remedial actions.

  (2) Post-release assessments of the impacts of *actual* releases made in routine operations, to demonstrate compliance with applicable requirements. For example, the radiological dose computations in the SER, or in the annual NESHAP compliance demonstration to USEPA, both of which require meteorological data as an input.

  (3) Projected, concurrent, or post-release assessments of the impacts of *accidental* airborne releases.

- Response to unplanned releases, including the provision of guidance to special sampling and field measurement activities.

The types of meteorological data needed for these various activities differ. All are addressed by the FEMP Meteorological Monitoring Program described in this Section (DOE/EH-0173T, Summary 4c). This Section of the EMP sets forth requirements for the FEMP Meteorological Monitoring Program. The "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix" (Attachment A) identifies the current implementation plan and

4.0 METEROLOGICAL MONITORING (cont.)

schedule. SCQ requirements shall be followed as applicable to the Meteorological Monitoring Program at the FEMP. Section 4.6 and Section 10.0 of this Plan discuss and reference quality assurance requirements.

4.2 Organizational Responsibilities

The overall responsibility for the conduct of the meteorological monitoring program rests with Environmental Monitoring and Surveillance (EMS). However, there are other responsibilities related to the meteorological monitoring program that affect the meteorological monitoring program. Responsibilities for specific activities within the program and activities that affect the program are assigned to FEMP Site organizations as follows:

- Specification, procurement, and setting of instrumentation - Environmental Monitoring and Surveillance Section of the ES&H Division (EMS).
- Maintenance and calibration of instrumentation - Facility Engineering and Maintenance Department of the RSO Division.
- Routine validation of meteorological data and verification of system operability - EMS.
- Selection of dispersion model for each impact assessment - EMS.
- Summarization of meteorological data to support impact assessments - EMS.
- Retention and control of meteorological monitoring records - EMS.
- Internal program audits - EMS.

4.0 METEROLOGICAL MONITORING (cont.)

4.3 Meteorological Monitoring Program Basis

The type and extent of meteorological monitoring appropriate to the site are determined by a number of operational and environmental factors. The meteorological information requirements for the FEMP shall be based on the factors discussed in the following four subsections (DOE/EH-0173T, Summary 4a,e,r).

4.3.1 Activities at the Site, Magnitude of Potential Source Terms, and Nature of Potential Releases

- As the FEMP is currently operated and maintained, *routine* airborne releases have minimal offsite radiological dose impact. The 1993 SER[5] discusses the effluent and environmental monitoring data measurements from 1993.

  For assessing the impact of current emissions (as opposed to the cumulative effects of historical emissions), the most relevant data are probably the environmental air sampling results. The 1993 SER presents the air sampling results and the dose equivalents that would result from exposure to the concentrations measured at each of the sampling stations. For the stations located at or beyond the site boundary, none had a 50-year committed effective dose equivalent exceeding 0.1 mrem; the DOE guideline for the maximum dose to a member of the public from all pathways is 100 mrem/yr.

  The 1993 NESHAP compliance demonstration[32] reports an effective dose equivalent of 0.016 mrem. Even though several conservative assumptions were made to derive this exposure, the dose is unquestionably low in absolute magnitude. Low doses of this type may be expected to prevail as long as the FEMP remains in the present operational mode. However, when remediation is well under way, the dose may increase due to fugitive emissions.

4.0 METEROLOGICAL MONITORING (cont.)

- As the FEMP is currently operated and maintained, significant *accidental* airborne releases that could be assessed and tracked with the aid of data provided by onsite meteorological instrumentation are unlikely. According to the FEMP Emergency Plan,[28] the current worst case scenario for the FEMP is the occurrence of a serious earthquake.

  Such an event would have the potential to start fires in stored materials, to collapse the caps on the K-65 silos, or otherwise cause releases of airborne materials; however, conventional meteorological towers would not be expected to survive a major earthquake. Tornados, which are also considered significant in the Emergency Plan,[28] have the potential for scattering contaminated materials stored outdoors at FEMP, and for destroying buildings and dispersing their contents; however, even if the meteorological tower was not itself destroyed by a tornado, data collected would be of little value in estimating the transport and dispersion of tornado-borne contaminants.

The two types of accidents most likely to cause an airborne release in the current operational mode are a hazardous material spill, or a fire not preceded by a natural disaster. These incidents have much higher probability, but much lower impact, than earthquakes or tornados. In addition, operational practices, worker training, and emergency planning should reduce the probability and severity of such events. Nevertheless, onsite meteorological data may be useful in tracking the progress and assessing the impact of either of these types of events.

- Significant changes to the operational mode of the FEMP over the next few years are likely. The above facts would support a minimal onsite meteorological monitoring program, or perhaps use only of offsite data from National Weather Service sources. However, the current condition of the FEMP site is likely to change in the next few years as remediation activities become more intense. For example, decontamination of some pieces of process equipment may require operating them for short periods in order to clear them of residual material. Other pieces of process equipment may be used as treatment units in the reclamation process. Finally, large-scale movements of hazardous

materials and waste stored onsite may be expected for such purposes as treatment and/or transportation offsite.

All of these activities would have the potential for generating airborne releases, and therefore support the need for onsite meteorological monitoring.

4.3.2 Possible Pathways to the Atmosphere

The routine airborne release points at the FEMP are all essentially ground-level sources. There is no free-standing stack at the FEMP. The site's former Production Area is densely built up, with a number of buildings, tanks, and other structures ranging in height from approximately 10 to 30 m. With the exception of the Boiler Plant smoke stacks, the atmospheric release points in the Production Area are short pipes, vents, and stacks (less than a few feet tall) on the roofs of these buildings; the air released is at or near ambient temperature. Other potentially significant release points are the waste pits and storage silos on the west side of the Site, and these are located at or below ground level. Considering these facts, it is not excessively conservative to treat all the current atmospheric releases as being at or near ground level by the time the released materials reach the site boundary. However, a more exact modeling method (for example, using the exact height of each stack) shall be acceptable.

4.3.3 Topographic Characteristics of the Site and Distances from Release Points to Critical Receptors

The topography of the FEMP and the immediate surrounding area is relatively flat. The center of the former Production Area is at approximately 180 m above sea level. The residences on the northern boundary of the site (which are historically the locations of the most-exposed individuals) are about 950 m from the center of the former Production Area, at an elevation of about 215 m; there are no significant obstructions other than the process buildings themselves, and some trees, along this path. The residences on the western and southwestern boundaries are about 1100 m from the center of the former Production Area, at an elevation of about 175 m;

the largest topographical change along this path is the narrow channel of Paddys Run, which drops as low as about 165 m.

The downward slope toward the Great Miami River course, which is 1000–2000 m to the south and east of the site boundary, is even more gradual.

Thus, the most-exposed individuals are nearby, across relatively flat terrain. In most cases, complex meteorological modeling and extensive meteorological monitoring are not required in this situation.

4.3.4 Proximity of the Site to Other DOE Facilities

There are no DOE or commercial nuclear facilities within 50 km of the FEMP. Thus, there is no need to assess additive impact from multiple facilities (DOE/EH-0173T, Summary 4t). However, neither is there supplementary meteorological data available, as might be provided by such installations.

4.4 Meteorological Modeling Methods

The choice of dispersion models to be used for impact assessment determines what data must be produced by the meteorological monitoring program. The methods to be used for meteorological transport and dispersion modeling are therefore described briefly below. The methods by which dispersion calculation results are further processed to determine doses to individual members of the public are discussed in Section 8. The applicability to the FEMP of each specific model used shall be evaluated, and the evaluation shall be documented and retained (DOE/EH-0173T, Summary 4b,g,h).

4.0 METEROLOGICAL MONITORING (cont.)

4.4.1 Modeling Methods for Routine Emissions

There are three principal types of routine emission assessments that must be made at the FEMP. Two pertain to the impact of actual annual releases: the NESHAP Subpart H[18] compliance demonstration for USEPA, and the DOE compliance demonstration made as part of the SER. The other is an evaluation of the potential impact of a planned operation or facility, made at the planning or permitting stage.

These assessments have in common that they are based on long-term continuous releases. The receptors of greatest interest are the individuals who live just beyond the site boundary, at distances of 500–1500 meters from the potential sources on the site. As discussed above, the site and its surroundings are relatively flat. Given the above factors, straight-line Gaussian modeling using annual average meteorology is adequate for these routine emission assessments.

Meterological dispersion modeling for routine release assessment at the FEMP site shall use CAP-88[33] modeling. CAP-88 (USEPA Clean Air Act Assessment Package) uses a modified straight-line Gaussian plume equation to model dispersion from point sources or uniform area sources. It allows application of plume rise corrections due to either momentum or buoyancy effects, and computes radionuclide concentrations in air, rates of surface deposition, concentrations in food, and intake rates for people due to inhalation and food ingestion. As a straight-line model for long-term releases, CAP-88 requires meteorological data from a single measurement point, summarized for a one-year or longer period.

4.4.2 Modeling Methods for Accident Emissions

The National Oceanic and Atmospheric Administration (NOAA) conducted a study at the FEMP to determine the amount and location of supplemental meteorological monitoring instrumentation necessary to resolve the local wind field with a reasonable error for use in the emergency preparedness program. Six meteorological stations were recommended as an optimum configuration for the site. Since the AHF, NH_3 and UF_6 inventories are being removed from

4.0 METEROLOGICAL MONITORING (cont.)

the site, the additional towers recommended for the emergency preparedness program would not be warranted at this time (WMCO:R:89-074).

Assessment of doses to members of the public due to accidental releases of airborne materials from the FEMP shall be performed using the HARM II puff advection model developed by the NOAA, or by backup manual methods (HARM II calculates plume transport and dispersion in near-real-time, based on 15-minute averages of meteorological data). The code results shall be used in accordance with the FEMP Emergency Plan to determine likely offsite impacts, and to direct field teams dispatched to verify the location and magnitudes of those impacts (DOE/EH-0173T, Summary 4j).[28]

Puff advection models are capable of using meteorological inputs that vary in both space and time, but can function with only time-varying data from a single measurement point. The more points in space where wind speed and direction are measured, the more accurate will be the model's prediction of plume transport distance and direction. However, given the relatively low hazard potential of accidental releases from FEMP in the shutdown mode, and the ability to deploy field teams rapidly, the predictions of a model based on single-location meteorological data are adequate for protective action recommendations and initial incident response.

The FEMP is evaluating other computer models for comparison with HARM II results. These models include Area Location of Hazardous Atmospheres (ALOHA) and Computer Aided Management of Emergency Operations (CAMEO). The Ohio Emergency Management Agency currently uses these models.

4.4.3 Atmospheric Stability Classification

For both routine and accident assessments, meteorological observations shall be used to classify atmospheric stability into one of seven classes, ranging from A (most unstable — highest dispersion) to G (most stable — lowest dispersion). Vertical and horizontal stability shall be assumed to be the same, and shall be selected according to the following hierarchy of methods:

4.0 METEROLOGICAL MONITORING (cont.)

- If lapse rate (vertical temperature gradient) data are available, classify stability according to the lapse rate criteria of Table 4-1.

- If lapse rate data are not available but σ_θ (horizontal wind fluctuation) data are, classify stability according to the σ_θ criteria of Table 4-1. The first choice input data for this method are the lowest-elevation available σ_θ data; higher-elevation data shall be used only if necessary for backup. Also, wind speed adjustments for determining final estimates of Pasquill stability categories shall be made in accordance with EPA-450/4-87-013[34] (see Table 4-1).

- If neither lapse rate nor σ_θ data are available, atmospheric stability shall be classified based on Turner's method using wind speed, cloud cover, and ceiling height.[35] First choice input data for this method shall be FEMP onsite data. Second choice input data shall be those from the Greater Cincinnati Airport at Covington, KY.

4.4.4 Diffusion Coefficients

For all routine and emergency calculations, the diffusion coefficients σ_y and σ_z shall be determined as a function of plume travel distance from standard Pasquill-Gifford curves, as modified to include stability class G [e.g., see Regulatory Guide 1.145[36]].

Potential doses due to emissions from the FEMP in the shutdown mode are too low to justify the expenditures required by alternate methods (such as the development of site-specific diffusion coefficients or the installation of σ_ϕ measurement equipment).

4.4.5 Plume Rise and Building Wakes

The specific atmospheric dispersion codes referenced above all have the capability to augment dispersion by considering the effect of plume rise (for an elevated release), and the effect of plume entrainment in the turbulent wake of a building (for a ground-level release). However,

4.0 METEROLOGICAL MONITORING (cont.)

plume rise should not be a major effect at the FEMP because there are no stacks free of the turbulent influence of adjacent solid structures. There are neither any free-standing stacks, nor any roof stacks that are at least twice the height of adjacent or nearby buildings, so that pure elevated releases do not occur at the FEMP. Thus, the elevated meteorological data required to support plume rise calculations are not required. No special meteorological data are required to support building wake corrections. Therefore, only near-ground level measurements are required at the FEMP.

4.5 Meteorological Measurements

In consideration of the scope and basis presented in Sections 4.1 and 4.3, and the information requirements of the models specified in Section 4.4, the following meteorological measurement program shall be practiced at the FEMP (DOE/EH-0173T, Summary 4a,f).

4.5.1 Location of Measurements

The FEMP meterological monitoring system consists of a single meterological tower, monitoring instruments, a data logger, and a Digital Equipment Corporation (DEC) MicroVAX 3100. The tower is equipped with measurement booms at heights of 2 meters, 10 meters, and 60 meters. The distance between a wind instrument on the tower and any obstruction is maintained in accordance with EPA-6000 vol IV and NRC Regulatory Guide 1.23, Revision 1.

Supplementary meteorological towers may be installed at the FEMP, but are not required by this Plan (DOE/EH-0173T, Summary 4s). Any such tower that produces data used for routine or emergency offsite dose assessments shall be located on level ground. The distance between a wind instrument and any obstruction will be at least 10 times the height of that obstruction. Any other towers that may be installed at the Site for other purposes (such as special short-term studies), and that are not used for reportable assessments of offsite exposures, are not covered by this Plan.

4.0 METEROLOGICAL MONITORING (cont.)

4.5.2 Instrument Requirements

The instrumentation for the primary meteorological tower measures the parameters listed in Table 4-2; other instruments may be added, but are not required by this Plan.

Any supplementary towers at the Site (as defined in Section 4.5.1) shall support the measurement of at least wind speed and direction for at least the 10-meter elevation. Meteorological instruments on the primary or supplementary towers shall be selected and maintained so as to meet the criteria of Table 4-3. Any instrument mounted on a tower boom should be at least two tower diameters from the nearest part of the tower. The orientation of booms for wind sensors should be selected to minimize tower effects, considering the prevailing wind directions (DOE/EH-0173T, Summary 41).

All instruments shall be selected for reliable operation in the climatic conditions typical of the FEMP site, and all towers shall be electrically protected to reduce the potential for instrument damage due to lightning strikes. Data recovery from wind speed, wind direction, and temperature difference instruments (or any instruments related to stability measurements) shall be at least 90% on an annual basis (DOE/EH-0173T, Summary 4a).

Additional appropriate measures shall be applied as required to achieve this data recovery objective; such measures may include installation of uninterruptible power supplies, or performance of maintenance on increased frequency (DOE/EH-0173T, Summary 4l). Each meteorological instrument shall be calibrated on a scheduled and routine semiannual basis, unless the manufacturer's instructions call for more frequent calibration (DOE/EH-0173T, Summary 41).

4.0 METEROLOGICAL MONITORING (cont.)

4.5.3 Data Recording and Processing Requirements

Hourly and fifteen minute averages of wind speed and direction measurements from both levels of the primary tower are retained as permanent records. These records are received and verified monthly. They are available to whomever requests this information.

A data logger temporarily stores all meterological data. The MicroVAX 3100 then polls the data logger and stores the information for future use. Calculated parameters include horizontal wind direction fluctuation (σ_θ), dew point, lapse rate, and fifteen-minute and hourly averages of each parameter. Data are stored on the hard disk of the MicroVAX and then downloaded to floppy disks for archiving. One-minute and fifteen-minute averages of meterological parameters are fed "near real time" to the FEMP Emergency Operations Center, the Communications Center, and to a remote display for continuous monitoring.

Before being stored, data are assigned a code using internal computer algorithms. Code assignments are based on predetermined range values typically seen under normal weather conditions. These codes highlight any records which may need further review before being considered as good data. Additionally, information is compared with other sources, e.g., the National Weather Service (NWS), U. S. National Institute for Science and Technology (NIST) calibrated standards, and alternate "backup" instruments. Finally, information is reviewed by a qualified meterologist to ensure the best possible quality of data.

The Maintenance Management and Inventory Control System (MMICS) is used for scheduling routine maintenance and calibration of meterological instruments. Maintenance and calibration activities are conducted according to established written procedures.

The Environmental Monitoring and Surveillance Program uses onsite meterological data in calculating doses from routine and accidental releases at the FEMP, and for release assessment. The CAP-88 program calculates population doses for demonstrating compliance with NESHAP, and for reporting in the annual Site Environmental Report. Dose to the public due to accidental

4.0 METEROLOGICAL MONITORING (cont.)

releases is calculated using the HARM II puff advection model. Other models, which are used for comparison, include Area Location of Hazardous Atmospheres (ALOHA) and Computer Aided Management of Emergency Operations (CAMEO), which are operated by the Ohio Emergency Management Agency (EMA).

4.5.4 Use of Offsite Data Sources

Routine and emergency assessments of the impacts of airborne releases normally shall be performed using data from the onsite measurement program described above. Hand-held "backup" instruments may be used if the equipment described above is unavailable. Offsite data sources shall be used only if an emergency occurs while the onsite instrumentation is unavailable (DOE/EH-0173T, Summary 4d).

In such an event, offsite data from the nearest National Weather Service (NWS) stations (currently those in Covington, KY and Dayton, OH) shall be applied as appropriate and available. Quality Assurance audits of these stations need not be conducted routinely, in view of the limited use of the data and the presumed high and uniform quality of NWS installations.

4.6 Quality Assurance

As it is applicable to meteorological monitoring, the full 10-criterion Quality Assurance Plan (the QAPD) and the 16-criterion Sitewide CERCLA Quality Assurance Project Plan (SCQ) described in Section 10.0 shall be observed (DOE/EH-0173T, Summary 4u). After the effective date of this Plan, specific quality-related measures in the meteorological monitoring program shall include the following:

- Organization. The Environmental Protection Manager shall designate the onsite organization(s) with primary responsibility for ensuring that the meteorological monitoring program is carried out, and specifically for ensuring the operability of instruments and the validity of results.

4.0 METEROLOGICAL MONITORING (cont.)

- Design Control. Decisions on the location, selection, and mounting of meteorological instruments shall be made with the advice of a qualified meteorologist. Conformance of installed systems to the specified designs shall be verified and documented.

- Instructions, Procedures, and Drawings. Meteorological instrument maintenance and calibration shall be in accordance with written and approved procedures (DOE/EH-0173T, Summary 4p).

- Document Control. Maintenance and calibration procedures shall be controlled in accordance with FEMP procedures, to ensure that only current instructions are in use.

- Control of Purchased Items. All meteorological instruments and computer hardware and software purchased by the FEMP shall be procured pursuant to written, approved, and controlled specifications. Conformance to the specifications shall be verified as appropriate, and documented.

- Inspections. On a regular basis, a qualified member of FEMP staff shall examine each day's listing of 15-minute average meteorological data to verify the continued correct operation of the instruments (DOE/EH-0173T, Summary 4o).

- Control of Measuring and Test Equipment. All calibration and testing equipment and standards shall be calibrated and adjusted on appropriate intervals, to maintain traceability to standards of NIST or other bodies recognized by DOE.

- Control of Nonconforming Items. Instruments out of service or calibration shall be clearly identified to prevent use of their data in impact assessments.

- Corrective Action. Maintenance requests for meteorological monitoring systems shall be generated and processed rapidly enough to support the achievement of the 90% data recovery objective.

4.0 METEROLOGICAL MONITORING (cont.)

- Quality Assurance Records. At least the following shall be maintained as permanent site records: specifications for procurement and testing of meteorological equipment, and records of verification of conformance to those specifications; procedures for instrument maintenance and calibration, and records of the performance of those procedures; records of identification of nonconforming items, and of correction of non-conformances; plans for audits of the meteorological monitoring program, and records of the performance of those audits (DOE/EH-0173T, Summary 4p).

- Audits. The Environmental Protection Department Manager shall ensure that periodic audits of the meteorological monitoring program are performed and documented. The purpose of these audits is to verify that the program is operated in accordance with Site procedures and policies and the provisions of this Plan.

SCQ requirements shall be followed as they apply to the Environmental Monitoring Program at the FEMP. Section 10.0 of the EMP, "Quality Assurance," requires that SCQ requirements be followed. It discusses and references additional SCQ requirements that apply to Meteorological Monitoring activities in general: Section 2.0, "Project Description"; Section 3.0, "Project Organization"; Section 4.0, "Quality Assurance Objectives"; Section 5.0, "Field Activities"; Section 8.0, "Calibration Procedures and Frequency"; Section 10.0, "Internal Quality Control Checks and Frequency"; Section 11.0, "Data Reduction, Validation, and Reporting"; Section 12.0, "Performance Assessment and System Audits"; Section 13.0, "Preventative Maintenance"; Section 14.0, "Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness"; Section 15.0, "Corrective Actions"; and Section 16.0, "Quality Assurance Reports to Management."

4.0 METEROLOGICAL MONITORING (cont.)

Table 4-1: Classification of Atmospheric Stability Based on Vertical Temperature Gradient or Horizontal Wind Direction Fluctuation*

Stability Classification	Pasquill Class	Vertical Temperature Gradient (°C/100 m)	Horizontal Wind Direction Fluctuation (degrees)
Extremely unstable	A	$\Delta T/\Delta Z \leq -1.9$	$\sigma_\theta \geq 22.5$
Moderately Unstable	B	$-1.9 < \Delta T/\Delta Z \leq -1.7$	$22.5 > \sigma_\theta \geq 17.5$
Slightly unstable	C	$-1.7 < \Delta T/\Delta z \leq -1.5$	$17.5 > \sigma_\theta \geq 12.5$
Neutral	D	$-1.5 < \Delta T/\Delta z \leq -0.5$	$12.5 > \sigma_\theta \geq 7.5$
Slightly stable	E	$-0.5 < \Delta T/\Delta z \leq 1.5$	$7.5 > \sigma_\theta \geq 3.8$
Moderately stable	F	$1.5 < \Delta T/\Delta z \leq 4.0$	$3.8 > \sigma_\theta \geq 2.1$
Extremely stable	G	$4.0 < \Delta T/\Delta z$	$2.1 > \sigma_\theta$

* - Numerical criteria fron USNRC Regulatory Guide 1.23, Revision 1; and EPA-450/4-87-013, "On-Site Meterological Program Guidance for Regulatory Modeling Applications

Table 4-2: Instrumentation for the Primary Meterological Tower

Measurement	Ground level	2 meters	10 meters	60 meters
Wind direction			X	X
Wind speed			X	X
Ambient temperature		X	X	X
Relative humidity		X		
Solar radiation		X		
Precipitation	X			
Barometric pressure	X			

4.0 METEROLOGICAL MONITORING (cont.)

Table 4-3: Instrument Performance Criteria*

Sensor Type	Required Accuracy	Other Criteria
Wind direction	± 5° azimuth	
Wind speed	± 0.22 m/sec for < 2.2 m/sec ± 10% for ≥ 2.2 m/sec	Starting speed 0.45 m/sec
Temperature	± 0.5 °C	
Temperature difference	± 0.15 °C/50 m	
Precipitation	± 10% for > 5 mm total	± 0.25 mm resolution
Time	± 5 minutes	

* - Performance criteria from ANSI/ANS-2.5-1984[37]

5.0 ENVIRONMENTAL SURVEILLANCE

Past production activities at the FEMP have resulted in releases of radioactive and non-radioactive contaminants to the environment surrounding the site. Current conditions at the site also contribute to releases. Therefore, the levels of contaminants in the environment must be monitored. An environmental surveillance program, as required by DOE Order 5400.1, is necessary to assess the impact on the environment and the general public due to FEMP operations. Specifically, the objectives of the FEMP environmental surveillance program are to:

- confirm predictions of public dose based on effluent models,
- characterize conditions of offsite environs,
- provide data for dose estimates to the public where appropriate,
- provide data for spacial and temporal analyses,
- provide data to demonstrate compliance with applicable federal, state, and local regulations, and
- provide data in areas of public interest.

The FEMP environmental surveillance program encompasses analyses of air, water, soil, foodstuffs, and biota samples collected at the FEMP boundaries and in the area surrounding the FEMP. This Section of the Plan sets forth criteria for the environmental surveillance program to ensure sampling and analyses are conducted according to the stated environmental monitoring sampling objectives. (Sections 2.0 and 3.0 of this Plan set forth the requirements for onsite liquid and airborne effluent monitoring). The "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix" (Attachment A) identifies the current implementation status and schedule. Applicable DQOs are referenced in Attachment B of this

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Plan. The FEMP environmental surveillance program shall be conducted in accordance with DOE 5400.1[1] and 5400.5[2] (DOE/EH-0173T, Summary 5b) and the SCQ.

As discussed in Section 1.1 of the EMP, applicable requirements set forth in the Comprehensive Environmental Occupational Safety and Health Program shall be followed. Any chemical handling shall be based on the Chemical Hygiene Plan.

5.1 Organizational Responsibilities

Environmental surveillance is the primary responsibility of the Environmental Protection Department. The Environmental Monitoring and Surveillance Section and the Groundwater Monitoring Section collect the environmental media samples. The Utilities Services Section of Facility Engineering and Maintenance Department of the RSO Division has some sample collection responsibilities within FERMCO, responsiblities are divided among these organizations as follows:

5.1.1 Environmental Monitoring and Surveillance - Radiological Environmental Monitoring Program

Environmental Monitoring and Surveillance (EMS) is responsible for collecting the majority of environmental samples including the following media samples: ambient air, sediment, soil, produce, milk, meat, fish, grass, drinking water well samples (considered groundwater), and some surface water samples. EMS is also responsible for monitoring levels of direct radiation and radon.

Analytical results are reviewed by EMS and assessed for compliance with the applicable federal, state, and local regulations. EMS also is responsible for compiling the Site Environmental Report (SER).

000128

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.1.2 Groundwater Monitoring Section Program

The Groundwater Monitoring Section is responsible for collecting groundwater samples from routine, CERCLA, and RCRA monitoring wells, submitting them for analysis, and reviewing the results to ensure compliance with applicable standards and requirements. In addition, the data are used for tracking and predicting the movement of contaminants through the aquifer system underlying the FEMP. The Groundwater Monitoring Section is responsible for compiling the Annual Groundwater Monitoring Report which summarizes the programs activities and findings. The Groundwater Section that is part of CRU5 is responsible for CERCLA/RCRA Program compliance with respect to groundwater monitoring.

5.1.3 Remediation Support Operations - Utilities Services

The Utilities Services Section is responsible for the collection of surface water samples and submittal of these samples to the analytical laboratory for analysis. Data are reviewed by EMS and incorporated into the SER.

5.2 Basis for Environmental Surveillance Program

The environmental surveillance program is based on an evaluation of the radiological composition in the liquid and airborne effluents released from the FEMP as well as factors that affect dilution, concentration, and dispersion in the environment. A risk assessment of the current status of the five CRU's at the FEMP was conducted and the potential exposure pathways for the next 100 years were determined through examination of FEMP operating history, environmental data, and probable land use.[22-25, 38] The five operable units within the FEMP, which were identified and approved for use in the Consent Agreement under CERCLA, are:

- CRU1: Waste Pit 1 - 6, Clearwell, and the Burn Pit
- CRU2: Other Waste Units

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- CRU3: Production Area and Suspect Areas
- CRU4: Silos 1, 2, 3, and 4
- CRU5: All Environmental Media.

