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FERNALD SITE ENVIRONMENTAL MONITORING PLAN

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N. C. Kaufman, President — Date

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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Record of Issue/Revisions

DATE	REV. NO.	DESCRIPTION AND AUTHORITY
11-06-92	0	New Plan required by the Department of Energy to document the rationale and design criteria for the FEMP's Routine Environmental Monitoring Program per Request P91-579, initiated by A.M. Snyder. It also directs the use of proven scientific methods to minimize variability in environmental analytical data and ensures the generation of quality data.
05-31-93	1	Major revision required to update plan to current organization functions and for required site technical review per Request No. S93-010 initiated by A. Snyder.

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ACRONYMS

AEC	U.S. Atomic Energy Commission (abolished 1974)
AER	Annual Environmental Report
AHF	Anhydrous Hydrogen Fluoride
ALARA	As Low As Reasonably Achievable
AMS	Air Monitoring Station
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWT	Advance Wastewater Treatment Facility
BAT	Best Available Technology
BDN	Biodenitrification Facility
BSL	Biodenitrification Surge Lagoon
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DOESAQP	Department of Environmental Services Air Quality Program
DQO	Data Quality Objective
FFCA	Federal Facilities Compliance Agreement
FS	Feasibility Study
EIS	Environmental Impact Statement
EML	U.S. Department of Energy Environmental Measurements Laboratory
EMP	Environmental Monitoring Plan
EPA	U.S. Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FMPC	Feed Materials Production Center
ICRP	International Commission on Radiological Protection
LERC	Local Emergency Response Center

ACRONYMS (cont.)

MMICS	Maintenance Management and Inventory Control System
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NWS	National Weather Service
ODIS	Onsite Discharge Information System
OEPA	Ohio Environmental Protection Agency
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
PSO	Program Secretarial Officer
PSP	Project Specific Plan
QA	Quality Assurance
QAPD	Quality Assurance Program Description (QAPD)
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RDA	Radiation Detection Alarm
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
SCQ	Site CERCLA QAPjP
SERC	State Emergency Response Center
SSLS	Storm Sewer Lift Station
SSOD	Storm Sewer Outfall Ditch
SWRB	Stormwater Retention Basin

ACRONYMS (cont.)

TDS	Total Dissolved Solids
TLD	Thermoluminescent Dosimeter
TOC	Total Organic Carbon
TOX	Total Organic Halogens (or Halides)
TQM	Total Quality Management
TRU	Transuranic
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WEMCO	Westinghouse Environmental Management Company of Ohio
WMCO	Westinghouse Materials Company of Ohio
WQM	Water Quality Management
WTP	Water Treatment Plant

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 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 activites 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.)

At the FEMP, 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, even those that are not driven by CERCLA requirements such as the Environmental Monitoring Program. The SCQ is currently being reviewed by the U. S. EPA Region 5. Its requirements are incorporated or referenced throughout the EMP where applicable by the request of DOE/FN. 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 and enhances 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 generally essential to a quality monitoring and surveillance program are denoted by should* within the Regulatory Guide.[2] A summary of each should* requirement is presented in the Summary Section of the Regulatory Guide (pp. xi-xxvi).[2] DOE requirements for routine environmental surveillance and effluent monitoring at the Fernald Environmental Management Project (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 the Guide (DOE/EH-0173T, Summary xx). The status of 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).

1.0 OVERVIEW (cont.)

The Matrix lists the should* criteria presented in the Regulatory Guide [2] 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 Section 11.0 of this Plan which includes a list of FEMP implementing procedures in Table 11-3. Both Attachment A and Section 11.0 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).

1.0 OVERVIEW (cont.)

1.3 Environmental Monitoring and the ALARA Policy

The site is required to implement ALARA requirements for the DOE 5400 Series Orders. The ALARA process applies to protection of the public and the environment. The ALARA program must also be established to control exposures to the public from normal operations and in the development of authorized limits for the release of DOE property containing residual radioactive material. The site is currently in the process of beginning the development/preparation of an ALARA Plan and implementing procedures that are applicable to the environment[5].

1.4 Environmental Monitoring and the SCQ

According to the SCQ, the EMP will serve as the PSP for the routine effluent monitoring and environmental activities. Because the Environmental Monitoring Program is an ongoing program with a program plan (the 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 requirement and, from an 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

1.0 OVERVIEW (cont.)

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 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. Per the SCQ, all DQOs will be approved and controlled by the SCQ implementation team and kept in a centrally located document, separate from the SCQ. Therefore, DQOs will be referenced in the EMP (Attachment B) only.

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.)

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

1.5 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.

1.0 OVERVIEW (cont.)

1.6 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.[6] Responsibility for implementation of all applicable environmental laws and regulations, including the implementation of DOE 5400.1,[1] rests primarily with three organizations:

- the DOE Headquarters Office of Environmental Restoration,
- the Eastern Area Program Division/FEMP Program Branch, 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.

1.0 OVERVIEW (cont.)

FERMCO "will be flexible and quick to respond to regulatory changes, and to address technical issues that may arise as the cleanup progresses."[72] 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.

The FEMP will be 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 NEPA regulations 40 code of Federal Regulations (CFR) 1500 through 1508, and with any other applicable state and federal environmental regulations.

A Sitewide Characterization Report shall be prepared that is a summary of site characterization data, and a Preliminary Baseline Risk Assessment shall consider the risks which currently exist at the site if no further response actions or institutional controls are applied. To ensure that the selection of the response actions for CRUs 1-5 are protective of human health and the environment, a Site-Wide RI/Projected Residual Risk Assessment report will be prepared as part of the Comprehensive CRU.

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

1.0 OVERVIEW (cont.)

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 will manage the development of 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 legal procedures. They will also coordinate occurrence reporting.

The primary responsibility of Environmental Programs will be 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 support organizations, to promote coordination across CERCLA/RCRA Units (CRUs) and throughout the FEMP.

Regulatory interfaces will be coordinated with Regulatory and Technology Programs (RTP) through regulatory specialists assigned to the CRUs to ensure consistency and overall site objectives and NEPA-approved actions. The CRU Project Directors will 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 and Technology Programs (RTP) Division will work with DOE to coordinate external interfaces with and input from the public, the regulatory authorities, and the technical community to develop and maintain a strategic version for completion, a regulatory consensus, a safe operating envelope, and opportunities for technology application. RTP has the functional responsibility for sitewide Risk Assessments. They provide the Regulatory Specialists to the CRUs. RTP processes and maintains all FEMP permits.

1.0 OVERVIEW (cont.)

RTP'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. RTP will evaluate 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 will 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.

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.

RTP will establish environmental and safety requirements and limits as they develop from analysis of proposed actions: The ES&H Division will ensure that they are included in policies and procedures and implemented sitewide.

1.0 OVERVIEW (cont.)

The Remediation Support Operation (RSO) Division will support the safe remediation and decontamination of the site through management of all waste materials, support to remediation contractors, and base activities including laboratory services and 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. This will be one of the Facility Engineering and Maintenance Department's responsibilities (RSO Division).

The Quality Control Department of the RSO Division will be responsible to establish, implement, and maintain QC programs for procurement, for Title I, II, 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 RSO Division will ensure 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 Configuration and Control (PCC) Division will maintain all cost, schedule, and technical baselines. The Information Resources Management group of PCC will provide for archival, indexing, retrieval and storage of site documents. The group will also perform optical imaging of selected historical and site operating documents. The group will have oversight

1.0 OVERVIEW (cont.)

responsibility to help ensure that sitewide records management procedures are being adhered to across the site.

The Communication Center of the PCC 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 will manage all ES&H programs for FERMCO to facilitate safe operations, ensure compliance with all applicable regulations and 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 will be 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 will work closely with the Vice-President of Regulatory and Technology Programs (RTP) to ensure site activities meet the regulatory requirements. The RTP Division will obtain 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. RTP as well as the QA organization will provide oversight of ES&H to ensure that ES&H criteria are being appropriately interpreted and implemented.

The Environmental Protection Department will ensure 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 ALARA. State-of-the-art monitoring equipment will be used to measure and document contamination and hazardous emissions to ensure they remain well below regulatory levels during all site activities, as defined in licenses, permits and compliance documents.

1.0 OVERVIEW (cont.)

The ES&H Assurance Department will establish top level policies and guidelines for all work. These will be designed to ensure that the terms of all DOE Orders and ES&H licenses and permits are met, and kept current, and that all activities are conducted to facilitate compliance and audit. This organization will also ensure that policies and procedures reflect limits and controls required to implement and sustain the safe operating envelope.

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 11-3.

In addition, a procedure to control programmatic changes to the EMP, SSOP-0076, "Reviewing the Environmental Monitoring Program," was written. The purpose of this procedure is to provide the instructions for reviewing and updating the EMP and the Environmental Monitoring Program at the FEMP to ensure site-specific and generic factors affecting this program are updated in accordance with DOE Order 5400.1, "General Environmental Protection Policies".

During the implementation of the EMP requirements, department managers are responsible for sending to the Manager of Environmental Monitoring and Surveillance documentation 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

1.0 OVERVIEW (cont.)

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.

Certain aspects of the Environmental Monitoring Program could 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:

- 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

- 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 and Technology Program Division as discussed previously.

1.0 OVERVIEW (cont.)

1.7 FEMP Site Description

1.7.1 History and Ownership of FEMP

To provide a perspective of the material presented in the EMP, Chapter One of the 1991[71] ASER contains the following introductory sections:

- The FEMP Mission: Changing from Production to Restoration - a historical overview of the site and its former operations including the evolution of the Environmental Monitoring Program;

- 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 varous 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 CAA 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. Applicable DQOs are referenced in Attachment B. Section 11.1 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.

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 below. Applicable SCQ requirements referenced in Section 2.8 and 10.0 of this Environmental Monitoring Plan also shall be followed.

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 greater than 100 mrem. The effective dose equivalent is the sum of the effective dose equivalent (or deep dose

equivalent, if dosimeter data are used) from exposures 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[12]. 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 Ra^{226} and Ra^{228} in drinking water to exceed 5 pCi/L,
- the concentration of gross alpha activity (including Ra^{226} but excluding radon and uranium) in drinking water to exceed 15 pCi/L, or
- the concentration of Sr^{90} 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.

2.1.3 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.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.1.3.1 Determination of 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[3]. 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.*

2.1.3.2 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,

2.0 LIQUID EFFLUENT MONITORING (cont.)

- 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.

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.

2.0 LIQUID EFFLUENT MONITORING (cont.)

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).

2.1.3.5 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 8.3. 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 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.

2.0 LIQUID EFFLUENT MONITORING (cont.)

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[13] issued by the OEPA.

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.[14]

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) to the OEPA. 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.

2.2.2 Permitting and Reporting

The R&TP 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

This Section is responsible for operating and maintaining the water treatment systems and obtaining liquid effluent samples. In addition, this Section is responsible for calibrating effluent monitoring and sampling equipment in accordance with 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

This 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 ASER in accordance with Section 9.0 of this Plan.

2.0 LIQUID EFFLUENT MONITORING (cont.)

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 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). During dry periods, stormwater from the former Production Area converges at the Storm Sewer Lift Station (SSLS). The purpose of the SSLS is to pump stormwater from the storm sewer to outfall 4001 to the Great Miami River. During heavy storm events, the SSLS pumps are deactivated to divert production area runoff to the Storm Water Retention Basin (SWRB) via gravity flow. 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 Outfall 4001 (Manhole-175) for discharge to the Great Miami River (the river).

Figure 2-1 FEMP Liquid Wastewater Flow Diagram[8]

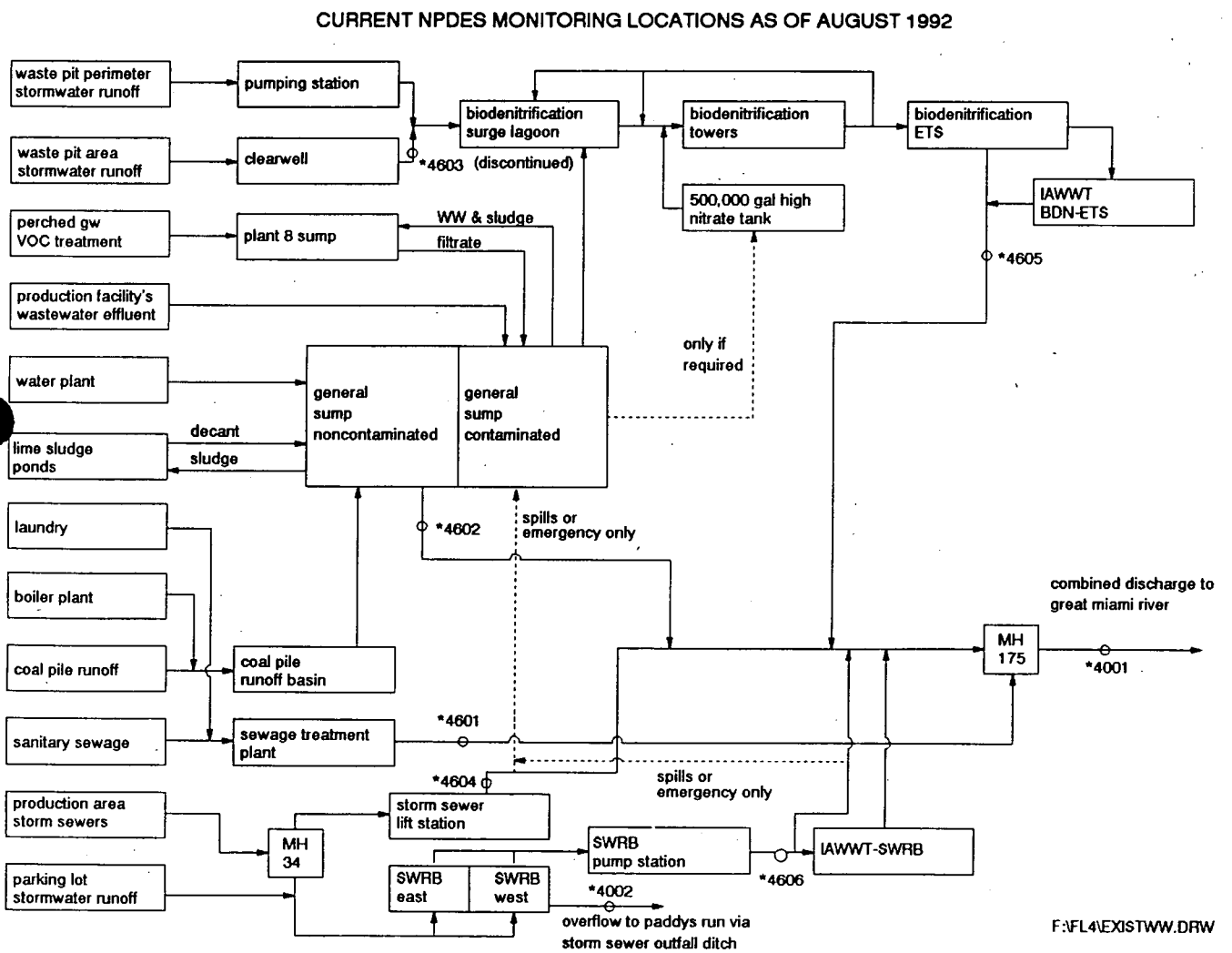
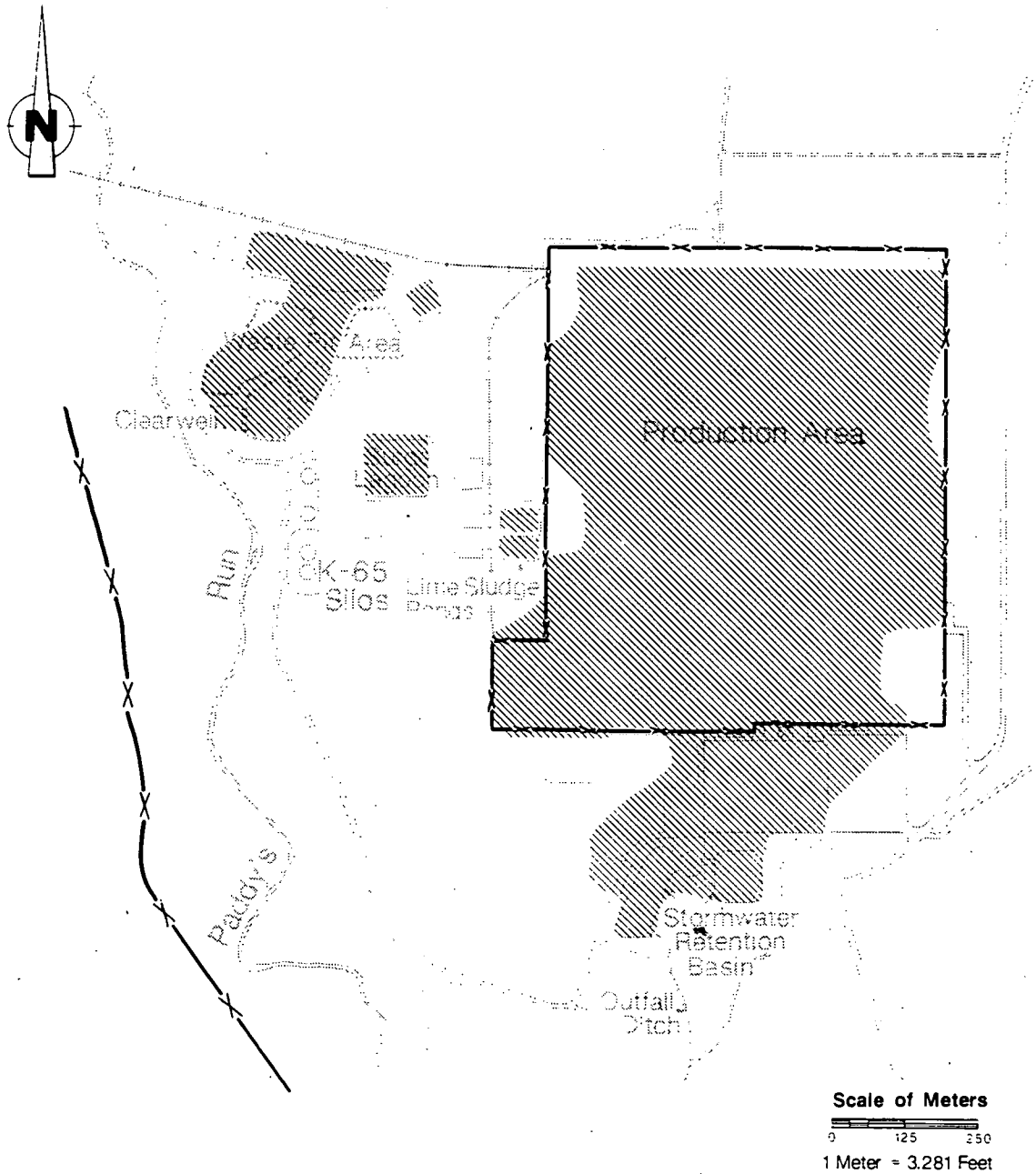


Figure 2-2 Areas of Controlled Stormwater Runoff at FEMP[8]



LEGEND

Shaded Areas are Collected and Eventually Discharged to the Great Miami River

×—× Plant Perimeter

×–×–× Production Area Perimeter

1588

2.0 LIQUID EFFLUENT MONITORING (cont.)

Presently, during dry weather or low flow conditions, waters collected in the storm sewer system are intercepted at the Storm Sewer Lift Station (SSLS) and pumped directly to Manhole-175. A project is underway to revise the lift station configuration so that all waters collected by the storm sewer system will normally be sent first to the SWRB for settling before discharge to the river.

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 Paddy's Run which ultimately flows into the Great Miami River.

Removal Action No. 2 - Waste Pit Area Runoff Control was completed in July 1992. This project provides a system for the collection and treatment of potentially contaminated stormwater from the perimeter of the waste pit area to prevent it from reaching Paddy's 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 completed removal action and the continued operation of the existing Stormwater Retention Basin will result in capturing a significant amount of additional stormwater runoff from the site. This will reduce the amount of contaminants released to the environment.

Another removal action -- Removal Action No. 16, Collect Uncontrolled Production Area Stormwater Runoff -- will redirect additional contaminated surface runoff that presently flows to Paddy's Run into the Storm Sewer System for discharge to the SWRB. Completion of these removal actions will result in capturing a significant amount of additional stormwater runoff from the site, thus reducing further the potential for release of contaminants to the environment.

2.0 LIQUID EFFLUENT MONITORING (cont.)

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 SSLS and 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 process stream.

Outfall 4001 and 4002 are the final monitoring locations for liquid effluent discharged from the FEMP to the Great Miami River via Manhole-175 and to Paddy's Run via SWRB overflow to the SSOD, respectively. Paddy's Run is recharged by runoff from active and inactive flyash piles.

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 1991 ASER[71], the primary radionuclides of interest at the FEMP are U^{238}, U^{235}, U^{234}, Th^{232}, and Ra^{226}. Since chemical processing of uranium bearing materials is no longer being 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.

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

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

2.0 LIQUID EFFLUENT MONITORING (cont.)

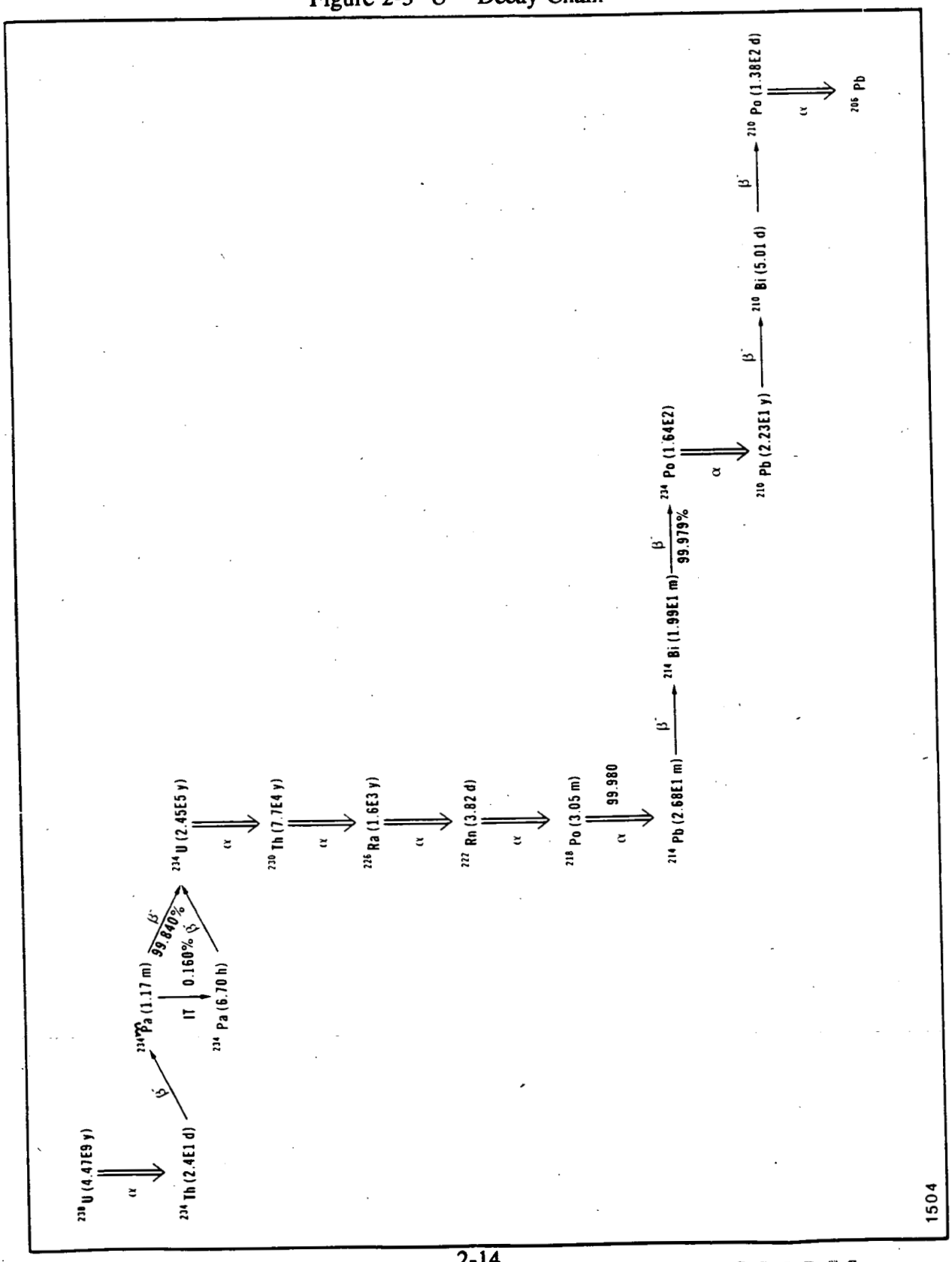
- Pa^{234m} is currently in equilibrium with its predecessors. Since it is a beta emitter with no significant photon emissions, and its half-life is approximately one minute, there is no practical means of analyzing for this radionuclide specifically. Therefore, it is <u>not</u> considered a target analyte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

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

- U^{234} is nearly in equilibrium with U^{238} since it was separated along with the U^{238} as part of past chemical processes. This fact is supported by data which indicates a U^{234} to U^{238} ratio of 0.85 in 1988 (see Table 2-1) and 0.78 in 1989 (see Table 2-2). Thus U^{234} is considered a target analyte in effluents.

- There will be no significant in-growth of Th^{230} due to the long half-life of U^{234}. However, Th^{230} and Ra^{226} 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 substantiated by the fact that Th^{230} has been quantified in liquid effluents since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4). Thus Th^{230} is considered a target analyte in liquid effluents. The analyses of liquid effluents have not identified Ra^{226} since 1988, however due to the known inventory of this radionuclide onsite, it cannot be dismissed as a potential contaminant in liquid effluents.

Figure 2-3 U^{238} Decay Chain[15]



2.0 LIQUID EFFLUENT MONITORING (cont.)

- Any in-growth of Ra^{226} daughters will not be significant for residues and contamination that are open to the atmosphere because the emanation of gaseous Rn^{222} will disrupt the decay chain. This is supported by the fact that analyses of liquid effluents have not detected Pb^{210} since 1988. Any contained materials bearing Ra^{226} would also contain its daughters through Pb^{210}, but the fact that such materials are confined makes these daughter products unlikely contaminants in liquid effluents. For these reasons, the Ra^{226} daughters are not considered target analytes for liquid effluent radiochemical analyses.

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

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

- There will be no significant in-growth of Pa^{231} and Ac^{227} due to their long half-lives, however Pa^{231} and Ac^{227} 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 Pa^{231} in the past. Routine analyses for Ac^{227} have not detected this radionuclide since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4). In addition, specific analyses for alpha-emitting thorium isotopes have not detected Th^{227} since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4).

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-1. Radionuclides Discharged to the Great Miami River in 1988[23].

Radio-nuclide	Curies Released	Percent Release	Average pCi/L	DCG pCi/L	DCG Fraction
Ac^{227}	< 1.6E-02		< 2.2E+01	1.0E+01	
Cs^{137}	< 4.9E-03		< 6.5E+00	3.0E+03	
K^{40}	< 6.8E-02		< 8.4E+01	7.0E+03	
Np^{237}	< 3.3E-05		< 4.5E-02	3.0E+01	
Pb^{210}	< 6.6E-03		< 8.6E+00	3.0E+01	
Pu^{238}	< 1.6E-05		< 2.2E-02	4.0E+01	
Pu^{239}/Pu^{240}	< 2.3E-05		< 2.8E-02	3.0E+01	
Ra^{226}	< 4.0E-03		< 6.7E+00	1.0E+02	
Ra^{228}	< 2.1E-03		< 5.6E+00	1.0E+02	
Ru^{106}	< 3.3E-02		< 4.2E+01	6.0E+03	
Sr^{90}	1.2E-03	0.02	1.6E+00	1.0E+03	1.6E-03
Tc^{99}	5.9E+00	91.54	7.3E+03	1.0E+05	7.3E-02
Th^{228}	3.2E-04	< 0.01	4.1E-01	4.0E+02	1.0E-03
Th^{230}	7.4E-04	0.01	9.2E-01	3.0E+02	3.1E-03
Th^{232}	8.7E-05	< 0.01	1.1E-01	5.0E+01	2.2E-03
Th^{234}	< 7.9E-02		< 7.9E+01	1.0E+04	
U^{234}	2.4E-01	3.72	3.1E+02	5.0E+02	6.2E-01
U^{235}	1.2E-02	0.19	1.5E+01	6.0E+02	2.5E-02
U^{236}	1.1E-02	0.17	1.5E+01	5.0E+02	3.0E-02
U^{238}	2.8E-01	4.34	3.4E+02	6.0E+02	5.7E-01
Totals	6.4E+00	100.00			1.3E+00

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-2. Radionuclides Discharged to the Great Miami River in 1989[8].

Radio-nuclide	Curies Released	Percent Release	Average pCi/L	DCG pCi/L	DCG Fraction
Ac^{227}	< 9.4E-04		< 1.0E+00	1.0E+01	
Cs^{137}	< 7.4E-03		< 7.9E+01	3.0E+03	
K^{40}	< 1.2E-01		< 1.3E+02	7.0E+03	
Np^{237}	< 9.0E-05		< 1.0E-01	3.0E+01	
Pb^{210}	< 4.1E-03		< 4.4E+00	3.0E+01	
Pu^{238}	< 7.0E-05		< 8.0E-02	4.0E+01	
Pu^{239}/Pu^{240}	1.0E-04	0.01	1.1E-01	3.0E+01	3.7E-03
Ra^{226}	< 2.6E-03		< 2.7E+00	1.0E+02	
Ra^{228}	< 5.8E-03		< 6.2E+00	1.0E+02	
Ru^{106}	< 6.7E-02		< 7.1E+01	6.0E+03	
Sr^{90}	< 5.2E-04		< 5.5E-01	1.0E+03	
Tc^{99}	< 3.3E+00		< 3.5E+03	1.0E+05	
Th^{228}	< 2.9E-04		< 3.1E-01	4.0E+02	
Th^{230}	2.6E-04	0.03	2.7E-01	3.0E+02	9.0E-04
Th^{232}	7.3E-04	0.09	7.8E-01	5.0E+01	1.6E-02
Th^{234}	2.8E-01	35.00	3.0E+02	1.0E+04	3.0E-02
U^{234}	2.2E-01	27.50	2.4E+02	5.0E+02	4.8E-01
U^{235}	1.1E-02	1.38	1.2E+01	6.0E+02	2.0E-02
U^{236}	7.9E-03	0.99	8.4E+00	5.0E+02	1.7E-02
U^{238}	2.8E-01	35.00	3.0E+02	6.0E+02	5.0E-01
Totals	8.0E-01	100.00			1.1E+00

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-3. Radionuclides Discharged to the Great Miami River in 1990.

Radio-nuclide	Curies Released	Percent Release	Average pCi/L	DCG pCi/L	DCG Fraction
Ac^{227}	< 9.8E-04		< 1.0E+00	1.0E+01	
Cs^{137}	< 3.6E-03		< 1.1E+01	3.0E+03	
K^{40}	< 1.6E-01		< 1.6E+02	7.0E+03	
Np^{237}	< 2.0E-04		< 2.1E-01	3.0E+01	
Pb^{210}	< 8.3E-03		< 8.5E+00	3.0E+01	
Pu^{238}	< 9.8E-05		< 1.0E-01	4.0E+01	
Pu^{239}/Pu^{240}	< 1.2E-04		< 1.3E-01	3.0E+01	
Ra^{226}	< 4.8E-03		< 4.9E+00	1.0E+02	
Ra^{228}	< 1.0E-02		< 10.6E+00	1.0E+02	
Ru^{106}	< 3.0E-02		< 9.0E+01	6.0E+03	
Sr^{90}	1.4E-04	0.02	4.0E-01	1.0E+03	4.0E-04
Tc^{99}	< 1.7E+00		< 1.69E+03	1.0E+05	
Th^{228}	< 2.7E-04		< 3.0E-01	4.0E+02	
Th^{230}	6.9E-04	0.10	7.0E-01	3.0E+02	2.3E-03
Th^{232}	< 5.0E-04		< 5.0E-01	5.0E+01	
Th^{234}	2.6E-01	36.2	2.67E+02	1.0E+04	2.7E-02
U^{234}	1.8E-01	25.0	1.854E+02	5.0E+02	3.7E-01
U^{235}	1.1E-02	1.5	1.1E+01	6.0E+02	1.8E-02
U^{236}	6.8E-03	1.0	7.0E+00	5.0E+02	1.4E-02
U^{238}	2.6E-01	36.2	2.67E+02	6.0E+02	4.5E-01
Totals	2.6E+00	100.00			8.8E-01

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-4. Radionuclides Discharged to the Great Miami River in 1991.

Radio-nuclide	Curies Released	Percent Release	Average pCi/L	DCG pCi/L	DCG Fraction
Ac^{227}	< 1.3E-04		< 1.6E-01	1.0E+01	
Cs^{137}	< 1.1E-03		< 4.0E+00	3.0E+03	
K^{40}	< 7.1E-02		< 8.6E+01	7.0E+03	
Np^{237}	1.6E-03	.026	1.9E+00	3.0E+01	6.3E-02
Pb^{210}	< 2.6E-03		< 3.1E+00	3.0E+01	
Pu^{238}	< 8.2E-05		< 1.0E-01	4.0E+01	
Pu^{239}/Pu^{240}	< 4.1E-05		< 5.0E-02	3.0E+01	
Ra^{226}	< 2.6E-03		< 3.1E+00	1.0E+02	
Ra^{228}	< 3.0E-03		< 3.7E+00	1.0E+02	
Ru^{106}	< 9.8E-03		< 3.6E+01	6.0E+03	
Sr^{90}	< 7.1E-04		< 2.7E+00	1.0E+03	
Tc^{99}	< 1.6E+00		< 2.0E+03	1.0E+05	
Th^{228}	< 1.1E-04		< 3.1E-01	4.0E+02	
Th^{230}	4.6E-04	0.073	5.6E-01	3.0E+02	1.87E-03
Th^{232}	< 5.0E-05		< 6.0E-01	5.0E+01	
Th^{234}	2.2E-01	35.11	2.7E+02	1.0E+04	2.7E-02
U^{234}	1.7E-01	27.13	2.1E+02	5.0E+02	4.2E-01
U^{235}	8.4E-03	1.34	1.0E+01	6.0E+02	1.6E-02
U^{236}	6.1E-03	0.97	7.4E+00	5.0E+02	1.5E-02
U^{238}	2.2E-01	35.11	2.7E+02	6.0E+02	4.5E-01
Totals	2.3E+00	100.00			9.9E-01

2.0 LIQUID EFFLUENT MONITORING (cont.)

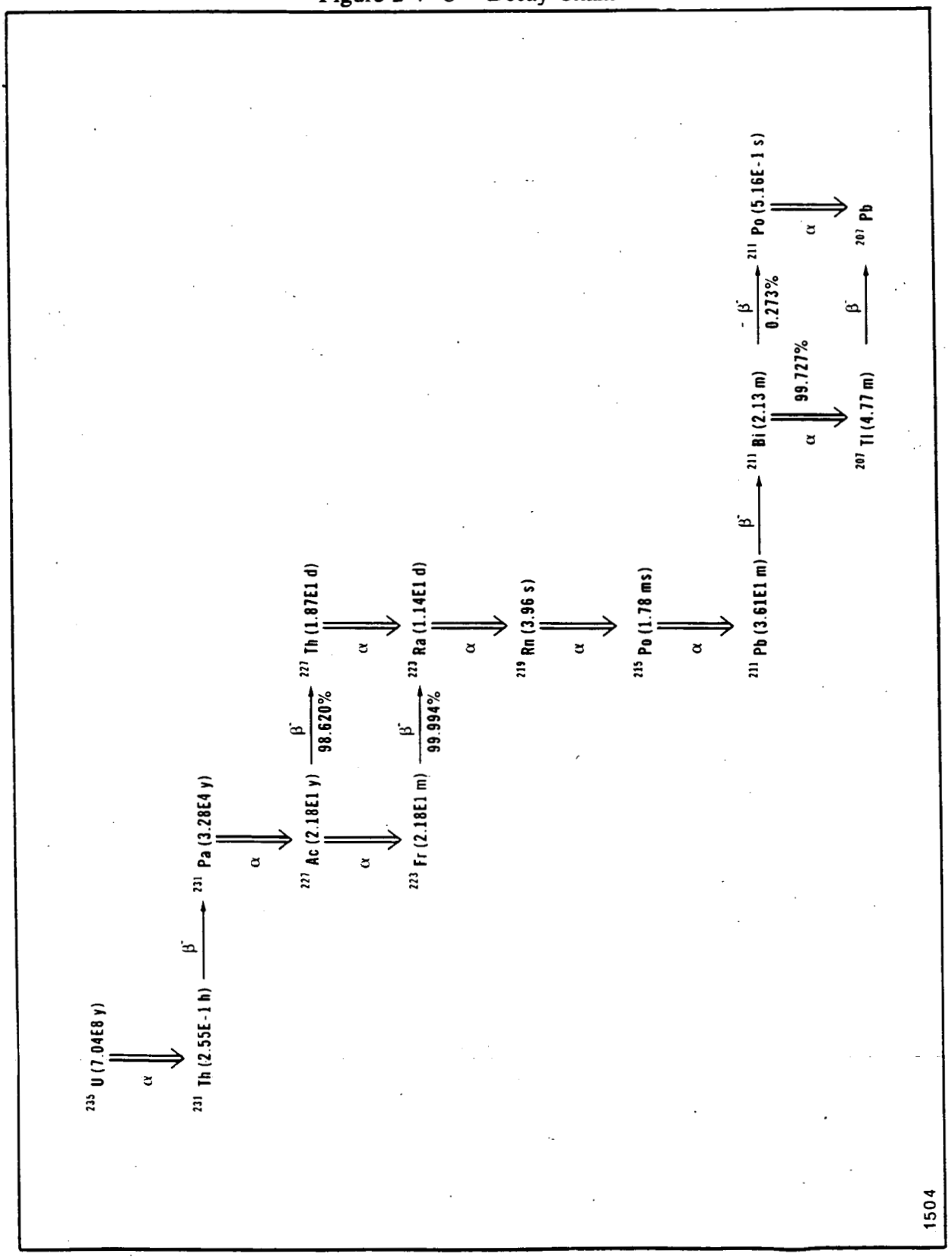
Based on these facts, it is reasonable to infer that site concentrations of Pa^{231}, Ac^{227}, Th^{227}, and radionuclides following Th^{227} in the decay chain, are not significant enough to warrant making them target analytes in radiochemical analyses of liquid effluents. Radionuclides associated with the Th^{232} 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 Ra^{224} is nearly in equilibrium. This is somewhat supported by the fact that Th^{228} was quantified in 1991 (see Table 2-4). Contrary to this, routine analyses for alpha emitting radium isotopes have not detected Ra^{224} since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4). Based on these observations, all Th^{232} daughters through Ra^{224} should be considered target analytes in radiochemical analyses of liquid effluents. Since it is reasonable to assume the equilibrium condition exists and there are no on-going site processes to chemically separate the elements in the Th^{232} decay chain, the Th^{232} daughters may be estimated using the assumption of equilibrium.

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

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

Figure 2-4 U^{235} Decay Chain[15]



2.0 LIQUID EFFLUENT MONITORING (cont.)

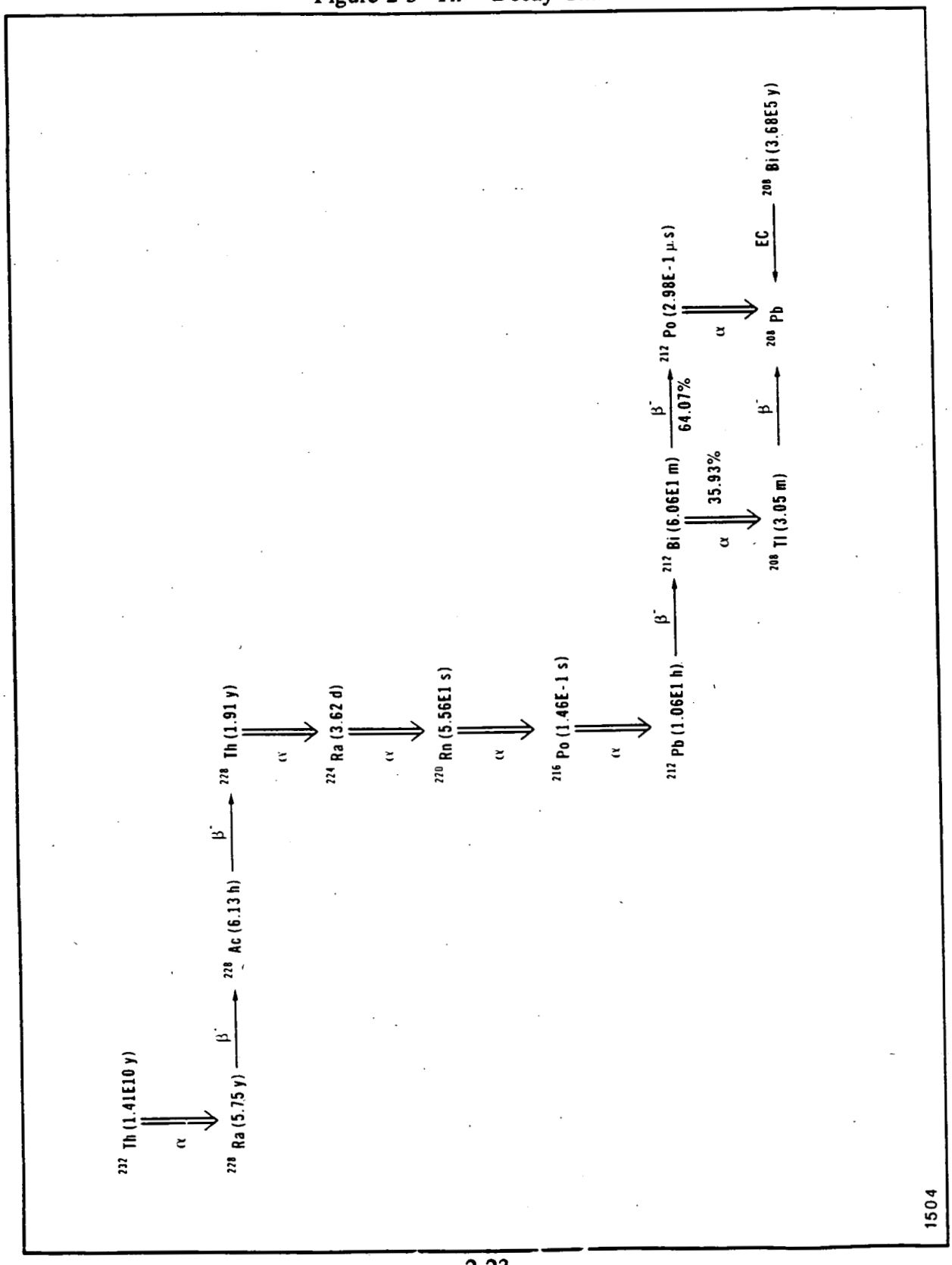
- Gamma emitting fission products such as Cs^{137} and Ru^{106} have not been quantified in liquid effluents since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4). Since both Cs^{137} and Ru^{106} are high yield fission products, their absence in liquid effluents makes it highly improbable that other fission 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 Sr^{90} and Tc^{99} were quantified in liquid effluents in 1988. However, the levels at which they were quantified were small fractions of their respective DCGs (see Tables 2-1, 2-2, 2-3, and 2-4). 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.

- U^{236} has been quantified in liquid effluents since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4). Therefore it is considered a target analyte for liquid effluent radiochemical analyses.

- The transuranics $Pu^{239/240}$ were quantified in liquid effluents in 1989. However, the levels at which these radionuclides were quantified was a small fraction of their DCGs (see Tables 2-3 and 2-4). Pu^{238} has not been quantified in liquid effluents since 1988 (see Tables 2-1, 2-2, 2-3, and 2-4). 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.

Figure 2-5 Th^{232} Decay Chain[15]



2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-5. Target Analytes In FEMP Liquid Effluents

Radio-nuclide	Alphas		Betas			Photons	
	MeV	Percent Yield	Max MeV	Avg MeV	Percent Yield	MeV	Percent Yield
Ac^{228}			0.606 0.983 1.014 1.168 1.741 2.079	0.182 0.317 0.328 0.386 0.611 0.748	8.00 7.00 6.60 32.00 12.00 8.00	0.013 0.338 0.911 0.965 0.969	39.11 11.36 27.70 5.21 16.62
Ra^{224}	5.686	95.10					
Ra^{226}	4.602 4.785	5.55 94.55					
Ra^{228}			0.039	0.010	100.00		
Th^{228}	5.341 5.423	26.70 72.70				0.012	9.56
Th^{230}	4.621 4.688	23.40 76.30				0.012	8.43
Th^{231}			0.206 0.287 0.288 0.305	0.055 0.079 0.080 0.085	15.00 9.00 41.00 35.00	0.013 0.026	70.78 14.65
Th^{232}	3.953 4.010	23.00 77.00				0.012	8.39
Th^{234}			0.096 0.096 0.189	0.025 0.025 0.051	6.80 18.50 72.50	0.013	9.57
U^{234}	4.724 4.776	27.40 72.40				0.013	10.50
U^{235}	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
U^{236}	4.445 4.494	26.00 74.00				0.013	9.98
U^{238}	4.147 4.196	23.00 77.00				0.013	8.83

2.0 LIQUID EFFLUENT MONITORING (cont.)

Based on the foregoing evaluation, target analytes for radiochemical analyses of liquid effluents at the FEMP are given in Table 2-5.

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[13] 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 a thorough discussion.

2.5 Sampling and Monitoring Methods

2.5.1 Radiological

Inspection of Table 2-1 through Table 2-4 reveals that the most abundant radionuclides reported in the FEMP liquid effluents are U^{238}, U^{234}, Th^{234}, and Tc^{99}. The data in Table 2-5 shows that alpha is the principal radioactive emission associated with U^{238} and U^{234}, while beta is the principal emission from Th^{234}. Tc^{99} is essentially a pure beta emitter. None of these radionuclides emit photons suitable for reliable gamma measurement. State of the art continuous monitoring instruments for radioactive contaminants in liquid effluent streams are designed to detect photon emissions from such contaminants.

2.0 LIQUID EFFLUENT MONITORING (cont.)

Because none of 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 11-3. Currently the Maintenance Management and Inventory Control System (MMICS) is being used for calibration and maintenance. Procedures are currently being written 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.

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.

2.5.2 Non-Radiological

The sampling requirements for non-radiological contaminants of concern are prescribed by the current NPDES Permit[13] issued by the OEPA. Procedures shall exist for implementing the sampling and monitoring requirements established by the permit. Refer to Section 2.7 for a thorough discussion.

2.6 Analytical Requirements

2.6.1 Radiological

Table 2-6 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

In general, the chemistry required to obtain isotope specific results for the target analytes listed in Table 2-4 is too complex and expensive to be performed very frequently. On the other hand, 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 2-6. Minimum Analytical Requirements of FEMP Liquid Effluents

Description of Analysis	Minimum Analysis Frequency	Target Analytes	Required MDA	Overall Uncertainty at 10 x MDA
Total Gross Alpha	Weekly Composite	*	5E+00 pCi/L	±50%
Total Gross Beta	Weekly Composite	*	1E+02 pCi/L	±50%
Gamma Spectrometry	Quarterly Composite	Ac^{228}	6E+02 pCi/L	±50%
Isotopic Radium	Quarterly Composite	Ra^{224} Ra^{226} Ra^{228}	4E+00 pCi/L 1E+00 pCi/L 1E+00 pCi/L	±50%
Isotopic Thorium	Quarterly Composite	Th^{228} Th^{230} Th^{231} Th^{232} Th^{234}	4E+00 pCi/L 3E+00 pCi/L 1E+03 pCi/L 5E-01 pCi/L 1E+02 pCi/L	±50%
Isotopic Uranium	Quarterly Composite	U^{234} U^{235} U^{236} U^{238}	5E+00 pCi/L 6E+00 pCi/L 5E+00 pCi/L 6E+00 pCi/L	±50%

* Action levels to be developed and incorporated in written procedure(s).

2.0 LIQUID EFFLUENT MONITORING (cont.)

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 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 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

2.0 LIQUID EFFLUENT MONITORING (cont.)

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)

For the most part, the MDAs specified in Table 2-5 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 in Tables 2-1, 2-2, 2-3, and 2-4 resulted in the choice of U^{234} as the basis for the gross alpha MDA and Th^{234} 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.

2.0 LIQUID EFFLUENT MONITORING (cont.)

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[63]. 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 2-6 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.

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 below.

2.0 LIQUID EFFLUENT MONITORING (cont.)

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 to remove the effluent limitation and monitoring requirement for fluoride at the Biodenitrification Effluent Treatment System (BETS - Outfall 4605) and the OEPA NPDES Permit Number was revised to 1IOOOOO4*CD to reflect this change. The current NPDES permit is in effect until February 9, 1995.

The FEMP NPDES Permit covers eight discharge points, six of which are internal monitoring points and two of which are direct discharges to receiving surface waters. The permitted discharges are as follows:

Sampling Station	Description of Location
1IOOOOO4001	Manhole 175, final effluent before Great Miami River.
1IOOOOO4002	Spillway from Stormwater Retention Basin to Paddy's Run.
1IOOOOO4601	Sewage Treatment Plant effluent, after disinfection, prior to mixing with other wastestreams discharged via Manhole 175 and final outfall (001).

2.0 LIQUID EFFLUENT MONITORING (cont.)

Sampling Station	Description of Location
1IOOOOO4602	General Sump, effluent directed to Manhole 175 then discharged.
1IOOOOO4603	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.
1IOOOOO4604	Storm Sewer Lift Station effluent pumped to Manhole 175 and discharged.
1IOOOOO4605	Effluent from Biodenitrification after settling and/or biological treatment discharged via Manhole 175.
1IOOOOO4606	Stormwater Retention Basin pump station effluent discharged via Manhole 175.

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, Final Effluent to Great Miami River**

Manhole 175 serves as the final inspection point for FEMP discharges to the 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 MH-175. Flows are recorded on a continuous basis using a 6-inch parshall flume and are recorded on charts located at MH-175. NPDES parameters, their corresponding effluent

2.0 LIQUID EFFLUENT MONITORING (cont.)

limitations/loading rates, and monitoring requirements for discharge point *4001 are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirements	
Reporting		*Concentration*		*Loadings**		Measurement Frequency	Sample Type
Units	Parameter	30 day	Daily	30 day	Daily		
mg/L	Dissolved Oxygen	—	(5.0 Min.)	—	—	1/Week	Grab
mg/L	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 (NH3)	—	—	—	—	1/Week	24 Hr. Comp.
mg/L	Nitrate-N	—	—	—	—	1/Week	24 Hr. Comp.
mg/L	Cyanide, Total	0.036	0.076	0.120	0.251	1/Week	Grab
mg/L	Fluoride, Total	—	—	—	—	1/Week	24 Hr. Comp.
µg/L	Chromium, Total	—	—	—	—	1/Week	24 Hr. Comp.
µg/L	Copper, Total	23	94	0.077	0.310	1/Week	24 Hr. Comp.
µg/L	Lead, Total	60	776	0.199	2.562	1/Week	24 Hr. Comp.
µg/L	Nickel, Total	--	--	--	--	1/Week	24 Hr. Comp.
µg/L	Silver, Total	12	26	0.040	0.086	1/Week	24 Hr. Comp.
µg/L	Chromium, Hexavalent	--	--	--	--	1/Week	24 Hr. Comp.
mgd	Flow Rate	--	--	--	--	Daily	24 Hr. Total
mg/L	BOD, carb.	20	30	66	99	1/Week	24 Hr. Comp.