For a more detailed description of each of the five operable units, refer to Section 3.4.3. A summary of the potential pathways for exposure to radiological contaminants within each operable unit is presented in Table 5-1. The results of this pathway analysis shall serve as the basis of the current environmental surveillance program, and will be further summarized in this Section of the Plan (DOE/EH-0173T, Summary 5a).

The radiological and non-radiological analytes to be considered are based on the current site effluents and plant operational history. The specific analytes of concern are discussed in Section 2.0 (Liquid Effluent Monitoring) and Section 3.0 (Airborne Effluent Monitoring) of this Plan.

The major atmospheric and liquid pathways by which it is possible for a person to be exposed are illustrated in Figures 5-1 and 5-2, respectively. Major exposure pathways at the FEMP originate from air and water. According to the exposure pathway analysis performed at FEMP, the potential exposure modes to humans are through the air pathways (inhalation and ingestion), surface water pathways, groundwater pathways, and direct radiation pathway.

5.2.1 Exposure via the Air Pathway

Potentially significant exposure to humans through the air pathways results from:

- inhalation of contaminated fugitive dust from waste pits,
- inhalation of stack and vent releases,
- inhalation of radon and progeny releases from silos and waste pits,

000130

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- ingestion of foodstuff contaminated by direct deposition onto crops,
- ingestion of foodstuff contaminated indirectly by deposition onto soil where crops are grown, and
- consumption of meat from animals that consumed contaminated feed.

Note: Ingestion of soil contaminated through atmospheric deposition is not considered a significant pathway since institutional controls are expected to be in place for the next 100 years. Levels of soil contamination outside the facility boundaries do not contribute significantly to soil ingestion dose.

5.2.2 Exposures via the Liquid Pathway

Potentially significant exposures via surface water pathways include:

- consumption of foodstuff contaminated through irrigation with contaminated surface water,
- consumption of meats and milk contaminated though animal consumption of foodstuff irrigated with contaminated surface water, and
- consumption of fish from Greater Miami River.

Note: Direct consumption of surface water is not considered a pathway since surface water is not used as a source of drinking water in the FEMP vicinity.

Potentially significant exposure via the groundwater pathways results from:

- consumption of foodstuff contaminated through irrigation with contaminated groundwater,

- consumption of meats and milk contaminated though animal consumption of foodstuff irrigated with groundwater, and

- consumption of drinking water from offsite wells.

Contaminated soil can result in exposure due to:

- consumption of foodstuffs contaminated through animal consumption of vegetation grown on contaminated soil and of the soil itself.

5.2.3 Exposure via the Direct Radiation Pathway

Exposure from direct radiation may result from:

- direct radiation from materials stored at the FEMP, and

- plume shine from airborne releases.

5.3 Criteria for Environmental Surveillance

The extent and intensity of the environmental surveillance program is based, in part, on the size of the annual dose (of site origin) that is delivered at the site boundary.

Recent estimates for the annual dose at the site boundary show that the annual dose is currently around 1 mrem.[5] According to DOE Orders and guidance documents,[1, 2, 7, 19] an extensive environmental monitoring program is not required for offsite exposures at this level. However,

increased remediation activities at the FEMP could raise offsite exposure rates, and so a thorough environmental monitoring program is maintained.

Additional environmental surveillance and sampling may be necessary in order to provide information for the following:

- routine surveillance of potential exposure pathways,
- control data collection for spacial analysis,
- monitoring of unplanned releases,
- demonstration of regulatory and DOE commitment compliance,
- evaluation of long-term trends, and
- data collection in areas of public concern.

An expanded explanation of the criteria for environmental surveillance and the programs in place to ensure the criteria are met are provided in the following paragraphs.

5.3.1 Routine Surveillance of Pathways

The environmental media that have the potential to lead to a measurable annual dose (greater than 1% of applicable dose limit) at the site boundary shall be routinely sampled and analyzed for the analytes contributing to dose. Based on the analysis of pathways of potential concern (see Section 5.2), the air, liquid, and direct radiation pathways all require monitoring under the environmental surveillance program. Specifically, the following media require monitoring:

- ambient air,
- surface water,
- groundwater,
- sediment,
- foodstuffs (includes garden products, grains, and farm products),
- direct gamma exposure,

- exposure to radon,
- soil,
- aquatic animals/plants, and
- farm and game animals.

In addition to the media specified above, other media may be sampled, as necessary, for verification of the required media samples. For example, soil samples may be taken at the required air sampling stations as a means to assess deposition and resuspension of radioactive material even though soil ingestion is not a significant pathway for potential exposure. Additional environmental media samples which are routinely collected shall be justified in this Plan.

5.3.2 Control and Background Data

Control data are necessary to determine statistically significant differences between background levels and measurements at indicator sampling points. Appropriate control sampling data collection points shall be established and routinely sampled for each environmental medium sampled. Control sampling points shall be located outside the influence of plant operations. Media specific requirements for control locations are discussed in Section 5.6.

5.3.3 Unplanned Releases

The environmental surveillance program is based on controlled, planned releases. In the event of an unplanned release, environmental media may be collected as part of the effort to quantify the impacts of the release. The environmental surveillance program is not specifically designed for emergency monitoring. The known provisions for detecting and quantifying unplanned releases shall be set forth in the FEMP emergency response plan (DOE/EH-0173T, Summary 5g).

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.3.4 Compliance Demonstration

Samples necessary to demonstrate compliance with specific regulatory requirements or DOE commitments shall be collected. According to DOE 5400.1,[1] the FEMP must comply with the following federal regulations as they pertain to environmental surveillance:

- DOE Order 5400.1,[1] (Section IV, paragraphs 5, 7, 8, and 9)
- DOE Order 5400.5,[7]
- Draft 10 CFR 834, "DOE Facilities Radiation Protection of the Public and Environment,"[19]
- 40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards,"[39]
- 40 CFR Part 53, "Ambient Air Monitoring Reference and Equivalent Methods,"
- 40 CFR Part 58, "Ambient Air Quality Surveillance,"[29]
- 40 CFR 61, "National Emission Standards for Radionuclide Emissions from Department of Energy (DOE) Facilities (NESHAP),"[18]
- 40 CFR Part 130, "Water Quality Management (WQM),"[40]
- 40 CFR Part 265, Subpart F, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,"[41] and
- 40 CFR Part 300, "National Oil and Hazardous Substance Pollution Contingency Plan."[42]

5.3.5 Evaluation of Long-Term Trends

Since contaminants released during past and present FEMP activities may accumulate in the environment, sampling points may be established as needed to assess the potential for long-term buildup. The data collected will support the recognition of environmental trends.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.3.6 Public Concern

Additional routine sampling points may be established for collection of data in areas of public concern. The current environmetal surveillance program takes into account the heightened public interest and awareness of FEMP emissions. As a result of this public concern the frequency and amount of media sampling tends to be greater than what would be required from a technical or dose monitoring viewpoint. This increased monitoring is explained in the media specific descriptions in Section 5.6.

5.4 Environmental Surveillance Sampling Design

In addition to meeting the criteria for environmental surveillance discussed in Section 5.3, the environmental surveillance program shall be designed to meet the general environmental protection and reporting objectives stated in Section 1.0. These objectives include the ability to address the:

- potential for release of hazardous materials,
- extent to which facility operations are routine and unchanging,
- need for supplementing effluent monitoring,
- the size and distribution of the exposed population,
- the cost effectiveness of the environmental surveillance program, and
- the availability of measurement techniques that provide sufficiently sensitive comparisons with the applicable standard and background measurements.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

The following Section considers the minimum number of samples that must be collected for each environmental medium based on the dose delivered via the medium, the frequency at which sampling must occur, and the sensitivity of the analysis that is required. This Section sets forth the minimum sampling required under the environmental surveillance program. Sampling which is performed in excess of the minimums is justified in the media specific description in Section 5.6.

5.5 Minimum Sampling Requirements

Environmental surveillance samples can be separated into two distinct categories: indicator samples and control samples. Indicator samples are collected at points in the environment where there is a potential for contamination due to plant processes. Indicator sampling points shall be established for environmental media of concern as indicated by the pathway analysis. Control locations are established at points in the environment that are outside the influence of plant operations to provide data for comparison with data collected from indicator sampling points. Control sampling points shall be established for every significant radionuclide/pathway combination for which environmental measurements are used in the dose calculations (DOE/EH-0173T, Summary 5o).

Because of the need to have both indicator and control samples, two environmental media samples shall be collected for each potential pathway/radionuclide combination. For effluent streams that are monitored, only the environmental medium that directly exposes the receptor must be sampled for each potential exposure pathway. Effluent streams that are not monitored require two different environmental media to be monitored for each potential exposure pathway, one of which is the medium that directly exposes the final receptor (DOE/EH-0173T, Summary 5c).

The minimum number of indicator samples for each medium is also based on the potential dose to the maximally exposed human receptor via pathways involving that medium. The determination of this potential dose is discussed in detail in Chapter 8.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Additional samples may be collected, as necessary, based on the criteria and objectives listed in Sections 5.3 and 5.4. Other samples, such as soil samples, that are not required as part of the environmental program may be desirable for verification of required media sampling results. These samples should be collected at the same frequency as the required media that they are intended to verify.

Minimum sampling requirements for specific media will be discussed in Section 5.6 with the media-specific sampling criteria.

5.5.1 Required Analytical Detection Levels

In general, each radiological analysis performed on environmental surviellance samples is sensitive enough to detect the activity or concentration that would lead to a dose of 0.1% of the limit for the medium sampled. For environmental media where the detection level cannot be attained to meet 0.1% of the dose limit, the required detection level shall be based on a reasonably achievable detection level considering analysis costs, sample sizes, and laboratory related factors.

The 0.1% of the dose limit criterion (100 mrem standard for each nuclide) was chosen because it is a small fraction of the dose limit. This percentage is justified based on the potential cumulative effect of missed doses for multiple radionuclides and multiple exposure modes at a higher analytical detection level, such as 1%. Thus, if analytes are routinely not detected at their respective dose based detection levels, it is not likely that the dose limits will be exceeded.

In order to ensure that the minimum detectable dose is achievable, calculation of the required detection level for each sample medium and target analyte is necessary. The required detection level can be thought of as the estimated practically achievable activity or concentration based on a certain analytical instrument, analytical method, type of sample, and set of assumptions on pathway or media exposure. Factors such as sample volume, counting time, and instrumentation can be varied to meet the required detection level.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

The required detection level was determined by carrying the minimum detectable dose through the dose calculations for each of the media and the radionuclides. Dose calculations are specified in Chapter 8. The required detection levels for the target analytes associated with each environmental medium and the required overall uncertainty for the analytical result are stated in Table 5-2. The specifications for overall uncertainty are based on analyte concentrations 10 times the required detection limit to minimize the effect of random error on the measurement.

The required detection level for ^{222}Rn measurements is based on currently available technology. The current detection level for the alpha track etch cups used is 1.7 pCi/ℓ. Although a lower detection limit would be desirable, this is not possible with currently available technology.

5.5.2 Sampling Frequency

The following shall be considered when determining the sampling frequency for routine environmental surveillance samples:

- annual dose potential,
- radionuclide half-life,
- desired sensitivity, and
- seasonal habits of people and animals.

Periodic environmental surveillance shall be performed at least every 5 years to confirm doses less than 0.01 mrem resulting from environmental media identified during the pathway analysis (DOE/EH-0173T, Summary 5c). Environmental media responsible for annual dose equivalents resulting from emissions in a year that are greater than 20% of the applicable guide, shall be surveyed at least annually.

Intervals between media sampling should not exceed more than twice the half-life of the shortest target nuclide, to the extent possible. This will not always be possible for short-lived daughters

of long-lived parents. The desired sensitivity also should be considered when determining sampling frequency, especially for short-lived radionuclides.

Seasonal habits of people and animals may affect potential for exposure and therefore shall be considered when determining sampling frequencies. For example, certain foodstuffs may only be locally grown during a particular season and need only be collected during the growing season.

5.5.3 Sample Representativeness

Environmental samples are collected and analyzed to determine conditions in the physical environment. Since only a small part of the environment is actually collected and analyzed, the sample that is collected should represent the conditions in the environment. Sampling procedures shall be established and maintained to provide guidance for obtaining consistent and representative samples (DOE/EH-0173T, Summary 5m). The sampling procedures should consider the effects of at least the following:

- air and water circulation patterns,
- local concentrations of natural radioactivity,
- building wake effecs,
- dilution from precipitation,
- heavy dust-raising activities,
- abnormal area activities,
- backwater areas in streams,
- topographical anomalies,
- atypical vegetation patterns, and
- loss of target analytes in sample lines and container walls.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

EMS collects samples from several different environmental media, utilizing several different sampling techniques. EMS continually evaluates the sampling locations to ensure that the collected samples are representative of the environment.

5.5.4 Sample Treatment

Sample preservation methods shall be consistent with the analytical procedures used (DOE/EH-0173T, Summary 51). Environmental procedures listed in Table 5-3 state any required treatments to collected samples, or pre-treatment of sample containers.

An evaluation was performed to determine whether sample preservation methods for environmental surveillance are consistent with the analytical procedure used (WEMCO:EM:92:409). The results of the evaluation showed that the preservation methods used and analytical methods are consistent with each other. Required preservatives for various constituents are given in Table 6-1 (Appendix A) of the SCQ.

5.5.5 Sample Identification and Tracking

All samples collected shall be uniquely identified and controlled to ensure that data quality objectives are satisfied and to facilitate efficient processing. Procedures shall exist that direct the assignment of a unique tracking number to every sample collected. Sample identification procedures shall be maintained that ensure that sample and aliquot labels are durable, able to withstand processing and storage conditions, legible, and securely attached to sample containers.

Field storage and shipment of samples are addressed in Section 6.0, "Sampling Requirements," of the SCQ.

To maintain traceability of samples from collection to disposal, initiation of a chain of custody for all collected samples shall begin at the point of collection and continue until sample disposal

or offsite transfer. Specific procedures for transfers in chain of custody shall be established and maintained. Access to collected samples shall be controlled and minimized.

Custody of samples shipped offsite shall be transferred according to the written chain of custody procedures. A site-wide chain of custody procedure is currently in use. Samples shall be clearly identified, controlled, and tracked throughout field operations or collection and the analytical process according to the procedures listed in Table 5-3.

Section 7.0, "Sample Custody," of the SCQ sets forth additional sample custody and documentation requirements for the FEMP. Sample custody procedures and documentation are conducted in accordance with the guidelines in the EPA Region V Model Superfund Quality Assurance Project Plan, which are derived from EPA sample custody protocols described in "NEIC Policies and Procedures", EPA-330/9-78-001-R (revised May 1986). Custody requirements are addressed in three parts: 1) sample custody and handling in the field, 2) custody during laboratory receipt and analysis, and 3) evidence files.

5.5.6 Sample Analysis

In general, analyses requested on a particular sample shall be based on knowledge of operational history, results of past analyses, special operating considerations, and applicable regulatory requirements. Specific analytes of concern at the FEMP are listed in Sections 2.0 (Liquid Effluent Monitoring) and 3.0 (Airborne Effluent Monitoring) of this Plan.

Specific analytical requirements are specified in Section 6.0 (Laboratory Procedures) of this Plan. Section 6.0 of this Plan references SCQ requirements that shall be followed. The following general guidelines shall be applied to all environmental sample analyses:

- Instruments will be calibrated to National Institute of Standards and Technology (NIST) traceable sources (DOE/EH-0173T, Summary 5i) (non-radon analyses).

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- Gross radioactivity analyses should be used only as trend indicators. (DOE/EH-0173T, Summary 5j).
- The overall accuracy should be estimated and the analytical sensitivity at a specified confidence level should be determined and documented (DOE/EH-0173T, Summary 5k).
- Reporting values as less than detectable should be avoided when this is not precluded by the analytical method. Actual values should be reported, when possible, instead of less than detectable values.
- Sample analyses shall be performed and reported in a timely manner.

5.5.7 Basis for Determining Target Analytes In Environmental Media

The following evaluation is based on data collected in 1993. In order to determine the target analytes for environmental media (soil, foodstuffs, etc), data from air and liquid effluent from the FEMP were reviewed to identify the radionuclides released and determine the relative contribution (from a dosimetric viewpoint) of each radionuclide. From this review, the radionuclides which contribute the majority of dose (*i.e.*, at least 90% of the total dose) can be identified and designated as target analytes in environmental media. Through this approach, at least 90% of the dose delivered to a member of the public via environmental media will be accounted for.

5.5.7.1 Airborne Effluent Evaluation

Due to the shutdown of all FEMP production processes, there is very limited data on actual emissions from FEMP stacks. Therefore, data from the ambient air monitoring stations (AMS) located on the FEMP site and boundary were used as a data source for determining the relative radionuclide contributions. Specifically data from AMS-9/9A and AMS-8, located in the northeast quadrant of the site, were used. These monitors are located in the best location for detecting site emissions since the primary wind direction is from the southwest quadrant. Detected isotopes at the AMSs are shown in Tables 5-4 and 5-5.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

From a review of the DCG ratios for AMS-8 and AMS-9/9A, it is clear that uranium dominates the sum of the DCG fractions and contributes approximately 94 percent of the dose at AMS 9 and approximately 79 percent of the dose at AMS 8. On the basis of this data, all environmental media influenced by airborne effluents except the composite ambient air samples will be analyzed for uranium. The composite ambient air samples will be analyzed for the pertinent uranium, thorium, radium isotopes as well as ^{238}Pu, $^{239/240}Pu$, ^{237}Np, ^{90}Sr, ^{137}Cs, and ^{99}Tc.

These analyses allow for the evaluation of target analytes in environmental media (as was performed in this section) and also address public concerns on the amount of these radionuclides released to the Fernald environment.

5.5.7.2 Liquid Effluent Evaluation

Effluent data from Manhole 175 (MH-175) are used for determining the target analytes for environmental media affected by liquid effluent. Detected isotopes at MH-175 are shown in Table 5-6.

From a review of the DCG ratios for MH-175, it is clear that the isotopes of uranium dominate the sum of the DCG fractions and comprise 98 percent of the dose from the liquid effluent. On the basis of this data, all environmental media influenced by the liquid effluent will be analyzed for uranium.

5.5.7.3 Use of Gross Radioactivity Analysis in Environmental Surveillance

Considering the decreased airborne and liquid releases since production ceased, the current mission of the FEMP, and restoration activities, the need to perform gross alpha/beta measurements is relatively low.

Due to the presence of naturally occurring radionuclides and the fact that the source term at the FEMP consists largely of these radionuclides (uranium and thorium isotopes), developing a

reliable empirical relationship between gross alpha/beta results and FEMP emissions and doses would be difficult. No dose or emission concentrations are derived from gross alpha/beta results. There is no effort to develop a reliable empirical relationship between gross alpha/beta results and FEMP emissions due to the predominance of naturally occurring radionuclides at the FEMP.

5.6 Media Specific Sampling Methods and Criteria

Certain specific sampling methods and criteria pertain to each sample medium. This Section sets forth media-specific sampling criteria for each environmental medium identified as a potential source of exposure to members of the public (refer to Section 5.2). For each medium, this Section describes the selection of sampling locations, the sampling methods, the sampling frequency, the target analytes, and required detection limits. In cases were a relatively long-lived parent is more readily measured than is a target analyte, the assumption of secular equilibrium may be used to quantify the daughter analyte. If sampling required by this Plan cannot be performed, written justification shall be developed, reviewed by the EMS Manager or designee, and maintained in the EMS files. DOE-FN shall also be notified if the required sampling cannot be performed.

5.6.1 Air

The potential for exposure to radioactive air particulates is due to current releases from the facility, as well as resuspension of materials previously released and deposited. Particulate radioactivity is primarily due to uranium, thorium, and their daughters. Therefore, particulate air sampling is required for confirmation of compliance with applicable dose limits.

Besides exposure to particulates, there is potential for exposure from radon emissions from material stored onsite. Specific requirements for monitoring ambient radon concentrations are described in Section 5.6.11.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.6.1.1 Air Monitoring Locations

Based on air monitoring criteria outlined in DOE/EH-0173T, at least 3 indicator air sampling locations are necessary. Indicator sampling locations for air particulate filters and radon shall be apportioned to meteorological sectors based on Waite's methodology for air sampling station locations.[44] An evaluation of air sampler placement based on the Waite Methodology was conducted[44] and the results are reported in Table 5-7.

Additional air sampler locations may be added as needed based on public concern and special studies. Justification of any additional monitoring stations, or omission of any existing stations, shall be maintained in EMS files.

The FEMP ambient air quality is monitored by 16 high-volume air samplers as shown in Figure 5-3. Six stations (AMSs 2-7) are located around the perimeter fenceline of the FEMP where the public has closest access to the site. Three stations (AMSs 1A, 8, and 9A) are placed within the fenceline in the north and northeast areas of the facility due to the direction of the prevailing winds. One air station (AMS 10) is at a nearby community (Fernald, Ohio). Four stations (AMSs 11, 12, 13 and 14) are located at schools and small industries near the FEMP. AMSs 15 and 16 were installed to accumulate background data. AMS 15 is currently located near the University of Cincinnati and is in the process of being relocated to a new background location, and AMS 16 is located in Miamitown, Ohio.

5.6.1.2 Air Samplers

Environmental air sampling equipment must meet the following criteria:

- Environmental air samplers shall be mounted in locked, all-weather stations with the sampler discharge located to prevent the recirculation of air.

- The air sampling system shall have a flow-rate meter, and the total air flow or total running time should be indicated.

- The air sampling rate should not vary by more than 20% for the collection of a given sample.

- Linear flow-rate across air particulate filters should be maintained between 20 and 50 m/min.

- Air sampling systems shall be flow-calibrated, tested, and inspected routinely according to written procedures (DOE/EH-0173T, Summary 5q). Flow calibration shall be at least as often as recommended by the manufacturer.

- As a minimum, collection efficiency, particle size selectivity, ease of radiochemical analysis, and cost shall be considered when selecting air particulate filters for use at the FEMP.

Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

The high-volume air samplers used at the FEMP continuously collect samples of airborne particulates by drawing air through a 20 cm × 25 cm filter at the rate of approximately 1 m^3/minute. Any changes in flow rate over the sampling period are accounted for by inspecting charts which continuously record flow data. These air samplers meet all of the criteria outlined above.

5.6.1.3 Air Analytes

Average airborne radionuclide concentration results will be used in dose calculations to determine the ambient air dose to the public as specified in Chapter 8 of this Plan. The air

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

pathway dose calculations estimate doses from past and current emissions that may have accumulated throughout the site history.

The air pathway dose estimates (monitoring results based) may be compared to the CAP-88 (effluent based) air pathway dose estimates. The CAP-88 air pathway dose estimates are normally less than the air pathway dose estimates derived from Section 8.0 methodology. The CAP-88 methodology only considers emissions for the year in question; it does not account for residual or accumulated concentrations over the facility's entire history.

The environmental detection limit (EDL) at a 95% confidence level is defined as the minimum detectable activity (MDA) at the 95% confidence level defined by the formula in §7.4.5.1.

Air filters are collected weekly and analyzed in accordance with Table 5-2. In summary, a total uranium analysis is required for each bi-weekly composite. The weekly samples shall be composited annually and analyzed for the trace radionuclides (Table 5-2) to account for the site specific minor emissions of these contaminants. In addition, ^{239}Pu will be analyzed for QA/comparative purposes.

During analysis, the filters are dissolved in acid and the solutions are then analyzed for uranium content. A portion of each solution is retained to provide an annual composite, used to detect the presence of trace radionuclides such as radium, neptunium, plutonium, and thorium. More frequent analysis for trace radionuclides is not considered necessary since analyses to date have shown only extremely small amounts of these elements.

5.6.2 Groundwater

Contaminated groundwater may lead to human exposure through several pathways as detailed in Section 5.2. Therefore, groundwater monitoring is a required part of the routine environmental surveillance program. Specific groundwater monitoring requirements for the FEMP are stated in the FEMP Comprehensive Groundwater Monitoring Plan (December

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

1992),[45] which is required by DOE Order 5400.1 [paragraph III.4.a.]. The Groundwater Monitoring Plan sets forth specific sampling frequencies, sampling locations, required analyses, and justifications thereof. Therefore, that information will not be repeated in this Plan. However, this Section of the EMP will set forth the general criteria that must be met concerning sampling methods, locations, and frequency. In addition, the "FEMP Groundwater Protection Management Program Plan" impacts the routine groundwater monitoring activites and reporting requirements.

Routine environmental surveillance of groundwater consists of two activities: site perimeter sampling and offsite drinking water well testing. Sampling groundwater at the site boundary is conducted to identify and document any exit pathways through which contaminated groundwater may be leaving the site. Perimeter groundwater surveillance allows assessment of the impact of FEMP facility operations on the surrounding environment, and are monitored to ensure that drinking water dose limits are not exceeded.

5.6.2.1 Groundwater Monitoring Locations

Since surface water is not considered a direct source of exposure at the FEMP, offsite property owner wells shall be sampled to demonstrate compliance with the 4 mrem drinking water standard. The sampling locations for drinking water derived from groundwater sources shall be at the nearest available domestically used wells down-gradient from the site boundary. Specific locations shall be specified by sampling procedure and property owner cooperation. In addition to indicator locations, at least one control location shall be located up-gradient from the facility.

The private wells sampled to demonstrate compliance with the 4 mrem drinking water standard are shown in Figure 5-4.

The location of indicator groundwater monitoring wells shall be based on groundwater use, location of known and potential sources of pollution, and groundwater flow direction. Sampling locations, monitoring frequencies, and required analyses shall be documented and justified in the

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

FEMP Groundwater Monitoring Plan. Control monitoring wells shall be monitored at the same frequency as indicator wells. Environmental surveillance groundwater wells shall be located along the down-gradient site boundary for the purpose of monitoring exit pathways for contaminated groundwater leaving the site.

5.6.2.2 Groundwater Sampling Methods

Methods for sampling groundwater shall be documented in written sampling procedures. Groundwater sampling procedures shall consider at least the following:

- introduction of contamination through the sampling process,
- prevention of cross contamination of samples,
- sample volume needed to achieve the required analytical sensitivity,
- criteria for obtaining a representative sample of water in the aquifer,
- proper sample preservation, and
- filtration of the sample to remove artifacts.

The FEMP shall ensure that Groundwater Monitoring Plans are consistent with state and regional EPA groundwater monitoring requirements. Specific information can be found in the FEMP Groundwater Monitoring Plan.

5.6.2.3 Groundwater Analytes

Drinking (well) water samples shall be analyzed at least annually for total uranium, in accordance with Table 5-2. Annual total uranium analysis is sufficient since uranium isotopes are long-lived. The concentration results obtained from the annual total uranium analyses shall be used in the dose calculations specified in Chapter 8 to determine the potential annual public dose from drinking water consumption. Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

The intervals between collection of groundwater samples shall be sufficient to ensure the collection of independent groundwater samples during each sampling event. The rate of contaminant migration shall be used to determine the frequency of sampling at down-gradient locations.

Groundwater at the site boundary is sampled quarterly. These groundwater samples are analyzed for TOC/TOX, VOC, metals, sulfate, nitrate, chloride, alkalinity, TDS, pH, specific conductivity, carbonate, bi-carbonate, and total uranium. There are also 14 background wells that are analyzed for these same parameters.