* Loadings based on 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 Paddy's 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 Paddy's 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:

2.0 LIQUID EFFLUENT MONITORING (cont.)

Effluent Characteristic		Discharge Limitation				Monitoring Requirement	
Reporting		Concentration		Loadings*		Measurement	Sample
Units	Parameter	30 day	Daily	30 day	Daily	Frequency	Type
mg/L	TSS	–	100	–	–	Daily	Composite
mg/L	Oil & Grease, Total	–	15	–	–	Daily	Grab
mg/L	Nitrogen, Ammonia, Total	–	–	–	–	Daily	Composite
mg/L	Nitrogen, Nitrate	–	–	–	–	Daily	Composite
mg/L	Fluoride, Total	–	–	–	–	Daily	Composite
µg/L	Chromium, Total	–	3986	–	–	Daily	Composite
µg/L	Copper, Total	–	45	–	–	Daily	Composite
µg/L	Nickel, Total	–	3137	–	–	Daily	Composite
µg/L	Silver, Total	–	11.6	–	–	Daily	Composite
µg/L	Chromium, Hex.	–	19	–	–	Daily	Composite
mgd	Flow Rate	–	–	–	–	Daily	24 Hr. Total Estimate

*** Loadings 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 MH-175 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 Requirement	
Reporting		Concentration		Loadings*		Measurement	Sample
Units	Parameter	30 day	Daily	30 day	Daily	Frequency	Type
mg/L	BOD, 5 Day	20	40	9.5	19	1/Week	24 Hr. Comp.
mg/L	TSS	20	40	9.5	19	1/Week	24 Hr. Comp.
mg/L	Nitrogen, Ammonia	–	–	–	–	1/Week	24 Hr. Comp.
mg/L	Fluoride, Total	2.3	5.1	1.08	2.43	1/Week	24 Hr. Comp.
µg/L	Chromium, Total	13	32	0.006	0.015	1/Week	24 Hr. Comp.
µg/L	Copper, Total	53	112	0.025	0.053	1/Week	24 Hr. Comp.
µg/L	Nickel, Total	32	49	0.015	0.023	1/Week	24 Hr. Comp.
#/100ml	Fecal Coliform (Summer Only)	1000	2000	–	–	1/Week	24 Hr. Comp.
mgd	Flow Rate	–	–	–	–	Daily	24 Hr. Total

***Loadings based on flow rate of 0.125 mgd and reported in kg/day**
pH monitoring continuous, acceptable range 6.5 S.U. to 9.0 S.U.

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 MH-175 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 Requirement	
Reporting		Concentration		Loadings*		Measurement	Sample
Units	Parameter	30 day	Daily	30 day	Daily	Frequency	Type
µg/L	Chromium, Total	41	54	0.010	0.013	1/Week	24 Hr. Comp.
µg/L	Copper, Total	66	111	0.016	0.027	1/Week	24 Hr. Comp.
µg/L	Nickel, Total	91	165	0.022	0.040	1/Week	24 Hr. Comp.
µg/L	Chromium, Hexavalent	12	17	0.003	0.004	1/Week	24 Hr. Comp.
mgd	Flow Rate	–	–	–	–	Daily	24 Hr. Total

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

pH monitored 1/week by grab sample, acceptable range 6.5 S.U. to 9.0 S.U.

*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.

*4604 - Storm Sewer Lift Station Effluent

Storm Sewer Lift Station (SSLS) effluent consists of stormwater runoff from FEMP process areas. An automatic sampler is used to collect samples at the SSLS building (MH-34). Flows are measured using a Venturi meter and are recorded on charts at the MH-34 building. NPDES parameters, their corresponding effluent limitations and monitoring requirements for discharge point *4604 are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirement	
Reporting		Concentration		Loadings*		Measurement	Sample
Units	Parameter	30 day	Daily	30 day	Daily	Frequency	Type
mg/L	TSS	30	100	–	–	1/Week	24 Hr. Comp.
mg/L	Oil & Grease, Total	15	15	–	–	1/Week	Grab
mg/L	Nitrate-N	–	–	–	–	1/Week	24 Hr. Comp.
mg/L	Fluoride, Total	–	–	–	–	1/Week	24 Hr. Comp.
mgd	Flow Rate	–	–	–	–	Daily	24 Hr. Total

pH is monitored on a continuous basis, acceptable range 6.5 S.U to 9.0 S.U.

*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 MH-175 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

2.0 LIQUID EFFLUENT MONITORING (cont.)

automatic sampler located at the BDN-ETS. NPDES parameters, their corresponding effluent limitations, and monitoring requirements are as follows:

Effluent Characteristic		Discharge Limitation				Monitoring Requirement	
Reporting		Concentration		Loadings*		Measurement	Sample
Units	Parameter	30 day	Daily	30 day	Daily	Frequency	Type
mg/L	BOD, 5 Day	30	45	26	38	1/Week	24 Hr. Comp.
mg/L	TSS	30	45	26	38	1/Week	24 Hr. Comp.
mg/L	Nitrogen, Ammonia (NH3)	–	–	–	–	1/Week	24 Hr. Comp.
mg/L	Nitrate-N	72.7	145	62	124	1/Week	24 Hr. Comp.
µg/L	Chromium, Total	12	27	0.0101	0.0226	1/Week	24 Hr. Comp.
µg/L	Copper, Total	45	90	0.0387	0.0770	1/Week	24 Hr. Comp.
µg/L	Nickel, Total	29	42	0.0251	0.0361	1/Week	24 Hr. Comp.
µg/L	Chromium, Hexavalent	–	–	–	–	1/Week	24 Hr. Comp.
mgd	Flow Rate	–	–	–	–	Daily	24 Hr. Total

*** Loadings are based on flow rate of 0.2252 mgd and reported in kg/day**

pH monitored on continuous basis, acceptable range 6.5 S.U. to 9.0 S.U.

*4606 - Storm Water Retention Basin Effluent

The Storm Water Retention Basin (SWRB) collects stormwater runoff from the FEMP parking lot and production areas. Samples are collected by an automatic sampler located in the building adjacent to the discharge pump. Flows are recorded on a chart at the SWRB.

Effluent Characteristic		Discharge Limitation				Monitoring Requirement	
Reporting		Concentration		Loadings*		Measurement	Sample
Units	Parameter	30 day	Daily	30 day	Daily	Frequency	Type
mg/L	TSS	–	–	–	–	Daily	24 Hr. Comp.
mg/L	Oil & Grease	–	–	–	–	Daily	Grab
mgd	Flow Rate	–	–	–	–	Daily	24 Hr. Total

pH monitored on continuous basis, acceptable range 6.5 S.U. to 9.0 S.U. This limitation applies only when basins are discharging.

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.7.3 Analytical Requirements

Three on-site laboratories are involved in conducting NPDES laboratory testing. These include the Water Treatment Plant Lab, the Analytical Laboratory Bioassay Section, and the Analytical Laboratory Inorganic and Special Analyses Section. Other labs involved are the Quality Control Lab and a contract lab for the cyanide analysis. Table 2-7 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 Part III, 5 requires that test procedures for the permitted parameters conform to 40 CFR Part 136 unless otherwise approved. Application for alternative test procedures can be made to the Regional Administrator under 40 CFR 136.4.

Part III, 5 requires that periodic calibration and maintenance be performed on all monitoring and analytical instrumentation to insure accuracy of the measurements. Part III, 6 requires certain information including the date the analyses were performed, the person who did the analysis, the techniques used, and the results. Part III, 7 requires all analytical records, original instrumentation recordings, and calibration and maintenance records to 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".

2.0 LIQUID EFFLUENT MONITORING (cont.)

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 2-7. 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 executed. 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.

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 2-8 lists site SSOPs for the various laboratory analyses.

Results of the NPDES laboratory analyses are entered into the Analytical Laboratory Information System (ANALIS) after completion. 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 insure that the calculations are correct. After the work cards have been verified the sample data is entered into the AnaLis system and are rechecked to assure they have been entered accurately.

2.7.4 Lower Limit of Detection for NPDES Parameters

Parameter	Lower Limit of Detection
TSS	2.0 mg/L
Oil & Grease, Total	5.0 mg/L
Nitrogen, Ammonia (NH_3)	0.1 mg/L
Nitrate-N	0.1 mg/L
Cyanide, Total	0.005 mg/L

2.0 LIQUID EFFLUENT MONITORING (cont.)

Parameter	Lower Limit of Detection
Fluoride, Total	0.1 mg/L
Chromium, Total	6 μg/L
Copper, Total	14 μg/L
Lead, Total	3 μg/L
Nickel, Total	17 μg/L
Silver, total	10 μg/L
Chromium, Hexavalent	6 μg/L
BOD	NA

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.

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-7. Laboratory Analyses NPDES Parameters

PARAMETER	SAMPLE HOLDING TIME	SAMPLE PRESERVATION	LABORATORY	TECHNIQUE USED	METHOD NUMBER	REFERENCE EMPLOYED
Dissolved Oxygen (DO)	analyze immediately	none	WTP	probe	43-M-1002	Standard Methods[2]
Total Suspended Solids (TSS)	7 days	Cool 4° C	ALS INORG.	gravimetric	method 9094	U.S. EPA Method No. 160.2[3]
Oil & Grease	28 days	Cool 4° C; H_2SO_4 to pH < 2	ALS INORG.	gravimetric	method 1001	U.S. EPA Method No. 413.1
Ammonia-Nitrogen	28 days	Cool 4° C; H_2SO_4 to pH < 2	ALS INORG.	electrode	method 3001	U.S. EPA Method No. 350.2
Nitrate-Nitrogen	48 hours	Cool 4° C; H_2SO_4 to pH < 2	ALS INORG.	brucine sulfate	method 3051	U.S. EPA 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[2]
CBOD 5-Day	set up immediately	Cool 4° C	WTP	electrode	43-M-1000	Standard Methods[2]
BOD 5-Day	set up immediately	Cool 4° C	WTP	electrode	43-M-1000	Standard Methods[2]
Chromium Total (Cr)	6 months	Cool 4° C; HNO_3 to pH < 2	ALS INORG. AA/ICP	inductively coupled plasma	method 9043	U.S. EPA Method No. 218.2
Chromium Dissolved Hexavalent (Cr+6)	24 hours	Cool 4° C	ALS INORG. AA/ICP	graphite furnace; AA unit	method 1026	U.S. EPA 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	U.S. EPA Method No. 230.2
Cyanide-Total (CN)[1]	14 days	Cool 4° C; NaOH to pH > 12; 0.6 g ascorbic acid	Contract Lab		N/A	U.S. EPA SW-846 Method No. 9010
Fluoride-Total (F)	28 days	none	ALS INORG.	ion selective electrode	method 9145	U.S. EPA 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	U.S. EPA 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	U.S. EPA 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	U.S. EPA Method No. 272.2

2.0 LIQUID EFFLUENT MONITORING (cont.)

Table 2-8. NPDES Related Standard Operating Procedures

SOP #	*SOP TITLE*	*DEPARTMENT*
Anl-01-0017	Preparation of Reagents and Standards	Analytical
Anl-01-0038	Handling and Storing Chemcials	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	Biodentrification 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	Biodentrification Facility Operation	BDN
SOP 43-C-324	Sampling FMPC Water Supplies	Water Plant
SOP 43-C-325	Biodentrification 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 Sewage Treatment Plant	Water Plant
SOP 43-C-701	General Sump Operation	General Sump
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 Mebrane Filter Method	Water Plant
SOP EC-4-004	National Pollutant Discharge Elimination System	Regulatory Technology Programs

2.0 LIQUID EFFLUENT MONITORING (cont.)

2.7.6 NPDES Reporting Requirements

All NPDES monitoring data is 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: Outfall from the Stormsewer Outfall Ditch (SSOD) into Paddy's 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 1IOOOOO4002. Located South of Stormwater Retention basin in an unnamed tributary of Paddy's Run. The monitoring point is located within the stream bed.

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

2.0 LIQUID EFFLUENT MONITORING (cont.)

STRM 003: Outfall containing 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. Located in unnamed tributary to Paddy's 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: Outfall containing 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 a yearly basis.

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.

2.8 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 QAPD, RM-0012, and the SCQ, FD-1000 (DOE/EH-0173T, Summary 2s).

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 aqueous matrix samples. Section 10.0 of the EMP, "Quality Assurance," requires that SCQ requirements be

2.0 LIQUID EFFLUENT MONITORING (cont.)

followed. 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, 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.

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 11.2 describes current airborne effluent monitoring practices at the FEMP. 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):

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

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

The limit includes doses from remedial actions and naturally occurring radionuclides released by DOE processes and operations. 40 CFR 61 Subpart H requirements has been intrepreted to include the decay products of radon.

- 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 (Rn^{222}) due to onsite interim storage facilities shall not exceed the following [paragraph IV.6b]:

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

Note: The Rn-222 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 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

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

FEMP's inability to satisfy the Rn-222 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. The Environmental Monitoring and Control Section within ES&H is responsible for the Clean Air Program. 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 Industrial Hygiene, Radiological Assessment, and Radiological Environmental Monitoring. In addition, the 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 or coordinates analysis of samples collected for airborne particulate matter. It also 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 Analytical Laboratory Services, Facilities Engineering & Maintenance, and RSO Operations.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- The Regulatory & Technology Programs (RTP) 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 Permitting and Reporting.

3.3 Basis for Airborne Effluent Monitoring

A review of environmental monitoring results from 1989 through 1991 indicates that the airborne emissions (both estimated and measured) from the FEMP have decreased. Although emissions have dropped significantly during this 3 year period, the potential for significant emissions (those capable of contributing a dose of 0.1 mrem/year or greater) continues, and emissions are expected to increase over present levels as remediation (i.e., building demolition, waste pit excavation, waste solidification/vitrification and safe shutdown activities, etc.) proceeds.

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:

- exhaust from processing equipment,
- general building ventilation,
- releases during demolition and clean-up activities (fugitive emissions),

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- 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 has discontinued production. As of January 14, 1993, the FEMP had a total of 191 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 exhausts discharge through stacks or chimneys distributed on the various buildings throughout the former Production Area. Some of the stacks are equipped with air pollution control equipment, primarily HEPA filtration devices (HFDs), while others have no specific effluent controls other than the ability to turn off the processing equipment to stop the release.

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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.4.3 Fugitive Dust Emission

(DOE/EH-0173T Summary 3i)

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 significantly.[9]

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

- 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.[17] 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

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 Fly Ash Disposal Areas, and the Southfield Area — collectively known as the Solid Waste Units. The South Lime Sludge Pond, the Sanitary Landfill, and the Southfield 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[19]. 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.[20] 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.[21]

- 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.[22]

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.

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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 off-site 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 (40 CFR 61, Subpart H) 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. Based on modeling of sources using USEPA approved computer codes and process knowledge, the following stacks will require continuous monitoring. Table 3.2 is a list of all the FEMP stacks requiring continuous monitoring.

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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 one of the 1991 ASER 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 U^{238}, U^{235}, U^{234}, Th^{232}, and Ra^{226}. 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 1988[23], 1989[8], 1990[73], and 1991[71] ASERs.

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

- Th^{234} is assumed to be in equilibrium with U^{238}, and therefore is considered a potential contaminant in airborne effluents. It was reported as having been released in 1988, 1989, 1990, and 1991. It <u>is</u> a target analyte for airborne effluent accounting.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- Pa^{234m} 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.

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

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

- Th^{230} and Ra^{226}. There has been no significant in-growth of Th^{230} and Ra^{226} from U^{234} at the FEMP, due to its long half-life. However, Th^{230} and Ra^{226} were both separated from uranium in past FEMP chemical processes. They are present in process residues and general site contamination, and both nuclides were reported as having been released in 1988, 1989, 1990, and 1991. Thus they are considered target analytes for airborne effluent accounting.

- Rn^{222} 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. Rn^{222} is a target analyte, per 40 CFR 61, Subpart Q.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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

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

- Pa^{231} and later daughters. There has been no significant in-growth of Pa^{231} and the later daughters from Th^{231} at the FEMP, due to the long half-life of Pa^{231}. However, Pa^{231} and Ac^{227} 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 Th^{227} in 1988, 1989, 1990 or 1991. Based on these facts, it is reasonable to infer that site concentrations of Pa^{231}, Ac^{227}, Th^{227}, and radionuclides following Th^{227} in the decay chain, are not high enough to warrant making them target analytes in radiochemical analyses for airborne effluent accounting.

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

- Daughters through Ra^{224}. Due to the long storage period onsite since chemical separation processes were performed, the Th^{232} decay chain through Ra^{224} should be nearly in equilibrium. This is consistent with the fact that Th^{232} and Th^{228} were reported as having been released in roughly the same amounts during the years 1988 through 1991. Although routine analyses for alpha-emitting radium isotopes did not detect Ra^{234} in any of these years, it nevertheless is concluded that all Th^{232} daughters through Ra^{224}

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

should be considered target analytes in radiochemical analyses for airborne effluent accounting.

- Rn^{220} 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 Rn^{220}, it is much less likely than Rn^{222} will escape from the equipment or residues in which it may be contained. Rn^{220} and daughters are <u>not</u> considered target analytes for airborne effluent accounting. However by the request of DOE, the site evaluates Rn^{220} through the same process used to evaluate emissions for compliance with NESHAP Subpart H compliance.

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

- Non-gamma-emitting fission products. The fission products Sr^{90} and Tc^{99} were reported in airborne effluents in 1988, 1989, 1990, and 1991. 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 <u>not</u> considered target analytes for airborne effluent accounting.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- Gamma-emitting fission products. Cs^{137} and Ru^{106} were reported in 1988, 1989, 1990, and 1991, 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.

- U^{236} was reported in 1988, 1989, 1990, and 1991. Therefore, it is considered a target analyte for airborne effluent accounting.

- Transuranics. Isotopes of neptunium and plutonium were reported in airborne effluents in 1988, 1989, 1990, and 1991 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 2-5 for liquid effluents are also applicable to airborne effluent accounting.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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

- Rn^{222} and its daughters 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 ASERs indicate a low aggregate dose impact from the FEMP's point and diffuse sources: 1989 ASER data indicate a 5.2 mrem annual effective dose equivalent (EDE) (1.2 mrem/year EDE excluding the waste pits) by all pathways to the maximally-exposed member of the public, due to all airborne releases of non-radon radionuclides; 1990 ASER data indicate an EDE due to air emissions of 0.6 mrem/year (0.03 mrem/year EDE excluding the waste pits) and; 1991 ASER data indicate an EDE due to air emissions of 0.3 mrem/year EDE (0.005 mrem/year EDE excluding the waste pits). Diffuse sources, which are not readily amenable to controls or to monitoring at the point of emission, dominate these totals. This may be demonstrated as follows:

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3.4 is based on the data in Table 24 of the 1989 ASER. It shows the best estimates of radioactivity released in airborne effluents from monitored point sources, from the waste pits, and from other sources (including unmonitored point and diffuse sources). The report shows (pages 100–102) that excluding the waste pit estimates leads to the best match between estimated releases and the concentrations measured by ambient air monitors. Table 3.4 shows that monitored releases in 1989 were a small fraction of the total for all three groups of sources, and remain less than about 10% of the total even if the waste pit estimates are excluded.

The monitored released activity for 1989 is the total of the releases from the 33 monitored point sources that operated during the year. The FEMP had far more than 33 point release sources in 1989; nevertheless, the 33 points continuously sampled had a *total* dose impact of less than 10% of 1.2 mrem/year, or less than 0.12 mrem/year. Any one of the sampled point sources had a dose impact far less than 0.1 mrem in 1989.

Table 3.5 is based on data in Table 21 of the 1990 ASER. It shows that the monitored releases in 1990 were a small fraction of the *total* for all three sources. Individual measured releases, on the average, remain less than 0.2% of the total activity even if the waste pit estimates are excluded. Theoretically, each point source had a *total* dose impact of less than 0.2% of 0.03 mrem/year, or less than 0.008 mrem/year. Any one of the sampled point sources had a dose impact far less than 0.1 mrem in 1990.

Table 3.6 is based on data in Table 18 of the 1991 ASER. It shows that the monitored releases in 1991 were a small fraction of the *total* for all three sources. Individual measured releases, on the average, remain less than 0.4% of the total activity even if the waste pit estimates are excluded. Theoretically, each point source had a *total* dose impact of less than 0.4% of 0.005 mrem/year, or less than 0.00002 mrem/year. Any one of the sampled point sources had a dose impact far less than 0.1 mrem in 1991.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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.

3.7.1 Point Source Continuous Monitoring for Current Site Conditions (DOE/EH-0173T Summary 3a)

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[16] (20% of the 10 mrem standard) (DOE/EH-0173T Summary 3l). Table 3.1 identifies those point sources which are expected to operate during the next year. 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[22], or based on the criteria stated in Section 3.5.2 and the SCQ.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 (DOE/EH-0173T Summary 3a)

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:

- 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

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- 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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.7.3 Routine Emissions Monitoring

3.7.3.1 Ambient Air Measurements

The following factors discussed above 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:

- The annual effective dose equivalent due to all FEMP point and diffuse airborne emission sources is very low, about 0.3 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 currently in the process of obtaining 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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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, to determine source-based impacts. High volume ambient air monitoring for non-radon radionuclides is preferred for NESHAP Subpart H compliance as discussed previously.

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 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.

In the past, Oak Ridge National Laboratory (ORNL) compared the measured concentrations at the air monitoring stations to modeled concentrations/dose ratios, based on a summation of the sources modeled. In the site's request for the use of an alternative method for demonstration of NESHAP Subpart H compliance (use of critical receptors), the site proposes to compare the measured concentrations to standards provided in the NESHAP Appendices. If the sum of the ratios is less than one, then that would indicate compliance at the receptor location.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 model, the variation 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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

3.7.3.2 Concentrations of Rn^{222}

The Rn^{222} 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 (Section 3.4.4). Silo 3 is a source of Rn^{222} 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 Rn^{222} 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 Rn^{222} in the air at points immediately adjacent to the silos, and at points on the FEMP facility fenceline. The ambient radon measurement program established in Section 5.4.1 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 Rn^{222} 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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

- 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[25] 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

(DOE/EH-0173T Summary 3j)

3.8.1 Radiological

Analysis Regimen

Table 3-7, 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 Section 6.0; data analysis and statistical methods shall comply with the requirements of Section 7.0. Current analytical procedures for the determination of particulate emissions in accordance with USEPA Method 5 (40 CFR Part 60) will be modified or new ones will be developed if necessary in order to meet the above requirements.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 3-7, Minimum Analysis Regimen for Air Particulate Samples, is too complex and expensive to be performed very frequently. Additionally for approximately 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.

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 spectroscopy 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 3-7, Minimum Analysis Regimen for Air Particulate Samples, provides the minimum analysis regimen for the radionuclide target analytes. Ac^{228} will be assumed to be in equilibrium with Ra^{228}. Ra^{224} will be assumed to be in equilibrium with Th^{228}. Th^{231} will be assumed to be in equilibrium with U^{235}. Th^{234} will be assumed to be in equilibrium with U^{238}.

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 alpha 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 analysis, best estimates based on production knowledge, past site-specific data, and site mission will be made to perform the site compliance demonstration.

3.8.1.4 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 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 $\pm$ 50% for each analyte in Table 3-7 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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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.[27]

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.[28] 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.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 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 .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,

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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 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 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 .2% and is .3% for coal containing greater than 5% moisture. Reproducibility for coal containing less than 5% moisture is not more than .3% and is .5% for coal containing more than 5% moisture. For ash analysis, repeatability is .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 .05% and reproducibility is .15% for samples containing less than 2% sulfur and is .25% for samples containing greater than 2% sulfur. For volatile analysis, repeatability is .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[29] states how the facility policies will be implemented to achieve or exceed the required quality involved in monitoring stacks and vents at the FEMP.

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

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.