Offsite (drinking water) wells are sampled monthly and analyzed for total uranium. Annual samples from these wells are analyzed for the following non-radioactive elements: silver, arsenic, barium, calcium, cadmium, chromium, copper, iron, potassium, magnesium, manganese, sodium, nickel, lead, selenium, and zinc.[46]

Specific conductance, pH, and temperature measurements are taken during onsite and offsite well water collection.

5.6.3 External Exposure

At the FEMP, there is potential for gamma exposure to members of the general public, primarily from the K-65 silos. Therefore, external exposure shall be monitored as part of the routine environmental surveillance program. There is also the possibility of a criticality accident during the handling of ^{235}U at the FEMP. However, there are precautions in place to prevent a criticality accident during the handling of ^{235}U at the FEMP so that the potential for a criticality accident is very low.[47] Therefore, neutron monitoring is not part of the routine environmental surveillance program at FEMP (DOE/EH-0173T, Summary 5u). There are Radiation Detection Alarms (RDAs) in place to detect low levels of radiation if a criticality accident occurrs. The FMPC Emergency Plan[28] sets forth appropriate actions in the event of a criticality accident.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

At the FEMP, thermoluminescent dosimeters (TLDs) shall be used to determine the dose to the public from external radiation exposure. TLDs shall be placed at each air monitoring station to measure external exposure. At least 3 TLDs shall be placed at each location at a height of 1 meter above the ground. TLDs shall be collected quarterly and read by the next scheduled TLD reading at the beginning of the month, in accordance with EP-REM-002, "Environmental Direct Radiation Monitoring." TLD calibration shall be based on traceability to NIST standards (DOE-EH-0173T, Summary 5i).

Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

Environmental TLD locations are shown in Figure 5-5. All TLDs are exchanged quarterly. Care is taken to minimize any additional exposure to the TLDs after collection and before processing. Pressurized ionization chamber (PIC) measurements are also taken quarterly at several locations. These PIC measurements provide real-time readings of direct exposure rates, and are intended to supplement the environmental TLD program.

5.6.4 Milk

Dose to the general public due to consumption of contaminated milk is possible at the FEMP. Therefore, milk sampling is part of the FEMP routine environmental surveillance program.

5.6.4.1 Milk Sampling Locations

At a minimum, milk samples shall be taken at an indicator location and a control location. Milk samples are collected from the local dairy near the FEMP, and from a control (background) dairy outside the influence of FEMP operations.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.6.4.2 Milk Sampling Methods

Milk samples shall be collected and preserved in accordance with EP-REM-007, "Milk Sampling." The sampling procedure shall consider at least the following:

- collection of a sample that is representative of the local area of interest;
- a preservation method consistent with the measurement of radionuclides (DOE/EH-0173T, Summary 5w); and
- a sample size necessary to achieve a required level of analytical sensitivity.

Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

5.6.4.3 Milk Sample Analytes

Milk samples are collected monthly at each sampling location and analyzed for isotopic uranium (^{234}U, ^{235}U, and ^{238}U). Given the inherent difficulties in analyzing milk as an environmental matrix, isotopic uranium provides a better means of analysis than total uranium. Once per year, preferably in the summer months when cattle are on pasture, a larger sample is collected and subjected to a more thorough radiological analysis in accordance with Table 5-2. The required radionuclides are selected based on the FEMP operating history and historical analytical data which are applicable to liquid and atmospheric releases as detailed in Sections 2.4 and 3.4. Annual isotopic analysis is sufficient since the target radionuclides are long-lived, or are daughters of long-lived radionuclides.

5.6.5 Produce

Because there is potential for exposure to the general public due to consumption of contaminated produce, monitoring of locally grown produce shall be part of the routine environmental surveillance program.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.6.5.1 Produce Sampling Locations

Potential produce sampling locations shall be established at the expected location of the maximum ground concentration of radionuclides (if determinable, *i.e.*, based on prevailing winds, computer modeling, etc.), at any area irrigated with water into which FEMP effluents have been discharged, and at at least one control location outside the influence of plant operations. Samples shall be collected annually during the growing season and shall be sufficient in size to meet sensitivity requirements. Currently established produce sampling locations are shown in Figure 5-6. Specific locations are selected based on availability of produce and voluntary landowner cooperation.

5.6.5.2 Produce Sampling Methods

Produce is collected annually from each sampling location, based on availability of produce. To the extent possible, the same varieties of produce are collected at indicator and background locations. What types of produce are collected will depend on what types of produce are locally available. Popular locally grown foodstuffs in the Fernald area include cabbage, sweet corn, soybeans, tomatoes, lettuce, and green beans. Each produce sample must weigh at least 500 grams. Samples of fertilizer used to enhance the growth of sampled produce may also be obtained, if available, to supplement produce results. Annual collection of produce samples is sufficient based on the seasonality of produce grown in the region.

Produce samples are collected in accordance with EP-REM-006, "Produce Sampling." Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ. Soil samples are also collected at all produce sampling locations.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.6.5.3 Produce Sample Analytes

The produce samples are analyzed for total uranium content, in accordance with Table 5-2. The results obtained from the total uranium analyses shall be used in the dose calculations specified in Chapter 8 to determine the potential annual public dose from produce. Since dose calculations for foodstuffs are based on wet weights, analytical results for produce should be corrected for wet weight concentrations if necessary.

5.6.6 Meat (Fish and Beef)

Because there is potential for dose to the general public due to consumption of contaminated fish, fish samples shall be collected as part of the routine environmental surveillance program. In addition, beef samples may be collected annually if locally contaminated meat becomes a site concern and samples are available.

5.6.6.1 Fish and Beef Sampling Locations

If site conditions warrant and a sample is available, a beef sample shall be collected at a location within 10 miles of the site. This indicator animal sampled shall have been fed on crops grown in the vicinity of the site or at a location where drinking water is supplied from a downstream source. A control beef sample should be taken from an animal that has been raised in an area that is outside the influence of plant operations, if available. Specific locations shall vary annually according to availability.

At least two fish samples shall be taken at least annually, one upstream of the outfall point and the other at a downstream location. One control sample shall be taken at a location outside the influence of plant operations.

Fish sample locations are on the Great Miami River at three established locations as shown in Figure 5-7. One location is upstream from the effluent line and serves as the control location.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Two sampling locations are downstream of the effluent line, one point near the outfall pipe from the stormwater treatment facility, and one point at the outfall of Paddys Run.

5.6.6.2 Fish and Beef Sampling Methods

Fish samples are collected annually using an electrofishing technique. Fish samples are normally collected during September or October. A variety of fish species are collected to determine whether or not concentrations vary among species. Bottom feeders, middle and higher level feeders, and predators are collected. Fish samples should be selected from species that are most likely to be consumed by the local population. Fish samples shall be separated by family and analyzed and reported as separate samples.

Written sampling procedures shall be maintained that direct the sampling and preservation of beef and fish. EP-REM-005, "Fish Sampling," is not written to great detail since the actual collection of fish samples is done by a subcontractor. Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

5.6.6.3 Fish and Beef Sample Analytes

Beef and fish samples shall be analyzed in accordance with Table 5-2. Analytical results for fish shall be used in the dose calculations specified in Chapter 8 to determine the potential annual dose to the public due to fish consumption. Since dose calculations for foodstuffs are based on wet weights, analytical results for fish should be corrected for wet weight concentrations if necessary.

As discussed in the 1993 Site Environmental Report, several threatened or endangered wildlife species may be present at the FEMP. Should it become necessary to sample a protected species, state and local game officials shall be consulted prior to sampling (DOE/EH-0173T, Summary 5r).

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.6.7 Sediment

Sediment sampling can provide an indication of buildup of undissolved radionuclides in streams. Therefore, sediment sampling at points in the Great Miami River and Paddys Run shall be part of the routine environmental surveillance program.

Locations that should be considered include downstream locations where flow-rate is the greatest and areas that favor sedimentation such as the inner bank of a bend. At least one control sediment sample shall be collected at a location that is outside the influences of plant operations.

Sediment sampling is performed annually in the Great Miami River, both above and below the FEMP outfall, at 9 locations. In addition, 24 samples are collected in Paddys Run at points above and below the confluence with the outfall ditch. Four background sampling locations north of the site and outside the influence of plant operation have been established. Eight samples are collected at the SSOD. Figure 5-8 illustrates the current sediment sampling locations.

Sediment samples shall be collected annually according to EP-REM-003, "Sediment Sampling," and analyzed in accordance with Table 5-2. Annual collection is sufficient since target radionuclides are either long-lived, or daughters of long-lived parents. Target radionuclides are based on operating history and historical data applicable to liquid effluent releases as discussed in Section 2.4 of this Plan.

Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.6.8 Surface Water

Although surface water is not considered a direct source of exposure, analysis of surface water can indicate accumulation of contaminants that could affect other media such as irrigated foodstuffs. Surface water is an intermediate transport mechanism to other media such as fish.

In addition, DOE guidance states that two media for each critical radionuclide/exposure pathway combination shall be monitored, one of which may be the effluent stream (Summary (DOE/EH-0173T, Summary 5c). Liquid effluents are monitored according to specifications of Section 2.0 of this Plan. Since liquid effluents are released directly into surface waters, surface water sampling shall serve as the second media for sampling for critical pathways involving liquid effluents.

5.6.8.1 Surface Water Sampling Locations

Indicator samples shall be collected downstream of the outfall at multiple depths on the traverse of the stream. At least one control surface water sample shall be collected at a point that is outside the influence of plant operations. Procedures shall state specific sampling locations.

Surface water is sampled in the Great Miami River at three locations, one upstream of the discharge and two downstream. Paddys Run is sampled offsite at three locations, one upstream from the site and two downstream. Paddys Run also is sampled onsite due to the potential for contaminated runoff into the creek. Surface water sampling locations are illustrated in Figure 5-9.

5.6.8.2 Surface Water Sampling Methods

Surface water sampling shall be conducted according to EP-REM-009, "Surface Water Sampling." Surface water samples shall be collected weekly. Additional SCQ sampling

requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

5.6.8.3 Surface Water Analytes

At a minimum, weekly surface water samples shall be collected and screened for total uranium. Weekly screening analyses are justified since liquid effluents are released directly in to streams. Screening analyses will indicate potential problems with liquid effluent releases. Since uranium is the principal contaminant at the FEMP, the total uranium analysis provides a reliable indicator of other contaminants being released to the surface water.

As a general rule, action levels throughout this Plan have been set at 10% of the applicable dose limit. At the FEMP, however, surface water is not considered a direct source of exposure to the public. Therefore, there is no directly applicable dose limit for determination of an action level. Surface water screening data shall be compared to historical data. Isotopic analyses shall be conducted on any significant outlier, and the need for further investigation shall be evaluated.

In addition to screening analyses, weekly surface water samples shall be composited monthly and semiannualy, and analyzed in accordance with Table 5-2. Specifically, monthly composites are analyzed for Ra^{226} and Ra^{228}. Semi-annual composites are analyzed for Cs^{137}, Sr^{90} and Tc^{99}. The required analytes are based on operating history and review of historical data applicable to liquid effluent releases as discussed in Section 2.4. Since surface water at the FEMP is not considered a direct source of exposure, and is rather an intermediate transport mechanism to fish, the RDLs stated for surface water are 10 times lower than the MDAs for fish.

5.6.9 Grass Sampling

Grass may become contaminated by deposition of radionuclides from the air. Although grass is not considered a direct source of exposure, grass is part of the intermediate transport mechanisms in meat and milk pathways. DOE guidance states that two media for each critical

radionuclide/exit pathway combination shall be monitored, one of which may be the effluent stream (Summary (DOE/EH-0173T, Summary 5c). Airborne effluents are monitored according to specifications in Section 3.0 of this Plan. Grass sampling shall serve as an additional medium for sampling for the air inhalation pathway.

Grass sampling locations should be selected to coincide with air monitoring location stations where possible. Grass sampling is performed annually at approximately 30 locations, as shown in Figure 5-10. ASTM Standard C 998-90[48] was used to guide the selection of grass and soil locations. Each grass sample is a composite of at least three sub-samples clipped near ground level from a representative area near the soil sample. Samples are analyzed for total uranium, in accordance with Table 5-2. Samples of fertilizer used to enhance the growth of sampled grass may also be obtained, if available, to supplement grass results.

Grass sampling shall be conducted annually according to EP-REM-012, "Soil and Grass Sampling." Annual sampling is sufficient based on the half-lives of uranium isotopes. Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ. Soil samples are also collected at all grass sampling locations.

5.6.10 Soil Sampling

Soil may become contaminated by deposition of radionuclides from the air. Although soil is not considered a direct source of exposure, it is part of the intermediate transport mechanisms in meat and milk pathways.

Soil sampling is performed annually at the same times and locations as both grass and produce samples. ASTM Standard C 998-90 was used to guide the selection of these locations. Each soil sample is a composite of several borings made into the ground in the same general area. Soil samples are collected at a depth of 0-5 cm, and analyzed in accordance with Table 5-2.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Soil sampling shall be conducted annually according to EP-REM-012, "Soil and Grass Sampling." Annual sampling is sufficient based on the half-lives of uranium isotopes. Additional SCQ sampling requirements, as applicable, shall be followed. They are found in Section 6.0, "Sampling Requirements" and Appendix K of the SCQ.

5.6.11 Radon Monitoring

5.6.11.1 Long-Term Integrating Radon Monitoring

The following requirements from DOE Order 5400.5[7] govern the activities of the radon monitoring program at the FEMP:

"At facilities where radium-bearing materials are stored, controls shall be designed such that ^{222}Rn concentrations in the atmosphere above facility surfaces or openings, in addition to background levels, will not exceed:

(a) 100 pCi/ℓ at any given point;

(b) an annual average concentration of 30 pCi/ℓ over the facility site;

(c) an annual average concentration of 3 pCi/ℓ at or above any location outside the facility site;

(d) flux rates from the storage of radon-producing wastes shall not exceed 20 pCi/m^2-sec, as required by 40 CFR 61."

To comply with these requirements, two types of radon detection devices are used: track-etch radon monitoring cups (integrating passive units), and real-time continuous passive radon detectors.

Track-etch radon monitoring cups are used for demonstrating compliance with the 3 pCi/ℓ and 30 pCi/ℓ concentration limits. These cups are appropriate since the concentration limits are based on annual averages and these detectors integrate the effects of alpha particles released

from the decay of radon over time. Beginning in 1995, all radon cups will measure airborne radon concentrations only. (Prior to this, some radon cups also measured thoron concentrations.)

There are currently 64 radon cup monitoring locations, as shown in Figure 5-11: 20 along the FEMP fenceline; 24 in the vicinity of the K-65 silos (the most significant source of radon on site); 9 onsite at various distances from the silos; and 11 offsite locations, including 4 background locations. Field blanks and spiked cups are submitted for analysis in addition to these 64 locations for quality assurance purposes. Radon is analyzed in accordance with Table 5-2.

5.6.11.2 Continuous Radon Monitoring

Continuous radon monitors allow for immediate response to elevated radon concentrations, and allow for the tracking of contamination in the event of an accidental release.

Continuous radon monitoring is performed at 20 locations on- and off-site. The continuous radon monitors provide hourly measurements of radon concentrations at each of these locations. Eight of these locations are required as part of the FFA: four around the K-65 silos, two along Paddys Run, one near the Pilot Plant, and one background location in Fairfield, OH. Additional continuous monitors are placed around the perimeter of the FEMP fenceline and other strategic locations to monitor for changes in radon concentrations, which may be attributed to remedial actions at the FEMP.

5.7 Quality Assurance

Implementation and maintenance of a comprehensive site quality assurance program is essential for generation of quality analytical results. This Section of the Plan sets forth specific quality assurance requirements that are related to field measurements and sample collection. The general quality assurance provision described in Section 10.0 of this Plan shall be followed

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

(DOE/EH-0173T, Summary 5x). Additional SCQ requirements, as applicable to the Environmental Monitoring Program, shall be followed. These requirements are referenced in Section 10.0 of the EMP. The DOE requirements differ in some respects from those of the SCQ in a few areas. The SCQ requires additional QA/QC requirements for field and laboratory samples, including: the types and frequencies of required field and laboratory QA/QC samples, requirements for the use of FEMP specified analytical methods, and requirements for participating laboratories to generate and use control charts for various parameters. Again the EMP directs that the site follow applicable DOE requirements and the applicable SCQ or EPA based requirements for those activities which fall under the routine Environmental Monitoring Program.

Before being allowed to make field measurements or collect samples, personnel will be trained as appropriate and meet the necessary qualifications. Written procedures shall specify personnel training requirements. Records shall be maintained that track the status of personnel qualifications.

Written procedures shall be maintained that direct routine calibration of field measurement instruments. Calibration shall be in accordance with manufacturers' specifications. Calibration standards shall be traceable to NIST standards or other nationally recognized standards. Calibration records shall be maintained on each instrument. Before use in the field, instruments shall be checked to ensure that they are within calibration limits.

Written procedures shall exist that direct the collection and analysis of field quality assurance samples. Procedures shall specify the frequency of collection of field blanks, trip blanks, equipment blanks, and duplicate samples. Procedures for split sample analysis with inter-comparison laboratories shall be maintained. Laboratory quality assurance is described in Section 6.0 of this Plan.

The FEMP is no longer in production and the current emphasis at the site is on cleanup and environmental restoration. Although the composition of the effluents from the FEMP are not

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

likely to change substantially in the future, an annual review of the radionuclide contained in the effluents and emissions will be made and compared with those used to establish this Plan. Any changes to environmental sampling practices dictated by such changes in emissions shall be documented in revisions to this Plan (DOE/EH-0173T, Summary 5p). Any changes in the site-specific or generic factors shall be noted in this Plan and the retired or replaced value preserved for historical purposes (DOE/EH-0173T, Summary 5t).

000164

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-1: Radiological Exposure Pathways of Potential Concern in Remedial Investigation Baseline Risk Assessments (Current Land Use Only)

Potential Exposure Pathway	CRU 1	CRU 2	CRU 3	CRU 4	CRU 5
Inhalation of fugitive dust	χ				
Irrigation with surface water: foodstuffs/meat/milk	χ	χ	χ		
Groundwater ingestion	χ	χ	χ	χ	χ
Irrigation with groundwater: foodstuffs/meat/milk	χ	χ	χ	χ	χ
Surface water: fish	χ	χ	χ		χ
Soil: beef and milk			χ		χ
Direct radiation				χ	
Radon in air	χ			χ	

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-2: Minimum Analysis Regimen for Environmental Media Samples

Sampling Medium	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level (RDL)	Required Accuracy at 10 x RDL
Well Water	Uranium by KPA	Each Sample	Total Uranium	1.0 $\mu g/\ell$	± 50%
Milk	Isotopic uranium	Monthly samples	^{234}U	0.1 pCi/ℓ	± 50%
			$^{235/236}U$	0.1 pCi/ℓ	± 50%
			^{238}U	0.1 pCi/ℓ	± 50%
	Isotopic Thorium, Radium, and other radionuclides	Annual samples	^{228}Th	0.5 pCi/ℓ	± 50%
			^{230}Th	0.5 pCi/ℓ	± 50%
			^{232}Th	0.5 pCi/ℓ	± 50%
			^{226}Ra	0.1 pCi/ℓ	± 50%
			^{228}Ra	1.0 pCi/ℓ	± 50%
			^{90}Sr	2.0 pCi/ℓ	± 50%
			^{99}Tc	50 pCi/ℓ	± 50%
			^{137}Cs	30 pCi/ℓ	± 50%
Farm and Garden Produce	Uranium by KPA	Each Sample	Total Uranium	0.001$\mu g/g$	± 50%
Animal Tissue	Isotopic Uranium	Each sample	U^{234}	0.02 pCi/g	± 50%
			$U^{235/236}$	0.02 pCi/g	± 50%
			U^{238}	0.02 pCi/g	± 50%
	Isotopic Thorium and Plutonium	As required by specific concerns	Th^{228}	0.02 pCi/g	± 50%
			Th^{230}	0.02 pCi/g	± 50%
			Th^{232}	0.02 pCi/g	± 50%
			Pu^{238}	0.01 pCi/g	± 50%
			$Pu^{239/240}$	0.01 pCi/g	± 50%

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-2: Minimum Analysis Regimen for Environmental Media Samples

Sampling Medium	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level (RDL)	Required Accuracy at 10 x RDL
Fish and Aquatic Animals	Uranium by KPA	Each Sample	Total Uranium	0.001 μg/g	± 50%
Sediment	Uranium by KPA	Dependent on sample location	Total Uranium	0.1 μg/g	± 50%
	Isotopic Thorium and Radium		Th^{228}	0.1 pCi/g	± 50%
			Th^{230}	0.1 pCi/g	± 50%
			Th^{232}	0.1 pCi/g	± 50%
			Ra^{226}	0.25 pCi/g	± 50%
Surface Water	Uranium by KPA	Each Sample	Total Uranium	1.0 μg/ℓ	± 50%
	Isotopics	Monthly composites	^{226}Ra	0.5 pCi/ℓ	± 50%
			^{228}Ra	0.5 pCi/ℓ	± 50%
	Isotopics	6-month composites	^{90}Sr	0.2 pCi/ℓ	± 50%
			^{99}Tc	15 pCi/ℓ	± 50%
			^{137}Cs	4.0 pCi/ℓ	± 50%
	Gross alpha and beta	ODH/OEPA splits	Gross Alpha	50 pCi/ℓ	± 50%
			Gross Beta	5 pCi/ℓ	± 50%
			Total Uranium	1.0 μg/ℓ	± 50%
			Ra-226	0.5 pCi/ℓ	± 50%
			Ra-228	0.5 pCi/ℓ	± 50%
Soil	Uranium by KPA	Each Sample	Total Uranium	0.1 μg/g	± 50%

000157

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-2: Minimum Analysis Regimen for Environmental Media Samples

Sampling Medium	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level (RDL)	Required Accuracy at 10 x RDL
Grass	Uranium by KPA	Each Sample	Total Uranium	0.001 μg/g	± 50%
Ambient Air	Uranium by KPA	Each bi-weekly filter composite	Total Uranium	2.0 μg/filter	± 50%
	Isotopics	Annual composites	^{99}Tc	74.0×10^{-6} pCi/m^3	± 50%
			^{234}U	7.0×10^{-6} pCi/m^3	± 50%
			$^{235/236}$U	7.0×10^{-6} pCi/m^3	± 50%
			^{238}U	7.0×10^{-6} pCi/m^3	± 50%
			^{228}Th	2.3×10^{-6} pCi/m^3	± 50%
			^{230}Th	2.3×10^{-6} pCi/m^3	± 50%
			^{232}Th	2.3×10^{-6} pCi/m^3	± 50%
			^{238}Pu	0.7×10^{-6} pCi/m^3	± 50%
			$^{238/240}$Pu	0.7×10^{-6} pCi/m^3	± 50%
			^{237}Np	0.3×10^{-6} pCi/m^3	± 50%
			^{226}Ra	0.8×10^{-6} pCi/m^3	± 50%
			^{228}Ra	8.0×10^{-6} pCi/m^3	± 50%
			^{90}Sr	0.7×10^{-6} pCi/m^3	± 50%
			^{137}Cs	11.0×10^{-6} pCi/m^3	± 50%
Ambient Air (Radon)	Radon	Quarterly* and Hourly Analyses:	^{222}Rn	1.7 pCi/ℓ (quarterly*)	± 50%
			^{222}Rn	1.0 pCi/ℓ (hourly)	± 50%

* - Beginning in 1995, radon cups will be in the field for six months.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures	
Procedure #	**Procedure Title**
Liquid Effluent Monitoring	
FMPC-0718	Measuring and Test Equipment Calibration and Control
SOP 43-C-324	Sampling FMPC Water Samples
MMICS	Maintenance Management and Inventory Control System
SOP-43-C-314	Stormwater Retention/Emergency Spill Containment Sampling
FD-1000	Site CERCLA Quality Assurance Project Plan (SCQ)
SOP 43-C-301	Water Treatment Plant Operations
SSOP-0100	Readiness Review Process
Airborne Effluent Monitoring	
SOP 1-C-701	Plant 1 Dust Collectors
SOP 2-C-701	Plant 2/3 Dust Collectors
SOP 4-C-701	Plant 4 Dust Collectors
SOP 5-C-701	Plant 5 Dust Collectors
SOP 6-C-701	Plant 6 Dust Collectors
SOP 8-C-701	Plant 8 Dust Collectors
SOP 9-C-701	Plant 9 Dust Collectors
SOP 11-C-238	Pilot Plant Dust Collector
SP-P-35-028	Inspection and Performance Testing of Portable Radiation Survey Instruments
SP-P-35-026	Occupational Sampling for Radioactivity
SP-P-029	Measuring Radon and Thoron Daughter Concentrations
OSH-P-52-017	Stack Sampler Inspection and Filter Change Procedure
20-C-622	Long Duration Sampling and Analysis
OSH-P-45-1005	SOP - Inspection of Single-Point Stack Sampler Housing and Probes

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures	
Procedure #	**Procedure Title**
SOP-20-C-708	Inspection and Troubleshooting Baghouse Type Dust Collectors and Precipitrons
SSOP-0069	Freon Management
SOP-43-C-410	Receipt, Sampling, and Storing Coal
FD-1000	SCQ
EC/QASP	Annual Radioactive Effluent Discharge Report
EC/QASP	National Pollutant Discharge Elimination System
SSOP-0100	Readiness Review Process
Environmental Surveillance	
EM-AD-002	Procedure Preparation and Control
EM-AD-003	Surveillance Program
EM-AD-004	Training Documentation
EM-AD-006	Records Management
EP-REM-003	Split Sampling
EM-AD-008	Chain of Custody and Request for Analysis
EM-GW-001	Shipping Groundwater Samples
EM-GW-002	Sampling of Groundwater Monitoring Wells
EM-GW-003	Groundwater Elevation Measurements
EM-GW-004	Well Plugging and Abandonment
EM-GW-005	Purging of Groundwater Monitoring Wells
EM-GW-006	Measuring pH, Temperature, Specific Conductance, and Dissolved Oxygen Content of Groundwater
EM-GW-007	Hnu HW-101 Portable Photoionization Detector Maintenance and Use
EM-GW-008	A.C. Portable Generator Usage
EM-GW-009	Groundwater Sampling Equipment Decontamination
EM-GW-010	Entering Lab Data into the Groundwater Database

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures

Procedure #	Procedure Title
EM-GW-011	Groundwater Exceptions Tracking Procedure
EM-GW-012	Verification Protocols
EM-GW-013	Well Wizard Dedicated Pump Usage
EP-REM-001	REM Air Monitoring
EM-RM-002	Logkeeping Procedure
EM-RM-003	Sediment Sampling
EM-RM-004	Reporting Airborne Emissions and Releases
EP-REM-005	Fish Sampling
EP-REM-006	Produce Sampling
EP-REM-007	Milk Sampling
EP-REM-008	REM Well Sampling
EP-REM-009	Surface Water Sampling.
EP-REM-002	Environmental Direct Radiation Monitoring
EP-REM-011	Environmental Radon Monitoring
EP-REM-012	Soil and Grass Sampling
EP-REM-013	REM Data Review and Analysis
EM-RM-013	Calibration, Maintenance, and Inspection of REM Instruments/ Equipment
EM-RM-014	Real-Time Environmental Radon Monitoring
EM-RM-016	Estimating Radiological Pathway Dose
EM-RM-017	Radon Flux Surface Sampling
EM-RM-018	Downloading the OM-160 Data Logger
EM-RM-019	Comparison of Reported Annual Releases to Determine the Applicability to the Environmental Surveillance Program
EM-RM-020	Meteorological Tower Maintenance
EM-RM-021	Meteorological Computer and Data Management