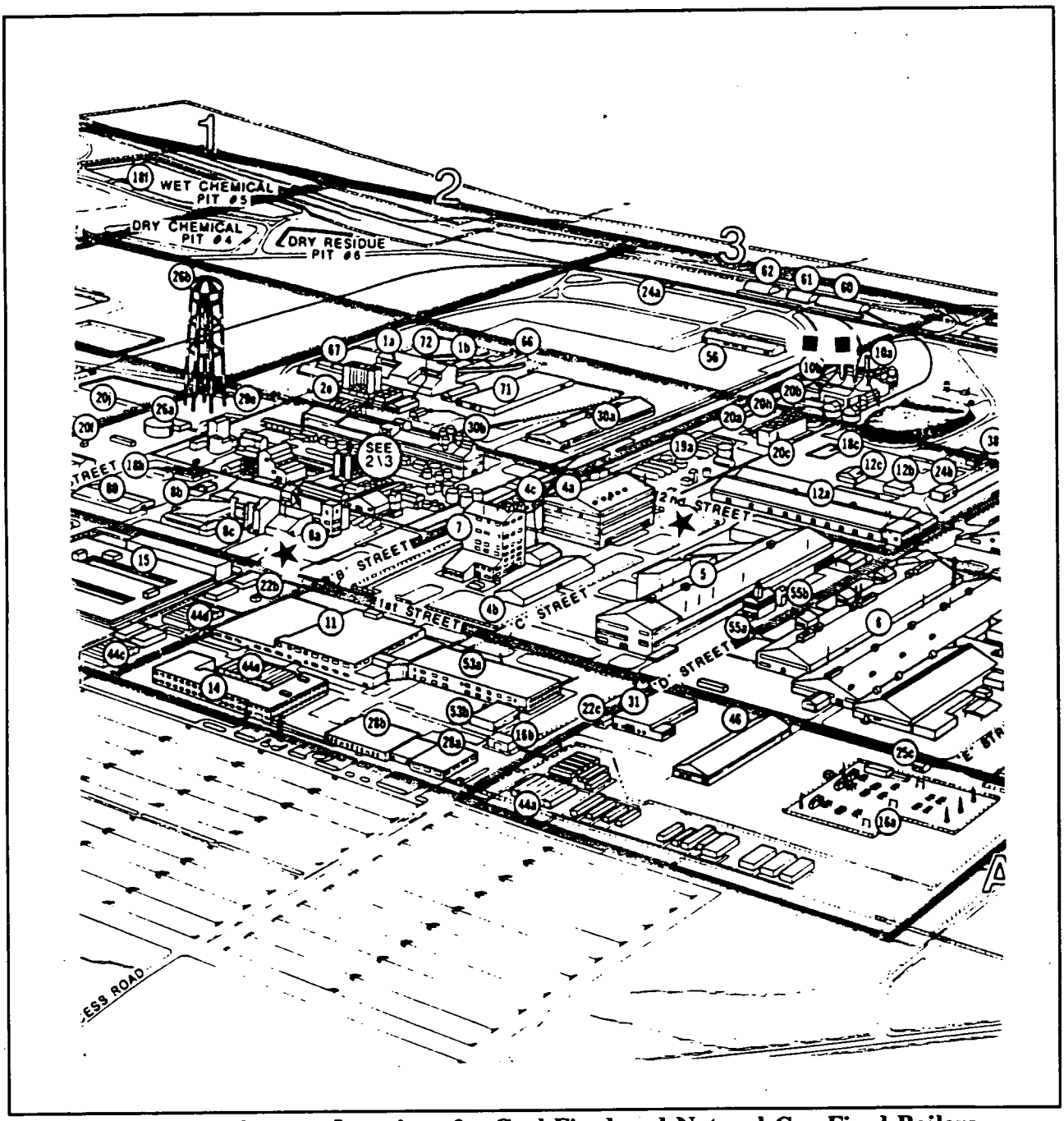


Figure 3-1. Current Locations for Coal-Fired and Natural Gas Fired Boilers

Coal Fired Boilers ■ Natural Gas Fired Boilers ★
Building Legend found in 1991 ASER, Figure 3

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

TABLE 3.1, FEMP Radiological Point Sources

FEMP EMISSION POINT NO.	OEPA STACK MONITORING SOURCE DESCRIPTION	OEPA Permit PTO No.	REQUIREMENTS (assume NESHAP driven, unless otherwise noted)
EP1-TBD	Large drum sampling	P258	Continuous-MPIS(1)
EP1-TBD	Plant 1 Ore Silo general ventilation	N/A	CERCLA work plan, continuous, SPIS
EP1-TBD	Plant 1 Ore Silo reduction building ventilation system	N/A	CERCLA work plan, continuous, SPIS
EP8-013	East Oliver filter	P239	Periodic
EP8-014	West Eimco filter	P240	Periodic
EP8-015	East Eimco filter	P248	Periodic
C-08J-6800	Rotary Kiln offgas system and cartridge/ MEPA/HEPA filtration system	P247	Continuous-MPIS(1)
C-08F-2300	Rotary Kiln offgas system emergency stack	P247	Periodic
G-08J-1400	Soil washing cartridge/ MEPA/HEPA	N/A	Continuous-MPIS(1)
EP9-002	MAWS area exhaust system	N/A	Continuous-MPIS(1)
EP9-TBD	MAWS melter offgas system	N/A	Continuous-MPIS(1)
EP11-002	Contaminated clothing dryers	P274	Monitoring required by OEPA
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)

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

TABLE 3.1, FEMP Radiological Point Sources (continued)

FEMP EMISSION POINT NO.	OEPA STACK MONITORING SOURCE DESCRIPTION	OEPA Permit PTO No.	REQUIREMENTS (assume NESHAP driven, unless otherwise noted)
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)
EP15-015	Lab perchloric hood	TBD	(3)
EP39-001	Trash compactor/baler	P227	OEPA, area monitoring
EP42-001	Respirator cleaning trailer exhaust system	TBD	Periodic
EP65-001	Thorium repacking general exhaust system	N/A	TBD
EP78-001	New Decontamination Bldg 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

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

TABLE 3-2, FEMP Point Sources Requiring Continuous Monitoring

FEMP EMISSION POINT NO.	OEPA STACK MONITORING SOURCE DESCRIPTION	OEPA Permit PTO No.	REQUIREMENTS (assume NESHAP driven, unless otherwise noted)
EP1-TBD	Large drum sampling	P258	Continuous-MPIS(1)
EP1-TBD	Plant 1 Ore Silo general ventilation	N/A	CERCLA work plan, continuous, SPIS
EP1-TBD	Plant 1 Ore Silo reduction building ventilation system	N/A	CERCLA work plan, continuous, SPIS
C-08J-6800	Rotary Kiln offgas system and cartridge/ MEPA/HEPA filtration system	P247	Continuous-MPIS(1)
G-08J-1400	Soil washing cartridge/ MEPA/HEPA	N/A	TBD
EP9-002	MAWS area exhaust system	N/A	Continuous-MPIS(1)
EP9-TBD	MAWS melter offgas system	N/A	Monitoring required by OEPA
EP11-002	Contaminated clothing dryers	P274	Continuous-MPIS(1)
EP15-001	Laboratory MEPA/HEPA exhaust system	TBD	TBD
EP65-001	Thorium repacking general exhaust system	N/A	Continuous-MPIS(1)
EP78-001	New Decontamination Bldg cartridge/MEPA/HEPA	P261, P263, P264	Continuous-MPIS(1)

(1) - Multipoint continuous isokinetic sampler.
(2) - Single point continuous sampler.
N/A - 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 NO.	OEPA STACK MONITORING SOURCE DESCRIPTION	OEPA Permit PTO No.	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
C-08F-2300	Rotary Kiln offgas system emergency stack	P247	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)

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

TABLE 3-3, Unmonitored FEMP Radiological Point Sources (continued)

FEMP EMISSION POINT NO.	OEPA STACK MONITORING SOURCE DESCRIPTION	OEPA Permit PTO No.	REQUIREMENTS (assume NESHAP driven, unless otherwise noted)
EP15-015	Lab perchloric hood	TBD	(1)
EP39-001	Trash compactor/bailer	P227	OEPA, area monitoring
EP42-001	Respirator cleaning trailer exhaust system	TBD	Periodic
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

(1) - It is uncertain if this point source can be periodically tested safely due to location of source (i.e., roof, etc.).
N/A - Not Applicable, CERCLA action - No OEPA permit required.
Periodic - Stacks will be tested per 40 CFR 61.93(B)(4)(i) requirements.

Table 3.4. Estimated Airborne Releases from FEMP, 1989

Radio-nuclide	Activity Released (Ci)			Total Activity (Ci)		Measured, as a fraction of:	
	Measured	Waste Pit Estimate	Other Estimated	All Sources	Pits Excluded	All Total	No Pits Total
U^{234}	2.56 E-04	1.48 E-03	3.21 E-03	4.95 E-03	3.47 E-03	5.2%	7.4%
U^{235}	1.31 E-05	3.96 E-04	1.63 E-04	5.72 E-04	1.76 E-04	2.3%	7.4%
U^{236}	1.24 E-05	2.52 E-04	1.62 E-04	4.26 E-04	1.74 E-04	2.9%	7.1%
U^{238}	2.57 E-04	6.48 E-03	3.15 E-03	9.89 E-03	3.41 E-03	2.6%	7.5%
Sr^{90}	9.50 E-07	3.48 E-06	1.04 E-05	1.48 E-05	1.14 E-05	6.4%	8.4%
Tc^{99}	2.86 E-05	4.91 E-04	3.50 E-04	8.70 E-04	3.79 E-04	3.3%	7.6%
Ru^{106}	5.31 E-06	0.00	6.48 E-05	7.01 E-05	7.01 E-05	7.6%	7.6%
Cs^{137}	2.83 E-06	1.54 E-05	3.10 E-05	4.92 E-05	3.38 E-05	5.7%	8.4%
Ba^{137m}	2.83 E-06	1.54 E-05	3.10 E-05	4.92 E-05	3.38 E-05	5.7%	8.4%
Ra^{226}	1.14 E-07	1.92 E-04	1.00 E-06	1.93 E-04	1.11 E-06	0.1%	10.2%
Ra^{228}	4.54 E-07	2.39 E-05	4.90 E-06	2.93 E-05	5.35 E-06	1.6%	8.5%
Th^{228}	4.73 E-06	3.10 E-05	5.10 E-05	8.67 E-05	5.57 E-05	5.5%	8.5%
Th^{230}	1.41 E-05	3.45 E-03	1.60 E-04	3.62 E-03	1.74 E-04	0.4%	8.1%
Th^{232}	7.47 E-07	2.39 E-05	8.10 E-06	3.27 E-05	8.85 E-06	2.3%	8.4%
Th^{234}	7.92 E-04	6.48 E-03	8.92 E-03	1.62 E-02	9.71 E-03	4.9%	8.2%
Pa^{234m}	7.92 E-04	6.48 E-03	8.92 E-03	1.62 E-02	9.71 E-03	4.9%	8.2%
Np^{237}	1.02 E-07	4.48 E-06	1.31 E-06	5.89 E-06	1.41 E-06	1.7%	7.2%
Pu^{238}	1.05 E-07	9.79 E-07	1.32 E-06	2.40 E-06	1.43 E-06	4.4%	7.4%
Pu^{239}	8.46 E-07	2.47 E-06	1.10 E-05	1.43 E-05	1.18 E-05	5.9%	7.1%
Pu^{240}	2.18 E-07	2.47 E-06	2.83 E-06	5.52 E-06	3.05 E-06	4.0%	7.2%
Pu^{241}	3.20 E-06	1.68 E-05	4.17 E-05	6.17 E-05	4.49 E-05	5.2%	7.1%
Pu^{242}	4.59 E-11	0.00	2.53 E-09	2.58 E-09	2.58 E-09	1.8%	1.8%
Average:						3.8%	7.6%

Table 3.5. Estimated Airborne Releases from FEMP, 1990

Radio-nuclide	Activity Released (Ci)			Total Activity (Ci)		Measured, as a fraction of:	
	Measured	Waste Pit Estimate	Other Estimated	All Sources	Pits Excluded	All Total	No Pits Total
U^{234}	7.93 E-07	2.85 E-04	5.33 E-04	8.19 E-04	5.34 E-04	.096%	.15%
U^{235}	4.20 E-08	7.17 E-06	2.82 E-05	3.54 E-05	2.82 E-05	.12%	.15%
U^{236}	3.08 E-08	3.31 E-06	2.07 E-05	2.41 E-05	2.08 E-05	.13%	.15%
U^{238}	8.86 E-07	4.87 E-04	5.96 E-04	1.08 E-03	5.93 E-04	.082%	.15%
Sr^{90}	4.70 E-09	2.72 E-07	3.14 E-06	3.42 E-06	3.16 E-06	.14%	.15%
Tc^{99}	9.81 E-08	3.86 E-05	6.60 E-05	1.05 E-04	6.64 E-05	.093%	.14%
Ru^{106}	1.82 E-08	0.00 E+00	1.23 E-05	1.23 E-05	1.23 E-05	.15%	.15%
Cs^{137}	1.36 E-08	1.19 E-06	9.16 E-06	1.04 E-05	9.21 E-06	.13%	.15%
Ba^{137m}	1.36 E-08	1.19 E-06	9.16 E-06	1.04 E-05	9.21 E-06	.13%	.15%
Ra^{226}	6.00 E-10	1.52 E-05	3.79 E-07	1.56 E-05	4.00 E-07	.0038%	.15%
Ra^{228}	2.30 E-09	1.89 E-06	1.51 E-06	3.41 E-06	1.52 E-06	.0073%	.15%
Th^{228}	2.58 E-08	2.44 E-06	1.60 E-05	1.85 E-05	1.61 E-05	.13%	.15%
Th^{230}	7.01 E-08	2.73 E-04	4.72 E-05	3.20 E-04	4.70 E-05	.022%	.15%
Th^{232}	3.79 E-09	1.89 E-06	2.52 E-06	4.41 E-06	2.52 E-06	.084%	.15%
Th^{234}	3.50 E-06	4.86 E-04	2.36 E-03	2.85 E-03	2.36 E-03	.12%	.15%
Pa^{234m}	3.50 E-06	4.86 E-04	2.36 E-03	2.85 E-03	2.36 E-03	.12%	.15%
Np^{237}	3.00 E-10	3.50 E-07	1.91 E-07	5.42 E-07	1.92 E-07	.055%	.16%
Pu^{238}	3.00 E-10	7.62 E-08	2.33 E-07	3.03 E-07	2.27 E-07	.099%	.13%
Pu^{239}	2.20 E-09	1.88 E-07	1.46 E-06	1.65 E-06	1.46 E-06	.13%	.15%
Pu^{240}	5.00 E-10	1.88 E-07	3.64 E-07	5.53 E-07	3.65 E-07	.094%	.14%
Pu^{241}	7.80 E-09	1.29 E-06	5.23 E-06	6.52 E-06	5.23 E-06	.12%	.15%
Pu^{242}	1.24 E-13	6.80 E-11	8.43 E-11	1.52 E-10	8.40 E-11	.082%	.15%
Average:						.097%	.15%

Table 3.6. Estimated Airborne Releases from FEMP, 1991

Radio-nuclide	Activity Released (Ci)			Total Activity (Ci)		Measured, as a fraction of:	
	Measured	Waste Pit Estimate	Other Estimated	All Sources	Pits Excluded	All Total	No Pits Total
U^{234}	2.07 E-07	3.09 E-05	6.43 E-05	9.54 E-05	6.45 E-05	.22%	.32%
U^{235}	1.09 E-08	1.27 E-06	3.40 E-06	4.69 E-06	3.42 E-06	.23%	.32%
U^{236}	8.04 E-09	3.19 E-06	2.50 E-06	5.69 E-06	2.50 E-06	.14%	.32%
U^{238}	2.31 E-07	2.32 E-05	7.18 E-05	6.52 E-05	4.20 E-05	.35%	.55%
Sr^{90}	1.22 E-09	2.91 E-07	3.79 E-07	6.71 E-07	3.80 E-07	.18%	.32%
Tc^{99}	2.56 E-08	4.64 E-05	7.95 E-06	5.44 E-05	8.09 E-06	.047%	.32%
Ru^{106}	4.75 E-09	0.00	1.48 E-06	1.48 E-06	1.48 E-06	.32%	.32%
Cs^{137}	3.56 E-09	9.45 E-07	1.10 E-06	2.05 E-06	1.11 E-06	.17%	.32%
Ba^{137m}	3.56 E-09	9.54 E-07	1.10 E-06	2.05 E-06	1.11 E-06	.17%	.32%
Ra^{226}	1.47 E-10	2.01 E-05	4.56 E-08	2.01 E-05	0.00 E+00	.0007%	0.0%
Ra^{228}	5.89 E-10	2.48 E-06	1.83 E-07	2.66 E-06	1.80 E-07	.022%	.33%
Th^{228}	6.22 E-09	3.19 E-06	1.93 E-06	5.31 E-06	2.12 E-06	.12%	.29%
Th^{230}	1.83 E-08	3.59 E-04	5.68 E-07	3.65 E-04	6.00 E-06	.005%	.31%
Th^{232}	9.77 E-10	2.48 E-06	3.04 E-08	2.78 E-06	3.00 E-07	.035%	.33%
Th^{234}	9.14 E-07	2.33 E-05	2.84 E-04	3.08 E-04	2.85 E-04	.30%	.32%
Pa^{234m}	9.14 E-09	2.33 E-05	2.84 E-04	3.08 E-04	2.85 E-04	.003%	.0032%
Np^{237}	7.42 E-11	3.72 E-07	2.30 E-08	3.95 E-07	2.30 E-08	.019%	.32%
Pu^{238}	8.80 E-11	7.28 E-08	2.73 E-08	1.00 E-07	2.72 E-08	.088%	.32%
Pu^{239}	5.81 E-10	9.10 E-08	1.81 E-07	2.72 E-07	1.81 E-07	.21%	.32%
Pu^{240}	1.48 E-10	9.10 E-08	4.61 E-068	1.37 E-07	4.60 E-08	.11%	.32%
Pu^{241}	2.17 E-09	6.16 E-07	6.73 E-07	1.29 E-06	6.74 E-07	.17%	.32%
Pu^{242}	3.19 E-14	3.22 E-12	9.90 E-12	1.32 E-11	9.98 E-12	.24%	.32%
Average:						.14%	.30%

3.0 AIRBORNE EFFLUENT MONITORING (cont.)

Table 3.7, Minimum Analysis Regimen for Air Particulate Samples

Radionuclide	Required Detection Limit (pCi/mL)
Ra^{226}	4E - 09
Ra^{228}	4E - 09
Th^{228}	4E - 09
Th^{230}	4E - 09
Th^{232}	4E - 09
U^{234}	4E - 09
U^{235}/U^{236}	4E - 09
U^{238}	4E - 09
Ac^{228}	**
Ra^{224}	**
Th^{231}	**
Th^{234}	**

* 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 rate of 2 cfm over a 30 day sampling period. Detection limits may be adjusted if sampling or laboratory conditions vary.

** These radionuclide concentrations will be estimated using the assumption that they are in equilibrium with their parent radionuclide. Therefore, no detection limits are required.

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 ASER, 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.

4.0 METEOROLOGICAL MONITORING (cont.)

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. Section 11.3 of this Plan provides a description of current FEMP activities in meteorological monitoring. The "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix" (Attachment A) identifies the current implementation plan and 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 Radiological Environmental Monitoring and Surveillance. 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 - Radiological Environmental Monitoring Section of the ES&H Division (REM).

- Maintenance and calibration of instrumentation - Facility Engineering and Maintenance Department of the RSO Division.

- Routine validation of meteorological data and verification of system operability - REM.

4.0 METEOROLOGICAL MONITORING (cont.)

- Selection of dispersion model for each impact assessment - REM.
- Summarization of meteorological data to support impact assessments - REM.
- Retention and control of meteorological monitoring records - REM.
- Internal program audits - REM.

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 FEMP is currently operated and maintained, *routine* airborne releases have minimal offsite radiological dose impact. The ASER for 1991[71] discusses the effluent and environmental monitoring data measurements from 1991.

4.0 METEOROLOGICAL MONITORING (cont.)

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 ASER presents the air sampling results and the dose equivalents that would result from exposure to the concentrations measured at each of the sampling stations (page A-27). For the stations located at or beyond the site boundary, none had a 50-year committed effective dose equivalent exceeding 1.6 mrem; the DOE guideline for the maximum dose to a member of the public from all pathways is 100 mrem/yr.

The 1990 NESHAP compliance demonstration[16] reports even lower doses than 1989 for the first year of complete shutdown: 0.6 mrem/yr if the estimated waste pit releases are included, and 0.03 mrem/yr if they are not included. The 1991 NESHAP compliance demonstration reports even lower doses than 1990: 0.3 mrem if the estimated waste pit releases are included, and 0.005 mrem if they are not included. Some conservative assumptions were made in estimating waste pit releases that are not measured. Regardless of whether the actual offsite dose is closer to 0.3 mrem/yr or 0.005 mrem/yr, it 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.

- As 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,[25] the current worst case scenario for the FEMP is the occurrence of a serious earthquake.

4.0 METEOROLOGICAL MONITORING (cont.)

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,[25] 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 quiescent 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.

4.0 METEOROLOGICAL MONITORING (cont.)

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 Site 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 Paddy's 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 site 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 METEOROLOGICAL 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 site. Two pertain to the impact of actual annual releases: the NESHAP Subpart H[30] compliance demonstration for USEPA, and the DOE compliance demonstration made as part of the ASER. 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.

Meteorological dispersion modeling for routine release assessment at the FEMP site shall use one of the following two models as appropriate (DOE/EH-0173T, Summary 4j):

- CAP-88[31] (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.

4.0 METEOROLOGICAL MONITORING (cont.)

At the FEMP site, CAP-88 may be used in any of the routine emission assessments.

- COMPLY[32] employs a Gaussian dispersion model that incorporates building wake or plume rise effects (as appropriate to the type of release point), but which is useful only for point sources. It allows selection from among four levels of complexity that range from the simplest and most conservative Level 1 (which uses only amounts of radionuclides possessed, and no meteorological data), to the most complex and realistic Level 4 (which uses site-specific meteorological data, realistic pathway dose parameters, etc.). When COMPLY is used for FEMP site assessments, Level 2 or higher complexity should be used; however, even at the highest levels of complexity, COMPLY requires meteorological data only from a single measurement point, summarized for a one-year or longer period.

  Currently the site plans to use CAP88PC, which is a USEPA approved version of the CAP88 code, supportable by PC rather than mainframe. The site is currently phasing out the use of COMPLY.

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 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,

4.0 METEOROLOGICAL MONITORING (cont.)

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[25] 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).[25]

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.

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:

- 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.

4.0 METEOROLOGICAL MONITORING (cont.)

- 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.[33] 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[34]].

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 from USNRC Regulatory Guide 1.23, Revision 1.

4.0 METEOROLOGICAL MONITORING (cont.)

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, plume rise should not be a major effect at 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 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).

4.0 METEOROLOGICAL MONITORING (cont.)

4.5.1 Location of Measurements

At least one onsite meteorological tower shall be maintained at the FEMP, to support the measurements described in Section 4.5.2. The primary meteorological tower shall have sensors for at least the 10-meter and 60-meter elevations (DOE/EH-0173T, Summary 4k,m). The distance between a wind instrument and any obstruction will be at least 10 times the height of that obstruction. (EPA-6000 vol IV and NRC Regulatory Guide 1.23, Revision 1).

Currently, the FEMP meteorological tower is not in compliance with these guidelines due to a number of pinetrees in the area of the tower. FERMCO and the DOE have reviewed several proposals on how best to correct this problem; i.e., remove the trees, move the existing tower, or erect a new tower. Recently FERMCO recommended that the minimum number of trees be removed in order to comply with NRC and EPA guidance. DOE is expected to reply with their final decision soon.

Supplementary meteorological towers <u>may</u> 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, <u>are not</u> covered by this Plan.

4.5.2 Instrument Requirements

Minimum installed instrumentation for the primary meteorological tower shall be capable of measuring the parameters listed in Table 4-2; other instruments may be added, but are <u>not</u> required by this Plan.

4.0 METEOROLOGICAL MONITORING (cont.)

Table 4-2

Minimum Installed Instrumentation for the Primary Meteorological Tower

Elevation	Measurement(s)
Ground Level	Precipitation Barometric Pressure
10 meters	Wind speed Wind direction Ambient temperature Dew point temperature
60 meters	Wind speed Wind direction Delta temperature, 10 to 60 meters

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).

4.0 METEOROLOGICAL MONITORING (cont.)

Table 4-3

Instrument Performance Criteria*

Sensor Type	Required Accuracy	Other Criteria
Wind Direction	± 5° azimuth	Damping ratio in range 0.4 to 0.6. Delay distance ≤ 2 m.
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.[35]

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 41). 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).

4.5.2.1 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.

4.0 METEOROLOGICAL MONITORING (cont.)

All meteorological instruments on the primary tower (including the wind speed and direction sensors) shall be interfaced to a digital computer for routine data recording and processing. The computer software shall be equipped with appropriate hardware and software to do the following:

- Sample the signals on appropriate frequencies,
- Determine σ_θ,
- Calculate and record 15-minute and hourly averages of each parameter,
- On command, print out a listing of any calendar day's 15-minute average data,
- Display current meteorological data continuously on a video terminal in a regularly occupied area of the Occupational Safety and Health Building, and
- Upon command, use the hourly average data to generate annual joint-frequency meteorology summaries in the Stability Array (STAR)[32] format, for input into CAP-88 dose assessments.

Data shall be retained as follows: For the primary tower the 15-minute average data shall be maintained on-line in the computer for at least 24 hours; hourly average data shall be maintained on-line in the computer for at least one year, and archived hourly average data shall be retained as permanent site records. Hourly average data from any supplementary towers shall be retained as permanent site records. All retained data shall be recoverable, and in appropriate form (hard copy or electronic).

4.0 METEOROLOGICAL MONITORING (cont.)

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. 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.

- 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.

4.0 METEOROLOGICAL MONITORING (cont.)

- 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 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 METEOROLOGICAL 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." These requirements must be followed and incorporated in the Meteorological Monitoring Program at the implementing level.

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 for the ASER,
- 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 site. 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

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

and airborne effluent monitoring). Section 11.4 of this Plan provides a description of current FEMP activities in environmental surveillance. 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 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. 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

Radiological Environmental Monitoring 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. Radiological Environmental Monitoring is also responsible for monitoring levels of direct radiation and radon.

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

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. 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 Radiological Environmental Monitoring and incorporated into the ASER.

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

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

land use.[18,19,20,21,22] 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
- 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 shall be 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 the Plan (DOE/EH-0173T, Summary 5d). A pending pathway analysis of the restoration process at the FEMP may result in revisions to the Environmental Surveillance program. The results of this analysis will be summarized and referenced in a future revision to the Plan.

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	X				
Irrigation with surface water: foodstuffs/meat/milk	X	X	X		
Sediment ingestion by children	X	X		X	
Groundwater ingestion	X	X	X	X	X
Irrigation with groundwater: foodstuffs/meat/milk	X	X	X	X	X
Surface water: fish	X	X	X		X
Soil: beef and milk			X		X
Direct radiation				X	
Radon in air	X			X	

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 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.