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures	
Procedure #	**Procedure Title**
FD-1000	Sitewide CERCLA Quality Assurance Implementation Plan (SCQ)
Analytical Laboratories	
AnL-QAP	Analytical Laboratories QA Plan
SOP-AnL-01-0035	Using ANALIS
AnL-01-0054	Training and Qualifications of Analysts within the WMCO Analytical Laboratories
SOP-9031	Management and Reporting of Analytical Laboratory Results
SOP-AnL-QAP	Analytical Laboratories Quality Assurance Plan
AnL-22-0043	The Preparation, Storage, and Documentation of Monthly and Yearly Stack Filter Composite Samples
CIO C90-048	Gross Alpha and Gross Beta Radioactivity in Drinking Water
ESH-P-34-001	Determination of pH Value of Water Using an Orion Model 611 Meter
ESH-P-34-004	Determination of Uranium in Water: Fluorometric Fusion Method
ESH-P-34-014	SOP - Determination of Residue, Total Non-Filterable, In Water (Total Suspended Solids)
Method 1001	The Determination of Oil and Grease in Water and Wastes Using the Partition-Gravimetric Method
Method 1025	Graphite Furnace Atomic Absorption Method for the Determination of Total Chromium in NPDES Water Samples
Method 1026	Graphite Furnace Atomic Absorption Method for the Determination of Hexavalent Chromium in NPDES Water Samples
Method 1028	Graphite Furnace Atomic Absorption Method for the Determination of Nickel in NPDES Water Samples
Method 1029	Graphite Furnace Atomic Absorption Method for the Determination of Copper in NPDES Water Samples
Method 1055	Graphite Furnace Atomic Absorption Method for the Determination of Silver

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures

Procedure #	Procedure Title
Method 1060	Graphite Furnace Atomic Absorption Method for the Determination of Lead
Method 3001	The Determination of Ammonia-Nitrogen In Wastewater Using the Potentiometric Ammonia Sensing Electrode Method
Method 3002	The Colorimetric (BR PADAP) Determination of Uranium Using an Autoanalyzer
Method 3003	Gravimetric Determination of Non-Volatile Particulates on Stack Filters (including sample preparation for total uranium determination)
Method 3033	Determination of pH Using an Accument 915 pH Meter
Method 3039	Determination of Fluoride in Wastewater Using Potentiometric, Ion-Selective Electrode Method
D3173-73	Coal - moisture
D3174-82	Coal - ash
D2015-77	Coal - BTU
D3177-575	Coal - sulfur
D3175-77	Coal - volatile
Method 3051	The Simultaneous Determination of Nitrate, Nitrite, and Phosphate in Water by an Automated Continuous Flow Analyzer
Method 3062	Determination of Trace Uranium by Kinetic Phosphorescence Analysis
Method 4002	The Radiometric Determination of Radium-226 and Radium-228 in Various Matrices
Method 4007	Radiometric Procedure for the Determination of Technetium-99
Method 4013	Radiometric Screening Method for Determining Total Radioactivity in Various Matrices
Method 8001	Radiochemical Determination of Gross Alpha Particle Activity in Water
Method 8002	Radiological Determination of Gross Beta Activity in Water
Method 8003	Determination of Uranium in Water UA-3 Laser Induced Phosphorescence Method

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures	
Procedure #	**Procedure Title**
Method 8004	Determination of Uranium and Gross Activity in High Volume Air Dust Samples
Method 8008	Gravimetric Determination of Airborne Particulates
Method 9013	Determination of pH Using an Accmet 950 Selective Ion Analyzer for NPDES Samples
Method 9020	CLP:239.2/GFAA Method for the Determination of Lead
Method 9021	CLP:218.2/GFAA Method for the Determination of Chromium
Method 9032	CLP-200.7 Flash Determination of Metals by Leeman PS3000 ICP (Simultaneous Operation)
Method 9095	Calibration of Alpha and Beta Check Sources
SP-P-32-011	Operation of the Panasonic UD-710A Automatic TLD Reader
SP-P-32-015	TLD Irradiation
SP-P-32-019	TLD Accountability, Selection and Screening
SP-P-32-040	Operation of the TLD Processing Computer Systems
FD-1000	SCQ
AnL 9120	Calibration and Operation of a Computer Controlled Spectrometry System
AnL-20-C-810	Disposition of Sample Residues
AnL-45-0060	Performance Checks
Quality Assurance	
SSOP-0103	FEMP Site Document System
FMPC-0212	Environmental Council Charter
FMPC-0302	Request for Purchase
SSOP-0317	Initiating and Preparing a Technical Evaluation of a Proposal
FMPC-0512	Configuration Control of Safety Systems, Design Features for Safety, and OSR-Affected Procedures
FMPC-0609	Records Management

000174

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3: Sampling and Analysis Procedures	
Procedure #	**Procedure Title**
FMPC-0705	Operational Readiness Process
FMPC-0708	Personnel Certification
PP-0709	Conduct of Quality Assurance Surveillance Activity
PP-0710	Quality Assurance Plans
PO-0712	Risk Assessment and Management
FMPC-0718	Measuring and Test Equipment Calibration and Control
RM-0012	Quality Assurance Program Description (QAPD)
SSOP-0315	Controlling the Purchase of Supplies and Services
FMPC-0716	Control of Processes
SSOP-0049	Audit Program
SSOP-0023	Deviation and Corrective Action Reporting
FD-1000	SCQ
Records	
EQP-7.01	Administration and Conduct of Surveillance
EQP-16.01	Annual EIS/ODIS Report
EQP-16.02	NPDES Reporting
FMPC-0609	Records Management
FD-1000	SCQ
General Procedures	
RM-0012	QAPD
FD-1000	SCQ
PL-3020I	Site Emergency Plan
Method 4013	Radiometric Screening Method for Determining Total Radioactivity in Various Matrices

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-4: Measured Radionuclides at AMS 9/9A

Analyte	Measured (pCi/m^3)	DCG (pCi/m^3)	Fraction of DCG
^{137}Cs	-----	400	-----
^{239}Np	-----	0.02	-----
^{238}Pu	-----	0.03	2.8×10^{-5}
$^{239/240}Pu$	-----	0.02	-----
^{226}Ra	3.5×10^{-5}	1.0	3.5×10^{-5}
^{228}Ra	-----	3.0	-----
^{90}Sr	1.1×10^{-5}	9.0	1.2×10^{-6}
^{99}Tc	7.6×10^{-3}	2000	3.8×10^{-6}
^{228}Th	1.0×10^{-5}	0.04	2.5×10^{-4}
^{230}Th	1.7×10^{-5}	0.04	4.3×10^{-4}
^{232}Th	-----	0.007	-----
U-natural	1.6×10^{-3}	0.1	1.6×10^{-2}

Sum = 1.7×10^{-2}

Percent of dose from uranium = $\frac{1.6 \times 10^{-2}}{1.7 \times 10^{-2}} \approx 0.94$ $\simeq 94\%$

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-5: Measured Radionuclides at AMS 8

Analyte	Measured (pCi/m^3)	DCG (pCi/m^3)	Fraction of DCG
^{137}Cs	-----	400	-----
^{239}Np	-----	0.02	-----
^{238}Pu	-----	0.03	-----
$^{239/240}Pu$	-----	0.02	-----
^{226}Ra	1.9×10^{-5}	1.0	1.9×10^{-5}
^{228}Ra	-----	3.0	-----
^{90}Sr	3.9×10^{-5}	9.0	4.3×10^{-6}
^{99}Tc	6.7×10^{-4}	2000	3.4×10^{-7}
^{228}Th	1.2×10^{-5}	0.04	3.0×10^{-4}
^{230}Th	2.7×10^{-5}	0.04	6.8×10^{-4}
^{232}Th	5.2×10^{-6}	0.007	7.4×10^{-4}
U-natural	6.5×10^{-4}	0.1	6.5×10^{-3}

Sum = 8.2×10^{-3}

Percent of dose from uranium = $\frac{6.5 \times 10^{-3}}{8.2 \times 10^{-3}} \approx .79$ $\simeq 79\%$

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-6: Measured radionuclides at MH-175

Analyte	Measured (pCi/L)	DCG (pCi/L)	Fraction of DCG
^{231}Th	5.4	100,000	0.00
^{234}Th	140	10,000	0.014
^{234}U	96	500	0.19
^{235}U	5.4	600	0.01
^{236}U	3.7	500	0.01
^{238}U	140	600	0.23

Sum = 0.45

Percent of dose from uranium = $\frac{0.44}{0.45} \approx .98 \approx 98\%$

Table 5-7: Results of Air Sample Location Analysis

Direction from source	Number of Air Samplers
North	2
North East	2
East	2
South East	1
South	1
South West	1
West	1
North West	0

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

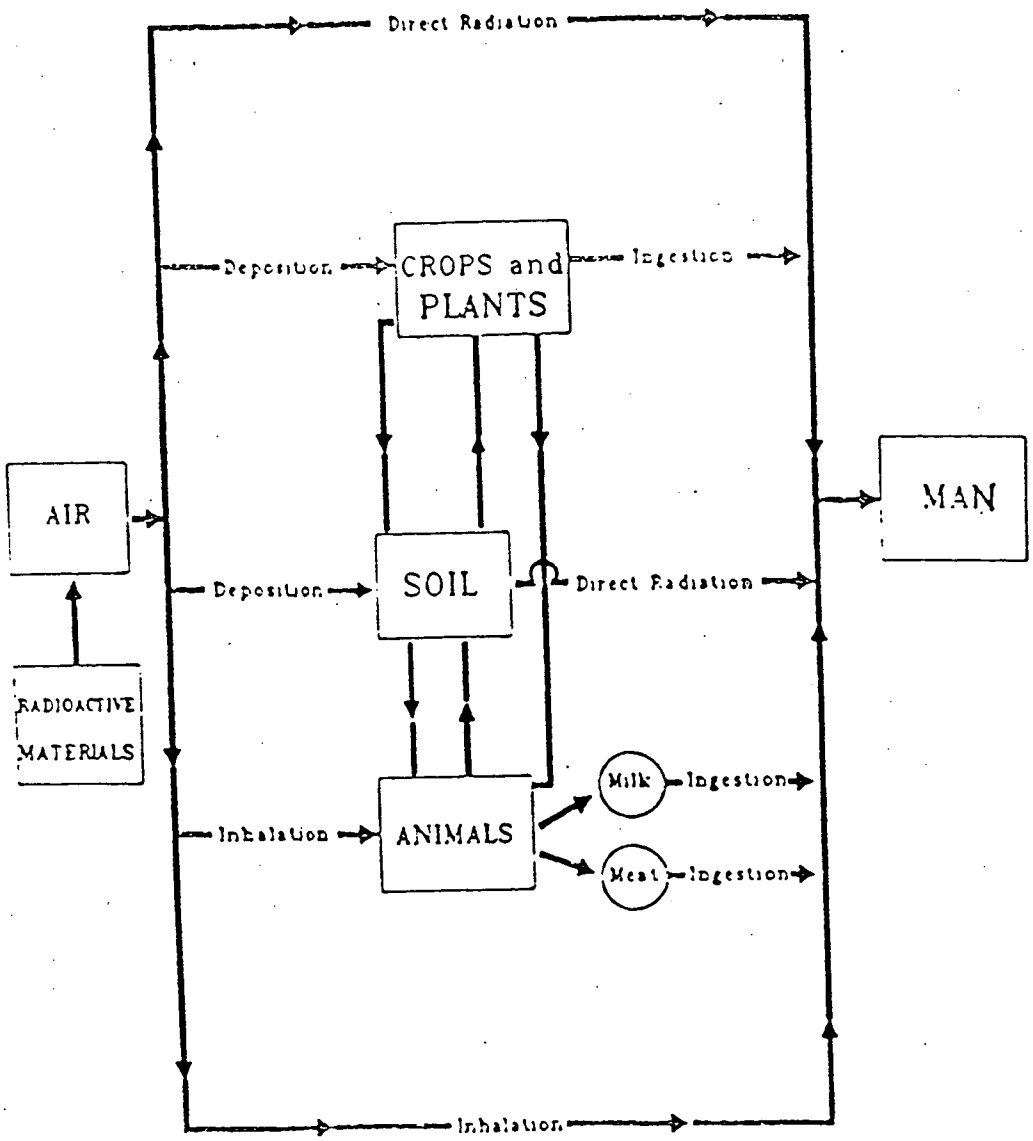


Figure 5-1: Atmospheric Pathways for Human Exposure

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

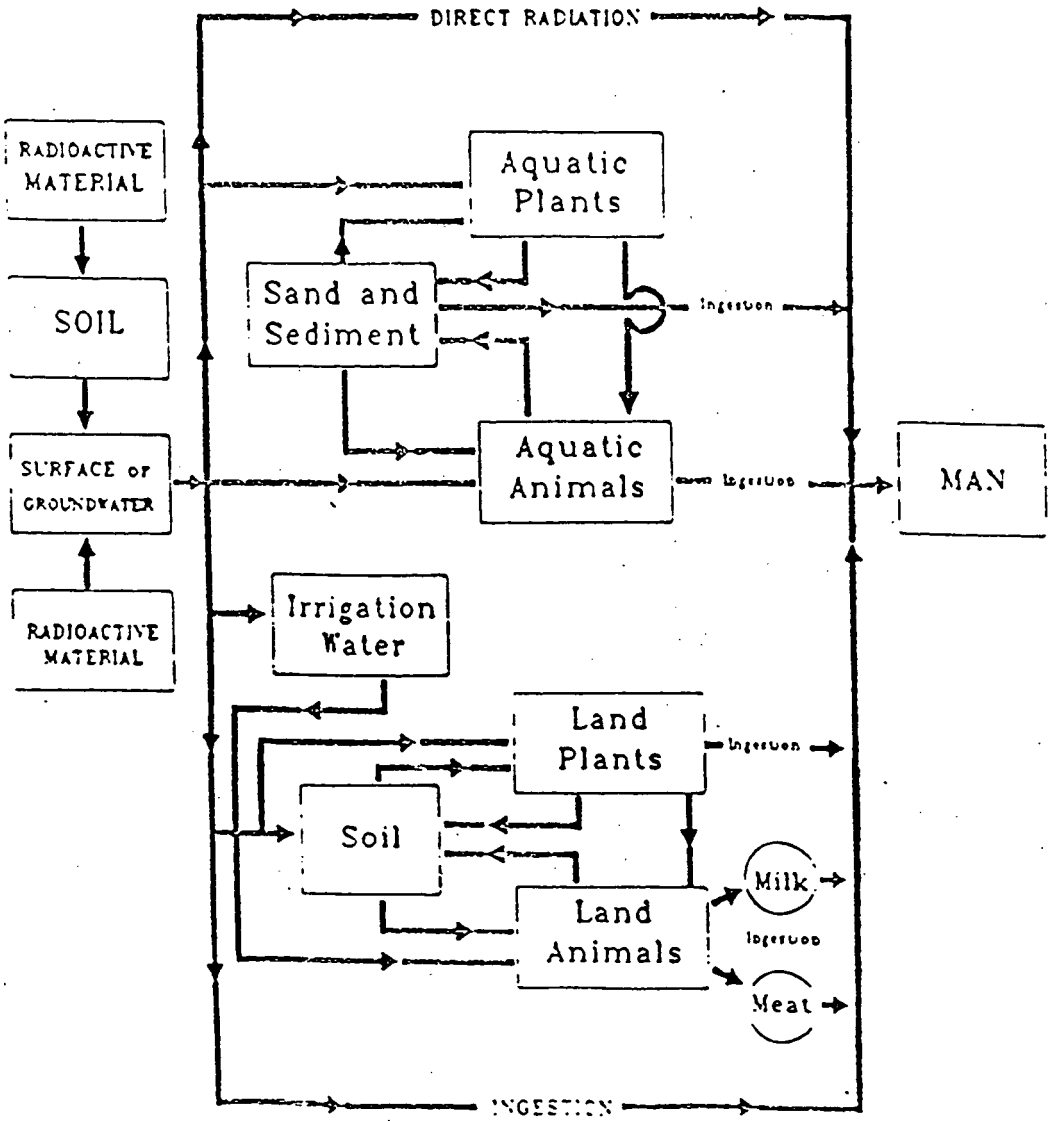


Figure 5-2: Liquid Pathways for Human Exposure

000180

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

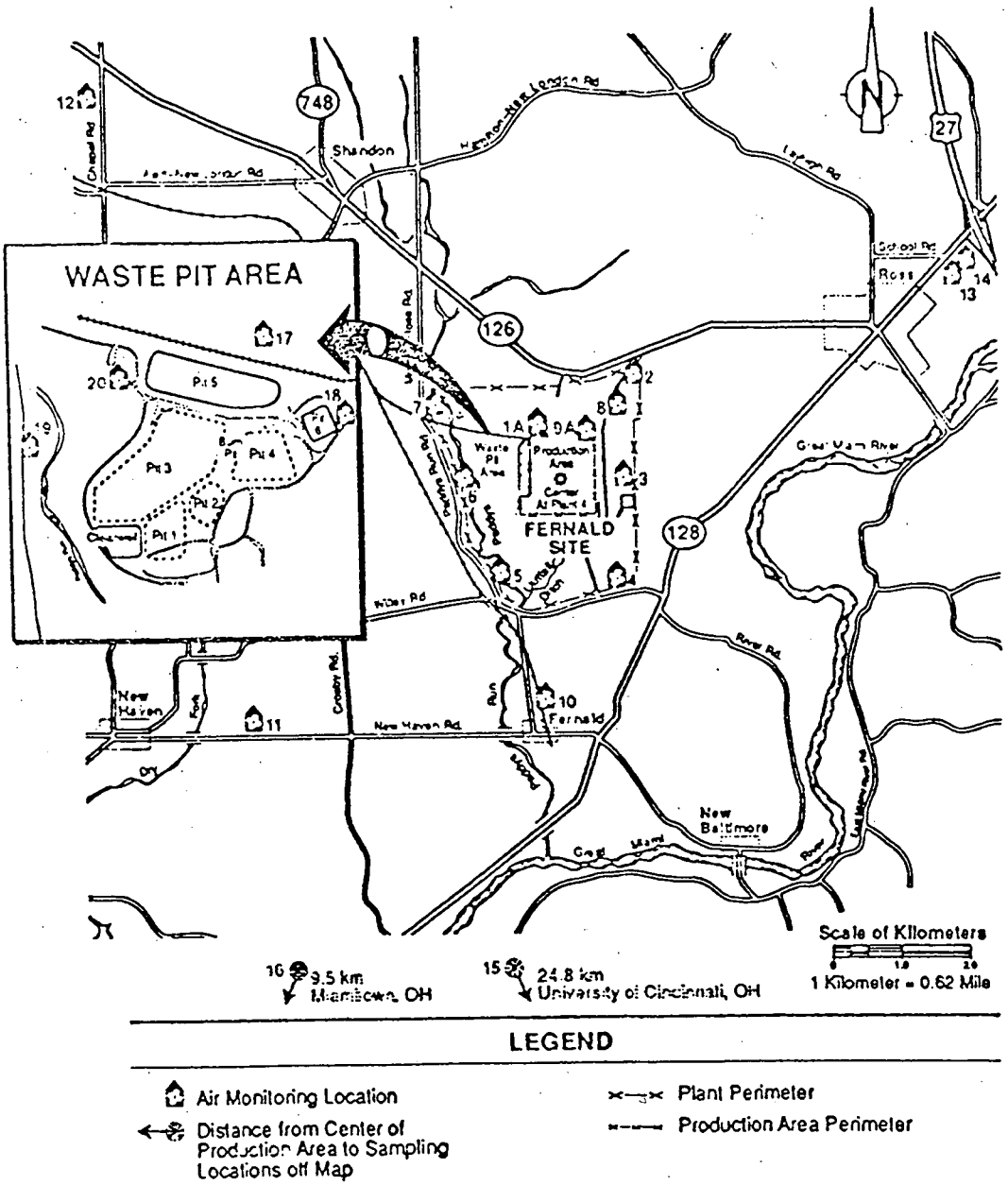


Figure 5-3: Air Monitoring Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

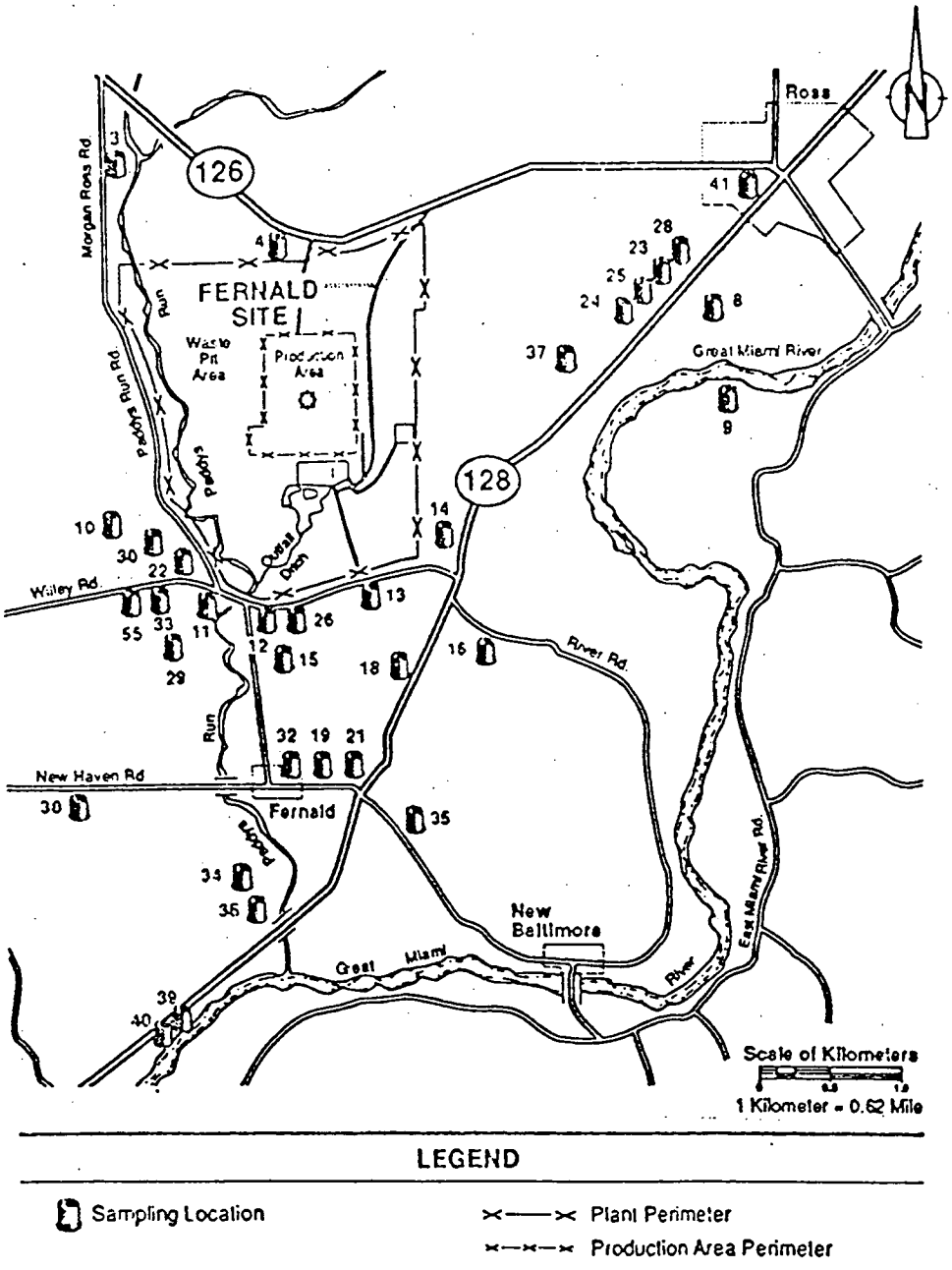


Figure 5-4: Private Well Monitoring Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

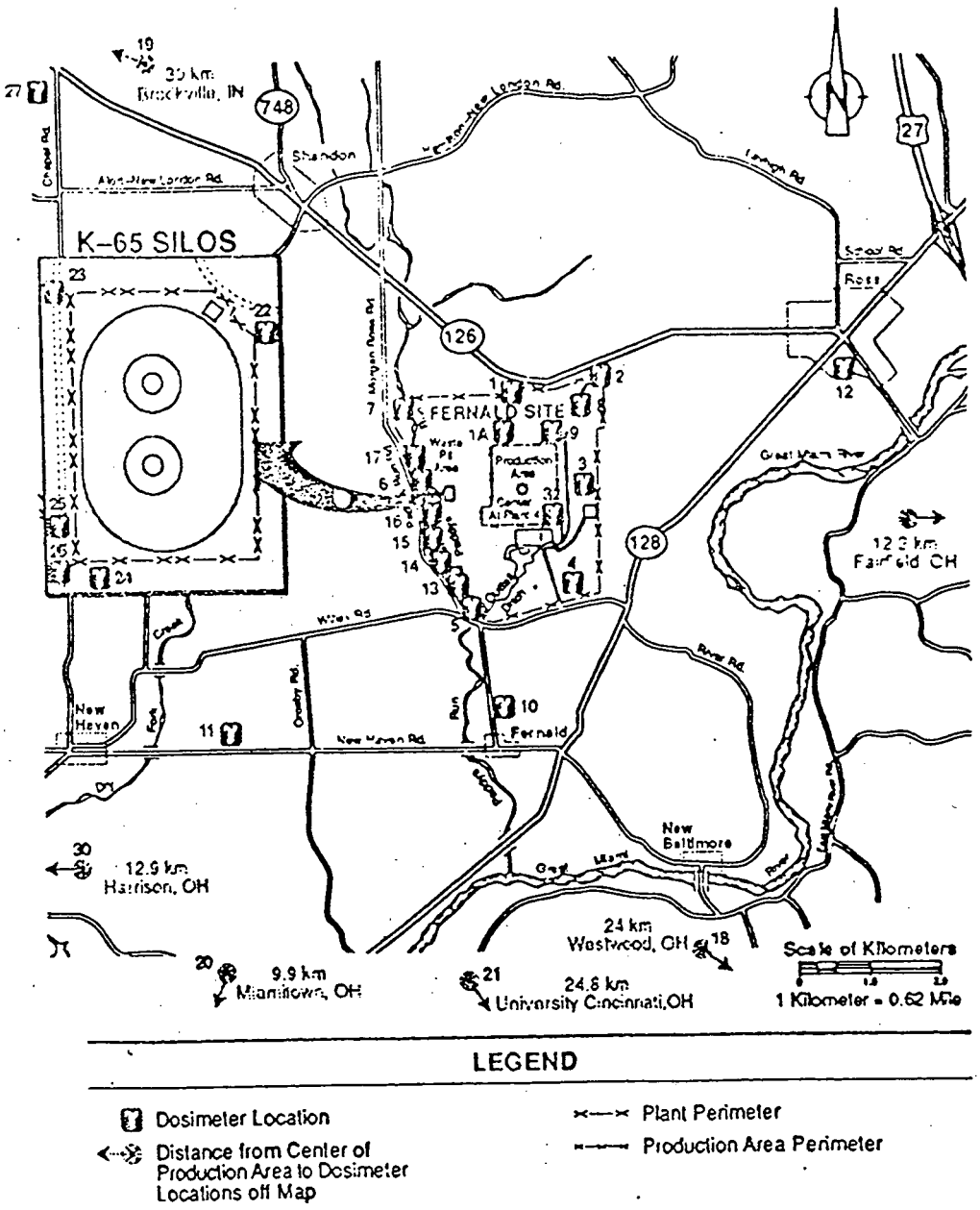


Figure 5-5: Direct Radiation Monitoring Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

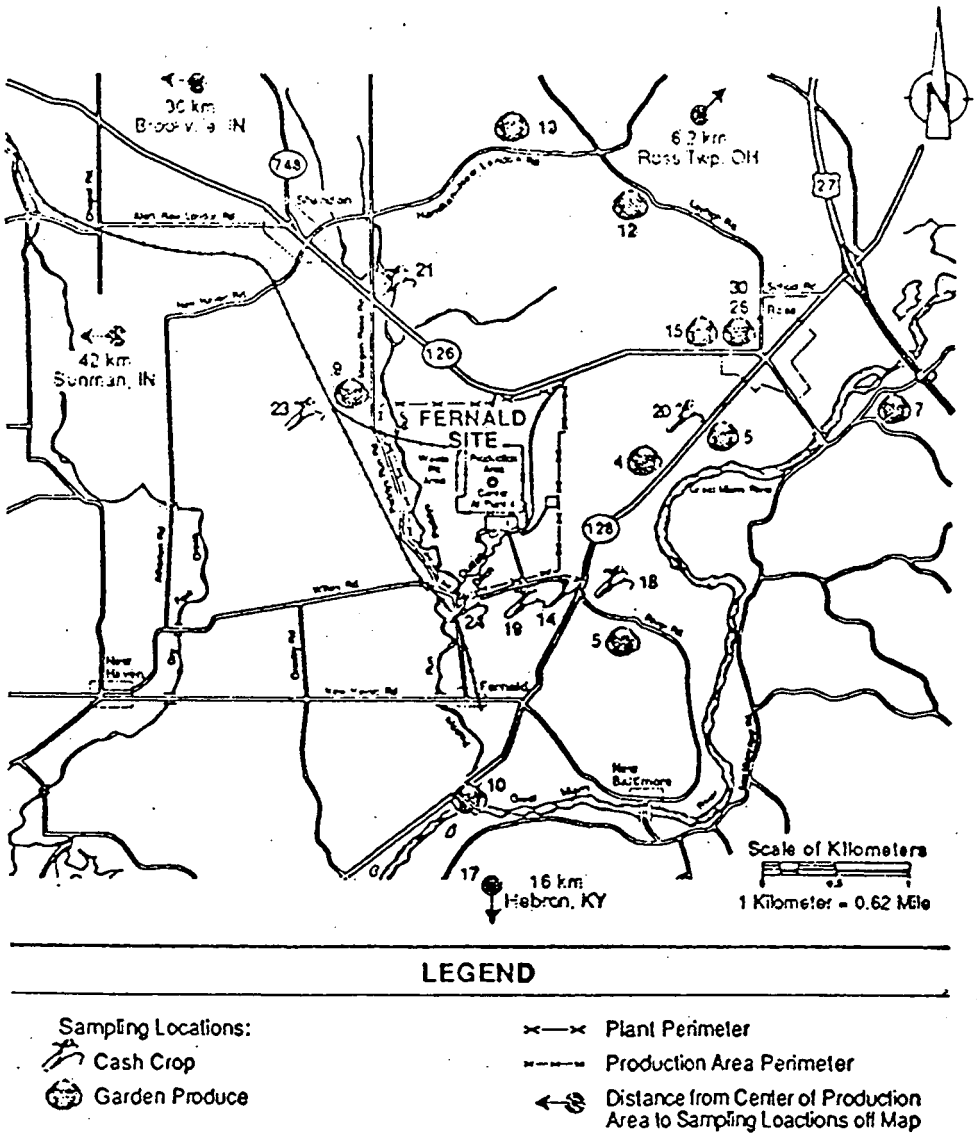


Figure 5-6: Produce Sampling Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

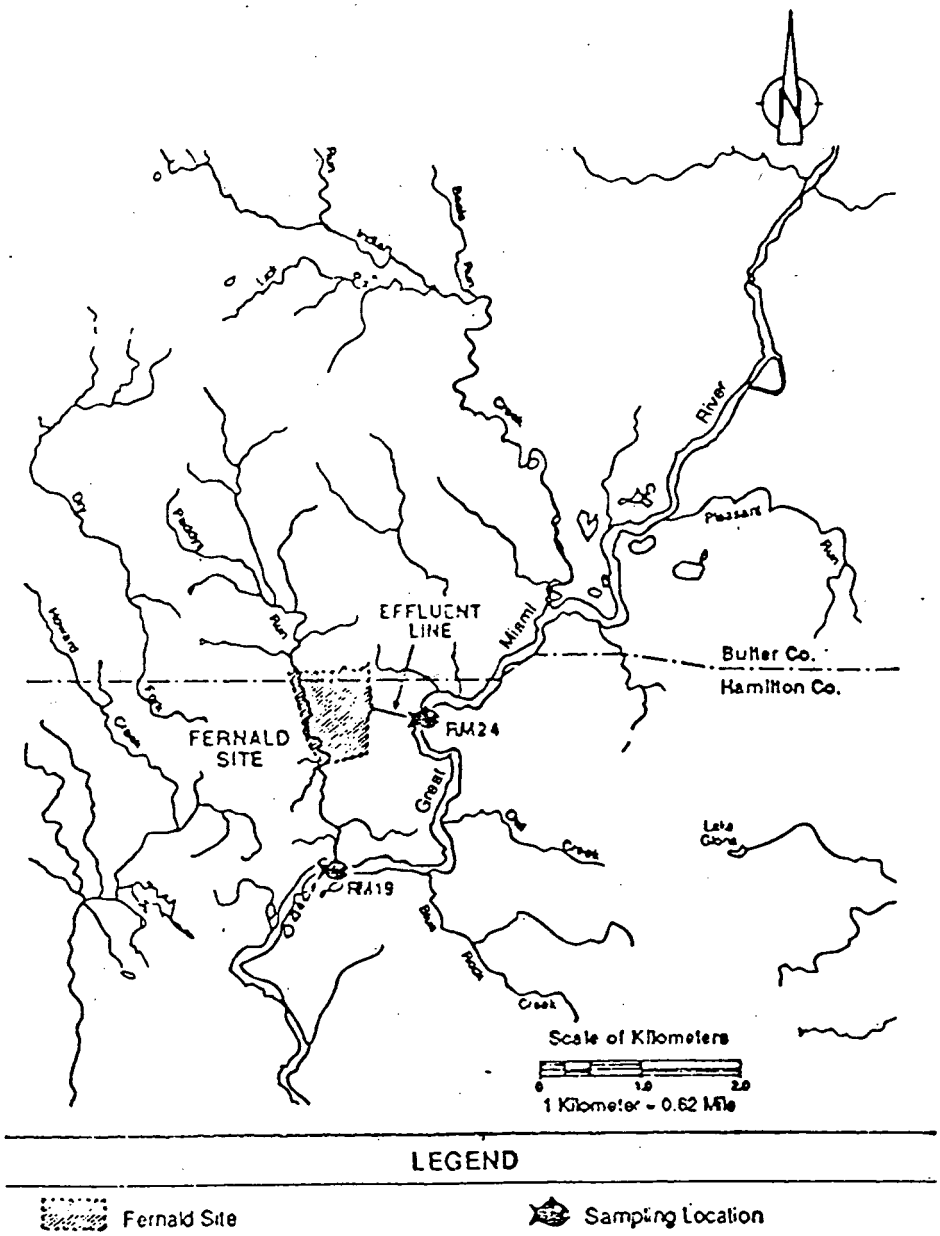
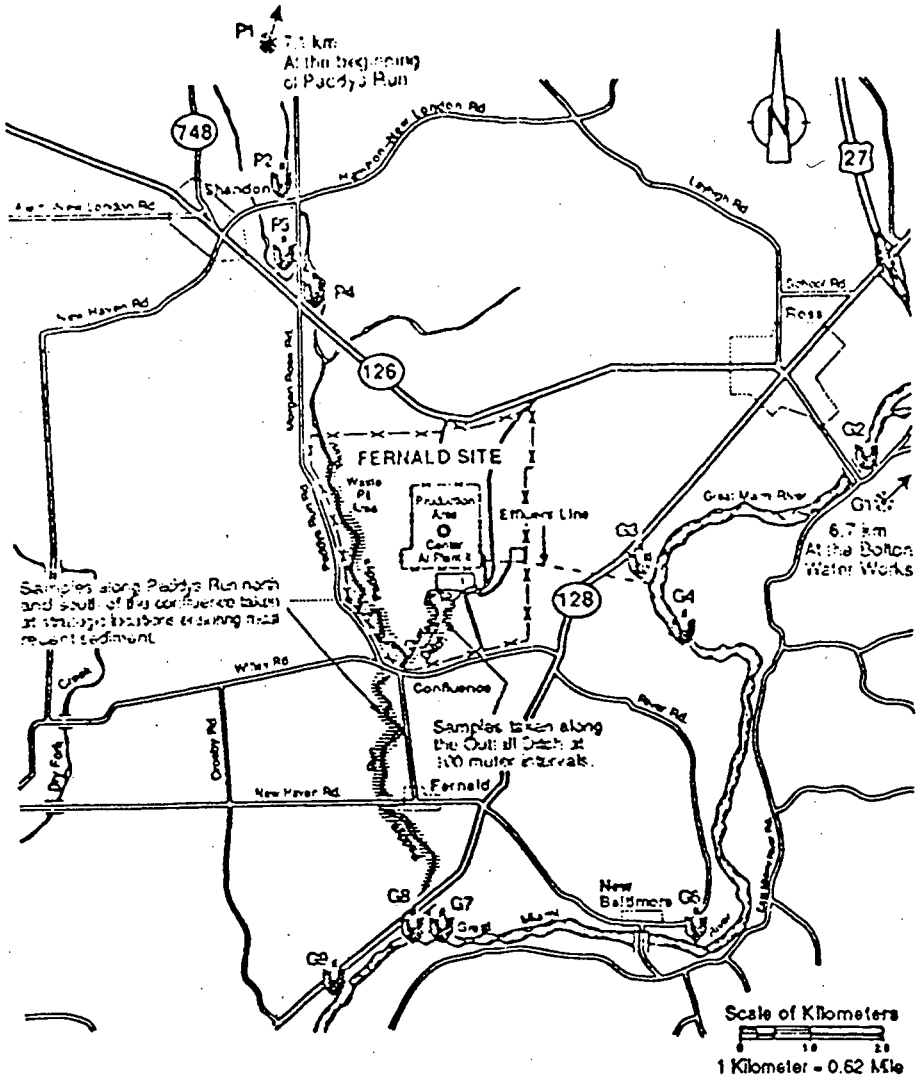


Figure 5-7: Fish Sampling Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)



LEGEND

- Single Sampling Location
- Distance from Center of Production Area to Dosimeter Locations off Map
- Plant Perimeter
- Production Area Perimeter

Figure 5-8: Sediment Sampling Locations

000186

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

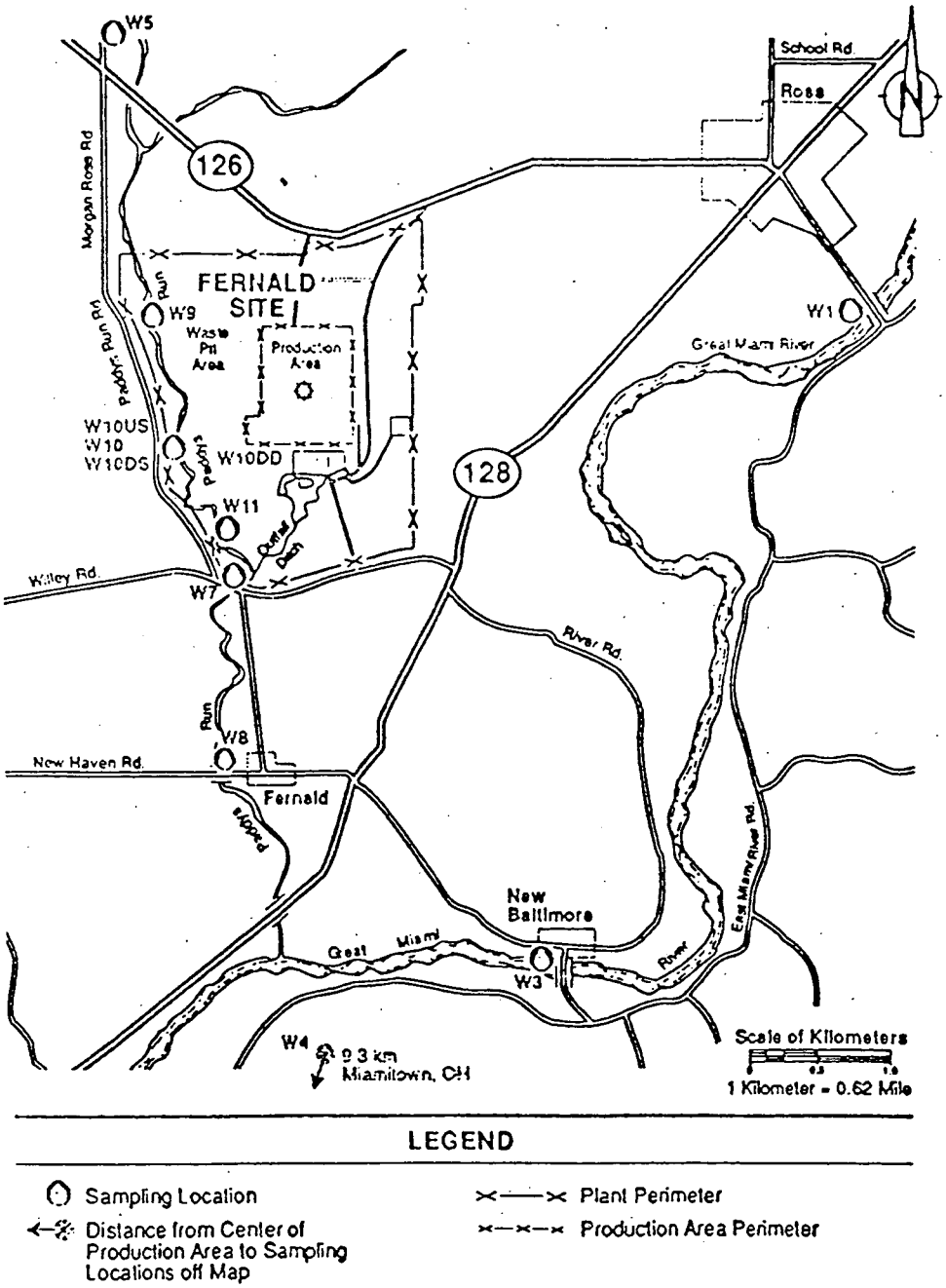


Figure 5-9: Surface Water Sampling Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

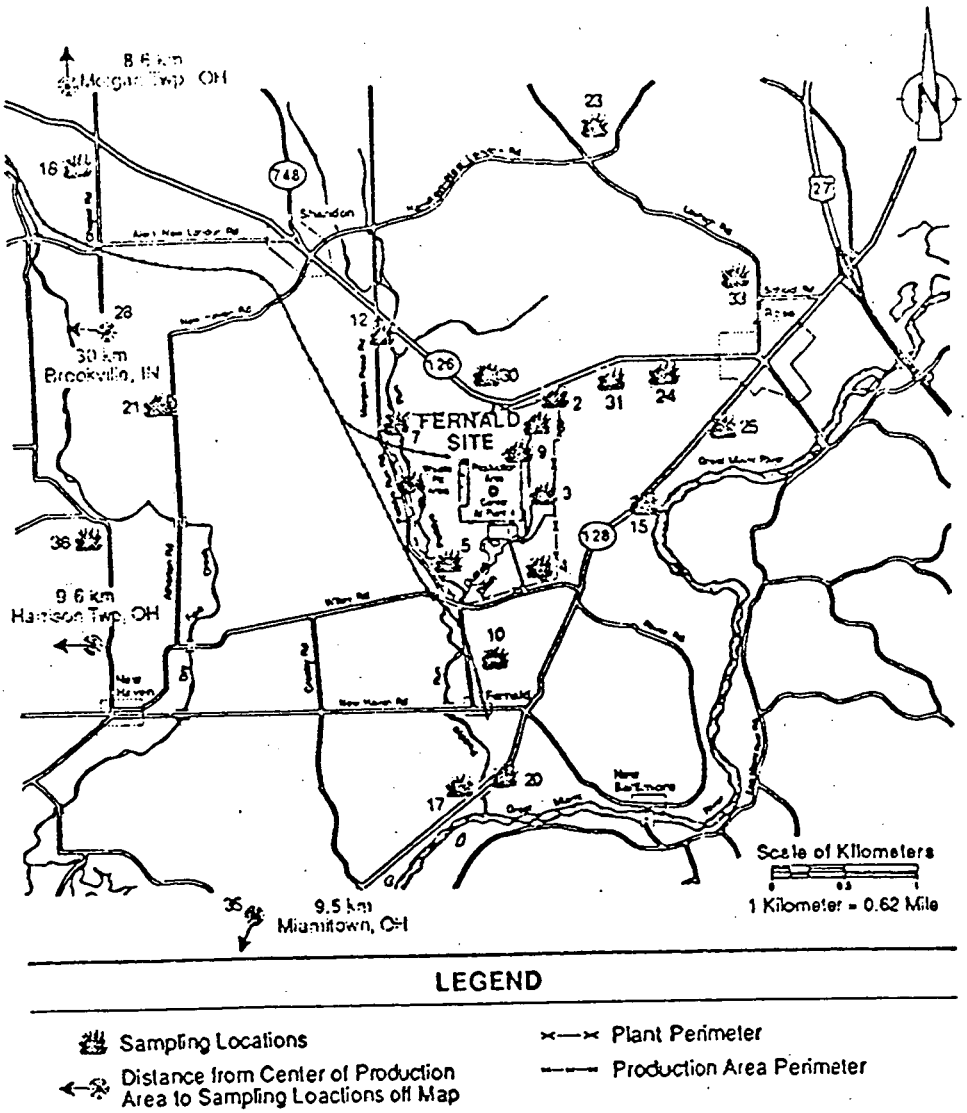


Figure 5-10: Soil and Grass Sampling Locations

000188

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

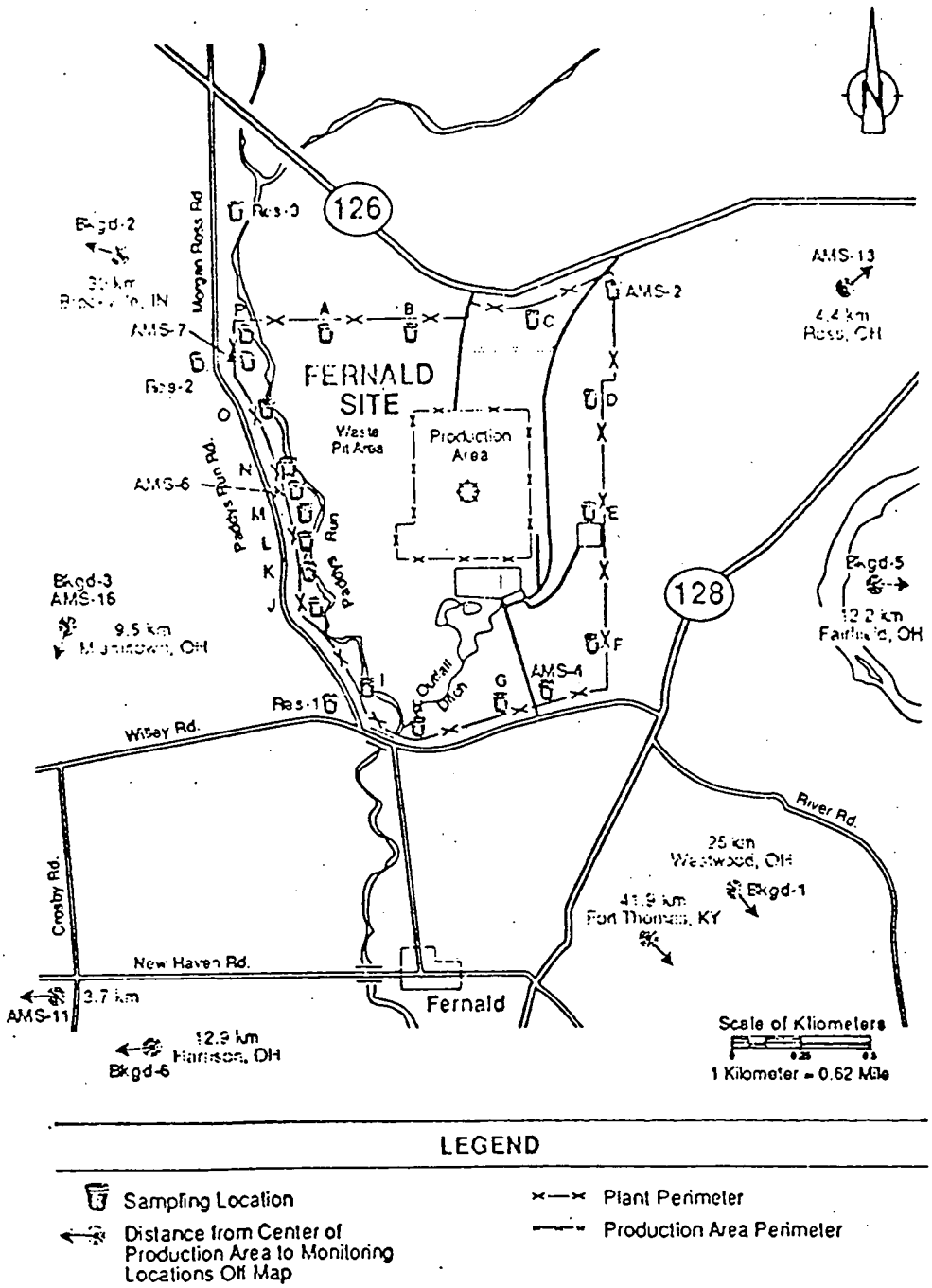


Figure 5-11: Radon Monitoring Locations

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

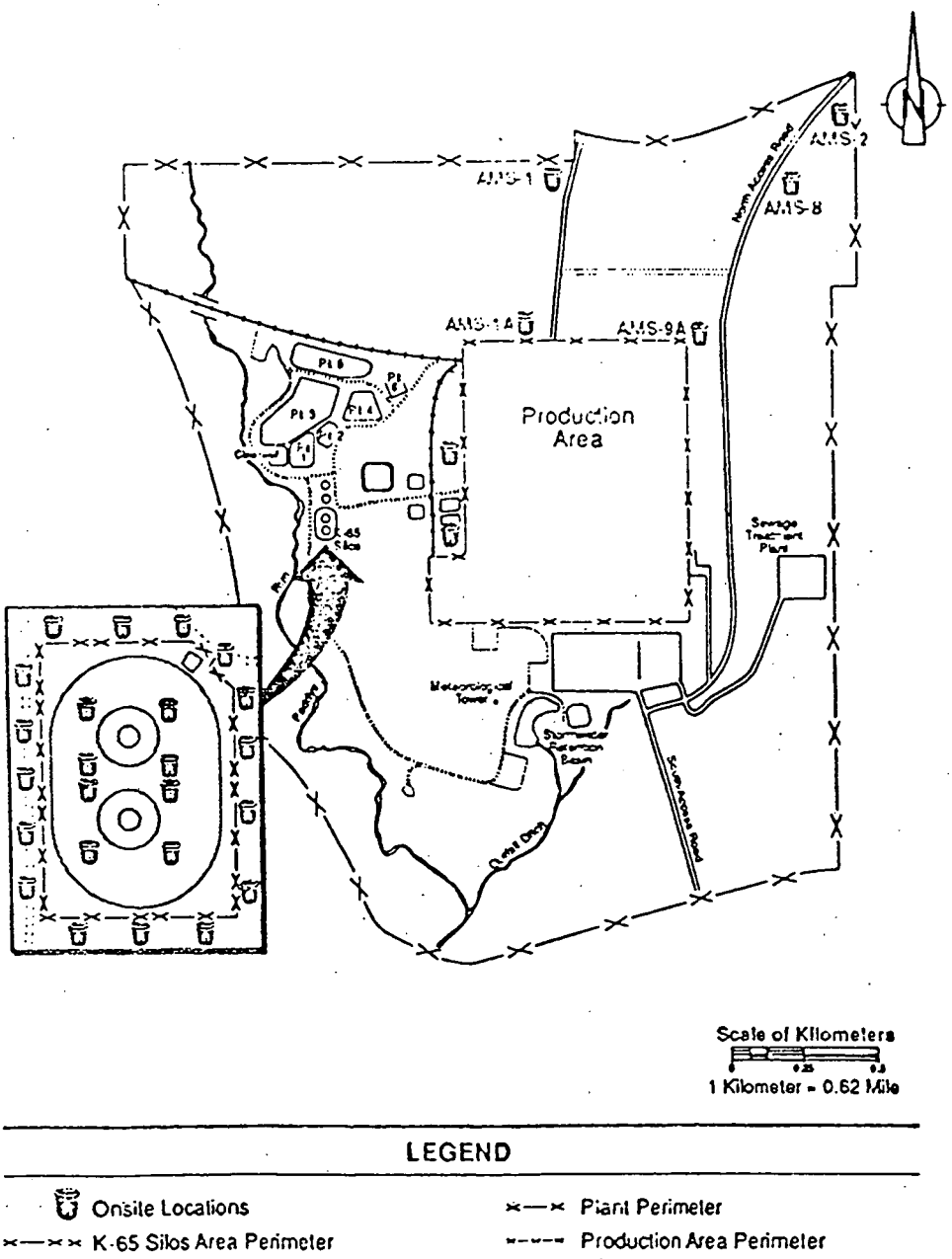


Figure 5-11 (cont.): Radon Monitoring Locations

000190

6.0 LABORATORY PROCEDURES

6.1 Introduction

Assessments of the impact of facility operations on the environment and the risk to the public depend upon generation of quality analytical results in the laboratory. In turn, the establishment, implementation, and maintenance of good laboratory practices are essential for obtaining quality results from the analysis of environmental and effluent samples.

This Section of the Environmental Monitoring Plan establishes criteria for the FEMP procedures that direct activities in the onsite laboratories. The Plan also establishes criteria to ensure that contract laboratories meet the comparable criteria. Section 5.0 of this Plan provides a description of current analyses conducted at the FEMP as well as those conducted in offsite labs. Section 9.0, "Analytical Procedures," of the SCQ also addresses laboratory procedures required for FEMP activities. These procedures are found in the FEMP Laboratory Analytical Methods Manual. It is a compilation of standardized analytical methods, identified to date, that will be used at the FEMP. General laboratory quality control procedures that are mandatory for performance of analyses are also incorporated in Attachment I of the SCQ.

As discussed in Section 1.1 of the EMP, applicable requirements set forth in the Comprehensive Environmental Occupational Safety and Health Program shall be followed. Any chemical handling shall be based on the Chemical Hygiene Plan.

This Section of the Plan sets forth criteria that must be met by both onsite and contract labs in the following areas (DOE/EH-0173T, Summary 6a):

- sample identification and tracking,
- sample handling,
- preparation of sample mounts,
- operation of analytical instrumentation,

6.0 LABORATORY PROCEDURES (cont.)

- reporting of results, and
- quality assurance.

Sitewide CERCLA Quality Assurance Project Plan (SCQ) requirements for laboratories shall be followed and are referenced where applicable in this Section.

6.1.1 Responsibilities

The Laboratory Service Department of the Environmental Division will ensure development of analytical methodologies in both onsite and offsite laboratories in order to meet the requirements of the SCQ and this plan. The Analytical Laboratory Services Department will ensure that organizational elements, laboratory utilization strategies, manpower and equipment, and streamlined procedures are in place in order that FERMCO operating units receive the highest quality of analytical data in adherence to performance schedule and in compliance with data quality objectives.