Figure 5-1. Atmospheric Pathways for Human Exposure

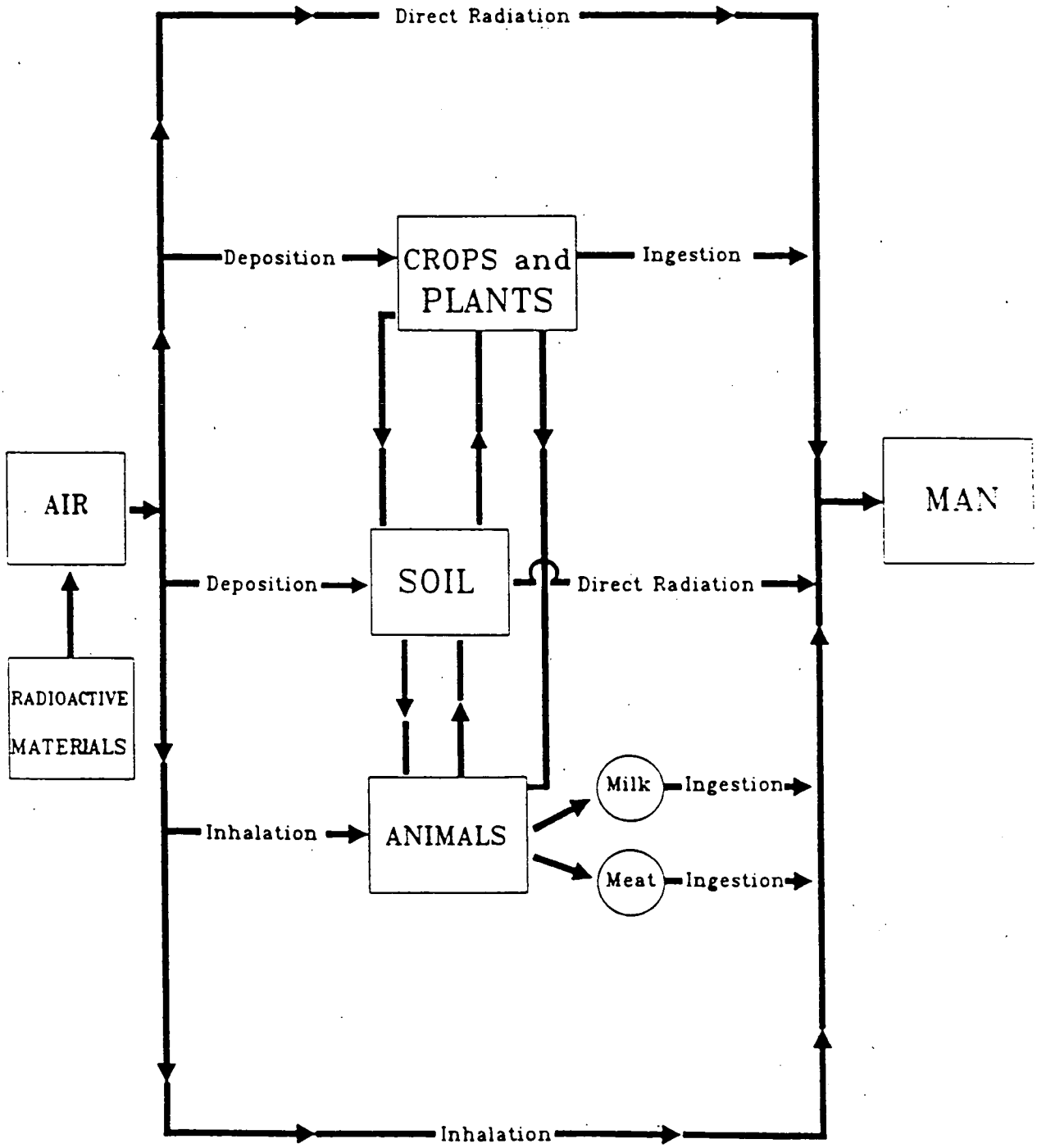
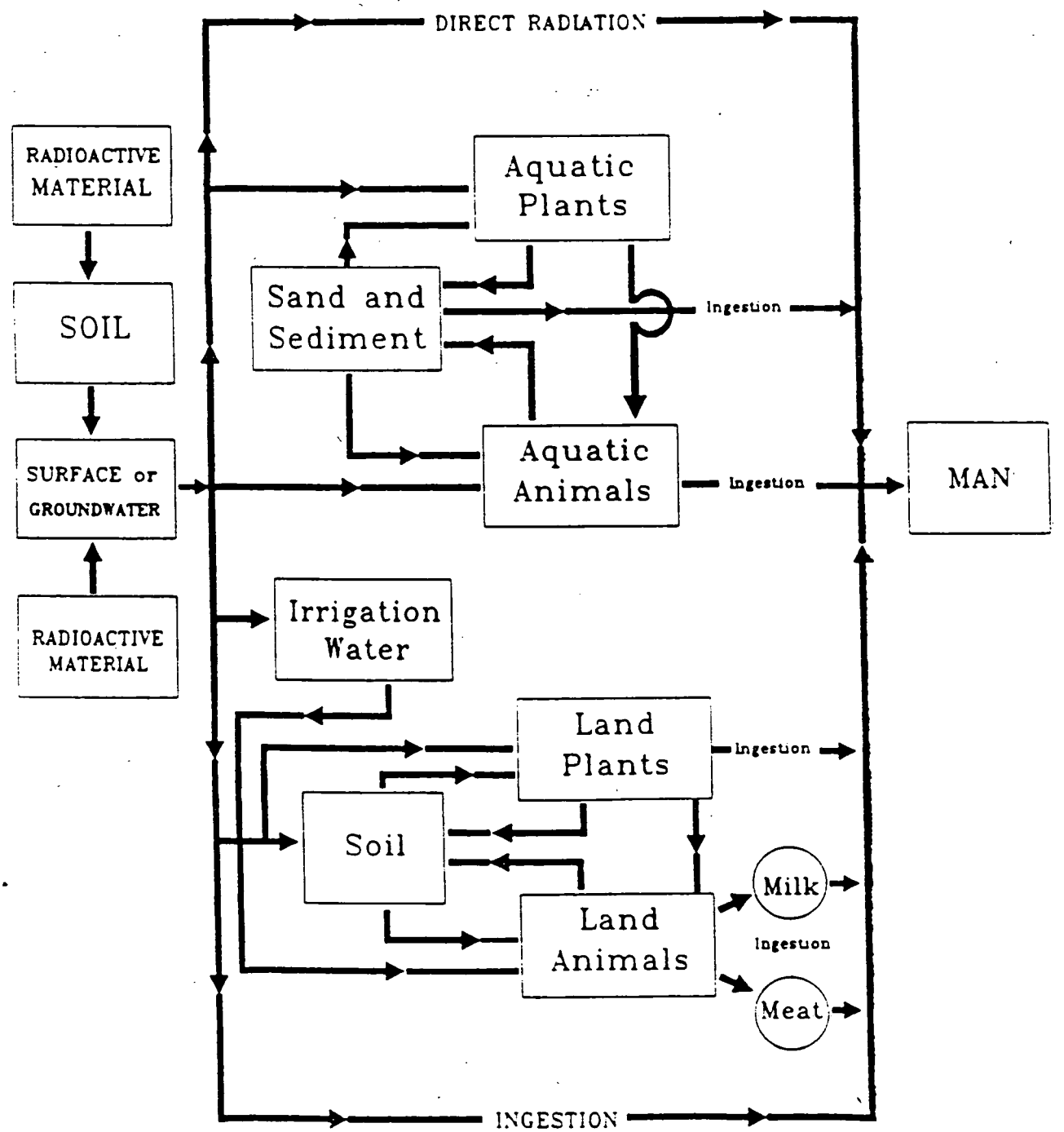


Figure 5-2. Liquid Pathways for Human Exposure



5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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,
- 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,

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- consumption of meats and milk contaminated though animal consumption of foodstuff irrigated with contaminated surface water,
- consumption of fish from Greater Miami River, and
- child ingestion of sediment contaminated by surface water.

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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.2.3 Exposure via the Direct Radiation Pathway

Exposure from direct radiation may result from:

- direct radiation from materials stored at the FEMP
- 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 are available in the latest ASERs and show that the dose is currently in the range of 8-10 mrem. The direct radiation dose (from materials stored in the K-65 silos) dominates this total. Per the recommendations of DOE Orders and guidance documents (DOE/EH-0173T) the routine surveillance of all pathways (ingestion, inhalation, immersion, and submersion) is suggested at this dose level.

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 buildup, and
- data collection in areas of public concern.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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 that 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),
- FEMP boundary (for direct radiation monitoring),
- soil,
- aquatic animals/plants,
- farm and game animals.

In addition to the environmental media listed above, doses due to penetrating radiation must also be considered. In 1991, the maximum dose at the site boundary due to penetrating radiation was 9.1 mrem above background. [71]

Therefore, penetrating radiation shall be measured routinely since the annual dose at the site boundary exceeds 5 mrem. Routine monitoring at the FEMP shall continue as long as the annual

dose at the site boundary exceeds 5 mrem or 100 person-rem collective effective dose within a radius of 80 km of a central point in the site (DOE/EH-0173T, Summary 5c).

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,[3]
- 40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards,"[38]
- 40 CFR Part 53, "Ambient Air Monitoring Reference and Equivalent Methods,"
- 40 CFR Part 58, "Ambient Air Quality Surveillance,"[27]
- 40 CFR Part 130, "Water Quality Management (WQM),"[39]
- 40 CFR Part 265, Subpart F, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,"[40] and
- 40 CFR Part 300, "National Oil and Hazardous Substance Pollution Contingency Plan."[41]

5.3.5 Evaluation of Long-Term Buildup

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 at a minimum, 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).

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

In addition to at least one control and indicator sample, the minimum number of indicator samples for each medium is based on the potential dose to the maximally exposed human receptor. The method that was used to determine the minimum number of sampling points for each required sampling medium was based on the annual dose from the site during 1991. The FEMP annual dose from the sample media of each potential exposure pathway indicated the minimum number of samples that are required for environmental surveillance.[8, 42] The results are displayed in Table 5-2.

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 samples 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.

Criteria for selecting sampling locations for specific media will be discussed in Section 5.6 with the media-specific sampling criteria.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-2

Minimum Number of Indicator Samples Required Based on Annual Dose to the Maximally Exposed Individual

Environmental Media	Approximate Dose Level (mrem)	Minimum Number Samples
Beef	not estimated*	0
Fish	< 0.01	1
Produce	0.0	0
Milk	not estimated*	0
Groundwater	3.0 E-01	2
Ambient Air	3.0 E-01	3
Direct Radiation	8.8	10
Radon in Air	93	30
Sediment	not estimated*	0

* Dose from beef, milk, and sediment were not estimated. These doses are assumed to be small (< 0.1 mrem) since there is not a history of detecting above background levels in these media.

5.5.1 Required Analytical Detection Levels

In general, each radiological analysis performed on environmental surveillance samples (other than drinking water) shall be sensitive enough to detect the activity or concentration that would lead to a dose of 0.1 mrem from the media sampled (Table 5-3). The required analytical detection levels for drinking water is already at a level such that the current state-of-the-art technology prohibits further reduction at the present time. For environmental media where the detection level cannot be attained in order to meet the 0.1 mrem dose, the detection level is based on a reasonably achievable detection level, analysis costs, sample size, and laboratory related factor considered.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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 dose 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.

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 Section 8.2. Since there is no dose limit for radon, the required detection level for Ra^{222} measurements shall be the concentration that leads to 10% of the concentration limit of 3 pCi/L [paragraph 5b(2)(c)]. Although 1% of this limit would be desirable, this is not possible with currently available technology. The required detection levels for the target analytes associated with each environmental medium and the required overall uncertainty for the analytical result is also stated in Table 5-8. 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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5-3 Required Detectable Dose from Environmental Media

Environmental Media	Minimum Detectable Dose (mrem)
Air	0.1
Drinking Water	0.04
Other Media (Except Radon)	0.1*

* Except where practical considerations prohibit attainment of this dose.

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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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 effects,
- 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.)

An evaluation was performed to determine sample representatives for the environmental surveillance program (WEMCO:EM:92:410). In conclusion, REM collects several different environmental media, utilizing several different sampling techniques. Through the above evaluation, REM has determined sampling techniques for the different media to be representative.

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 11-3 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 of 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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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 continues 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 11-3.

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. This Section of the Plan dictates the analyses that should be requested for environmental surveillance samples.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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).
- The analytical methods contained in the SCQ shall be used.
- 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 1991. 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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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 AMS9 and AMS8, 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. Using data from the 1991 detected isotopes at the AMSs are as follows:

Table 5.4
Detected Radionuclides at Air Monitoring Station 9

Analyte	Detected Conc. (pCi/m^3)	DCG Conc. (pCi/m^3)	Fraction of DCG
Cs-137	-----	-----	-----
Np-239	1.85 E-05	0.02	9.3 E-04
Pu-238	1.01 E-05	.03	3.4 E-04
Pu-239/240	6.7 E-06	0.02	3.4 E-04
Ra-226	1.34 E-05	1.0	1.3 E-05
Ra-228	7.47 E-05	3.0	2.5 E-05
Ru-106	-----	-----	-----
Sr-90	-----	-----	-----
Tc-99	3.96 E-04	2000	2 E-07
Th-228	1.2 E-05	0.04	3 E-04
Th-230	4.03 E-05	0.04	1 E-03
Th-232	6.69 E-06	0.007	9.6 E-04
U-natural	2.2 E-03	0.1	2.2 E-02

Sum = 2.6 E-02

$$\text{Percent of dose from uranium} = \frac{2.2\text{ E-02}}{2.6\text{ E-02}} \approx 0.85 \qquad \approx 85\%$$

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Table 5.5
Detected Radionuclides at Air Monitoring Station 8

Analyte	Detected Conc. (pCi/m^3)	DCG Conc. (pCi/m^3)	Fraction of DCG
Cs-137	-----	400	-----
Np-239	1.4 E-06	.02	7 E-05
Pu-238	-----	-----	-----
Pu-239/240	7.3 E-08	0.02	3.7 E-06
Ra-226	-----	1.0	-----
Ra-228	-----	-----	-----
Ru-106	-----	-----	-----
Sr-90	-----	-----	-----
Tc-99	8.7 E-05	2000	4.4 E-08
Th-228	1.07 E-06	0.04	2.7 E-05
Th-230	8.9 E-06	0.04	2.2 E-04
Th-232	2.27 E-06	0.007	3.2 E-04
U-mat'l	3.5 E-04	0.1	3.5 E-02

Sum = 3.56 E-02

$$\text{Percent of dose from uranium} = \frac{3.5\text{ E-02}}{3.56\text{ E-02}} \approx .98 \qquad \simeq 98\%$$

From a review of the DCG ratios for AMS8 and AMS9, it is clear that uranium dominates the sum of the DCG fractions and contributes approximately 85 percent of the dose at AMS 9 and approximately 98 percent of the dose at AMS 8. On the basis of these data, all environmental media with the exception of the composite ambient air samples influenced by airborne emissions will be analyzed for uranium.

The composite ambient air samples are analyzed for the pertinent uranium, thorium, radium isotopes as well as the radionuclides of Pu-238, Pu-239/240, Np-237, Sr-90, Cs-137 and Tc-99.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

These additional 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. Using data from the 1991 ASER, detected isotopes at MH 175 are as follows:

Table 5.6
Detected Radionuclides at MH 175

Analyte	Detected Conc. (pCi/L)	DCG (pCi/L)	Fraction of DCG
Np-237	1.9	30	0.063
Th-230	0.56	300	0.002
U-234	210	500	0.42
U-235	10	600	0.016
U-236	7.4	500	0.015
U-238	270	600	0.45
			Sum = 0.966

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 93 percent of the dose from the liquid effluent. On the basis of these data, all environmental media influenced by the liquid effluent will be analyzed for uranium.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

5.5.7.3 Use of Gross Radioactivity Analysis in Environmental Surveillance

The environmental surveillance program currently requests gross beta analysis on air monitoring station filters. The gross beta results from ambient air filters are used to trend the emissions from the site; no dose or radionuclide concentrations are derived from the gross beta results.

Gross alpha/beta analysis results are also requested for sediment samples which the FEMP splits with the Ohio Department of Health (ODH). The purpose is to provide a comparison between the ODH and the FEMP lab results. No dose or specific radionuclide concentration is derived from the gross analyses.

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. However, the gross alpha/beta measurements are expected to continue. The current use of these analyses at the FEMP does provide a useful tool for trending airborne emissions and, to a lesser extent, comparing the analytical results from the ODH and FEMP laboratories.

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 method, 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. In the event that sampling required by this Plan cannot be performed, written justification shall be developed, reviewed by the Environmental Monitoring and Surveillance Manager, or designee, and maintained in the Environmental Monitoring and Surveillance files.

5.6.1 Air

The potential for exposure to radioactive air particulates is due to direct current releases from the facility, as well as resuspension of materials previously released and deposited. Particulate activity 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. DOE Order 5400.5 [paragraph 6b2(c)] requires that storage of residual radioactive material shall not result in an annual average Rn^{222} concentration exceeding 3.0 pCi/L at any point outside the site boundaries. Therefore, radon concentrations shall be monitored at the plant boundaries to demonstrate compliance with this regulation. Specific requirements for monitoring ambient air and radon concentrations are described below.

Environmental air sampling equipment must meet the criteria that follow:

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

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- 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 to 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. Selection of a particular type of track-etch radon detector shall be based on effectiveness and cost.

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

Based on the annual dose from ambient concentrations (see Table 5-2), 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.[43, 44] An evaluation of air sampler placement based on the Waite Methodology was conducted[45] and the results reported in Table 5-7. As a minimum, air samplers and radon monitors shall be maintained in the 8 sectors as shown.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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

Additional air sampler locations and radon monitoring locations may be added as needed based on public concern, control location, and special studies. Justification of any additional monitoring stations, or omission of any existing stations shall be documented in this Plan.

Average analytical air concentration results will be used in dose calculations to determine the ambient air dose to the public as specified in Section 8.2.2.1 of this Plan. The air pathway dose calculations estimate doses from past and current emissions that possibly accumulated throughout the site history. These air pathway dose estimates may be compared to the CAP-88 air pathway dose estimates (effluent source based and ambient monitoring based).

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

The CAP-88 air pathway dose estimates normally are 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, this does not account for residual or accumulative concentrations over the facility's entire history as the Section 8.0 dose methodology.

Radon detectors at each air monitoring station shall be changed quarterly and sent to an offsite vendor for analysis in accordance with vendor recommendations and industry accepted practice. Results shall be used to demonstrate compliance at the site boundary with the stated regulations.

5.6.1.1 Accuracy of Ambient Air Gross Beta Measurements

Accuracy is the indicator of how close a measurement result is to the true value. Accuracy may be determined through the analysis of samples containing known values of an analyte. Through the routine analysis of standards by the FEMP Bioassay lab, the accuracy of the gross beta measurements performed for air samples has been determined to be $\pm$ 15%.

5.6.1.2 Environmental Detection Limit for Ambient Air Measurements

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

From the blank air filters analyzed during 1991, the standard deviation of gross beta analysis was calculated to be 13.6 disintegrations per minute (dpm). The MDA is then calculated to be 66.2 dpm. This converts to approximately 30 pCi/filter, or 0.003 pCi/m^3 assuming a typical sample volume of 10,000 m^3.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Weekly air samples shall be collected and analyzed in accordance with Table 5-8. In summary, a total uranium analysis is required for each sample with a gross beta measurement for use in trending. The weekly samples shall be composited and analyzed for the trace radionuclides (Table 5-8) once per year to account for the site specific minor emissions of these contaminants. In addition Pu^{239} which is naturally occurring and the result of weapons fallout will be analyzed for QA/comparative purposes.

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 dated December 1992 which is required by DOE Order 5400.1 [paragraph III.4.a.][46] (DOE/EH-0173T, Summary 5s). The groundwater monitoring Plan[46] sets forth specific sampling frequencies, sampling locations, required analyses, and justification thereof. Therefore, that detailed 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, sample locations, and sampling frequency. In addition, the DOE is in the process of developing a "Comprehensive Groundwater Protection Policy". This policy will impact the routine groundwater monitoring activites and reporting requirements. The policy impacts will have to be factored into the annual EMP review process and EMP revisions.

<u>NOTE</u>: Table 5-2 applies to the offsite property owner well sampling only.

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,

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- 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 location of indicator groundwater monitoring wells shall be based on the nature of groundwater use, location of known and potential sources of pollution, and flow direction. Sampling locations, monitoring frequencies, and required analyses shall be documented and justified in "The FEMP Comprehensive Groundwater Monitoring Plan".[46] 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. 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.

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 Comprehensive Groundwater Monitoring Plan, dated December 1992.

The routine groundwater program at the FEMP does <u>not</u> include drinking water sampling at offsite property owner wells. Since surface water is not considered a direct source of exposure at the FEMP, 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 domestically used well down-gradient from the site boundary. As a minimum, drinking water samples shall be collected annually at established property owner wells which meet the criteria specified above. Specific locations shall be specified by sampling procedure. In

addition to indicator locations, at least one control location shall be located up-gradient from the facility. As a minimum, annual drinking water samples shall be collected from private wells and analyzed in accordance with Table 5-8. Annual total uranium analysis is sufficient since these radionuclides are long-lived, or are daughters of long-lived parents. The concentration results obtained from the annual total uranium analyses shall be used in the dose calculations specified in Section 8.0 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.

5.6.3 Direct Exposure

Gamma and neutron radiation are potential sources that must be considered when measuring direct radiation exposure. At the FEMP, there is potential for gamma exposure to members of the general public, primarily from the K-65 silos. Therefore, direct gamma exposure shall be monitored as part of the routine environmental surveillance program. There is the remote possibility of a criticality accident during the handling of U^{235} at the FEMP. However, there are precautions in place to prevent a criticality accident during the handling of U^{235} 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 that would occur if a criticality accident occurred. The FMPC Emergency Plan[25] sets forth appropriate actions in the event of a criticality accident.

At FEMP, thermoluminescent dosimeters (TLDs) shall be placed at each air monitoring station to measure direct gamma exposure. Calibration of dosimeters shall be based on traceability to NIST standards (DOE-EH-0173T, Summary 5i). 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 written procedures.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Care is taken to minimize any additional exposure to the TLDs after collection and before processing. TLD results shall be used to determine the potential dose due to the public from direct radiation exposure.

A review of Table 22, "Radon in Air 1991", and Table 21, "Direct Radiation Dose, 1991" from the 1991 ASER[71] indicates that most of the dose at AMSs near the K-65 silos can be attributed to direct radiation rather than, the Radon Plume.

Specifically, in comparing TLD data with radon concentration data at AMSs #6 and #2, the TLD results are significantly higher at AMS #6 (near the K-65 Silos) than at AMS # 2 (distant from the K-65 Silos). Yet, radon concentrations at the each AMS location are similar.

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 Milk

Dose to the general public due to consumption of contaminated milk is possible at the FEMP. Therefore, milk sampling is part of the routine environmental surveillance program at the FEMP. As a minimum, milk samples shall be taken at three locations. Based on the annual dose to members of the public (Table 5-2), a minimum of two indicator milk samples are required. Two locations shall be at the point of highest expected concentration of radionuclides in milk (if determinable) and the other location shall be a control location outside the influence of plant operations. Milk samples shall be collected and preserved in accordance with written sampling procedures. The sampling procedures shall consider at least the following:

- collection of a sample that is representative of the local area of interest,

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

- 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.

Annual milk samples shall be collected and analyzed in accordance with Table 5-8. On a monthly basis, an uranium isotopic analysis will be performed. And once per year, preferably in the summer months when cattle are on pasture, a "full" radiometric analysis will be performed to account for the potential influence of trace radionuclide contaminants. 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. The concentration results obtained from the annual isotopic analyses shall be used in the dose calculations specified in Section 8.0 to determine the potential annual public dose from milk 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.

5.6.5 Produce

Because there is potential for dose to the general public due to consumption of contaminated produce, monitoring of locally grown produce shall be part of the routine environmental surveillance program. Based on the annual dose to members of the public (Table 5-2), a minimum of five produce samples shall be collected locally within 15 km of the FEMP site. Samples shall be collected at the expected location of the maximum ground concentration of radionuclides (if determinable), at any area irrigated with water into which plant effluents have been discharged, and at a 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. Specific locations shall be selected based on availability of produce. Written procedures shall be maintained that direct the collection of produce.

Annual collection of produce samples is sufficient based on the seasonality of produce grown in the region. The annually collected produce samples shall be analyzed in accordance with Table 5-8. The required radionuclides are based on FEMP operating history and historical analytical data which are applicable to liquid and atmospheric releases as detailed in Sections 2.4 and 3.4. The concentration results obtained from the total uranium analyses shall be used in the dose calculations specified in Section 8.0 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 reported in wet weight concentrations.

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 Meat (Fish and Beef)

Because there is potential for dose to the general public due to consumption of contaminated meat, beef and fish samples shall be collected as part of the routine environmental surveillance program.

As a minimum, a beef sample shall be collected annually at a location within 10 miles of the site. Annual sampling is sufficient since target radionuclides are either long-lived, or daughters of long-lived radionuclides. The indicator animal sampled shall have been fed on crops grown in the prevailing downwind location of the site or at a location where drinking water is supplied from a downstream source. A control beef sample shall be taken annually from an animal that has been raised in an area that is outside the influence of plant operations. Specific locations shall vary annually according to availability.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

Fish samples should be selected from species that are most likely to be consumed by the local population. Species of fish sampled should be selected such that the individuals collected may be defensibly characterized as control or indicator samples. Different species shall be analyzed and reported separately. At least two fish samples shall be taken at least annually, one upstream of outfall point and the other at a downstream location. One control sample shall be taken at a location outside the influence of the plant operations (see Table 5-2). Written sampling procedures shall be maintained that direct the sampling and preservation of beef and fish.

Beef and fish samples shall be analyzed in accordance with Table 5-8. The required radionuclides are based on FEMP operational history and past data which are applicable to liquid and atmospheric releases as discussed in Sections 2.4 and 3.4. Concentration results shall be used in the dose calculations specified in Section 8.0 to determine the potential annual dose to the public due to beef and fish consumption. Since dose calculations for foodstuffs are based on wet weights, analytical results for meat should be reported in wet weight concentrations.

As discussed in the ASER 1991, 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).

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.)

5.6.7 Sediment

Sediment ingestion is considered a potential mode of exposure to children. Sediment sampling also can provide an indication of buildup of undissolved radionuclides in streams. Therefore, sediment sampling at points in the Great Miami River and Paddy's 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 samples shall be collected annually according to written sampling procedures, and analyzed in accordance with Table 5-8. 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. Concentration results shall be used in the dose calculations provided in Section 8.0 to determine the potential annual dose to the public.

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 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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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.

Surface water sampling shall be conducted according to written procedure, which shall specify methods for collection of representative samples and the size of a sample needed to obtain levels of sensitivity required. Procedures also shall state specific 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. Surface water samples shall be collected weekly.

As 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. Total uranium is a relatively inexpensive indicator for the spectrum of radionuclides present at FEMP. Since uranium is the principal contaminant at the FEMP, the total uranium analysis provides a reliable indicator of other contaminants being released to the surfact water. As a general rule, actions limit 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 limit. 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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

In addition to screening analyses, weekly surface water samples shall be composited annually and analyzed in accordance with Table 5-8. 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 to account for bioaccumulation in the fish.

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

5.6.9 Soil and Grass

Soil and grass may become contaminated by deposition of radionuclides from the air. Although soil and grass are not considered a direct source of exposure, soil and grass are 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 of Section 3.0 of this Plan. Soil and grass sampling shall serve as the second media for sampling.

Soil sampling locations should be selected to coincide with air monitoring location stations, where possible. Grass and soil sampling shall be conducted annually according to written procedure and analyzed for the evaluation of long-term accumulation of contaminants. Annual sampling is sufficient based on the half-lives of target radionuclides, which are selected based on the operating history of the FEMP and historical data applicable to liquid and atmospheric effluent releases as discussed in Sections 2.4 and 3.4.

The soil and grass samples shall be analyzed in accordance with Table 5-8. Since soil and grass at the FEMP are not considered a direct source of exposure, but rather an intermediate transport mechanism in other pathways, the RDLs stated for soil and grass are 10 times lower that than the most conservative related source of direct exposure.

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

5.7 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 (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.

5.0 ENVIRONMENTAL SURVEILLANCE (cont.)

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. In general, 10% of the sample load should be quality assurance samples. 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. There are several processes that have been shutdown for an extended period. Plans are to restart these processes temporarily to facilitate cleanup. Before startup, a pre-operational assessment shall be performed and documented in this Plan (DOE/EH-0173T, Summary 5h). In addition, a pre-operational assessment shall be performed for any new facilities constructed at the FEMP. Although the composition of the effluents from the FEMP are not 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). Risk assessments shall be conducted in accordance with the FEMP policy, "Risk Assessment and Management System."[48]

Table 5-8 Minimum Analysis Regimen for Environmental Media Samples

Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Drinking Water	Uranium by Kinetic Phosphorescence Analysis (KPA)	Each Sample	Total Uranium	1.0 μg/L	$\pm$ 50%
Milk	Isotopic: Uranium, Thorium, Radium, etc. and Gamma Scan once per year from each sampling location.	Each Sample (monthly)	U^{234}	0.1 pCi/L	$\pm$ 50%
			$U^{235/236}$	0.1 pCi/L	$\pm$ 50%
			U^{238}	0.1 pCi/L	$\pm$ 50%
			Th^{228}	0.5 pCi/L	$\pm$ 50%
			Th^{230}	0.5 pCi/L	$\pm$ 50%
			Th^{232}	0.5 pCi/L	$\pm$ 50%
			Ra^{226}	0.1 pCi/L	$\pm$ 50%
			Ra^{228}	1.0 pCi/L	$\pm$ 50%
			Sr^{90}	2.0 pCi/L	$\pm$ 50%
			Tc^{99}	50 pCi/L	$\pm$ 50%
			Cs^{137}	30 pCi/L	$\pm$ 50%
	* Detection Level relative to Cs^{137} RDL accounting for differences in abundances and efficiencies.		Tl^{208}	*	$\pm$ 50%
			Bi^{214}	*	$\pm$ 50%
			Pb^{214}	*	$\pm$ 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Milk (Continued)	Isotopic: Pa^{234} and Th^{234}	Each Sample (monthly)	Pa^{234}	*	± 50%
			Th^{234}	*	± 50%
Farm and Garden Produce	Uranium by KPA	Each Sample	Total Uranium	0.001μg/g	± 50%
Farm and Game Animal Tissue	Isotopic: Uranium, Thorium, and Plutonium	Each Sample	U^{234}	0.02 pCi/g	± 50%
			$U^{235/236}$	0.02 pCi/g	± 50%
			U^{238}	0.02 pCi/g	± 50%
			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%
Fish and Aquatic Animals and Plants	Uranium by KPA	Each Sample	Total Uranium	0.001 μg/g	± 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Sediment	Uranium by KPA Isotopic: Thorium and Radium	Each Sample	Total Uranium	0.1 μg/g	$\pm$ 50%
			Th^{228}	0.1 pCi/g	$\pm$ 50%
			Th^{230}	0.1 pCi/g	$\pm$ 50%
			Th^{232}	0.1 pCi/g	$\pm$ 50%
			Ra^{226}	0.25 pCi/g	$\pm$ 50%
Sediment	Uranium by KPA Isotopic: Thorium, Ra^{226}, Gross Alpha, Gross Beta, Gamma Scan: Cs^{137}, Th^{208}, Pb^{212}, Bi^{214}, Pb^{214}, Ra^{226}, Ac^{228}, Pa^{234}, and Th^{234} * Detection Level relative to Cs^{137} RDL accounting for differences in abundances and efficiencies.	Annual Split Samples with the Ohio Department of Health	Total Uranium	0.1 μg/g	$\pm$ 50%
			Th^{228}	0.1 pCi/g	$\pm$ 50%
			Th^{230}	0.1 pCi/g	$\pm$ 50%
			Th^{232}	0.1 pCi/g	$\pm$ 50%
			Ra^{226}	0.25 pCi/g	$\pm$ 50%
			Gross Alpha	15 pCi/g	$\pm$ 50%
			Gross Beta	30 pCi/g	$\pm$ 50%
			Cs^{137}	20 pCi/g	$\pm$ 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Sediment (continued)	Uranium by KPA Isotopic: Thorium, Ra^{226}, Gross Alpha, Gross Beta, Gamma Scan: Cs^{137}, Th^{208}, Pb^{212}, Bi^{214}, Pb^{214}, Ra^{226}, Ac^{228}, Pa^{234}, and Th^{234} * Detection Level relative to Cs^{137} RDL accounting for differences in abundances and efficiencies.	Annual Split Samples with the Ohio Department of Health	Th^{208}	*	± 50%
			Pb^{212}	*	± 50%
			Bi^{214}	*	± 50%
			Pb^{214}	*	± 50%
			Ra^{226}	*	± 50%
			Ac^{228}	*	± 50%
			Pa^{234}	*	± 50%
			Th^{234}	*	± 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Surface Water	Uranium by KPA Isotopics Gross Alpha and Gross Beta (Ohio Department of Health Split Analyses)	Each Sample Total Uranium - weekly Ra^{226} and Ra^{228} - monthly composite Sr^{90} and Cs^{137} - 6 month composite	Total Uranium	1.0 μg/L	$\pm$ 50%
			Ra^{226}	0.5 pCi/L	$\pm$ 50%
			Ra^{228}	0.5 pCi/L	$\pm$ 50%
			Sr^{90}	0.2 pCi/L	$\pm$ 50%
			Tc^{99}	15 pCi/L	$\pm$ 50%
			Cs^{137}	4.0 pCi/L	$\pm$ 50%
			Gross Alpha	50 pCi/L	$\pm$ 50%
			Gross Beta	5 pCi/L	$\pm$ 50%
Soil	Uranium by KPA	Each Sample	Total Uranium	0.1 μg/g	$\pm$ 50%
Grass	Uranium by KPA	Each Sample	Total Uranium	0.001 μg/g	$\pm$ 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Ambient Air	Uranium by KPA Gross Beta Gamma Scan (Optional)	Each weekly filter: Total Uranium and Gross Beta Each Offsite air filter - Gamma Scan: Cs^{137}, Tl^{208}, Pb^{212}, Bi^{214}, Pb^{214}, Ra^{226}, Ac^{228}, Pa^{234}, Th^{234} * Detection levels for these analytes shall be calculated relative to Cs^{137} accounting for differences in intensities and efficiencies	Total Uranium	2.0 μg/filter	$\pm$ 50%
			Gross Beta	30 pCi/filter	$\pm$ 50%
			Cs^{137}	30 pCi/filter	$\pm$ 50%
			Tl^{208}	*	$\pm$ 50%
			Pb^{212}	*	$\pm$ 50%
			Bi^{214}	*	$\pm$ 50%
			Pb^{124}	*	$\pm$ 50%
			Ra^{226}	*	$\pm$ 50%
			Ac^{228}	*	$\pm$ 50%
			Pa^{234}	*	$\pm$ 50%
			Th^{234}	*	$\pm$ 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Ambient Air (Composite Sample)	Isotopics- Tc^{99}, Uranium, Thorium, Plutonium, Np^{237}, and Ra^{226}	Each annual composite:	Tc^{99}	74.0 E-06 pCi/m^3	± 50%
			U^{234}	7.0 E-06 pCi/m^3	± 50%
			$U^{235/236}$	7.0 E-06 pCi/m^3	± 50%
			U^{238}	7.0 E-06 pCi/m^3	± 50%
			Th^{228}	2.3 E-06 pCi/m^3	± 50%
			Th^{230}	2.3 E-06 pCi/m^3	± 50%
			Th^{232}	2.3 E-06 pCi/m^3	± 50%
			Pu^{238}	0.7 E-06 pCi/m^3	± 50%
			$Pu^{238/240}$	0.7 E-06 pCi/m^3	± 50%
			Np^{237}	0.3 E-06 pCi/m^3	± 50%
			Ra^{226}	0.8 E-06 pCi/m^3	± 50%

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Sample Media	Description of Analysis	Analysis Frequency	Target Analytes	Required Detection Level	Required Accuracy at 10x RDL
Ambient Air (Composite Sample) (Continued)	Isotopics- (continued) Ra^{228}, Sr^{90}, and Cs^{137}	Each annual composite:	Ra^{228}	8.0 E-06 pCi/m^3	± 50%
			Sr^{90}	0.7 E-06 pCi/m^3	± 50%
			Cs^{137}	11.0 E-06 pCi/m^3	± 50%
Ambient Air (Radon)	Radon	Quarterly and Hourly Analyses:	Rn^{222}	0.3 pCi/L (quarterly)	± 50%
			Rn^{222}	0.1 pCi/L (hourly)	± 50%

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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 11.5 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 Attachment I, "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. The "Effluent Monitoring and Environmental Surveillance Program Essential Elements Matrix" (Attachment A) identifies the current status and schedule for items that are scheduled for implementation.

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.

In general, 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,
- 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 RSO 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 unambiguously 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.

6.0 LABORATORY PROCEDURES (cont.)

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. Chain-of-custody forms must be used.

6.2.1 Sample Identification

All samples collected and 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.

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.

6.0 LABORATORY PROCEDURES (cont.)

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.

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.

6.0 LABORATORY PROCEDURES (cont.)

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.

This segregation technique requires samples and their aliquots to be classified into groups of similar analyte concentrations. The number of groups needed to properly implement this technique depends on the overall range of concentrations that are encountered by the laboratory. A subjective review of effluent management and environmental surveillance data for the years 1989 and 1990 indicates that at least two concentration level classifications, high and low, are warranted for the FEMP Analytical Laboratory to maintain proper control over cross-contamination. Data for years prior to 1989 were excluded from this review on the basis that the site's mission was production oriented as opposed to the current mission of remediation.

Procedures shall be maintained that, as a minimum, require sample materials undergoing analysis to be classified into either a high concentration group or a low concentration group. These procedures shall prescribe numerical limits that define the range of each concentration group.

6.0 LABORATORY PROCEDURES (cont.)

Procedures shall be maintained that prescribe methods for classifying samples and their aliquots into the specified concentration groups. Acceptable sample classification techniques include:

- screening surveys or analyses upon receipt,
- knowledge of expected analyte concentrations in the sample,
- knowledge of analyte concentrations in the vicinity of the sample collection site, or
- sampling objective (e.g., control sample, indicator sample, effluent sample, accident response sample, etc.).

Procedures shall be maintained that require the processing of samples and their aliquots to be segregated according to concentration group classification (DOE/EH-0173T, Summary 6c). Appropriate methods for achieving segregation shall be established by procedure. Acceptable segregation methods include:

- dedicating different laboratories to each concentration group and requiring that only sample materials meeting a lab's classification can be processed there,
- dedicating different locations within a laboratory to each concentration group and requiring that only sample materials meeting a location's classification can be processed there, or
- dedicating equipment (e.g., glassware, hot plates, etc.) to each concentration group and requiring that only sample materials meeting the equipment's classification can be processed using that equipment.

6.0 LABORATORY PROCEDURES (cont.)

Procedures shall be established that prescribe appropriate methods and practices for preventing cross-contamination between sample materials within the same concentration group (DOE/EH-0173T, Summary 6c). Recommended methods and practices include:

- rinsing clean, reusable glassware with a disposable portion of sample prior to aliquoting,
- using disposable labware,
- using a clean material, such as bench paper, to cover laboratory benches before processing a new batch of samples,
- conducting periodic surveys of the laboratory and decontaminating when permissible contamination levels established by procedure are exceeded,
- conducting post decontamination surveys to ensure contamination is below permissible levels prior to resuming the processing of samples,
- diluting high concentration samples to levels that are less likely to cause cross-contamination,
- over-packing sample containers using plastic bags or other suitable containers for storage or transport through locations with lower concentration group ratings, and
- incorporating reagent blanks in each analytical batch to verify the effectiveness of glassware cleaning procedures, purity of reagents, and sample handling techniques.

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

Routine sample analysis and result verification should normally be completed within 90 days of collection. However, special conditions might occur that prevent timely analysis of samples. Sample archiving may be considered as an acceptable alternative to immediate analysis of some samples, but be totally inappropriate for other samples or analytes. Therefore, procedures shall exist that direct the preservation and archiving of samples (DOE/EH-0173T, Summary 6d).

6.0 LABORATORY PROCEDURES (cont.)

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.

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).

6.0 LABORATORY PROCEDURES (cont.)

6.3.5 Disposal

Samples with a high degree of variability in composition are processed by the Analytical Laboratory. 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.

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.

6.0 LABORATORY PROCEDURES (cont.)

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:

- 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 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:

6.0 LABORATORY PROCEDURES (cont.)

- 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.

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.

6.0 LABORATORY PROCEDURES (cont.)

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
- 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,

6.0 LABORATORY PROCEDURES (cont.)

- routine quality control performance checks (DOE/EH-0173T, Summary 6j), and
- identification and resolution of non-conformance.

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.

6.0 LABORATORY PROCEDURES (cont.)

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 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.

6.0 LABORATORY PROCEDURES (cont.)

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.

6.8.2 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

6.0 LABORATORY PROCEDURES (cont.)

- 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,
- 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.

6.0 LABORATORY PROCEDURES (cont.)

Section 4.0, "Data Quality 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. Analytical QC samples appropriate for ASL E and user-defined ASL B shall be described in DQOs. DQOs are referenced in the EMP (Attachment B).

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. In general, contract labs 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 and listed in the SCQ 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,

6.0 LABORATORY PROCEDURES (cont.)

- 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.

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.

6.0 LABORATORY PROCEDURES (cont.)

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[3] 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.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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 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.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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.

7.1 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 utilized 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 Quality Control Department of the RSO Division will be 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).

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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, 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),

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

- 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 are currently coordinating a joint effort to design, implement, and maintain an 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 FEMP personnel.

Additionally, other systems being developed such as the Automated Sampling and Analysis Plan and the Geographical Information System will be able to 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, refer to the Environmental Monitoring Section Procedures Manual, procedure EM-AD-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data." This procedure provides a controlled and consistent system within Environmental Monitoring for the preparation, performance, documentation, review and approval, and reporting of statistical studies.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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 shall be documented by procedure. Data review procedures shall 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.

7.4 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. In addition, refer to the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data."

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

7.4.1 Distribution Analyses

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. Procedures shall exist that direct performance of statistical calculations. Refer to the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data."

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. Specific procedures shall be maintained that direct computation of measures of central tendency. Refer to the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data."

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 variance (σ^2) for normally distributed data. In cases where data are <u>not</u> 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. Specific procedures shall be

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

maintained that direct computation of measures of dispersion. Refer to the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" for additional guidance and requirements.

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 the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" for additional guidance and requirements.

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:

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

- criteria for data rejection,
- 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 the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" for additional guidance and requirements.

7.4.5.1 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)

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

Y =	the fractional yield for the radiochemical separation
V =	sample size
T =	counting time interval
S =	the self-absorption correction factor
ϵ =	the detection counting efficiency
$\exp(-\lambda t)$ =	the correction for radioactive decay between sample collection and counting (time interval, t)
λ =	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 the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" for additional guidance and requirements.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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.
- 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 the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" 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.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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.

There may be some measurement techniques that prevent the determination of a measurement below the detection limit. For these cases, refer to the SCQ and the Environmental Monitoring Section Procedures Manual, procedure EM-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" for additional guidance and requirements.

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. EM-AD-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data, 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. When applicable and practical, the DOE 5400.1[1] and SCQ requirements for reporting units shall be followed.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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:

- 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.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT (cont.)

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 for the following purposes: to demonstrate the compliance of routine operations with the regulations or orders of DOE or EPA; and to support the ASER. 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 ASER. 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[3].

- 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)].

8.0 DOSE CALCULATIONS (cont.)

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.

- 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,[30] Rn^{222} 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].[12] 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 Ra^{226} and Ra^{228} 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.

8.0 DOSE CALCULATIONS (cont.)

- 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][3] implement the EPA regulations of 40 CFR 61, Subpart Q.[30] 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. Therefore, no dose calculation methods are required by this Plan for radon and its decay products. However, measurements required to demonstrate compliance with the flux and concentration guidelines are described in Section 5.0 of this Plan.

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

8.2.1 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.

8.0 DOSE CALCULATIONS (cont.)

Most dose calculations (including all those described in the following subsections) will normally 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[8] indicates that such methods lead to unrealistically high estimates of offsite air concentrations.

- 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.

8.0 DOSE CALCULATIONS (cont.)

- 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: Notwithstanding the above, 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.

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.

8.2.2 DOE All-Pathways Guideline

The following equation (or the mathematical equivalent) shall be used for calculation of dose equivalent to be compared to the DOE 100-mrem all-pathways guideline:

8.0 DOSE CALCULATIONS (cont.)

$$H_T = H_a + H_w + \sum_f H_f + H_s + H_d \qquad \text{Equation 8-1}$$

where:

H_T = the total annual dose from all pathways (mrem/yr);

H_a = the committed effective dose equivalent due to inhalation intakes in the current year (mrem/yr), from Section 8.2.2.1;

H_w = the committed effective dose equivalent due to drinking water intakes in the current year (mrem/yr), from Section 8.2.2.2;

$\sum H_f$ = summation of effective dose equivalents due to consumption of foodstuff f in the current year (mrem/yr), from Section 8.2.2.3;

H_s = the committed effective dose equivalent due to hypothetical ingestion of contaminated sediment in the current year (mrem/yr), from Section 8.2.2.4; and

H_d = the effective dose equivalent due to direct irradiation in the current year (mrem/yr), from Section 8.2.2.5.

Although all the listed pathways shall be used for initial dose assessments, a given pathway may be deleted from future assessments *provided that* it is determined and documented that the pathway does not contribute significantly to the calculated dose. In calculations for determining compliance with the 100-mrem all-pathways guideline, all pathways shall be included that may contribute 10 mrem/yr or 10% of the actual dose, whichever is less.

8.0 DOSE CALCULATIONS (cont.)

Note: In all the calculations specified in subsections 8.2.2.1 - 8.2.2.4, radon and its decay products are specifically excluded from the guideline and should be omitted from the calculation.

Air and liquid pathway monitoring provide the basis for the extensive environmental sampling described in Section 5.0 of this Plan. Dose estimates resulting from air emissions (Section 8.4), liquid effluents (Section 8.5), and direct radiation (Section 8.2.2.5) shall be differentiated.

8.2.2.1 Air Inhalation Dose

The committed effective dose equivalent due to air inhalation shall be included. The following equation (or the equivalent) shall be used:

$$H_a = 0.001\ U_a \sum_i (C_{a,i}\ \ h_{E,50,A,i}) \qquad \text{Equation 8-2}$$

where:

0.001 = conversion factor to convert mrem to rem;

H_a = the committed effective dose equivalent due to inhalation intakes in the current year (mrem/yr);

U_a = the adult breathing rate, 8400 m^3/yr (paragraph III.2a of DOE 5400.5[3]);

$C_{a,i}$ = the annual average concentration of radionuclide i in air at the indicator location at or beyond the site boundary for which the results yield the highest dose commitment (pCi/m^3); and

$h_{E,50,A,i}$ = the adult 50-year effective dose equivalent commitment factor for inhalation of radio nuclide i (rem/μCi), from DOE/EH-0071[26].

8.0 DOSE CALCULATIONS (cont.)

Each $C_{a,i}$ may be corrected for the background concentration of the same radionuclide (as measured at control locations), *provided that*: the control locations have been qualified and documented properly according to the provisions of Section 5.3; and the corrected concentration for each radionuclide shall not be less than zero.

8.2.2.2 Drinking Water Ingestion Dose

Effective dose commitment due to drinking water ingestion shall be included. The following equation (or the equivalent) shall be used:

$$H_w = 0.001\ U_w \sum_i (C_{w,i}\ h_{E,50,I,i}) \qquad \text{Equation 8-3}$$

where:

0.001 = conversion factor to convert mrem to rem;

H_w = the committed effective dose equivalent due to drinking water intakes in the current year (mrem/yr);

U_w = the adult drinking water consumption rate, 730 L/yr (paragraph III.2a of DOE 5400.5[3]);

$C_{w,i}$ = the annual average concentration of radionuclide i in groundwater from the well at or beyond the site boundary that is used for drinking water, and for which the results yield the highest dose commitment (pCi/L); and

$h_{E,50,I,i}$ = the adult 50-year effective dose equivalent commitment factor for ingestion of radionuclide i (rem/μCi), from DOE/EH-0071.[26]

8.0 DOSE CALCULATIONS (cont.)

Each $C_{w,i}$ may be corrected for the background concentration of the same radionuclide (as measured in control wells), *provided that*: the control wells have been qualified and documented properly according to the provisions of Section 5.3; and the corrected concentration for each radionuclide shall not be less than zero. For the purposes of the DOE all-pathways determination, all measured radionuclides (other than radon and its decay products) shall be included.

8.2.2.3 Foodstuff Ingestion Dose

The committed effective dose equivalent due to ingestion of contaminated foodstuff shall be included. The following equation (or the equivalent) shall be used for each applicable foodstuff grown in the areas near FEMP:

$$H_f = 0.001\ U_f \sum_i (C_{f,i}\ h_{E,50,I,i}) \qquad \text{Equation 8-4}$$

where:

0.001 = conversion factor to convert mrem to rem;

H_f = the committed effective dose equivalent due to consumption of foodstuff f in the current year (mrem/yr);

U_f = the adult consumption rate of foodstuff f (kg/yr or L/yr);

$C_{f,i}$ = the annual average concentration of radionuclide i in foodstuff f, collected at the indicator location for which the results yield the highest dose commitment (pCi/kg or pCi/L); and

$h_{E,50,I,i}$ = the adult 50-year effective dose equivalent commitment factor for ingestion of radionuclide i (rem/μCi), from DOE/EH-0071.[26]

8.0 DOSE CALCULATIONS (cont.)

Each $C_{f,i}$ may be corrected for the background concentration of the same radionuclide (as measured at control locations), *provided that*: the control locations have been qualified and documented properly according to the provisions of Section 5.3; and the corrected concentration for each radionuclide in a given foodstuff shall not be less than zero.

All locally produced foodstuffs for which environmental monitoring results indicate the capability to cause a committed effective dose equivalent exceeding 2 mrem/yr (or 10% of the foodstuff dose, whichever is less) shall be included in the calculation. This determination shall be made by the ES&H Division Manager or designee, and shall be documented. For the purposes of this determination, a foodstuff is locally produced if it is harvested for human consumption within 5 miles of the FEMP site boundary.

At least the following foodstuff pathways shall be included in the DOE all-pathways determination, provided that they meet the criteria for making a significant dose contribution, and for being locally-produced:

- Milk. U_f = 310 L/yr, the default value for the maximum exposed adult in NRC Regulatory Guide 1.109.[49]

- Beef. U_f = 110 kg/yr wet weight, the default value for the maximum exposed adult in NRC Regulatory Guide 1.109.[49]

- Fin Fish. U_f = 21 kg/yr wet weight, the default value for the maximum exposed adult in NRC Regulatory Guide 1.109.[49] $C_{f,i}$ shall be measured in only the edible portions of Great Miami River fish.