6.2 Sample Identification and Tracking

Samples must be clearly identified and tracked from collection to disposal so that analytical results generated can be unambiguously associated with the appropriate collected sample. Sample results are used to make operational decisions and to assess environmental impact from plant operations. There is also potential for the results generated for any collected sample to be used as legal evidence. Therefore, samples shall be positively identified, controlled, and tracked throughout field operations or collection and the analytical process according to the requirements set forth in this Section of the Plan (DOE/EH-0173T, Summary 6b) and applicable Sections of the SCQ.

Section 7.0, "Sample Custody," of the SCQ sets forth additional sample custody and documentation requirements for the FEMP. Sample custody procedures and documentation are conducted in accordance with the guidelines in the EPA Region V Model Superfund Quality

6.0 LABORATORY PROCEDURES (cont.)

Assurance Project Plan, which are derived from EPA sample custody protocols described in "NEIC Policies and Procedures", EPA-330/9-78-001-R (revised May 1986). Custody requirements are addressed in three parts: 1) sample custody and handling in the field, 2) custody during laboratory receipt and analysis, and 3) evidence files. Chain-of-custody forms must be used.

6.2.1 Sample Identification

All samples collected and FEMP-generated aliquots thereof shall be uniquely identified to ensure that data quality objectives are satisfied and to facilitate efficient processing. An aliquot is the fraction of a field sample taken for complete processing through an analytical procedure (a "laboratory sample" of a field sample).

Laboratory procedures for sample identification shall be maintained which ensure that a unique tracking number is assigned to every sample collected, and to each aliquot thereof (DOE/EH-0173T, Summary 6b). Sample identification procedures shall be maintained which specify that <u>at least</u> the following information will be provided on sample labels:

- unique tracking number,
- sample medium description, and
- sample collection date.

Additional requirements as applicable to the routine environmental monitoring program are found in Section 7.1.3, "Sample Identification and Labeling" of the SCQ.

Sample identification practices shall ensure that sample and aliquot labels are durable enough to withstand processing and storage conditions, are legible, and are securely attached to sample or aliquot containers. In certain cases it may not be practical to attach a label to a sample aliquot. The sample identification procedures shall specify these circumstances and provide for alternative means for achieving positive identification.

6.0 LABORATORY PROCEDURES (cont.)

Sample identification practices shall ensure that the identity of blind QC samples shall not be known to the analyst. Placing descriptors on sample labels that may reveal the identity of blind samples shall be avoided.

6.2.2 Sample Tracking

Tracking the receipt, processing, and transfer of samples by the FEMP laboratories is an important link in maintaining proper chain of custody records throughout the sample life cycle and in promoting efficient laboratory operation. The FEMP Analytical Laboratory Services Department is one of several custodians that are responsible for tracking samples. This Section addresses chain of custody requirements as they pertain to the FEMP Analytical Laboratory Services Department.

Procedures shall specify that all incoming samples falling under the purview of this Plan shall be accompanied by a completed chain of custody document. Sample receiving personnel for the Analytical Laboratory shall verify that the sample identification data on the chain of custody document match the identification data on the sample label. Any discrepancies represent a possible breach of sampling objectives and must be resolved prior to acceptance for analysis.

Procedures shall prescribe requirements for tracking samples throughout the Analytical Laboratory facilities commencing with sample receipt and ending with transfer to other organizations. While in the custody of the Analytical Laboratory, sample materials shall either be under the direct supervision of laboratory personnel during processing, or when not in use, secured in a location to which access is controlled. Procedures shall describe the mechanisms for tracking the location of sample materials throughout the Analytical Laboratory's facilities.

The tracking of sample materials by the Analytical Laboratory terminates whenever sample materials are exhausted, disposed of, or transferred to another organization. Program requirements specific to disposal are addressed in Section 6.3.5 of this Plan.

6.0 LABORATORY PROCEDURES (cont.)

The transfer of sample materials to other organizations, such as contract laboratories or sample offerors, shall be governed by procedures requiring such transfers to be documented in a manner that demonstrates the chain of custody. As a minimum, this documentation shall include:

- identity of transferee,
- transfer date and time,
- identities of sample materials being transferred, and
- transferror signature.

6.3 Sample Handling

Improper sample handling may compromise sampling objectives, threaten personnel health and safety, or violate regulatory requirements. The Sections that follow set forth criteria to ensure proper handling of samples so that sampling objectives are not compromised.

6.3.1 Sample Receipt

Samples may be submitted for analysis that cannot be accepted due to improper labeling, improper packaging or preservation, excessive age, insufficient size, or other degradation that could compromise personnel health and safety, cross-contamination controls, or sampling objectives. Therefore, procedures shall be maintained that prescribe sample receipt acceptance criteria. The following shall be met:

- proper sample identification (DOE/EH-0173T, Summary 6b),
- completed chain of custody record,

- external contamination (DOE/EH-0173T, Summary 6k),
- hazards identification,
- appropriateness and identification of preservatives,
- appropriateness of container,
- container integrity (*i.e.*, resistance to tampering and leakage),
- age (*i.e.*, holding time, decay time), and
- required quantity.

In addition, the subject procedures shall specify methods for identifying receipt non-conformance and shall prescribe appropriate response actions.

6.3.2 Prevention of Cross-Contamination

The most effective control for cross-contamination is segregation of samples according to activity level: processing only sample materials containing similar analyte concentrations using facilities and equipment that are dedicated to that concentration level.

All samples analyzed at the FEMP analytical laboratory are low-level samples. Sample segregation is therefore not necessary. If an analytical sample is found to be sufficiently contaminated as to not be considered a low-level sample, sample processing is immediately discontinued and a blank sample is analyzed to ensure no cross-contamination from the higher-level sample. Only after the blank sample analysis verifies no contamination of analytical equipment may sample analysis continue.

6.0 LABORATORY PROCEDURES (cont.)

6.3.3 Sample Shipment

Procedures shall be maintained that prescribe requirements for shipping samples offsite in accordance with federal, state, and local regulations. These procedures shall require samples being prepared for offsite shipment to be monitored for removable radioactive contamination and external radiation levels, and to have screening analyses performed to determine the gross concentration of radioactive materials (DOE/EH-0173T, Summary 6k). Based on the DOE transportation guidelines, radiological contamination monitoring and screening analyses need only consider alpha and beta radiations as indicators of removable contamination. Sample containers found to have removable, external, radioactive contamination in excess of applicable shipping regulations shall be decontaminated, repackaged, or over-packed so that compliance is achieved (DOE/EH-0173T, Summary 6k). Field storage and shipment of samples are addressed in Section 6.0, "Sampling Requirements," of the SCQ.

6.3.4 Preservation and Archiving

Procedures shall exist that direct the preservation and archiving of samples (DOE/EH-0173T, Summary 6d). If samples are archived before or after analysis, procedures shall be maintained that direct decisions to archive them. The decision to archive samples should be documented and re-evaluated on an annual basis for archive periods greater than one year. When considering a sample for archiving, the following shall be considered:

- probability of future need for the sample,
- suitability of the analyte,
- media compatibility,
- impact on routine program, and
- data compatibility,
- length of archival time.

6.0 LABORATORY PROCEDURES (cont.)

Once a decision to archive a sample has been made, special considerations may be necessary that are not necessary during the analysis of a routine sample. Procedures shall exist that direct special preparation of samples for archiving including special container types needed for long-term storage and special storage needs.

Unless proper documentation is maintained to properly identify a sample when it is archived, it can be of no use in future analyses. Therefore, procedures shall exist that ensure that sufficient documentation is generated to clearly identify and to show accountability for archived samples, including chain-of-custody forms.

Recommended preservatives and holding times for various constituents are given in Table 6-1 (Appendix A of the SCQ).

6.3.5 Disposal

Procedures shall be maintained that prescribe requirements for proper disposal of samples and aliquots thereof, in accordance with federal, state, and local regulations. The subject procedures shall require disposal records to be generated and maintained that document at least the following for each sample:

- identity of sample being disposed,
- sample characteristics (*i.e.*, hazardous material, radioactive material, mixed hazardous material, or non-hazardous material),
- approximate amount of sample material disposed, and
- disposal method.

6.0 LABORATORY PROCEDURES (cont.)

The analytical samples slated for disposal from the analytical laboratory are typically very low-level samples. Segregation of samples slated for disposal is therefore not normally required. If a sample analysis indicates that a sample is sufficiently radioactive that it cannot be considered a low-level sample, that sample is segregated and disposed of appropriately, in accordance with Federal, state, and DOE regulations.

Procedures shall be maintained that require archived samples to be examined periodically for potential disposal, including assessing the impact that disposing of such samples will have on the program.

6.4 Preparation of Sample Mounts

The preparation of sample mounts encompasses the processing of the sample from the time of receipt by the Analytical Laboratory to loading of sample material onto analytical instrumentation.

6.4.1 Development and Documentation of Methods

Analyses that will be used to demonstrate compliance with government regulations shall be performed using analytical methods approved by the regulating agency. In the event that sanctioned analytical methods do not exist, as is the case for many radiochemical procedures, required methods may be derived from procedures recognized in technical literature or may be developed through research. Procedures for newly developed methods shall describe their technical basis and validation (DOE/EH-0173T, Summary 6f). Regardless of their origin, procedures shall be maintained for every analytical method falling under the purview of this Plan. The subject procedures shall require identification and quantification of all radionuclides determined to contribute 10% or more to the total offsite dose or known level of environmental contamination as described in Section 5.0 of this Plan (DOE/EH-0173T, Summary 6e). In addition, the following items shall be addressed in the development of these procedures:

6.0 LABORATORY PROCEDURES (cont.)

- physical, chemical, or nuclear characteristics of target analytes,
- required accuracy,
- required minimum detectable concentration or precision,
- operating limits of analytical instrumentation,
- impact of matrix interferences,
- impact of interfering contaminants,
- holding times,
- analyst qualifications,
- cost, and
- impact of effort on laboratory operations.

Analytical procedures for contract laboratories shall be audited in accordance with Section 6.9 of this Plan to ensure that the general requirements of this Plan are met. Section 12.0, "Performance Assessment and System Audit," of the SCQ sets forth additional self assessment and independent assessment or work processes and operations requirements. Audit results of activities covered by the SCQ are available to the EPA upon request to DOE/FN. EPA may conduct external audits of the FEMP activities covered by the 1991 amended Consent Agreement as required.

Analytical procedures shall be maintained as controlled documents. Document control procedures shall be maintained that govern modifications to laboratory procedures, approval of

6.0 LABORATORY PROCEDURES (cont.)

changes, documentation of changes, and distribution to controlled document holders (DOE/EH-0173T, Summary 6f).

6.4.2 Separative Chemistry

Numerous chemical separations have been developed to reduce interference from analytes other than the target analytes. Separative chemistry techniques shall be avoided whenever possible due to the potential for errors caused by the loss of the target analyte during processing, and the time and expense involved. The following items shall be considered in determining whether or not a separative chemistry technique is necessary:

- physical, chemical, or nuclear characteristics of target analytes,
- operating limits of analytical instrumentation,
- required accuracy,
- required minimum detectable concentration or precision,
- impact of matrix interferences,
- impact of interfering contaminants,
- analyst qualifications,
- cost, and
- impact of effort on laboratory operations.

6.0 LABORATORY PROCEDURES (cont.)

Preparation procedures involving separative chemistry techniques shall require carriers, surrogates, and/or tracers to be introduced at earliest possible stage in processing or at the stage dictated by a sanctioned method. This requirement is aimed at obtaining the most realistic estimate of method recoveries. Specific procedures for separative chemistry techniques shall be maintained in accordance with Section 6.4.1 of this document.

6.4.3 Selection of Sample Size

Analysis procedures shall specify the amount of sample material that should be analyzed to achieve required surveillance and monitoring objectives. The following factors shall be considered in establishing the sample size required for a given analytical procedure:

- estimated concentrations of the target analytes and interfering contaminants based on experience or screening analyses,
- relative importance of the target analytes with regard to sampling objectives,
- amount of sample material available for analysis,
- required minimum detectable concentration or analytical precision, and
- operating limits of analytical instrumentation.

6.5 Operation of Analytical Instrumentation

Proper calibration and operation of analytical instrumentation is essential for demonstrating that sampling objectives have been met. This Section sets forth criteria for calibration and operation of analytical instruments that prevent the compromising of sampling objectives.

6.0 LABORATORY PROCEDURES (cont.)

Section 8.0, "Calibration Procedures and Frequency," of the SCQ sets forth additional requirements. Specifically, equipment shall be of the type, range, accuracy, and precision necessary to provide data compatible with the Analytical Support Level (ASL) (Section 2.0 of the SCQ) as specified in applicable DQO (Appendix C of the SCQ). Manufacturer's instructions and specifications, as well as accepted procedures from the American Society for Testing and Materials, the EPA, and the National Institute of Standards and Technology may be used. Variance from procedures shall be justified and documented in accordance with the SCQ.

Section 13.0, "Preventative Maintenance," of the SCQ requires that field projects and laboratories develop and implement a preventative maintenance program that complies with the guidelines presented in this section. Preventative Maintenance requirements may be documented in SOPs, PSPs, or in separate preventative maintenance documents.

6.5.1 Calibration

Calibration procedures shall be maintained for each analytical instrument. Development of the subject procedures shall address the following items:

- manufacturer's recommendations (DOE/EH-0173T, Summary 6i),
- required calibration frequency,
- traceability to NIST, or to another nationally recognized standard in the event a NIST standard does not exist,
- documentation required to demonstrate traceability,
- analyst qualifications,
- instrument operating limits, and

6.0 LABORATORY PROCEDURES (cont.)

- methods for identifying and resolving non-conformance.

6.5.2 Documentation of Methods

Procedures shall be maintained for operation of each analytical instrument (DOE/EH-0173T, Summary 6f). The subject procedures shall require identification and quantification of all analytes determined to contribute 10% or more to the total offsite dose or known level of environmental contamination as described in Section 5.0 of this Plan (DOE/EH-0173T, Summary 6e).

The following shall be addressed in the development of operating procedures for analytical instrumentation:

- precautions, limitations, and safety,
- operator qualifications,
- routine maintenance,
- control settings for operation,
- determination of blank or baseline response,
- determination of instrument calibration status,
- routine quality control performance checks (DOE/EH-0173T, Summary 6j), and
- identification and resolution of non-conformance.

6.0 LABORATORY PROCEDURES (cont.)

Operational history at the FEMP indicates that the potential for releasing gamma-emitting radionuclides exists. Therefore, the capability for analyzing samples by gamma spectrometry shall exist either onsite or offsite (DOE/EH-0173T, Summary 6h). Operating procedures for onsite gamma spectrometry instrumentation shall be maintained in accordance with the requirements in this Section.

The instrument operating procedures of contract laboratories shall be audited in accordance with Section 6.9 of this Plan.

Instrument operating procedures shall be maintained as controlled documents. Document control procedures shall be maintained that direct modifications to laboratory procedures, approval of changes, documentation of changes, and distribution of changes to all controlled document holders (DOE/EH-0173T, Summary 6f).

Section 9.0, "Analytical Procedures," of the SCQ sets forth additional requirements. Attachment I, "FEMP Laboratory Analytical Methods Manual" establishes project requirements that laboratories performing analyses and generating data under the SCQ shall meet.

6.6 Validation of Laboratory Results

Environmental and effluent data are reviewed at several levels in the analytical process to ensure the quality of data released for reporting. This Section describes the first step in the data review process (as defined by DOE): the validation of analytical results generated in the laboratory. Data entry verification, data review, and data approval are discussed in Section 7.3 of this Plan.

NOTE: FERMCO has charged the Quality Control Department of the RSO Division with Data Validation as defined in Section 7.1 of this plan.

Also, Section 11.0, "Data Reduction, Validation, and Reporting," of the SCQ sets forth procedures that shall be used by FEMP personnel, the FEMP laboratory, and subcontractor

6.0 LABORATORY PROCEDURES (cont.)

laboratories for data reduction, validation, and reporting as applicable for each ASL (Section 2.0 of the SCQ). A Data Validation Plan that must be followed is described in Appendix D of the SCQ. Analytical results generated in the laboratory must be verified to ensure that the laboratory processes were under control and that results have not been adversely influenced. Procedures shall exist that establish the roles of the following in determining the validity of laboratory results:

- analysis of batch blanks,
- analysis of known spikes, and
- analysis of instrument check sources.

Refer to Section 6.8.2 of this Plan for specific quality assurance requirements that ensure laboratory process control.

In addition, Section 10.0, "Internal Quality Control Checks and Frequency," of the SCQ sets forth additional requirements. Internal Quality Control (QC) checks are performed to verify the quality of measurements of field and laboratory investigations and associated tasks. Required frequencies for internal QC checks are specified in Table 2-2 (Appendix A) of the SCQ).

6.7 Reporting of Results

Analytical results must be reported in a manner that is consistent with established sampling objectives. In recognition of the fact that analytical results will be viewed by a diverse set of user groups including members of the general public, results shall be reported in a manner that is both accurate and consistent. Reporting of analytical results shall be governed by the criteria set forth in Section 7.5 of this Plan.

Section 16.0, "Quality Assurance Reports to Management," of the SCQ sets forth additional reporting requirements that effect the routine Environmental Monitoring Program at the FEMP. This section sets forth requirements for laboratories and quality control coordinators to provide Laboratory Management Reports to management.

6.8 Quality Assurance

Implementation of a comprehensive laboratory quality assurance program is essential to the generation of reliable, credible analytical results. The general quality assurance provisions set forth in Section 10.0 of this document shall be followed (DOE/EH-0173T, Summary 61). These provisions reference SCQ requirements that shall be followed.

The Analytical Laboratory Service Department shall maintain procedures which ensure that a comprehensive laboratory QA program shall be maintained. The laboratory QA program shall encompass as many aspects of the analytical process as possible including control of chemical processing as well as control of analytical instrumentation.

6.8.1 Intercomparison Studies

The Analytical Laboratory Service Department shall participate in intercomparison studies with recognized laboratories such as EPA-Las Vegas or DOE Environmental Measurements Laboratory (EML), as an independent verification on the quality of results generated. Participation in these studies shall involve evaluation of blind spiked samples. In addition, split-sample intercomparison studies shall be conducted with reputable contract and government laboratories. Procedures shall be developed that specify requirements for shipping, receiving, handling, reporting, and evaluation of data associated with interlaboratory QC samples. QC procedures shall specify that QC samples will be processed and analyzed in the same manner as routine samples.

6.0 LABORATORY PROCEDURES (cont.)

6.8.2 Process Control

There are many variables in the analytic process. Control of these variables must be maintained to obtain reliable, consistent analytical results. Procedures shall be maintained that specify methods for controlling variability in the following:

- labware,
- reagents,
- analyst technique, and
- analytical instrumentation.

Procedures shall be maintained that specify methods for gauging control of specified variables through maintenance of control charts. Control charts shall be maintained that monitor the accuracy, precision and sensitivity of analytical results. The parameters to be controlled shall be specified in the procedures.

Procedures shall be maintained specifying laboratory "internal QC samples" that will be created and processed with every analytical batch. Instrument operating procedures shall ensure that instrument performance checks are performed on a periodic basis or performed in accordance with sanctioned analytical methods (DOE/EH-0173T, Summary 6j). The subject procedures shall set forth performance standards so that conformance of analytical methods and instrumentation to those standards can be evaluated. As a minimum, investigative action shall be required when the following performance standards are exceeded:

- data point outside upper or lower control limit on a process control chart,

6.0 LABORATORY PROCEDURES (cont.)

- seven consecutive data points on the same side of the central line of a process control chart,
- analytical instruments found out of calibration, and
- analyst overdue for requalification.

Section 4.0 of the SCQ, "Quality Assurance Objectives," addresses the type and frequency of Analytical Quality Control Samples: Laboratory Control Samples (LCS), method blanks, matrix spike, matrix duplicate/replicate or matrix spike duplicates, surrogate spikes, blind or double blind QC samples, and intercomparison study samples. These types of QC samples shall be analyzed by the analytical methods in Attachment I of the SCQ. Types of QC samples are based on ASLs. They are discussed in Section 9.0 of the SCQ and in Attachment I. Internal QC checks are specified in Section 10.0 of the SCQ.

6.8.3 Resolution of Non-Conformance

Procedures shall be maintained that set forth corrective actions to be taken in response to QC non-conformance. These procedures shall require documentation of the following:

- description of non-conformance,
- identity of the individual finding the non-conformance,
- date and time the non-conformance was identified,
- description of immediate corrective actions taken to eliminate further non-conformance,

6.0 LABORATORY PROCEDURES (cont.)

- review of the impact of the non-conformance on historical data and a description of any corrective actions taken, and

- description of corrective actions taken to prevent a recurrence.

Section 15.0, "Corrective Actions," of the SCQ addresses deviations, onsite and offsite corrective action protocols, evaluation of recurring deviations, and variances.

6.9 Control of Contract Laboratory Services

A significant number of FEMP samples are shipped offsite for analysis by contract labs. Contract laboratories must meet the requirements of this Plan. Procedures shall exist that ensure that the quality of results generated by contract laboratory services is maintained in accordance with this Plan throughout the contract (DOE/EH-0173T, Summary 6g). Contract laboratories must be approved prior to being used for sample analysis.

Procedures shall exist that list the minimum information to be specified in a written contract with an outside laboratory service. Items that shall be specified include:

- sample handling requirements,
- analytical performance requirements,
- required limits of detection,
- reporting requirements,
- quality assurance requirements,
- processing time requirements, and
- audit requirements (DOE/EH-0173T, Summary 6g).

Procedures shall exist that direct submittal of blind quality control samples to contract laboratories on a regular basis. These samples will provide continuing assurance that the accuracy, precision, and detection levels are being maintained as specified by the contract.

6.0 LABORATORY PROCEDURES (cont.)

In addition, procedures shall exist that direct periodic audits of the contract laboratory facility by qualified site personnel. As a minimum, the following audit requirements shall be considered in the development of audit procedures for control of contract labs:

- sample receipt and tracking procedures,
- analytical methodology procedures,
- instrument operating procedures,
- special contract requirements,
- QA/QC procedures, and
- activities conducted in accordance with written procedures.

As described in Section 3.4 of the SCQ, Analytical Laboratory Responsibilities, Analytical laboratories providing services for the FEMP are responsible for compliance with their specific contract, Appendix E, and Attachment I of the SCQ. Laboratory performance will be evaluated on an ongoing basis through the use of Audits (Section 12.0 of the SCQ) and performance evaluation samples (Appendix E of the SCQ).

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT

Analytical data generated in support of the environmental surveillance and effluent monitoring programs are used in assessing the quality of the environment, the effect of plant operations on the surrounding area, and the impact on the health and safety of the general public. The effluent monitoring and environmental surveillance program activities that are performed as required by DOE Order 5400.1[1] and DOE Order 5400.5[7] will produce estimated levels of selected analytes at indicator and control sampling points. These measurements, along with their accuracy and precision, will support the following types of data analyses:

- temporal analyses that will identify changes or inconsistencies in sample results;
- spacial analyses that will aid in assessing the impact, if any, that facility operations have had on the environment; and
- comparative analyses that will indicate the status of compliance with applicable regulations, operational limits, and guidelines,
- risk assessments.

Data that are generated through environmental surveillance and effluent monitoring activities must be validated and reviewed at several levels in order to ensure that the data are accurate and useable to meet the DQOs. The SCQ requirements for data analysis and statistical treatment shall be followed by FEMP personnel, the FEMP laboratory, and subcontractor laboratories for data reduction, validation, and reporting as applicable for each ASL (Section 2.0 of the SCQ). The data validation plan is described in Appendix D of the SCQ. Levels of review, which include data validation in the lab, verification after entry in the database, data analysis, and final approval, are discussed below. SCQ requirements are referenced.

Prior to use in the types of analyses stated above, the data that are generated by either onsite or contractor analytical laboratories must be validated. The validation process involves a review

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

of process control data to ensure that the analytical results were not adversely affected during the analytical process and that the results are believable; it is performed by the laboratory. Specific requirements for laboratory quality controls and data validation are specified in Section 6.6 of this document. Additional requirements that shall be followed are found in the SCQ, Section 4.0, "Quality Assurance Objectives;" Section 14.0, "Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness;" and Appendix D, "Data Validation Plan." The SCQ Data Validation Plan, addresses field data validation procedures as well as analytical validation procedures.

In addition, the SCQ addresses the "Data Management Plan" in Appendix F. The Data Management Plan addresses the FEMP Environmental Data Management System which comprises the Automated Sampling and Analysis Program System, the Fernald Analytical Computerized Tracking System (FACTS), the Data Validation System, the ORACLE Results Database, and the INTERGRAPH ERMA System. Consideration of on-property measurements across the property, for the appropriate parameter, is expected to be common place via implementation of the Data Management Plan. It will ensure integration and coordination of individual activities of each PSP with overall FEMP goals, reduce duplication of sampling efforts, and improve the use of data for multiple purposes.

The Section that follows describes subsequent data treatment requirements, beginning with the entry of data into an appropriate database and verification thereof. Following data entry and verification, data will be reviewed with the applicable field QC data to judge acceptability.

Data that are analyzed and judged as acceptable are approved. Data approval indicates release of data for use in reports, and in temporal, spacial, and comparative analyses.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

7.1 Organizational Responsibilities

Data review is defined as a contractual compliance data completeness determination, based on the PSP. It is not a technical evaluation of specific data points or sample tests. Data validation is defined as a technical assessment of data usability based on comparison of the data to an established set of guidelines, such as those found in Appendix D of the SCQ, or Functional Guidelines promulgated by the EPA. Data validation addresses precision and accuracy of the data, as measured by the evaluation of specific QC criteria, such as blanks, matrix spikes, field and lab duplicates, and other parameters. Data validation results in data that are considered confident, qualified (estimated or biased), or rejected.

Data validation does not encompass a statistical treatment of data sets, as discussed in Section 7.4 of this Plan, although usability determination may involve some statistical manipulation of individual sample data or a group of samples or analytes in a particular sample set. However, comparisons between data sets (trend analysis) are not part of the data validation effort as charged by FERMCO. The Data Validation Group in the Environmental Division is responsible for data validation as defined above.

According to DOE, data validation is defined differently. Data validation is a systematic review of a data set to identify outliers or suspect values. The process uses statistical techniques to screen out impossible or highly unlikely values. This will be the responsibility of data end users (responsible programs).

7.2 Variability of Effluent and Environmental Data

Variability in environmental and effluent data may be caused by various factors ranging from natural variability to gross instability, and includes systematic and random differences over time and space, non-representative sampling, cross-contamination, errors in results measurement, errors in measurement equipment calibration, and errors in data entry. The requirements specified in this document for sample collection, sample handling, sample analysis, data entry,

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

and data review and approval shall be implemented by procedure. These standard procedures provide the means for consistent sample handling, data analysis and data management which will reduce variability in results to a minimum (DOE/EH-0173T, Summary 7b).

7.3 Data Management

Field data and analytical data generated in the laboratory must be properly managed to facilitate timely review and reporting of data, and to prevent loss of critical data. Prompt sample analysis, data entry, and review are essential. The sections that follow set forth requirements for proper data management including data entry, verification, review, and approval.

7.3.1 Data Entry and Verification

Field data gathered while a sample is collected and analytical data generated in both onsite and offsite laboratories shall be entered into an appropriate database for analysis. Following data entry, data must be verified to ensure accurate posting in the database. Procedures shall be established and maintained that ensure:

- analytical results are entered promptly after they are examined and analyzed (DOE/EH-0173T, Summary 7e),
- results are verified after entry by qualified personnel other than the person that enters the results, and
- discrepancies are resolved.

Note: The FERMCO Analytical Laboratory, Environmental Monitoring, and the Information System groups have implemented a FEMP site-wide database using the ORACLE Relational Database Management System software. The database, when populated with data from the various storage media currently being used at the FEMP site, will be accessible by all key

000215

FEMP personnel. In addition, a Geographical Information System can access this data for graphical output and for preparation of sampling Plans and reports.

Section 4.0, "Quality Assurance Objectives," of the SCQ, addresses quality control for both field and analytical samples. Appendix D, "Data Validation Plan," of the SCQ addresses field data validation procedures. Appendix E, "Analytical Laboratory Performance Requirements," of the SCQ addresses quality assurance and quality control procedures. Appendix F, "Data Management Plan," addresses data entry, software, and database requirements. In addition, EP-REM-013, "REM Data Review and Analysis", provides a controlled and consistent system within Environmental Monitoring for the review of environmental data.

7.3.2 Data Review and Approval

Following data entry and verification, data shall be reviewed and approved by qualified personnel prior to release for use in reports. The data review process is documented by procedure EP-REM-013, "REM Data Review and Analysis."[49] This data review procedure is required to consider at least the following elements:

- comparison to control points,
- comparison to historical data,
- comparison to field QC sample results, and
- resolution of discrepancies.

All verified analytical results shall be maintained in the database regardless of whether or not they are approved for reporting. Reasons for data rejection shall be documented. Refer to Section 7.4.5 for data rejection criteria. For additional field and laboratory requirements, refer to Section 11.0, "Data Reduction, Validation, and Reporting," of the SCQ.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

7.4 Summarization of Data

Techniques for summarization of data sets shall be based on the characteristics of the environmental and effluent monitoring data (DOE/EH-0173T, Summary 7a). Requirements to be placed on data summarization techniques, including distribution analyses, measures of central tendency, and measures of dispersion follow. For additional field and laboratory data requirements, refer to Section 11.0, "Data Reduction, Validation, and Reporting," of the SCQ.

7.4.1 Distribution Analyses

Where applicable, distribution analyses shall be performed to determine the distribution model which best fits a given data set. Environmental and effluent monitoring data distributions are generally log-normal rather than normally distributed. Statistical techniques appropriate for the distribution of data shall be employed and documented. Non-parametric techniques or normal transformations will be necessary in most cases. Refer to procedure EP-REM-013, "REM Data Review and Analysis".

7.4.2 Measures of Central Tendency

The measure of central tendency that will be employed depends on the distribution of the data. In general, calculation of the arithmetic mean ($\bar{x}$) is an appropriate estimator of the true mean (μ) for normally distributed data. In cases where data are not normally distributed, or are censored, measures of central tendency such as the median, geometric mean, trimmed mean, or Winsorized mean will be more appropriate. Refer to procedure EP-REM-013, "REM Data Review and Analysis".

7.4.3 Measures of Dispersion

The measure of dispersion that should be employed also depends on the distribution of the data. In general, calculation of the sample variance (s^2) is the appropriate estimator of the true

000217

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

variance (σ^2) for normally distributed data. In cases where data are not normally distributed, other measures of dispersion such as geometric standard deviation, range, ratio of maximum value to minimum value, or the coefficient of variation may be more appropriate. Refer to procedure EP-REM-013, "REM Data Review and Analysis".

7.4.4 Testing for Outliers

Outliers are data points that fall on either extreme end of the data set. Outliers may be valid data points or may indicate errors in the sample collection and/or analytical process. Procedures for performing standard tests for outlier data points shall be documented and maintained. Outliers shall be investigated to determine whether or not they are due to errors in the measurement process. Outliers that cannot be attributed to specific, identifiable errors in the sample collection or analytical process or due to discontinuities, periodicities, runs, and trends shall not be excluded from the data set (DOE/EH-0173T, Summary 7f). If the outlier is due to an error, the data point should either be corrected (if possible) or excluded. Outlier testing should be performed immediately upon receipt of the data so that re-sampling, when necessary, can be scheduled as close in time to the original sampling event as possible. Refer to procedure EP-REM-013, "REM Data Review and Analysis".

7.4.5 Rejection of Data

Analytical results may be considered suspect due to errors that have occurred in the sample collection and data analysis process. For example, cross contamination may be suspected based on analysis of related field and laboratory control samples. Data that are suspect shall be investigated. Data may be rejected only if a legitimate specific cause can be identified (DOE/EH-0173T, Summary 7f). Procedures that govern rejection of data shall be established and maintained that consider:

- criteria for data rejection,

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

- documentation of rationale for data rejection, and
- maintenance of rejected data.

Deviation from historic experience, without a known sampling or analysis error, shall not be permitted as a cause for data rejection. Refer to procedure EP-REM-013, "REM Data Review and Analysis".

7.4.6 MDA Formula

The formula by which the FEMP will calculate estimated MDAs for radiological analyses is presented below. Variables in the denominator will be applied when applicable to the analysis type.

$$MDA = \frac{k^2 + 4.65\, S_b}{Y\, V\, T\, S\, \epsilon \exp(-\lambda t)}$$

where:

MDA =	The signal level such that a signal at or above this level is likely to be detected
k =	1.64, the value of the standardized normal deviate that is exceeded with probability (alpha) = 0.05.
S_b =	standard deviation of the laboratory blank (background)
Y =	the fractional yield for the radiochemical separation
V =	sample size

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

$T =$ counting time interval

$S =$ the self-absorption correction factor

$\epsilon =$ the detection counting efficiency

$\exp(-\lambda t) =$ the correction for radioactive decay between sample collection and counting (time interval, t)

$\lambda =$ the decay constant for the particular radionuclide

7.5 Data Reporting

Data generated from the analysis of environmental and effluent samples will be reviewed by a diverse group of people with different uses for the data. Therefore, data must be reported in a clear, consistent, and understandable format. The following Sections set forth the minimum criteria for procedures that direct reporting of data. Refer to the SCQ and procedure EP-REM-013, "REM Data Review and Analysis," for additional guidance and requirements.

7.5.1 Treatment of Significant Figures

Numeric analytical results shall be reported with the appropriate significant figures based on the accuracy of the result. All results reported need not have the same number of significant figures. The following are requirements for determining significant figures:

- Results shall be expressed with a number of significant figures that is indicative of the accuracy of the result.

- Numeric results shall be rounded off to drop digits that are not significant.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

- Expression of results and corresponding uncertainties shall show decimal agreement.

- Results shall be expressed to the last digit affected by the uncertainty statement.

Refer to procedure EP-REM-013, "REM Data Review and Analysis" for additional guidance and requirements.

7.5.2 Treatment of Values At or Below Detection Limits

Environmental surveillance data often contain measurements that are below the detection limit of the analytical instrumentation. Reporting less-than-detectable results as zeros, "less-than" a value, or "not detectable" cause the data to be left-censored since data below the detection limit are not included. Censored data sets require special statistical techniques to avoid misinterpretation of results.

The FEMP shall internally report all measured values, both above and below the detection limit, even if the measured value is negative (as could be the case with radionuclides) prior to statistical treatment. The intent of this practice is to prevent the introduction of systematic bias in the data evaluation process. However, the FEMP reserves the right to report values as less than detectable in external reports with wide public readership.

Statistical calculations are performed using unaltered data whenever possible, even if the unaltered results fall below the minimum detection level (or below zero). This is to prevent/ minimize the introduction of biases through statistical calculations. Results calculated in this way are not considered to be inaccurate information, and any presentation of these results will include an explanation of the conclusions that can reasonably be drawn from such results.

There may be some measurement techniques that prevent the determination of a measurement below the detection limit. For these cases, refer to procedure EP-REM-013, "REM Data Review and Analysis," for additional guidance and requirements.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

7.5.3 Reporting Uncertainty

Since the true amount of an analyte in a sample can never be known exactly, it is essential to report results with an unambiguous uncertainty statement, so that the confidence in the results is known. The total random uncertainty shall be propagated and combined with the systematic error. The overall uncertainty should be expressed as 2σ. The 2σ uncertainty shall be reported as an error statement with all numeric results (DOE/EH-0173T, Summary 7d). The meaning of the uncertainty statement shall be clearly stated on all reports. EP-REM-013, "REM Data Review and Analysis," and EQP-16-01, "EC/QASP, "Annual Radioactive Effluent Discharge Report," address these requirements.

7.5.4 Units

Data shall be reported in a consistent set of units. Units shall be appropriate for comparison with the applicable regulatory standards. The standard format for reporting values in text is to use metric units, followed by the equivalent standard unit in parenthees. Data in tables are normally expressed in metric units. When applicable and practical, the DOE 5400.1[1] and SCQ requirements for reporting units shall be followed.

7.6 Comparisons to Standards, Control Data, and Historical Data

Analysis of results from the environmental surveillance and effluent monitoring program shall include comparison to applicable standards as well as comparison to control and historical data. A continual historical record of the locations of measurement shall be provided. Historically available data shall be organized in Division, Project and Department files to provide clear identification in multi-year data presentations. In order to ensure comparison to the applicable standards, the following are necessary:

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

- Applicable federal, state and local limits and guidelines for concentrations of analytes released to the environment and for concentrations of analytes in the environment shall be identified, documented, and maintained.

- Control sampling points shall be established and maintained according to written procedures that are specified in Sections 2.0, 3.0, and 5.0 of this Plan and in accordance with the SCQ.

- Analytical data shall be compared to historical data so that significant changes in concentrations can be detected.

Investigation and action levels for use in comparison of results to applicable limits and control limits shall be established and maintained.

7.7 Quality Assurance

Implementation of a comprehensive quality assurance program is essential to the generation of reliable, credible analytical results. The general quality assurance provisions set forth in Section 10.0 of this document shall be followed (DOE/EH-0173T, Summary 7g). Field and laboratory QC samples shall be analyzed to estimate the confidence in the data as specified in Section 5.0 and Section 6.0 of this Plan (DOE/EH-0173T, Summary 7c). Procedures shall exist that ensure the security of data prior to entry into the database and while stored in the database. The data validation plan is described in Appendix D of the SCQ. SCQ requirements shall be followed.

8.0 DOSE CALCULATIONS

This Section describes radiological dose calculations as they are used by the FEMP to demonstrate the compliance of routine operations with the regulations or orders of DOE or EPA, and to support the SER. Any dose calculations performed for other purposes (such as evaluation of remedial action plans before the remediation begins) would be expected to conform with the broad provisions of this Plan, but are not controlled by this Plan. Dose calculations attendant to accidental releases are controlled by the site emergency response procedures, and not by this Plan. Doses calculated due to accidental releases are included in the NESHAP Annual Report.

This Section does not describe calculation methods for "doses" of non-radiological materials. Such calculations (*e.g.*, computation of lifetime risks) may be used in Remedial Investigations. However, they are not required for routine compliance demonstrations, nor are they used in the SER. Thus, they fall outside the scope of the Environmental Monitoring Plan.

8.1 General Requirements and Standards

Radiological dose calculation methods are needed to permit the FEMP to show compliance with the following limits and guidelines from the specified paragraphs of DOE Order 5400.5[7].

- The exposure of members of the public to radiation sources as a consequence of all routine activities at a DOE site shall not cause, in a year, an effective dose equivalent greater than 100 mrem [paragraph II.1a]. This annual effective dose equivalent is defined as the sum of penetrating external exposure for the year, plus the committed effective dose equivalent for intakes experienced during the year [paragraph II.1a(1)].

  The guideline includes doses from remedial actions and naturally occurring radionuclides released by DOE processes, but not radon and its decay products [paragraph II.1a(3)]. All pathways that could contribute significantly to the exposure are to be included in the calculations [paragraph II.1a(2)]. Significant exposures are considered to be 1% of the 100 mrem (1 mrem) dose limit or greater.

8.0 DOSE CALCULATIONS (cont.)

- The exposure of members of the public to radioactive materials released to the atmosphere as a consequence of all activities at a DOE site shall not cause, in a year, an effective dose equivalent greater than 10 mrem [paragraph II.1b]. Because this guideline implements the EPA regulations of 40 CFR 61 Subpart H,[18] ^{222}Rn is excepted. The same annual effective dose equivalent definition applies as above. In calculations governed by this Plan, all pathways shall be included that may contribute 1 mrem/yr to the total effective dose equivalent.

- The liquid effluents from DOE activities shall not cause private or public drinking water systems to exceed the drinking water radiological limits in 40 CFR 141 [paragraph II.1d].[6] That is, effluents must not cause the drinking water to exceed any of the following independent limits: man-made beta/gamma-emitting radionuclides at an annual average concentration that would cause an annual dose equivalent of 4 mrem to the total body or any internal organ; combined ^{226}Ra and ^{228}Ra at any time totaling 5 pCi/L; or gross alpha activity (including radium but excluding radon and uranium) of 15 pCi/L at any time.

- The absorbed dose to native aquatic animal organisms shall not exceed 1 rad per day from exposure to the radioactive material in liquid wastes discharged to natural waterways [paragraph II.3a(5)]. For the purposes of satisfying this requirement, the FEMP interprets the term "native aquatic animal organisms" (which is not otherwise defined by DOE) to mean insects, macroinvertebrates (crayfish, shellfish, etc.), fin fish, or mammals.

Note: The radon effluent guidelines of DOE Order 5400.5 [paragraph IV.6b][7] implement the EPA regulations of 40 CFR 61, Subpart Q.[18] These guidelines are expressed in terms of radon concentrations in air and radon flux at the surface of radon-producing wastes, not in terms of dose to humans or other organisms. Measurements required to demonstrate compliance with the flux and concentration guidelines are described in Section 5.0 of this Plan.

8.0 DOSE CALCULATIONS (cont.)

Sections 8.2 and 8.3 describe the methods to be used in dose calculations to demonstrate compliance with the above requirements. Section 8.4 sets out the quality assurance requirements applicable to this activity.

8.2 Human Exposure Calculations - General Requirements and Methods

Section 5.2 presents a detailed discussion of the exposure pathways that are most significant for the FEMP's current mode of operation, and that therefore merit consideration in the Environmental Surveillance Program (DOE/EH-0173T, Summary 8d). These are the same exposure pathways for which dose calculations governed by this Plan must be performed, as discussed in the subsections below.

Most dose calculations will be based on measurements of radionuclide concentrations in environmental media, rather than in effluent samples, for the following reasons (DOE/EH-0173T, Summary 8a):

- Calculations based on measured radionuclide concentrations in environmental media are less uncertain than those based on effluent measurements. Dose calculations based on environmental monitoring avoid the use of the transport and bioaccumulation models required by effluent-based calculations, reducing the overall uncertainty in the results.

- The potential exists for unmonitored releases from the FEMP, and the impact of all releases must be accounted for. Examples of potential unmonitored releases are: all releases from open waste pits, stormwater runoff from some areas of the former Production Area, fugitive releases from remediation activities, and any releases from unmonitored stacks in the former Production Area. In an effluent-based method, releases from such pathways must be estimated conservatively, adding to the uncertainty of the results and over-estimating the impact. Experience with estimating airborne releases at the FEMP using standard methods[50] indicates that such methods lead to unrealistically high estimates of offsite air concentrations.

8.0 DOSE CALCULATIONS (cont.)

- Calculations based on environmental measurements directly account for all DOE operations that impact a given receptor. Although the nearest DOE facility to the FEMP is over 50 km away in Miamisburg, OH, it is located on the same river system. Using environmental monitoring results for dose calculations conservatively accounts for all non-natural sources of environmental contaminants, without the need for assumptions regarding the impacts of multiple facilities.

- Despite the lower concentrations in environmental media compared to effluent samples, adequate dose sensitivity can be achieved. As described in Sections 5.0 and 6.0, environmental sampling frequencies, sample sizes, and analytical methods can be selected to obtain sufficient sensitivity to support the required dose calculations.

Note 1: One type of atmospheric dose calculation, the annual demonstration of compliance with EPA's NESHAP Subpart H standards, will normally be based on estimates of effluent activities. An effluent-based calculation is required in this case for demonstration of compliance with 40 CFR 61. Further information on dispersion and dose modeling for NESHAP Subpart H compliance demonstration is presented in Section 4.3.1. The site is developing a request to obtain DOE and EPA approval for the use of ambient air monitors to demonstrate NESHAP Subpart H compliance.

Note 2: In all dose equivalent calculations specified in Sections 8.2.2 and 8.2.3, if the chemical and physical form of the radionuclides is not determined, the dose assessment shall be performed by assuming the solubility class which would yield the highest dose equivalent.

Radiological exposure calculations are performed in accordance with EP-REM-008, Estimating Radiological Pathway Dose.[51]

8.0 DOSE CALCULATIONS (cont.)

8.3 Quality Assurance

As it is applicable to the radiological dose calculations governed by this Plan, the full 10-criterion QAPD and 16-criterion SCQ described in Section 10.0 of this Plan shall be followed (DOE/EH-0173T, Summary 8f). After the effective date of this Plan, specific quality-related measures applied to radiological dose calculations shall include the following:

- Organization. The ES&H Manager shall designate the onsite organization(s) with primary responsibility for performing dose calculations which are based on radionuclide concentrations in environmental media, and for verifying their correctness. The RP manager is responsible for dispersion and dose modeling to demonstrate NESHAP, Subpart H, compliance as stated in Section 4.2.1 of the Plan.

- Instructions, Procedures, and Drawings. Preparation of data, performance of calculations, documentation and verification of results, and retention of records shall be in accordance with written and approved procedures.

- Document Control. Dose calculation procedures, and related computer programs and data files, shall be controlled in accordance with the FEMP procedures to ensure that only current versions are in use.

- Inspections. Each manual dose calculation shall be verified by a qualified member of the FEMP staff other than the one who performed the calculation. Input data and results of computer calculations shall also be verified by a qualified member of the FEMP staff.

- Quality Assurance Records. At least the following shall be maintained as permanent site records, as they pertain to radiological dose calculations governed by this Plan: procedures for performance and verification of dose calculations; records of the calculations; documentation of the basis and appropriateness of parameters used in the calculations; plans for audits of dose calculation practices, and records of the

8.0 DOSE CALCULATIONS (cont.)

performance of those audits (DOE/EH-0173T, Summary 8b,c). Specifically, the records supporting calculations used in each compliance demonstration report or SER should be retained in a separate file keyed to the report they support; they shall include identification of the equations, models, or computer programs used, and documentation of the input data and assumed parameters used.

- Audits. The ES&H Manager shall ensure that periodic audits of radiological dose calculation practices are performed and documented. The purpose of these audits is to verify that the calculations are executed and documented in accordance with Site procedures and the provisions of this Plan.

SCQ requirements shall be followed as they apply to the Environmental Monitoring Program at the FEMP. Section 10.0 of this Plan, "Quality Assurance," requires that SCQ requirements be followed. It discusses and references additional SCQ requirements that apply to data management activities in general: Section 2.0, "Project Description;" Section 3.0, "Project Organization;" Section 4.0, "Quality Assurance Objectives;" Section 11.0, "Data Reduction, Validation, and Reporting;" Section 12.0, "Performance Assessment and System Audits;" Section 14.0, "Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness;" Section 15.0, "Corrective Actions;" and Section 16.0, "Quality Assurance Reports to Management." The applicable elements of these requirements must be followed and incorporated at the implementing level.

9.0 RECORDS AND REPORTS

Records and reports from environmental surveillance and effluent monitoring shall be generated, documented, and maintained to ensure the FEMP supports the DOE overall compliance strategy. The objectives of DOE reporting requirements are to:

- Alert DOE and facility management to occurrences for the purpose of investigation and evaluation of causes, and to identify appropriate measures to prevent recurrences;
- Obtain early, complete, and factual information on occurrences as a basis for reports to the Secretary of Energy, Congress, other Federal agencies, and the public, as appropriate;
- Identify trends in areas of concern for DOE and contractor operations;
- Provide a basis for the improvement of codes, guides, and standards used in the DOE and contractor operations;
- Monitor, evaluate, and report onsite discharges, liquid and airborne effluents, and environmental conditions in the vicinity of DOE sites, to assess the levels of radioactive pollutants and their impact on the public and the environment; and
- Comply with the regulations of other bodies (*e.g.*, CERCLA and NESHAP reporting requirements).

Section 11.0, "Data Reduction, Validation, and Reporting," of the SCQ sets forth procedures that shall be used by FEMP personnel, the FEMP laboratory, and subcontractor laboratories for data reduction, validation, and reporting as applicable for each Analytical Support Level (ASL) (Section 2.0 of the SCQ). Also, a Data Validation Plan that must be followed is described in Appendix D of the SCQ.

9.0 RECORDS AND REPORTS (cont.)

9.1 Records

Proper record keeping is essential to FEMP efforts toward complying with environmental surveillance and monitoring requirements of DOE orders and appropriate regulations.

Environmental surveillance and effluent monitoring records shall be maintained in accordance with DOE Order 1324.2A. Requirements in DOE Order 5400.1[1] for maintenance and retention of auditable records relating to the environmental surveillance and effluent monitoring programs shall be followed. These records shall include, but are not limited to, records of calculations, computer programs, procedures, and raw data. Procedures shall exist that direct the administration of both hard copy records and electronic records. The record administration procedures shall consider at least the following:

- Preparation of hard copy records to ensure accuracy, legibility, completeness, and authenticity,
- Receipt and indexing of records to facilitate retrieval and prevent loss of records,
- Control and handling practices to prevent record loss,
- Protection of records against damage or loss by keeping duplicate records in separate locations or by storing records in fireproof safes or cabinets, maintaining a controlled climate, and controlling access to records, and
- Routine auditing of records to ensure compliance with the applicable site procedures.

Records pursuant to RCRA including mixed waste shall be prepared and maintained in accordance with the requirements of 40 CFR Part 264.73[52] or 40 CFR Part 265.73[41] (DOE/EH-0173T, Summary 9c). Record retention and maintenance is addressed in SSOP-0609, "Records Management."[53]

000231

9.0 RECORDS AND REPORTS (cont.)

9.2 Reporting

Timely notification of occurrences involving the FEMP shall be made to the responsible authorities. DOE Order 5400.1,[1] DOE Order 5400.5,[7], DOE Order 5000.3 A and B, and DOE Order 5484.1[54] contain the reporting requirements applicable to FEMP environmental monitoring programs. Additional reporting requirements from the EPA and OMB shall also be met. Reports relevant to the environmental monitoring program are listed in Table 9-1 (DOE/EH-0173T, Summary 9a,b).

9.3 Quality Assurance

The quality assurance program provisions of Section 10.0 shall be followed (DOE/EH-0173T, Summary 9d). Section 11.0, "Data Reduction, Validation, and Reporting," of the SCQ sets forth procedures that shall be used by FEMP personnel, the FEMP laboratory, and subcontractor laboratories for data reduction, validation, and reporting as applicable for each Analytical Support Level (ASL) (Section 2.0 of the SCQ). Also a Data Validation Plan that must be followed is described in Appendix D of the SCQ.

9.0 RECORDS AND REPORTS (cont.)

Table 9-1: Applicable Reporting Requirements

Source of Requirement	Reporting	Requirement	Deadline
DOE Order 5400.1	Site Environmental Report	The FEMP shall prepare a Site Environmental Report for DOE-FN. The report must provide a comprehensive review of the environmental surveillance programs, status of environmental compliance, and effluent data for non-radioactive pollutants.	6/1*
DOE Order 5400.5	Notify	In a timely manner, the FEMP shall notify the relevant program office and the Deputy Assistant Secretary for Environment (EH-20) of actual or potential exposure of members of the public that could result in either an effective dose equivalent from DOE sources exceeding 10 mrem (0.1 mSv) in a year or exceeding any limit.	Timely
OMB Circular A-106	Departmental Pollution Abatement Projects	Departmental pollution abatement projects shall be reported to EH-1 by Field Organizations for 5-year plan as required by OMB Circular A-106, and by EPA and DOE guidance issued thereto. Confirmatory reports are required if no pollution abatement projects are planned or underway.	Semiannual (5/1, 12/15)
DOE Order 5400.1	Radioactive Effluent and Onsite Discharge Data Reports	All offsite and onsite releases of radioactive materials in airborne and liquid effluent streams shall be reported to the Information Systems Branch, EG&G Idaho.	4/1*
DOE Order 5400.1	Unplanned Releases of Radioactive Materials in Effluents	Unplanned offsite or onsite releases of radioactive materials in effluents shall be reported if they are of concern to the environment.	

000233

9.0 RECORDS AND REPORTS (cont.)

Table 9-1: Applicable Reporting Requirements

Source of Requirement	Reporting	Requirement	Deadline
NESHAP (40 CFR Part 61, Subpart H)	Annual Compliance Report	Reporting shall include results from monitoring of radionuclide emissions to the ambient air, as well as required dose calculations.	6/30*
DOE Order 5400.1	Preoperational Environmental Survey Report	An environmental study shall be conducted prior to startup of a new site, facility, or process which has the potential for significant adverse environmental impact. The study shall be consistent with NEPA compliance activities.	4/1
DOE Order 5400.1	Annual Environmental Status Sheet	A current summary of information regarding the environmental status of each site shall be provided to DOE-EH.	4/1
DOE Order 5000.3A	Occurrence Report	An Occurrence Report shall be prepared for events or conditions specified in accordance with the criteria defined in DOE 5000.3A.	Determined by category
DOE Order 5400.4 (CERCLA Implementation)	Radionuclide Release Report	Releases of radionuclides that exceed reportable quantities shall be reported to the EPA National Response Center and to DOE-FN.	
Clean Water Act Ohio EPA NPDES OH009580	Liquid Discharge Monitoring Report	Discharge Monitoring Reports are required for compliance with the state NPDES permit.	Monthly
SARA Title III	SARA Section 312 Report	Facilities at which hazardous chemicals are present in excess of specified thresholds shall submit inventory information to the LEPC, SERC, and local fire department.	Annual

000234
8202

9.0 RECORDS AND REPORTS (cont.)

Table 9-1: Applicable Reporting Requirements

Source of Requirement	Reporting	Requirement	Deadline
SARA Title III	SARA Section 313 Report	Covered facilities (see above) shall report to EPA and the state all environmental releases of specified toxic chemicals that are manufactured, processed, or otherwise used in excess of specified thresholds.	Annual
RCRA 40 CFR 264.98(g)	Monitoring Notification for Statistically Significant Increases of Parameters of Constituents	If there is a statistically significant increase for parameters of monitored constituents at any monitoring well at the point of compliance, this finding shall be reported to the EPA.	7 days
RCRA 40 CFR 265.93	Groundwater Quality Notification	If analysis confirms a significant increase (or pH decrease) for indicator parameters of groundwater contamination, the EPA shall be notified that the facility may be affecting groundwater quality.	7 days
RCRA 40 CFR 265	Annual RCRA Groundwater Monitoring Report	Summarizes results of RCRA groundwater monitoring program.	3/1
USEPA Consent Agreement	Monthly Progress Report	DOE shall submit to USEPA monthly progress reports that describe the actions that DOE has taken during the previous month to implement the requirements of the agreement.	Monthly

* - Covering previous calendar year.

000235

10.0 QUALITY ASSURANCE

10.1 Introduction

Total Quality Management (TQM) principles are incorporated in environmental activities at the site to ensure that the right action is performed right the first time. TQM is performed by teams with oversight, by DOE, the DOE prime operating contractor, and subcontractor personnel and resources. The six main factors, other than technical requirements, are required to be addressed in all Environmental Monitoring activities per the SCQ. The factors are as follows:

- Personnel Protection,
- Protection of General Public and Environment,
- Meeting Quality Objectives,
- Waste Minimization,
- Timeliness, and
- Cost Effectiveness.