8.0 DOSE CALCULATIONS (cont.)

- Leafy Vegetables (based on monitoring of cabbage or lettuce). U_f = 64 kg/yr wet weight, the default value for the maximum exposed adult in NRC Regulatory Guide 1.109.[49]

- Corn. U_f = 125 kg/yr wet weight, based on the default consumption rate for fruits, vegetables, and grain by the maximum exposed adult, given that 24% of this consumption is grain (0.24 x 520 = 125).[49]

- Other Vegetables (based on monitoring of green beans or tomatoes, etc.). U_f = 217 kg/yr wet weight, based on the default consumption rate for fruits, vegetables, and grain by the maximum exposed adult, given that 54% of this consumption is vegetables, of which 64 kg/yr is leafy vegetables [(0.54 x 520) - 64 = 217].[49]

The consumption rates given above are all generic default values. Properly referenced generic values from other sources may also be used, such as those from (Miller 1984). However, generic values from whatever source should not be used if local production of a given foodstuff is insufficient to support the assumed consumption rate. If site-specific values are determined and documented, they should be used in place of the default values (DOE/EH-0173T, Summary 8c).

8.2.2.4 Sediment Ingestion Dose

As discussed in Section 5.2, some incidental ingestion of sediment by children playing in surface waters and stream beds may be postulated. The inclusion of this pathway in the dose determination would be conservative for two principal reasons. First, the pathway is only postulated, not known to exist. In addition, this child-only exposure would be added to exposure from adult pathways.

8.0 DOSE CALCULATIONS (cont.)

Nevertheless, to be prudent, committed effective dose equivalent due to sediment ingestion shall be included in calculations for determining compliance with the DOE 100-mrem all-pathways guideline. The following equation (or the equivalent) shall be used:

$$H_s = 0.001\ U_s \sum_i (C_{s,i}\ h_{E,50,I,i}) \qquad \text{Equation 8-5}$$

where:

0.001 = conversion factor to convert mrem to rem;

H_s = the committed effective dose equivalent due to hypothetical ingestion of sediment in the current year (mrem/yr);

U_s = the child sediment consumption rate, 0.073 kg/yr;[22]

$C_{s,i}$ = the annual average concentration of radionuclide i in sediment from the indicator sediment sampling location at or beyond the site boundary for which the results yield the highest dose commitment (pCi/kg); and

$h_{E,50,I,i}$ = the child 50-year effective dose equivalent commitment factor for ingestion of radionuclide i (rem/μCi), from age dependent factors prepared at the Oak Ridge National Laboratory for the U.S. Nuclear Regulatory Commission ORNL/TM-9890, or other reference sources which provide child-specific radiation dose conversion factors for radionuclides.

8.0 DOSE CALCULATIONS (cont.)

Each $C_{s,i}$ may be corrected for the background concentration of the same radionuclide (as measured at control locations), *provided that*: the control locations have been qualified and documented properly according to the provisions of Section 5.3.1; and the corrected concentration for each radionuclide shall not be less than zero.

8.2.2.5 Direct Radiation Dose

Direct radiation dose is measured using environmental TLDs dosimeters, as described in Section 5.0. These measurements account for external dose due to passing radioactive plumes, and any sky shine due to radiation sources (such as the K-65 silos) within the FEMP site boundary. The sky shine contribution cannot be separated readily from the plume dose (including that due to the radon daughter products that are not covered by the guideline).

Therefore, for the purpose of demonstrating compliance with the DOE 100-mrem guideline for exposure by all pathways, the *entire* highest measured annual result from an indicator TLD location at or beyond the site boundary that is in a line with the closest residence shall be added to the inhalation and ingestion doses calculated according to subsections 8.2.2.1 - 8.2.2.4. The contribution of background direct dose (as measured by TLDs at control locations) may be subtracted from the indicator location dose to obtain the FEMP-related direct dose, *provided that*: the control locations have been qualified and documented properly according to the provisions of Section 5.3.1; and the computed FEMP-related direct radiation dose shall not be less than zero.

8.2.3 EPA 40 CFR 141 Drinking Water Limit

The following equation (or the equivalent) shall be used for determining compliance with the drinking water organ dose limit (DOE/EH-0173T, Summary 8e):

$$H_{w,j} = 0.001\ U_w \sum_i (C_{w,i}\ h_{j,50,I,i}) \qquad \text{Equation 8-6}$$

8.0 DOSE CALCULATIONS (cont.)

where:

0.001 = conversion factor to convert mrem to rem;

$H_{w,j}$ = the committed effective dose equivalent for organ j due to drinking water intakes in the current year (mrem/yr);

U_w = the adult drinking water consumption rate, 730 L/yr (paragraph III.2a of DOE 5400.5[3]);

$C_{w,i}$ = the annual average concentration of radionuclide i in groundwater from the well at or beyond the site boundary that is used for drinking water, and for which the results yield the highest dose commitment (pCi/L); and

$h_{j,\,50,\,I,\,i}$ = the adult 50-year dose equivalent commitment factor for organ j, due to ingestion of radionuclide i (rem/μCi), from DOE/EH-0071.[26] The dose commitment shall be calculated separately for each of the organs for which the reference provides dose equivalent commitment factors (including the effective dose equivalent commitment), and compared separately to the 4-mrem limit.

Each $C_{w,i}$ may be corrected for the background concentration of the same radionuclide (as measured in control wells), *provided that*: the control wells have been qualified and documented properly according to the provisions of Section 5.3.1; and the corrected concentration for each radionuclide shall not be less than zero. For the purposes of the 40 CFR 141[12] EPA drinking water determination, only man-made beta/gamma-emitting radionuclides shall be included; U-238, U-235, Th-232, and all their daughter products are specifically excluded.

8.0 DOSE CALCULATIONS (cont.)

8.3 Dose to Native Aquatic Animal Organisms

The dose calculation for native aquatic animal organisms shall be based on environmental monitoring results, considering only the dose due to radionuclide intake by the animal organisms. Either one of the following two methods shall be used:

8.3.1 Normal Method

Use the measured water concentrations to estimate the dose to invertebrates:

$$D = 2.74 \times 10^{-15} \sum_i (W_i F_i) \qquad \text{Equation 8-7}$$

where:

D = the dose to an invertebrate organism (rad/day);

W_i = the measured concentration of radionuclide i in the water in which the invertebrate is assumed to live (pCi/L); and

F_i = the dose conversion factor for radionuclide i in freshwater invertebrates, from Table 4-13A of ORNL-4992[50] (mrad/yr per μCi/mL).

Note: According to the dose factors listed in ORNL-4992,[50] invertebrates receive the highest dose from a given concentration of radionuclides in water. Thus if invertebrates are within the 1 rad/day DOE guideline, other animals will also be within the guideline.

8.0 DOSE CALCULATIONS (cont.)

8.3.2 Alternative Method

The method presented in subsection 8.3.1 tends to overestimate the dose to the organism because the F_i factors are based on: conservative generic bioaccumulation factors and radiation energy absorption in an organism 30 cm in radius. If necessary, a less conservative estimate for the dose to an animal organism can be obtained by using the measured activity concentration in the animal, rather than the concentration in the water in which the animal lives:

$$D = 5.12 \times 10^{-5} \; m \sum_i (A_i \, E_i) \qquad \text{Equation 8-8}$$

where:

D = the dose to the animal organism (rad/day);

m = the total body mass of the organism (kg);

A_i = the measured average concentration of radionuclide i in the whole animal organism (pCi/kg); and

E_i = the specific effective energy for radionuclide i in a tissue mass the size of the body of the organism (MeV/g per disintegration).

The techniques of ICRP Publications 2[51] or 30[52] may be applied to the calculation of E_i for aquatic animal organisms.

8.0 DOSE CALCULATIONS (cont.)

8.4 Air Pathway Dose

The air pathway includes contaminants reaching people directly as emissions and indirectly through foodstuff contaminated by airborne emissions and irrigation. Estimating air pathway dose is necessary for demonstrating NESHAP compliance.

Again, it should be noted that radon is excluded from the air pathway dose because the DOE is assessing the Derived Concentration Guides for radon. Additionally, the NESHAP, subpart H, requirements of the Clean Air Act specifically excludes radon when considering air pathway emissions.

In order to estimate Air pathway dose, the FEMP shall use the CAP-88 set of computer codes. The use of a modelling code, such as CAP-88, is required by the NESHAP, subpart H. Although many of the data used by the code are obtained through measurement and sampling, some data are not readily available and must be estimated. This is explained in more detail in Section 3.0 of this Plan.

Air pathway dose estimates also shall be obtained by adding the committed effective dose equivalent due to inhalation intakes in the current year (Section 8.2.2.1), the committed effective dose equivalent due to consumption of foodstuff and meat contaminated by airborne emissions in the current year (Section 8.2.2.3), and the committed dose equivalent due to contamination of foodstuffs due to irrigation. The dose due to fin fish, as specified in Section 8.2.2.3, is excluded for the air pathway dose. There is no easy way to determine the dose estimates due to irrigation since foodstuffs are included in both the air pathway dose and the liquid pathway dose.

8.0 DOSE CALCULATIONS (cont.)

Dose due to irrigation of foodstuffs will be apportioned to the air and liquid pathways by using the National Council on Radiation Protection and Measurements (NCRP) Commentary No. 3, "Screening Techniques for Determining Compliance with Environmental Standards". This is consistent with that used in the Draft Sitewide Characterization Report, dated August 1992.

An evaluation and documentation of the use of irrigation in the FEMP area via the draft Sitewide Characterization Report provided a basis for apportioning doses to the air and liquid pathways. The required actions were incorporated in the implementing procedure to estimate pathway dose, EM-RM-016, "Estimating Radiological Pathway Dose".

Furthermore, the air pathway dose estimates obtained shall be compared against the air pathway dose estimates obtained using CAP-88 to support demonstration of NESHAP compliance. The procedure to estimate pathway dose will also direct the appropriate response with respect to the differences among the respective doses obtained by the different methods.

8.5 Liquid Pathway Dose

Radionuclide concentrations in offsite private drinking water wells, sediment, foodstuffs contaminated by irrigation, and fish from the Great Miami River are used to estimate the liquid pathway dose.

Liquid pathway dose estimates shall be obtained by adding the committed effective dose equivalent due to drinking water intakes in the current year (Section 8.2.2.2), the committed effective dose equivalent due to consumption of fin fish in the current year (Section 8.2.2.3), the committed effective dose due to hypothetical ingestion of contaminated sediment in the current year (Section 8,2.2.4) and the committed effective dose equivalent due to foodstuffs contaminated due to irrigation.

8.0 DOSE CALCULATIONS (cont.)

8.6 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 RTP 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.

8.0 DOSE CALCULATIONS (cont.)

- 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 performance of those audits (DOE/EH-0173T, Summary 8b,c). Specifically, the records supporting calculations used in each compliance demonstration report or ASER 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.

8.0 DOSE CALCULATIONS (cont.)

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).

9.0 RECORDS AND REPORTS (cont.)

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.

9.1 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[54] or 40 CFR Part 265.73[40] (DOE/EH-0173T, Summary 9c). All record retention and maintenance shall be in accordance with written and approved procedures.

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,[3], DOE Order 5000.3 A and B, and DOE Order 5484.1[55] 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.

Table 9-1. Applicable Reporting Requirements

Source of Requirement	Reporting	Requirement	Deadline
DOE Order 5400.1	Annual Site Environmental Report	FEMP shall prepare an Annual 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.	

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Table 9-1. (Continued)

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

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Table 9-1. (Continued)

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.

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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
- Cost Effectiveness

Quality Assurance (QA) activities associated with the EMP includes the applicable features of the 18 elements of NQA-1[57] (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.

10.0 QUALITY ASSURANCE (cont.)

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 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.

10.0 QUALITY ASSURANCE (cont.)

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. **All of these requirements, as applicable, must be followed.** Applicable implementing procedures are referenced in each QA document and shall be referenced in EMP implementing procedures as applicable.

- 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.

- Section 1.0 through 4.0, of the QAPD address the Functional Category A: Management. This functional category contains the following program elements or criteria: Program, Personnel Training and Qualification, Quality Improvement, and Documents and Records. These criteria define the framework for management systems supporting the QA Program.

- Sections 5.0 through 8.0 of the QAPD address Functional Category B: Performance. This functional category contains the following program elements or criteria: Work Processes, Design, Procurement, and Inspection and Acceptance Testing. This category provides the controlling activities associated with establishing and maintaining the technical requirements for work done at the FEMP.

10.0 QUALITY ASSURANCE (cont.)

- Sections 9.0 through 10.0 of the QAPD address Functional Category C: Assessment. This functional category contains the following program elements or criteria: Management Assessment and Independent Assessment. This category provides for the assessment of the QA Program to determine its effectiveness and to promote quality improvement.

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 planning and 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.

10.0 QUALITY ASSURANCE (cont.)

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 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" does apply to this QAPD criterion.

General procedures used for noncompliance control are included in procedure SSOP-0023.

10.0 QUALITY ASSURANCE (cont.)

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.

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 FMPC-609. Procedures specific to the routine environmental surveillance activities are contained in the Environmental Monitoring Section Procedures Manual. Additionally, SSOP-0076, "Reviewing the Fernald Site Environmental Monitoring Program," is a procedure that controls changes to the Environmental Monitoring Program and the EMP document. It addresses review of site specific and generic factors affecting the Program, mandatory historical archival of such factors, actions required to change the Program, the associated approval process, and the annual EMP review process.

10.0 QUALITY ASSURANCE (cont.)

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.

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 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.

10.0 QUALITY ASSURANCE (cont.)

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."

10.0 QUALITY ASSURANCE (cont.)

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 in 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.

10.0 QUALITY ASSURANCE (cont.)

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).

As described in Section 3.5, "Field Responsibilities," 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 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 be included. Responsibilities for PSP implementation are described in Figure 3-4 (Appendix A of the SCQ).

Section 4.0, "Data Quality Objectives", of the SCQ 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.

10.0 QUALITY ASSURANCE (cont.)

The DQO EPA guidance provides information on the review of site data and the determination of data quality needs for sampling. Use of this guidance will help ensure that all environmental data collected in support of RI/FS activities are of known and documented quality[65]. The SCQ directs the development of DQOs. In addition, a site procedure is currently being developed.

All data are subject to some error. Different types of error may be introduced at different stages of data collection. For example, the error or uncertainty involved in sampling should generally determine the variability that can be tolerated in the analysis, when the analytical methodology is not the limiting factor.

Some types of errors can be controlled whereas others can be only described qualitatively. The magnitude of the error associated with a particular data set is called data quality. As the amount of the error associated with the data set increases, the quality of the data decreases. Collecting data with small levels of error may not always be possible or necessary; data of the very best quality are not always needed. Depending on the particular decisions that will be made with the data and the way in which the data will be used to support those decisions, specified levels of error may be tolerable or cost-effective. However, the quality of data must always be known. Data must always have error bars.

10.0 QUALITY ASSURANCE (cont.)

The quality of a data set is represented in terms of five characteristics: precision, accuracy, representativeness, completeness, and comparability. For a particular data set, data quality may be expressed in quantitative terms for some of the characteristics and in qualitative terms for others. The relative significance of the five characteristics may differ for different types of data and for different uses of data.

DQOs are statements that provide the critical definitions of confidence required in drawing conclusions from the entire program or project data. DQOs are qualitative and quantitative statements developed by data users to specify the quality of data needed form a particular data collection activity. The data objectives determine the degree of total variability (uncertainty or error) that can be tolerated in the data[66]. These limits of variability must be incorporated into the sampling and analysis plan and achieved with detailed sampling and analysis protocols. DQOs differ from measurement quality objectives (such as precision and accuracy) in that they are limits for the overall uncertainty of results, while the latter are only limits for the uncertainty of specific measurements."

Furthermore, DQOs should specify descriptions of actions that are to be taken if an answer does not meet the DQO and they reflect general decisions that must be taken. For example, what action is going to be taken if QC samples are found to contain significant amounts of contamination? A possible answer may include tracking down the problem and resampling. DQOs also contain quantitative terms such as standard deviation, percent recovery, and concentration. For example, if the desired limit of detection or a reliable detection level cannot be met, what actions will be taken? A possible answer may be to accept the composite of several samples to obtain a larger one. Often desired data quality

10.0 QUALITY ASSURANCE (cont.)

objectives must be balanced against the cost of a sampling and analysis project, and more realistic objectives must be adopted with concurrence of the data users. Case studies of previous efforts can be important in developing realistic data quality objectives[67].

The development of DQOs is a complicated and iterative process. It involves the decision makers and technical staff who are responsible for defining how they intend to use the data and determining the quality needed to support the use.

The site introduced the concepts and applications of the DQO process in March 1991. To write a DQO, the process is composed of two components. The first and most critical component is the seven step "logic flow" process. The DQO logic flow is the primary tool that project managers and their planning team will use to identify, very specifically, all the elements involved with their respective sampling and analysis projects. The seven criteria to be addressed include:

* A Statement of the Problem to be Resolved
* Identifying the Decision(s) to be Made
* Identifying the Inputs of those Decision(s)
* Defining the Boundaries of the Problem
* Developing a Decision Rule
* Specifying Limits of Uncertainty
* Optimizing a Design for Obtaining Data

The second step of the DQO process is the DQO Summary Sheet. It is completed after the logic flow has been written and will further specify requirements of the sampling and analysis project(s).

10.0 QUALITY ASSURANCE (cont.)

Once the DQO has been written, the project manager shall send a copy of the completed package to the SCQ implementation team. The SCQ implementation team will distribute the submitted DQO package to the CRU managers and other applicable managers for review.

These reviewers will have the opportunity to review the DQO package in order to determine if it impacts their sampling efforts. If the DQO package would impact their projects, then they would allow for additional input to the DQO. All comments would be returned to the project manager via the PP subgroup for comment resolution. Once the resolution is complete, then the DQO will be approved and entered into the SCQ implementation team controlled files[68]. All Environmental Monitoring Program DQOs are established per the SCQ. Guidelines for the development of FEMP DQOs are presented in Appendix C of the SCQ. Per the SCQ, all DQOs will be approved and controlled by the SCQ implementation team and kept in a centrally located document, separate from the SCQ[64]. Therefore, DQOs shall be referenced only in this plan. A reference table can be found in Attachment B.

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).

Also, Section 4.0 of the SCQ, 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 for 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.

10.0 QUALITY ASSURANCE (cont.)

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) custody during laboratory receipt and analysis, and 3) evidence files. Chain-of-custody forms must be used.

10.0 QUALITY ASSURANCE (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 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 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).

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.

10.0 QUALITY ASSURANCE (cont.)

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.

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.

10.0 QUALITY ASSURANCE (cont.)

Some of the activities under that EMP may apply to this. 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[58] - 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."

- 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[29] - Specifies the activities required to achieve the quality level required by 40 CFR 61,[30] 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.

10.0 QUALITY ASSURANCE (cont.)

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,[59] 5700.6,[56] , 5400.5, and the SCQ.[43] All procedure manuals shall be reviewed regularly and updated as necessary.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION

Sections 2.0 through 10.0 of this EMP describe the specific criteria to be met by the FEMP in complying with DOE Order 5400.5[5], the QAPD, and the SCQ. This section describes the current FEMP practices for liquid effluent monitoring, airborne effluent monitoring, meteorological monitoring, environmental surveillance, and analytical laboratory procedures.

The EMP was approved by DOE/FN in November 1992. Note that the target analytes discussed in Section 11.0 are different than those designated in the EMP. The target analytes identified under Sections 2.0, 3.0, and 5.0 of this Plan had to be approved by DOE/FN before target analytes could be changed and implemented.

11.1 Liquid Effluent Monitoring

The FEMP is required to maintain and comply with the provisions of a National Pollutant Discharge Elimination System (NPDES) permit[15], issued by the Ohio EPA. The current permit was issued on February 12, 1990 and was amended on July 15, 1991. The NPDES permit requires the FEMP to characterize its liquid effluent stream by collecting waste water effluent samples at seven designated locations on the site. Sampling frequencies, analytes, and effluent limitations including both concentration and mass limits at each of these locations are specified in the permit. Effluent data are submitted monthly to the OEPA. Additional discharge data, including information on radionuclide activity detected in the effluent stream, is reported to the USEPA, OEPA, and the Ohio Department of Health. The frequency of reporting is established by amended provisions of the 1986 Federal Facilities Compliance Agreement[46] (FFCA) as well as the Amended Consent Agreement between DOE and USEPA.

11.1.1 Discharge Outfalls

The NPDES permit identifies two sampling locations (4001 and 4002) as discharge outfalls. These are described in Section 2.3.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

The discharge from 4001 consists of the combined treated sanitary and process wastewater streams, and stormwater collected by the storm sewer system. Present sources of process wastewater include the coal-fired steam generation plant, the analytical laboratories, stormwater from controlled plant sumps and storage pads, wastewater from the production of FEMP potable water, coal pile runoff, and stormwater runoff from parts of the Waste Pit Area that is directed to the Biodenitrification Surge Lagoon. Treated water from the Perched Groundwater Removal Action also enters the process wastewater system. The monitoring point for this discharge is at Manhole-175, from where the effluent flows to the Great Miami River.

Discharge at Outfall 4001 is monitored continuously for flow and pH. A 24-hour composite of the discharge is analyzed daily for alpha and beta radiation and for uranium. The daily samples are composited and analyzed quarterly for Cs^{137}, Ru^{106}, and Sr^{90}. Weekly grab samples are composited and analyzed monthly for Np^{237}, Pu^{238}, $Pu^{239/240}$, Tc^{99}, Ac^{227}, K^{40}, Pb^{210}, Th^{230}, Th^{232}, U^{233}, U^{234}, U^{235}, U^{236}, U^{238}, Ra^{226}, and Ra^{228}. These data are tabulated, converted to units of radiation activity, and reported periodically to the USEPA, the OEPA, and the Ohio Department of Health in accordance with the FFCA.

In addition, at an average frequency of once every seven days, the discharge is sampled and analyzed for oil and grease, total suspended solids, fluorides, nitrates, ammonia, dissolved oxygen, BOD, cyanide, copper, hexavalent and total chromium, lead, silver, and nickel. These data are tabulated and reported monthly to the OEPA, consistent with the requirements of the NPDES permit.

The discharge from 4002 consists of stormwater that overflows the SWRB via a spillway and discharges to Paddy's Run via the Storm Sewer Outfall Ditch (SSOD). Discharge from 4002 is very infrequent; no overflow has occurred there since May 1990.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

Discharge 4002 is monitored daily for flow and pH during overflow conditions. Each overflow composite is also analyzed daily for alpha and beta radiation and for uranium. As required by the NPDES permit, overflow discharges are also sampled and analyzed daily for oil and grease, total suspended solids, hexavalent and total chromium, copper, silver, nickel, ammonia, nitrogen and fluorides.

11.1.1.1 Stormwater Monitoring

As of October 1, 1992 facilities associated with most categories of industrial activity were required to apply for a stormwater permit to cover any point source stormwater discharges not included in an existing NPDES permit. The FEMP prepared and submitted to OEPA an individual permit application for four on-site stormwater discharges to Paddy's Run. These outfalls drain areas outside the FEMP production area, and are associated primarily with waste storage and construction staging activities. In accordance with regulatory requirements for the permit application, samples were taken and analyzed at each of the four stormwater discharge points to Paddy's Run. Results were included with the permit application. Future sampling at these locations will depend on the requirements of the stormwater discharge permit when issued by OEPA.

11.1.2 Sampling System

The program for continuous sampling at specified monitoring locations on the FEMP site has been designed to meet the requirements of the NPDES permit[11]. This permit does not include requirements for the sampling of radionuclides. Sample collection containers are refrigerated. Equipment is calibrated routinely, and the systems are checked to assure they are in good working order.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

The predominant radioactivity of FEMP liquid discharges involves alpha radiation, with no readily identified ratios to beta and/or gamma emitters that could be used as radionuclide indicators. Therefore, continuous radiological monitoring of FEMP liquid discharges is not feasible.

Initially, the only radionuclide analyzed for was total uranium. Beginning in 1969, estimates were made annually for other nuclides based on the analysis of several long-term composite samples. Samples now are analyzed for expected radionuclides, and results are reported in the ASER[9] and to the appropriate regulatory agencies.

11.2 Airborne Effluent Monitoring

Emissions from each point source of radionuclides at the FEMP are determined consistent with the requirements of 40 CFR 61 Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From DOE Facilities."[10] The COMPLY model[12] has been used to estimate the contribution of a particular source to the dose received by any member of the public at or beyond the FEMP site boundary. Use of the COMPLY is acceptable since the maximally exposed individual has been determined to live within 3 kilometers of all sources of air emissions at the FEMP. The FEMP is now using CAP-88 PC as the model to estimate dose from point sources.

Continuous sampling is performed for point sources of radionuclide emissions where the model indicates a contribution greater than 0.1 mrem to the effective dose equivalent received annually by the maximally exposed individual. For those point sources estimated to contribute less than 0.1 mrem/year to the total dose, the radionuclide emissions may be estimated, but periodic confirmatory measurements are made to confirm the low estimated emission rates.

The results of these monitoring activities are reported annually to USEPA as required by 40 CFR 61 Subpart H.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

11.2.1 Point Sources Using HEPA Filtration Devices (HFDs)

Although some FEMP air emission point sources have HFDs installed, the majority of these sources are not presently operating. Production operations at the FEMP effectively ended in July 1989, and except for possible limited operation of some equipment as part of future clean-up and permanent shutdown of facilities, there are no plans for resuming operation of most currently existing sources.

The number of operating systems for which HFDs will be required is expected to increase as the level of remedial activity at the FEMP becomes greater. State of the art technologies are being considered for use in the CERCLA clean-up program, and many of these technologies will produce a source of air emissions which must be appropriately monitored and controlled.