Quality Assurance (QA) activities associated with the EMP includes the applicable features of the 18 elements of NQA-1[55] (DOE/EH-0173T, Summary 10a,e). At the FEMP the Prime Contractor's Quality Assurance Program Description (QAPD), RM-0012, is based on the appropriate criteria specified in DOE Order 5700.6C, "Quality Assurance," ANSI/ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities," 10 CFR 50 appendix B, "QA Criteria for Nuclear Power Plants and Fuel Reprocessing Plants", ANSI/ASQC-E4 (draft), "Quality Assurance Program Requirements for Environmental Programs," which was written to meet the guidance contained in QAMS-005/80 by the U.S. EPA, DOE Orders 4700.1, 5400.1, and other DOE Orders specifying quality assurance (QA) related requirements. The QAPD uses DOE Order 5700.6C for the basic requirements and uses the other requirements to enhance the QA Program and tailor it to meet the needs of the site.

The QAPD, however, does provide for the use of special QA Program Plans for programs or projects when additional control or special emphasis is needed. This applies to the FEMP

10.0 QUALITY ASSURANCE (cont.)

CERCLA program. Even though the requirements of QAMS-005/80 and DOE Order 5400.1 apply to environmental monitoring and measurement efforts mandated by EPA, the EPA requires that these efforts be covered under a centrally managed Quality Assurance (QA) program. Also, the Federal Facilities Compliance Agreement requires that an approved Quality Assurance Project Plan (QAPjP) be established in accordance with EPA requirements and QA Plans to address data generation activities. As a result, the SCQ, was developed to cover the EPA QAMS requirements for environmental sampling and analysis to support ultimate remediation of the site. All sampling and analysis activities at the FEMP fall under the SCQ.

The SCQ describes the procedures used to determine the precision, accuracy, representativeness, comparability, and completeness of environmental measurements. Therefore, the SCQ also applies to all sampling and analysis activities under the EMP.

According to the QAPD, "Project specific plans (in this case the EMP) should take into account organization wide standards established in the QAPD and the SCQ and not recreate anything that has already been established." According to the SCQ, "details required for PSPs (in this case the PSP is the EMP) may be incorporated from the SCQ by reference." The following Sections reference the applicable QAPD and SCQ requirements that all routine effluent monitoring and environmental surveillance activities at the FEMP shall follow. Specific quality-related activities of the EMP shall be included in implementing procedures found in the Environmental Monitoring Section Procedures Manual or Department and Division procedures manuals.

10.2 Mandatory Quality Assurance Requirements

This Section will address the QAPD requirements and SCQ requirements that apply to the Environmental Monitoring Program. Similarities and differences will be pointed out. Applicable implementing procedures are referenced in each QA document and shall be referenced in EMP implementing procedures as applicable.

10.0 QUALITY ASSURANCE (cont.)

10.2.1 Quality Assurance Program Description Requirements

The QAPD is organized into three functional categories: Management, Performance, and Assessment. Within these functional categories are a total of 10 QA criteria that should provide the foundation of a comprehensive quality assurance program. Each criterion, as described in the QAPD, also identifies responsibilities and outlines the procedural approach that will be followed for implementation. These functional categories, associated responsibilities and implementing procedures shall be followed for all activities under the EMP.

10.2.2 SCQ Requirements

The SCQ, on the other hand, is a cross between a quality assurance program plan and a quality assurance project plan that is required by EPA for remediation activities. The SCQ provides overall sitewide quality assurance requirements and requirements for sampling and analysis activities planned or ongoing at the FEMP. These activities include non-CERCLA environmental monitoring.

Requirements for planning, implementation of plans, and assessment of activities are included so that it may be used like a QA program plan as defined by EPA. The SCQ also fulfills the requirements of a QA project plan as defined by EPA except for the parts that refer to specific samples.

In the SCQ, planning requirements are identified in Sections 2.0, 3.0, 4.0; Appendices C, E, and F; and to a lesser degree, Sections 5.0, 6.0, and 7.0. Implementation requirements are set forth in Sections 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, and 13.0 and Appendices I, J, and K. Assessment requirements are defined in Section 4.0 and Appendix E.

10.0 QUALITY ASSURANCE (cont.)

10.3 Elements of the QA Plans

The following subsections discuss the applicability of each of the ten QAPD criterion and sixteen groups of SCQ requirements to the effluent monitoring and environmental surveillance activities at the FEMP. The QAPD criterion will be discussed first, followed by the requirements of the SCQ.

10.3.1 Program

This QAPD criterion, found in Section 1.0 of the QAPD, describes the Prime Contractor requirements to develop, implement, and maintain a documented Quality Assurance (QA) Program. It describes the organizational structure, functional responsibilities, level of authority, and interfaces for Prime Contractor Divisions in managing, performing, and assessing the adequacy of work.

The SCQ, overall, is designed to ensure that the environmental programs and supporting activities at the FEMP are of adequate quality to fulfill project-specific, or in the case of the EMP, program-specific, DQOs. In the SCQ, Section 4.0, "Quality Assurance Objectives" best fits this QAPD criterion, however Sections 2.0, "Project Description;" Section 3.0, "Project Organization and Responsibilities;" Section 16.0 " Quality Assurance Reports to Management;" Appendix C, "Data Quality Objectives;" Appendix E, "Analytical Laboratory Performance Requirements;" and Appendix F, "Data Management Plan" and to a lesser degree Section 5.0, "Field Activities;" Section 6.0, "Sampling Requirements;" and Section 7.0, "Sample Custody" apply also to this QAPD criterion.

10.3.2 Personnel Training and Qualification

This QAPD criterion, found in Section 2.0 of the QAPD, describes the Prime Contractor's requirements for personnel to be trained and qualified to ensure they are capable of performing

10.0 QUALITY ASSURANCE (cont.)

their assigned work. Personnel shall be provided continuing training to ensure job proficiency is maintained.

The only comparable element in the SCQ that must be followed for all activities under the EMP is Section 4.0, "Quality Assurance Objectives." Section 4.0 specifies training requirements with respect to sampling and analysis activities at the FEMP.

10.3.3 Quality Improvement

This QAPD criterion, found in Section 3.0 of the QAPD, describes the requirements and responsibilities for establishing and implementing processes to detect and prevent quality problems and to promote quality improvement. It also describes the requirements and responsibilities for initiating appropriate corrective action subsequent to identification of conditions adverse to quality.

There are not any Sections in the SCQ that are exactly comparable. However, with respect to sampling and analysis activities, elements of Section 3.0, "Project Management," Section 10, "Internal Quality Control Checks and Frequency," and Section 14, "Specific Routine Procedures to Access Data Precision, Accuracy, and Completeness" do apply to this QAPD criterion.

General procedures used for noncompliance control are included in procedure SSOP-0023.

10.3.4 Documents and Records

This QAPD criterion, found in Section 4.0 of the QAPD, describes the requirements and responsibilities for establishing and implementing a system for the control of documents and handling, collection, storage, and control of quality assurance and environmental records generated by the FEMP.

10.0 QUALITY ASSURANCE (cont.)

Comparable Sections of the SCQ are as follows: Section 4.0, "Quality Assurance Objectives" and Section 11.0, "Data Reduction, Validation, and Reporting" with respect to sampling and analysis.

Procedure preparation, review, approval, control, and revision shall be accomplished in accordance with procedures SSOP-0103. Records management procedures controlling the management of all records are contained in procedure SSOP-0609.[53]

10.3.5 Work Performance

Work performance describes the requirements and responsibilities for the control of processes affecting work performance. The purpose of work process control is to ensure that the standard processes and special processes are accomplished under controlled conditions. These standard processes and special processes include but are not limited to: waste handling, packaging, certification and shipping, environmental data operations, welding, heat treating, core drilling, or nondestructive testing. Environmental Monitoring procedures control work processes for sampling and monitoring activities. Procedures specific to the routine environmental surveillance activities are contained in the Environmental Monitoring Section Procedures Manual.

Comparable elements of SCQ Sections are as follows: Section 4.0, "Quality Assurance Objectives," Section 6.0, "Sampling Requirements;" Section 7.0, "Sample Custody;" Section 9.0, "Analytical Procedures;" Section 10.0, "Internal Quality Control Checks and Frequency;" and Section 11.0, "Data Reduction, Validation, and Reporting" with respect to sampling and analysis.

10.3.6 Design

Design describes the requirements and responsibilities for the implementation of a formal design control process. It is the Prime Contractor's policy to design items and processes using sound engineering/scientific principles and appropriate standards. These requirements apply to all

organizations that perform design or are responsible for design performed by contractors or subcontractors.

Comparable elements of SCQ Sections can be found in the planning sections as described in Section 10.3.1 of this Plan.

Specific requirements for design control related to the Environmental Monitoring Plan shall be included in the Environmental Monitoring Section Procedures Manual or Department or Division procedures manuals shall be in accordance with the EMP, the QAPD, the SCQ and with procedures FMPC-0512, FMPC-0705, and PO-0712.

10.3.7 Procurement

Procurement describes the requirements and responsibilities for the preparation, review and control of procurement documents. It also specifies the requirements and responsibilities for the control of purchased material, equipment, and services.

The only comparable element of SCQ that addresses sampling and analysis is Section 3.0, "Project Organization and Responsibilities."

The procurement of items and services for the Environmental Monitoring Program shall be in accordance with the EMP, the QAPD, and the SCQ and with procedures SSOP-0315, FMPC-0317, and FMPC-0302. Procedures for control of purchased items and services shall be contained in SSOP-0315 and the Purchasing Policies and Procedures Manual.

10.3.8 Inspection and Acceptance Testing

Inspection and Acceptance Testing describes the requirements and responsibilities for performing inspections and acceptance testing. It is the Prime Contractor's policy to perform inspection and

10.0 QUALITY ASSURANCE (cont.)

acceptance testing of specified items and processes using established acceptance and performance criteria, and to require calibration and maintenance of equipment used for inspections and tests.

Comparable elements of SCQ Sections are as follows: Section 8.0, "Calibration Procedures and Frequency" and Section 13.0, "Preventive Maintenance."

Periodic calibration of measuring and test devices shall be performed in accordance with procedure FMPC-0718. Operational calibration and standardization of environmental surveillance equipment (performed as part of instrument usage), when required, shall be performed in accordance with individual procedures contained in the Environmental Monitoring Section Procedures Manual or other Department/Division procedures manuals. All equipment used shall be of proper type, range, accuracy, and precision to provide data compatible with the specific testing requirements. All standards used in calibration will be traceable to the National Institute of Standards and Technology (NIST) or other standards recognized by the DOE, (DOE/EH-0173T, Summary 10f).

10.3.9 Management Assessment

Management Assessment describes the requirements and responsibilities for regularly assessing and documenting the adequacy and effectiveness of the QA Program in providing the framework to accomplish the FEMP's mission and objectives. Management at all levels shall periodically assess the integrated QA Program and its performance, and to identify and correct problems that hinder the organization from achieving its quality objectives.

Comparable elements of SCQ Sections are as follows: Section 12.0, "Performance and System Audits;" Section 15.0, "Corrective Actions;" and Section 16.0, "Quality Assurance Reports to Management."

10.3.10 Independent Assessment

Independent Assessment describes the requirements and responsibilities for the implementation of an independent assessment program. The Prime Contractor's independent assessment program evaluates the adequacy and effectiveness of activities for compliance requirements.

Comparable elements of SCQ Sections are as follows: Section 12.0, "Performance and System Audits," Section 15.0, "Corrective Actions," and Section 16.0, "Quality Assurance Reports to Management."

10.3.11 Major Differences Between the QA Plans to be Emphasized

The SCQ addresses sampling and analysis activities. Although the following SCQ requirements are not specifically discussed in the QAPD, they shall be followed as they apply to the routine DOE Environmental Monitoring Program.

As described in Section 3.3 of the SCQ, EPA guidance has been used to develop a process for defining DQOs for projects at the FEMP. Description of this process and a reference table for ongoing projects at the FEMP are provided in Appendix C. Support documentation for DQOs becomes part of the project files. For the EMP, supporting documentation is maintained by the DQO coordinator.

As described in Section 3.4 of the SCQ, analytical laboratories providing services for the FEMP are responsible for compliance with their specific contract, Appendix E, and Attachment I of the SCQ. Laboratory performance will be evaluated on an ongoing basis through the use of Audits (Section 12.0 of the SCQ) and performance evaluation samples (Appendix E of the SCQ).

As described in Section 3.5 of the SCQ, field responsibilities for contractors and subcontractors and individual field teams and their organizational structure shall be explicitly defined in the applicable implementing procedures. For the Environmental Monitoring Program, these

10.0 QUALITY ASSURANCE (cont.)

requirements shall be incorporated in EMP implementing procedures or in specific sampling activity files of the organization responsible for performing the sampling. Project management requirements, field personnel qualifications, sample handling specifications, and data management and interpretation requirements shall also be included. Responsibilities for PSP implementation are described in Figure 3-4 (Appendix A) of the SCQ.

Section 4.0 of the SCQ, "Quality Assurance Objectives," addresses specific objectives for the level of the quality control effort; accuracy, precision, and sensitivity of analytical data; and data completeness, representativeness, and comparability.

The SCQ directs the use of the data quality objective (DQO) process and implementing procedures that ensure precision, accuracy, completeness, and representativeness of the data and documentation thereof to ensure the generation of quality data. EPA QA/G-4, *Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process,*[56] provides information on the determination of data quality needs for sampling and the development of DQOs. Use of this guidance will help ensure that all environmental data collected in support of RI/FS activities are of known and documented quality.[57] In addition, a site procedure governing DQO development is currently being developed.

Requirements and justification for collection of field QA samples per sampling round shall be documented in DQOs. DQO shall be referenced in the EMP (Attachment B).

Section 4.0 of the SCQ also addresses the type and frequency of Analytical Quality Control Samples: laboratory control samples (LCSs), method blanks, matrix spikes, matrix duplicate/replicate or matrix spike duplicates, surrogate spikes, blind or double blind QC samples, and intercomparison study samples. Types of QC samples are based on analytical support levels (ASLs). They are discussed in Section 9.0 of the SCQ and in Attachment I.

10.0 QUALITY ASSURANCE (cont.)

In accordance with the comliance agreement between DOE and the State of Ohio, additional QA/QC samples may be collected for certain media and split with an outside agency. These split samples should be analyzed for parameters agreed on by the FEMP and the outside agency. These samples should be used as a QA measure, to evaluate the comparability of analytical practices at different analytical laboratories. The split sample results should be compared to each other, and the results of this comparison should be included in the Site Environmental Report.

Internal QC checks are specified in Section 10.0 of the SCQ. Analytical QC samples appropriate for ASL E and user-defined ASL B shall be described in DQOs.

Section 6.0 of the SCQ, "Sampling Requirements," sets forth the minimum requirements for sampling activities described in Section 6.0 and in Appendix K of the SCQ:

- Sample Collection Forms (subsection 6.1)
- Collection of Aqueous Samples (subsection 6.2)
- Solid Matrix Environmental Samples (subsection 6.3)
- Gaseous Matrix Samples (subsection 6.4)
- Biological Sampling (subsection 6.5)
- Miscellaneous Samples (subsection 6.6)
- Field storage and shipment of samples (subsection 6.7)
- Decontaminations (subsection 6.8)

Section 7.0, "Sample Custody," of the SCQ sets forth additional sample custody and documentation requirements for the FEMP. Sample custody procedures and documentation are conducted in accordance with the guidelines in the EPA Region V Model Superfund Quality Assurance Project Plan, which are derived from EPA sample custody protocols described in "NEIC Policies and Procedures," EPA-330/9-78-001-R (revised May 1986). Custody requirements are addressed in three parts: 1) sample custody and handling in the field, 2)

10.0 QUALITY ASSURANCE (cont.)

custody during laboratory receipt and analysis, and 3) evidence files. Chain-of-custody forms must be used.

Section 8.0, "Calibration Procedures and Frequency," of the SCQ sets forth additional requirements. Specifically, equipment shall be of the type, range, accuracy, and precision necessary to provide data compatible with the ASL (Section 2.0 of the SCQ) as specified in applicable DQO (Appendix C of the SCQ). Manufacturer's instructions and specifications, as well as accepted procedures from the American Society for Testing and Materials, the EPA, and the National Institute of Standards and Technology may be used. Variance from procedures shall be justified and documented in section or department files.

Section 9.0, "Analytical Procedures," of the SCQ sets forth additional requirements. Attachment I, "FEMP Laboratory Analytical Methods Manual" establishes project requirements that laboratories performing analyses and generating data under the SCQ shall meet.

Section 10.0, "Internal Quality Control Checks and Frequency," of the SCQ sets forth additional quality control requirements. Internal Quality Control (QC) checks are performed to verify the quality of measurements of field and laboratory investigations and associated tasks. Required frequencies for internal QC checks are specified in Table 2-2 (in Appendix A) of the SCQ.

Section 11.0, "Data Reduction, Validation, and Reporting," of the SCQ sets forth procedures that shall be used by FEMP personnel, the FEMP laboratory, and subcontractor laboratories for data reduction, validation, and reporting as applicable for each ASL (Section 2.0 of the SCQ). Also a Data Validation Plan that must be followed is described in Appendix D of the SCQ.

Section 12.0, "Performance Assessment and System Audit," of the SCQ sets forth additional self assessment and independent assessment or work processes and operations requirements. Audit results of activities covered by the SCQ are available to the EPA upon request to DOE/FN. The EPA may conduct external audits of the FEMP activities covered by the 1991 amended Consent Agreement as required.

10.0 QUALITY ASSURANCE (cont.)

Section 13.0, "Preventative Maintenance," of the SCQ requires that field projects and laboratories develop and implement a preventative maintenance program that complies with the guidelines presented. Preventative Maintenance requirements may be documented in SOPs, PSPs, or in separate preventative maintenance documents.

Section 14.0, "Specific Routine Procedures to Access Data Precision, Accuracy, and Completeness," of the SCQ, requires that field data be assessed for accuracy, precision and completeness taking into account overall project objectives, background data points, and field Quality Assurance samples as defined in Section 4.0 of the SCQ. Requirements for field documentation are included in Sections 5.0, 6.0, and 7.0 of the SCQ.

Section 15.0, "Corrective Actions," of the SCQ sets forth a procedure to be followed based on a system that has been established in response to DOE requirements and EPA guidance.

Section 16.0, "Quality Assurance Reports to Management," of the SCQ sets forth additional reporting requirements that effect the routine Environmental Monitoring Program at the FEMP. A Summary of Reports of Quality Assurance Activities that affect the 1991 amended Consent Agreement requirements shall be distributed by DOE to the EPA-Remedial Project Manager (RPM). The EPA-RPM is responsible for distributing reports to appropriate EPA personnel. In addition, this section sets forth requirements for laboratories and quality control coordinators to provide Laboratory Management Reports to management.

10.4 QA Document Summary

QA activities shall be conducted in accordance with the following documents:

- QAPD, RM-0012[16] - Outlines the overall QA policy for the FEMP. Implementing procedures are found at the end of each section in the QAPD and in Appendix C, "Implementing Site Documents."

10.0 QUALITY ASSURANCE (cont.)

- The SCQ - Developed to cover the EPA QAMS-005/80 and DOE Order 5700.6C requirements for environmental sampling and analysis to support the ultimate remediation of the FEMP. It is a working level document providing standardized procedures for common field activities. This document also describes the organizational responsibilities of the organizations participating in environmental remediation at the site.

- Radionuclide Air Emissions Quality Assurance Project Plan[31] - Specifies the activities required to achieve the quality level required by 40 CFR 61,[18] Subpart H.

- The Fernald Site Environmental Monitoring Plan (EMP), PL-1002.

- Environmental Monitoring Section Procedures Manual - Includes the detailed procedures necessary for the individual to perform the Radiological and Environmental Monitoring and Surveillance Sections and Groundwater Monitoring Section activities.

Adherence to the policies and procedures in these documents ensures compliance with federal QA requirements including ANSI NQA-1. This Section fulfills the requirements of a QA Plan specified in DOE Orders 5400.1,[1] 5000.3,[58] 5700.6,[59] 5400.5,[7] and the SCQ.[17] All procedure manuals shall be reviewed regularly and updated as necessary.

11.0 REFERENCES

1. "General Environmental Protection Program Requirements," DOE 5400.1, November 9, 1988.

2. "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance," DOE/EH-0173T, January 1991.

3. "Transfer of Responsibility for Waste Operations at the Feed Materials Production Center from EM-30 to EM-40, Attachment Transfer Agreement." United States Department of Energy Memorandum, April 19, 1991.

4. Draft FERMCO Management Plan.

5. "1993 Site Environmental Report." Fernald Environmental Restoration Management Corporation; June 1994.

6. "National Primary Drinking Water Regulations," (Safe Drinking Water Act), Title 40 CFR 141, Subparts A and H, July 1, 1990.

7. "Radiation Protection of the Public and the Environment," DOE 5400.5, Change 1, June 5, 1990.

8. "National Pollutant Discharge Elimination System (NPDES) Final Permit OH0009580," Feb. 12, 1990.

9. "Resource Conservation and Recovery Act (RCRA) Implementation," Title 40 CFR Parts 260-280, July 1, 1990.

10. "Feed Materials Production Center Environmental Monitoring Annual Report for 1988." Westinghouse Materials Company of Ohio; June 1989.

11. "Feed Materials Production Center Annual Environmental Report for Calendar Year 1989." Westinghouse Materials Company of Ohio; October 1990.

12. "Feed Materials Production Center Annual Environmental Report for Calendar Year 1990." Westinghouse Materials Company of Ohio; December 1991.

13. "Annual Site Environmental Report for Calendar Year 1991." Westinghouse Environmental Management Company of Ohio; December 1992.

14. "1992 Fernald Site Environmental Report." Fernald Environmental Restoration Management Corporation; June 1993.

15. "Draft American National Standard for Performance Criteria for Radiobioassay," N13.30, American National Standards Institute, Inc., New York, September 1989.

11.0 REFERENCES (cont.)

16. "Quality Assurance Program Description," FERMCO, RM-0012, November 12, 1992.

17. "Sitewide CERCLA Quality Assurance Project Plan", FD-1000, date September 22, 1992.

18. "National Emission Standards for Radionuclide Emissions from Department of Energy (DOE) Facilities (NESHAP)," Title 40 CFR 61, subpart H, July 1, 1990.

19. "DOE Facilities Radiation Protection of the Public and the Environment," Draft Title 10 CFR 834, March 25, 1993

20. "History of Radionuclide Discharges," FMPC-2082 Special UC-11, Feed Materials Production Center, Fernald, Ohio, May 1987 and addendum, dated 12/88.

21. Weston, R.F., Characterization Investigation Study Volume 2: Chemical and Radiological Analyses of the Waste Storage Pits, FMPC/SUB-008, Vol. 2, prepared by Roy F. Weston, Inc., for WMCO, Cincinnati, Ohio, 1987.

22. "Radiological and Chemical Baseline Risk Assessment Operable Unit 2," Feed Materials Production Center, Fernald, Ohio, FMPC-0204-4, Draft November 1990.

23. "Radiological and Chemical Baseline Risk Assessment Operable Unit 3," Feed Materials Production Center, Fernald, Ohio, FMPC-0306-2, Draft December 1990.

24. "Remedial Investigation Report for Operable Unit 4; Appendix E: Baseline Risk Assessment," Feed Materials Production Center, Fernald, Ohio, FMPC-0404-5, Draft October 1990.

25. "Remedial Investigation Report for Operable Unit 5; Appendix L: Baseline Risk Assessment", Feed Materials Production Center, Fernald, Ohio, FMPC-0506-3, Draft February 1991.

26. National Council on Radiation Protection and Measurements, "Evaluation of Occupational and Environmental Exposures to Radon and Radon Daughters in the United States," NCRP-78, 1984.

27. "1990 NESHAP Annual Report for FMPC, 40 CFR 61, Subpart H; with Requested Supplemental Information," Letter WMCO:EC&QA:91-258, E.D. Savage to G.W. Westerbeck, June 4, 1991.

28. "FEMP Emergency Plan, "Fernald Environmental Restoration Management Corporation, PL-3020, March 1993, Revision 0.

29. "Ambient Air Quality Surveillance," Title 40 CFR 58, July 1, 1990.

11.0 REFERENCES (cont.)

30. "Hamilton County Emission Limits, Laws and Regulations," Regulation 3745, Ohio Environmental Protection Agency, December 1979.

31. "Radionuclide Air Emissions Quality Assurance Project Plan," PL-FMPC-3008 Draft, Feed Materials Production Center, Fernald, Ohio.

32. "Annual Report for National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, Subpart H." Fernald Environmental Restoration Management Corporation; May 1, 1994.

33. Beres, D.A. The Clean Air Act Assessment Package - 1988 (CAP-88): A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air, SC&A, Inc., Prepared for U.S Environmental Protection Agency, Office of Radiation Programs. October 1990. Note: Contains a computerized methodology for estimating environmental concentrations and dose to man from airborne releases of radionuclides.

34. EPA-450/4-87-013, "On-Site Meterological Program Guidance for Regulatory Modeling Applications."

35. Turner, D.B., "A Diffusion Model for an Urban Area," Journal of Applied Meteorology 3: 1964, 83-91.

36. "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Regulatory Guide 1.145.

37. "American National Standard for Determining Meteorological Information at Nuclear Power Sites," ANSI/ANS-2.5-1984.

38. "Remedial Investigation Report for Operable Unit 1; Appendix D: Baseline Risk Assessment," Feed Materials Production Center, Fernald, Ohio, FMPC-0106-2, Draft September 1990.

39. "National Primary and Secondary Ambient Air Quality Standards," Title 40 CFR 50, July 1, 1990.

40. "Water Quality Management (WQM)," Title 40 CFR 130, July 1, 1990.

41. "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," Title 40 CFR 265, July 1, 1990.

42. "National Oil and Hazardous Substance Pollution Contingency Plan," Title 40 CFR 300, July 1, 1990.

11.0 REFERENCES (cont.)

43. Waite, D.A., 1973, "An Analytical Technique for Distributing Air Sampling Locations Around Nuclear Facilities," BNWL-SA-4534, Pacific Northwest Laboratory, Richard, Washington.

44. "Evaluation of Air Sampler Locations," August 1991. Radiological Environmental Monitoring Files.

45. "FEMP Comprehensive Groundwater Monitoring Plan" dated December 1992.

46. "Environmental Monitoring Program at the Feed Materials Production Center," Westinghouse Materials Company of Ohio, February 10, 1988.

47. "FMPC Nuclear Criticality Safety Guide," FMPC-2112, September 1, 1989.

48. ASTM C 998=90, "Standard Practice for Sampling Surface Soil for Radionuclides," June 29, 1990.

49. EP-REM-013, "REM Data Review and Analysis," Rev. 0; January 31, 1994.

50. "Feed Materials Production Center Annual Environmental Report for Calendar Year 1989," WMCO Report FMPC-2200, Westinghouse Material Company of Ohio, Fernald, Ohio.

51. EP-REM-008, "Estimating Radiological Pathway Dose," Rev. 0; January 1994.

52. "Regulations for Owners and Operators of Permitted Hazardous Waste Facilities," Title 40 CFR 264, July 1, 1990.

53. SSOP-0609, "Records Management," Rev. 0; March 1993.

54. "Environmental Protection, Safety, and Health Information Reporting Requirements," DOE 5484.1," June 29, 1990.

55. The American Society of Mechanical Engineers, Quality Assurance Program Requirements for Nuclear Facilities, ANSI/ASME NQA-1-1989 Edition.

56. EPA QA/G-4, "Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process." USEPA; October 6, 1993.

57. Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual (Part A), Interim Final, Office of Emergency and Remedial Response U.S. Environmental Protection Agency, Washington D.C. EPA/54011-89/002 December 1989.

7078

11.0 REFERENCES (cont.)

"Unusual Occurrence Reporting," DOE Order 5000.3A, November 1984.

59. "Quality Assurance," DOE 5700.6, November 22, 1989.

000254