These emission sources will be equipped with multi-point continuous isokinetic samplers when the estimated contribution of those sources to the dose received by the maximally exposed individual exceeds the criterion noted above in Section 11.2. Systems producing lower levels of radioactive emissions may be equipped either with single point particulate samplers or with no samplers at all.

Continuous samplers presently installed at the FEMP utilize a pleated paper filter of unknown efficiency within a cup-shaped holder. Air is drawn through the filter, leaving particulate on the paper. At regular intervals, the filters are destructively analyzed for uranium. The FEMP plans to modify the filter holders to accommodate a flat glass fiber filter. The glass fiber filters have a minimum efficiency of 99.97% when challenged with an 0.3 μm diameter particle.

11.2.2 Point Sources Using Scrubbers

There are no scrubber systems presently operating at the FEMP. With the single exception of the off-gas scrubber system installed at the new rotary kiln, there are no plans to operate any of the

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

existing scrubbers. However, additional scrubber systems may be installed and operated in the future as new remedial processes (e.g., vitrification) are started up.

Due to the high moisture content of the exhaust gas from many wet scrubber systems, conventional samplers may not function properly; the paper in a conventional filter sampler can become saturated and restrict air sampling flow. Thus, the design of these scrubber systems will require devices to remove moisture from the exhaust air prior to sampling. Because a real-time continuous air monitor has not yet been found that functions effectively in a scrubber exhaust, near-term particulate emissions reports from FEMP scrubber systems will include estimated uranium losses based on emissions factors derived from earlier EPA Method 5 stack testing.

11.2.3 Other Point Source Emissions

For those air emission sources that do not have direct samplers installed, estimated emissions are based either on the hours of operation in the mode which would result in an air emission, or on engineering calculations, or on the results of EPA Method 5 stack testing. The emissions from these sources are included in the annual NESHAP Subpart H compliance report.

11.2.4 Non-radiological Airborne Effluent Monitoring

The principal non-radiological emission sources at the FEMP are the coal-fired boiler plant and any natural gas-fired boilers used to supplement or substitute for the coal-fired boilers. Emissions from these sources include sulfur dioxide (SO_2), nitrogen oxides (NO_x), airborne dust (total suspended particulate, TSP), carbon monoxide (CO), and non-methane volatile organic compounds. The State of Ohio has established limits at the FEMP only for SO_2 and TSP.

The coal-fired boilers utilize electrostatic precipitators to remove particulate from exhaust gas. The exhaust stacks are equipped with opacity monitors to measure qualitatively the effectiveness of the

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

particulate controls. Emissions of SO_2 are estimated (i.e., not directly measured) using results from coal/natural gas chemical analysis, the quantity of fuel consumed, and are verified using results from periodic stack testing.

Whereas radionuclide sources are also sources of particulate emissions, the particulate emission levels are generally small compared to those from the operation of the boilers. However, the permits to install and operate for many of these sources issued by OEPA do include requirements for monitoring of radionuclide emissions and limits on particulate emissions.

Halogen compounds (CFCs) emitted from routine maintenance and operation of stationary halocarbon sources (e.g., air conditioners, refrigerators) and mobile sources (e.g., FEMP trucks, cars, etc.) do not require monitoring. However, the 1990 Clean Air Act Amendments impose additional requirements on the quantification, reduction and eventual elimination of these compounds at the FEMP.

11.3 Meteorological Monitoring

The FEMP meteorological monitoring system consists of a single meteorological tower, monitoring instruments, a data logger, and a PDP-1123 computer. The meteorological tower is equipped with measurement booms at 10 and 60 meters, making the measurements listed in Table 11-1.

Table 11-1. Current Meteorology Measurements

Measurement	Ground Level	10 m Elevation	60 m Elevation
Wind Direction		X	X
Wind Speed		X	X
Ambient Temperature		X	X
Dewpoint Temperature		X	
Precipitation	X		
Barometric Pressure	X		

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

A data logger records and integrates data and the computer has software that controls sampling frequencies at both the 10 meter and 60 meter elevations. Calculated parameters include horizontal wind direction fluctuation (σ_θ), relative humidity, lapse rate, and 15 minute and hourly averages of each parameter. Data are stored on the hard disk of the computer and on backup magnetic media. One-minute and 15-minute averages of meteorology parameters are fed real-time to the FEMP Emergency Response Center and to the Communications Center.

Meteorological instruments are maintained and calibrated utilizing the Maintenance Management and Inventory Control System (MMICS). MMICS supports scheduling of routine maintenance and calibration of meteorology instruments. Maintenance and calibration activities are conducted according to a checklist printed from MMICS.

The Radiological Environmental Monitoring Program uses onsite meteorological data in calculating doses from routine and accidental releases at the FEMP and for release assessment. The CAP-88 program calculates population dose to demonstrate compliance with NESHAP and for reporting in the Annual Environmental Report. Dose to the public due to accidental releases is calculated using the HARM II puff advection model.

During periods when the onsite meteorological system is inoperable, meteorological data are obtained from the Greater Cincinnati Airport. The onsite meteorology tower was operational approximately 96.5% of 1992.[36] Downtime was primarily due to difficulties with calibration and maintenance of meteorology instruments.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

11.4 Environmental Surveillance

The Environmental Surveillance Program currently collects samples of air, water, soil, foodstuffs, and biota in the area surrounding the FEMP site. This Section describes current environmental surveillance sampling activities conducted at the FEMP. Each environmental medium that is sampled is discussed separately.

11.4.1 Ambient Air Monitoring

The FEMP ambient air quality is monitored by 16 high-volume air samplers as shown in Figure 11-1. These samplers continuously collect samples of airborne particles by drawing air through a 20 cm x 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.

The ambient continuous air samplers are sited at various air monitoring stations (AMS). Sampling locations for environmental surveillance of air emissions are presently based on experience and changes in conditions at the FEMP. Seven stations (AMS 1-7) are located around the periphery fenceline of the FEMP where the public has closest access to the site. Two air stations (AMS 8 and 9) are placed within the fenceline in the northeast corner of the facility due to the direction of the prevailing winds. One air station (AMS 10) is at a nearby community, Fernald. Four air monitoring stations (AMS 11, 12, 13 and 14) are located at local elementary schools near the FEMP. AMS 15 and 16 were installed to accumulate background data; AMS 15 is located near the University of Cincinnati and AMS 16 is located in Miamitown, Ohio.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

Filters on the samplers are changed each week. The filters are weighed before and after use to determine the weight of the collected particulate. At the laboratory, technicians store the filters for at least three days after collection to allow for decay of naturally occurring, short-lived radionuclides. The filters are dissolved in acid and the solutions are then analyzed for uranium content and beta activity. A portion of each solution is retained to provide a long-term 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.

11.4.2 Radon Monitoring

The FEMP monitors radon concentrations by collecting data from two types of devices: active or real-time monitors (devices that continuously sample and quantify radon), and passive alpha track-etch radon detectors. A passive monitoring station may contain two, three, or six track-etch type radon detectors in a weatherproof housing. These detectors are changed quarterly and sent to an offsite vendor for analysis. The real-time continuous monitoring is not used for perimeter fenceline dose calculations but is used to provide data for estimating occupational doses.

There are 21 monitoring locations along the fenceline, 16 radon monitoring stations located immediately adjacent to the K-65 silos, four monitoring locations onsite at various distances from the silos, and nine offsite locations. Onsite radon monitoring locations are shown in Figure 11-2. Offsite radon monitoring locations are shown in Figure 11-3. The locations of the radon sampling points (passive and/or continuous) are as follows.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

11.4.2.1 Passive Samplers

The 21 fenceline locations are made up of passive samplers with five of the passive samplers located at air monitoring stations (AMS 1, 2, 4, 6 and 7). The nine offsite samplers are located so that four of the samplers are at offsite air monitoring stations (AMS 10, 11, 12, 13); three others are positioned outdoors at nearby residences. Two control locations (more than 20 km from the FEMP) are in the two least prevalent wind directions. The K-65 silo area has 16 passive samplers located around the silos' exclusion fence, and eight passive samples located within the fence area around silos 1 and 2. There are four general area passive samplers located within the plant perimeter fence, two of these near AMS 8 and 9.

11.4.2.2 Real-Time Continuous Monitors

There are four real-time monitors located along the K-65 exclusion fence (K-65 NE, SW, NE, SE). Five continuous monitors are located within the Production Area (Admin. Bldg., In Vivo Bldg., Pilot Plant, Plant 2/3, and Plant 5). There are four real-time monitors located within ambient air monitoring stations (AMS 1, 5, 6 and 7) and one located on the Meteorological Tower. The real-time monitors are examined once a week. They are visually inspected for any problems, an efficiency test is performed, and the weekly radon concentration data are retrieved.

11.4.3 Groundwater

The comprehensive groundwater monitoring program collects and analyzes samples to demonstrate compliance with applicable DOE, RCRA, and CERCLA requirements.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

This Section of the Plan describes the groundwater sampling that is part of the routine environmental surveillance program. Special characterization studies as well as RCRA and CERCLA analyses are not included in the description that follows since these activities are not governed by this Plan. Although these sampling activites are not governed by this Plan, routine environmental monitoring activities which are governed by this Plan are subject to applicable EPA QA requirements via the SCQ.

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 is leaving the site. Perimeter groundwater surveillance allows assessment of the impact of FEMP facility operations on the surrounding environment. Groundwater at the site boundary is sampled quarterly at 41 wells which are located at the FEMP site boundary as shown in Figure 11-4. 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 14 background wells that have been established outside the influence of plant operations. Background wells are analyzed for the same parameters as indicator wells for comparison.

In addition to groundwater sampling at the site boundary, drinking water collected from offsite property owner wells is tested routinely. Property owner wells are located in the vicinity of FEMP and are owned by individuals and private companies. The offsite drinking water wells are potential sources of drinking water for nearby residents and are monitored to ensure that drinking water dose limits are not exceeded. Offsite drinking water wells are sampled monthly and analyzed for total uranium. Offsite drinking water well samples are analyzed annually for the following non-radioactive elements: silver, arsenic, barium, calcium, cadmium, chromium, copper, iron, potassium, magnesium, manganese, sodium, nickel, lead, selenium, and zinc.[61]

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

Standard field measurements, pH, specific conductance, and temperature are taken during onsite and offsite drinking water collection.

Currently the site is in the process of obtaining approval from DOE/FN to do a chemical/ radiological pathway analysis to address parameters with respect to the Environmental Surveillance and Effluent Monitoring Programs for the remediation mode.

11.4.4 Direct Radiation

External exposure monitoring is accomplished by an environmental thermoluminescent dosimeter (TLD) located at each of the air sampling stations, with collection quarterly. Pressurized Ionization Chamber measurements are taken quarterly at several locations.

11.4.5 Milk

Milk sampling is performed monthly at an indicator location and a control location. One liter milk samples are collected from the local dairy closest to FEMP, which is the indicator location. A one liter control milk sample is collected monthly from a dairy in Indiana, 23 miles from the FEMP site. Samples are analyzed for total uranium monthly. Annually, 4 liter milk samples are collected instead of 1 liter samples. The 4 liter samples are analyzed for a spectrum of radionuclides including Ra^{226}, Ra^{228}, Tc^{99}, Sr^{90}, Th^{228}, Th^{230}, Th^{232}, U^{234}, U^{235}, U^{236}, U^{238} and Total U.

11.4.6 Produce

Produce is sampled annually at available locations and analyzed for total uranium. A list of approximately 20 indicator and control locations where produce is commonly available is maintained, and locations are selected from the list each year. Produce samples are collected

from approximately 12 indicator locations and 2 control locations. Produce sampling locations are shown in Figure 11-5. To the extent possible, the same varieties of produce collected at the indicator locations are collected at control locations. The size required for produce samples is 500 g. An attempt is made to collect at least the following varieties of produce: cabbage, sweet corn, soy beans, tomatoes, lettuce, beets, green beans, and apples.

11.4.7 Beef

Beef is sampled based on availability. An attempt is made to collect at least one beef sample from the dairy closest to FEMP and one beef sample from a control dairy location in Indiana. Beef samples are analyzed for the following radionuclides: Th^{228}, Th^{230}, Th^{232}, U^{234}, U^{235}, U^{238}, Pu^{238}, Pu^{239} and Pu^{240}. Currently, there are no procedures for collecting beef samples.

11.4.8 Fish

Annual electrofishing is performed between September and October. Sample locations are on the Great Miami River at three established locations as shown in Figure 11-6. One location is upstream from the effluent line and serves as the control location. 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 Paddy's Run which is the historical drainage route from the FEMP facility. 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. Samples are analyzed for total uranium.

11.4.9 Sediment

Sediment sampling is performed annually in the Great Miami River, both above and below the FEMP outfall, at 9 locations.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

In addition, 24 samples are collected in Paddy's 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 11-7 illustrates the current sediment sampling locations. Sediment samples are analyzed as shown in Table 11-2.

Table 11-2. Sediment Sample Analysis Regimen

Sampling Location	Analyses Requested
Great Miami River	Total U
Paddy's Run North	Total U, Ra^{224}, Ra^{226}, Ra^{228}, Th^{228}, Th^{230}, Th^{232}
Paddy's Run South	Total U, Ra^{224}, Ra^{226}, Ra^{228}, Th^{228}, Th^{230}, Th^{232}
Storm Sewer Outfall Ditch	Total U, Th^{228}, Th^{230}, Th^{232}
Control Locations	Total U, Ra^{224}, Ra^{226}, Ra^{228}, Th^{228}, Th^{230}, Th^{232}

11.4.10 Surface Water

Surface water is sampled in the Great Miami River at three locations, one upstream of the discharge and two downstream. Paddy's Run is sampled offsite at three locations, one upstream from the site and two downstream. Paddy's Run also is sampled onsite due to the potential for contaminated runoff into the creek. Surface water sampling locations are illustrated in Figure 11-8. Monthly composites are analyzed for Ra^{226} and Ra^{228}. Semi-annual composites are analyzed for Cs^{137}, Sr^{90} and Tc^{99}.

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

11.4.11 Soil and Grass

Soil sampling is performed annually at 30 locations, some of which are located at the same locations as the air sampling stations (Figure 11-9). Soil samples are taken at two depths (0-5 cm and 5-10 cm), and analyzed for total uranium.

Grass samples are collected at the same sample locations as soil samples. 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.

Figure 11-1. Air Monitoring Locations

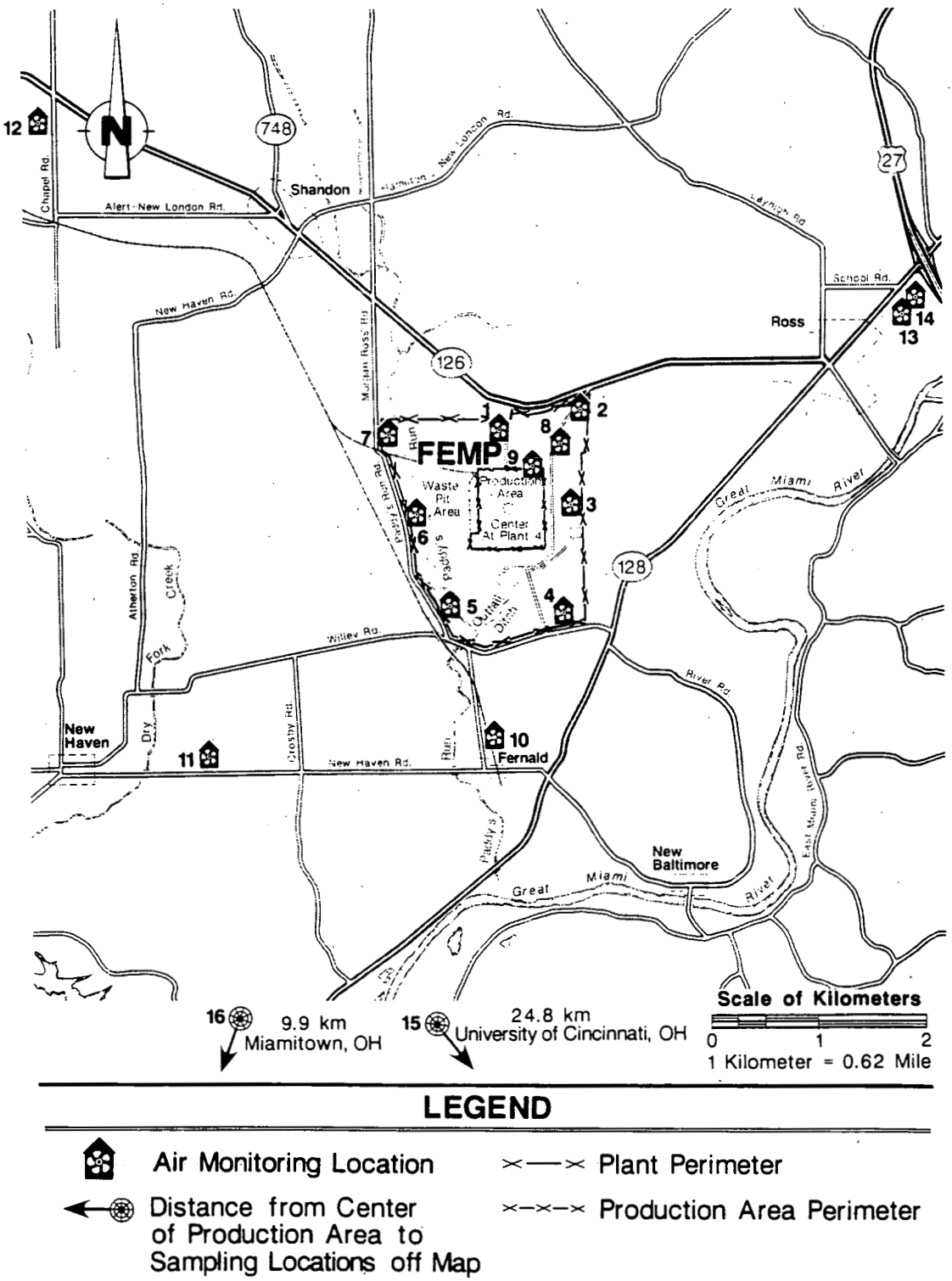
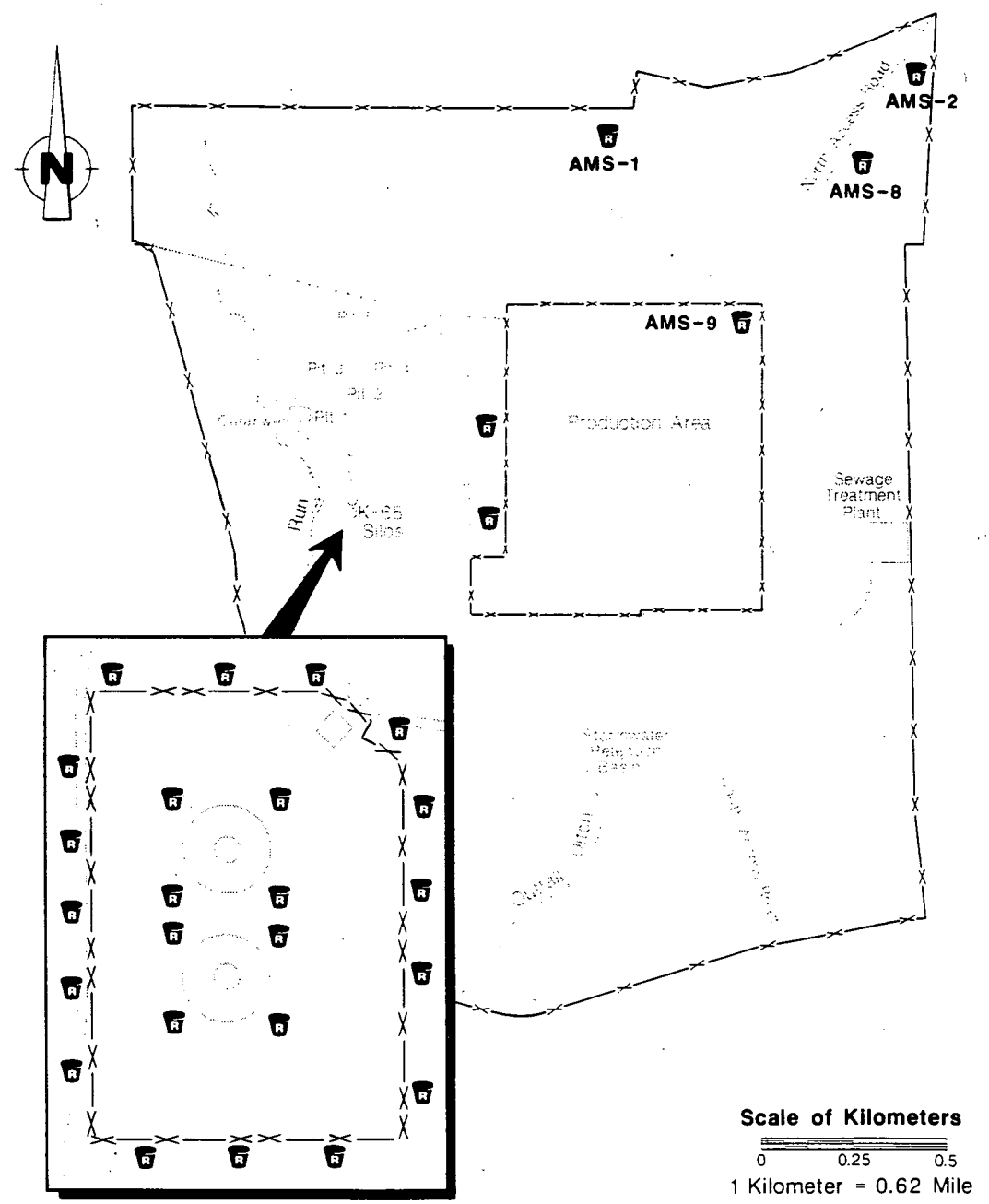


Figure 11-2. Onsite Radon Monitoring Locations



LEGEND

Onsite Locations

Plant Perimeter

K-65 Silos Area Perimeter

Production Area Perimeter

1588

Figure 11-3. Offsite Radon Monitoring Locations

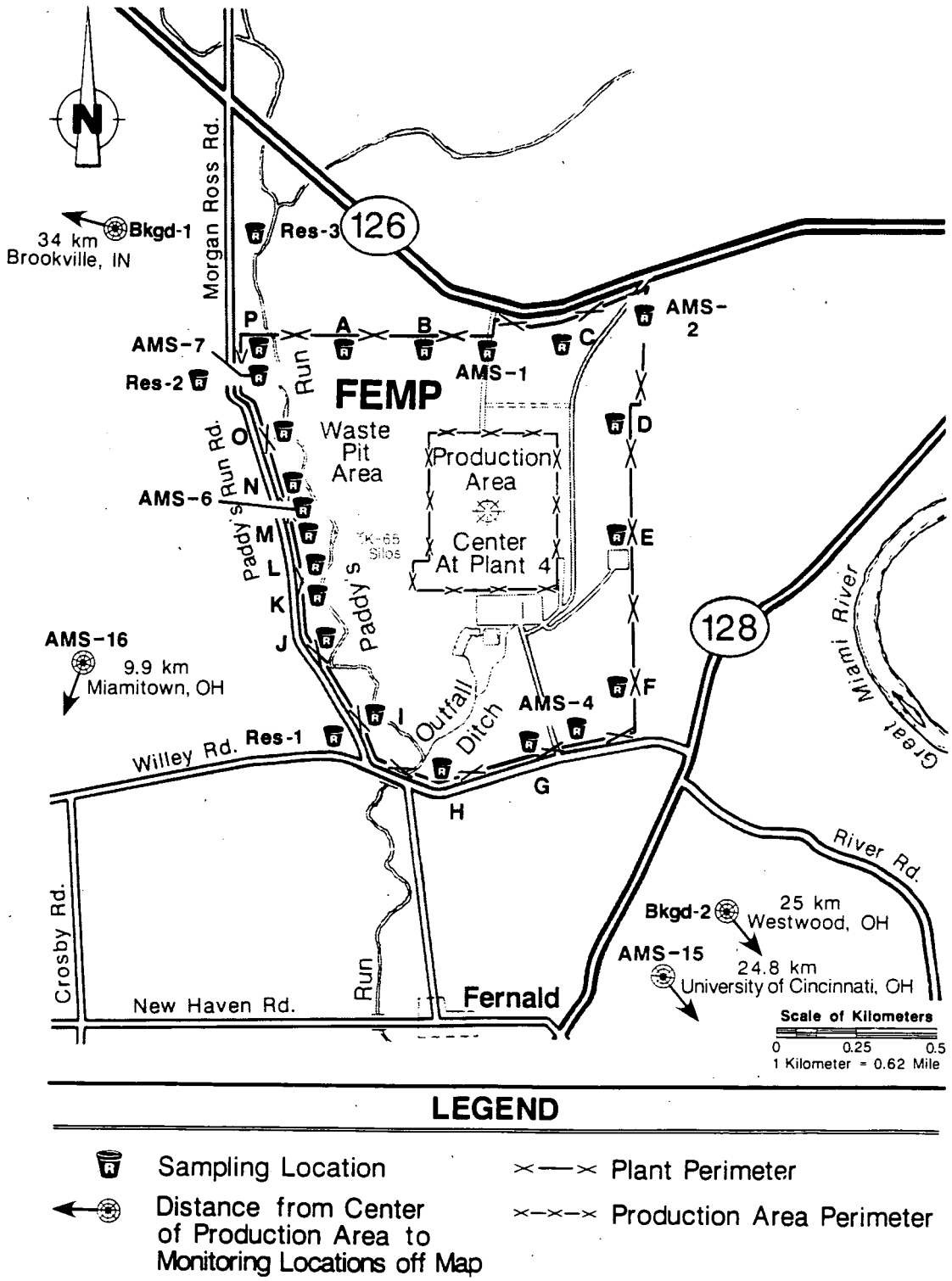


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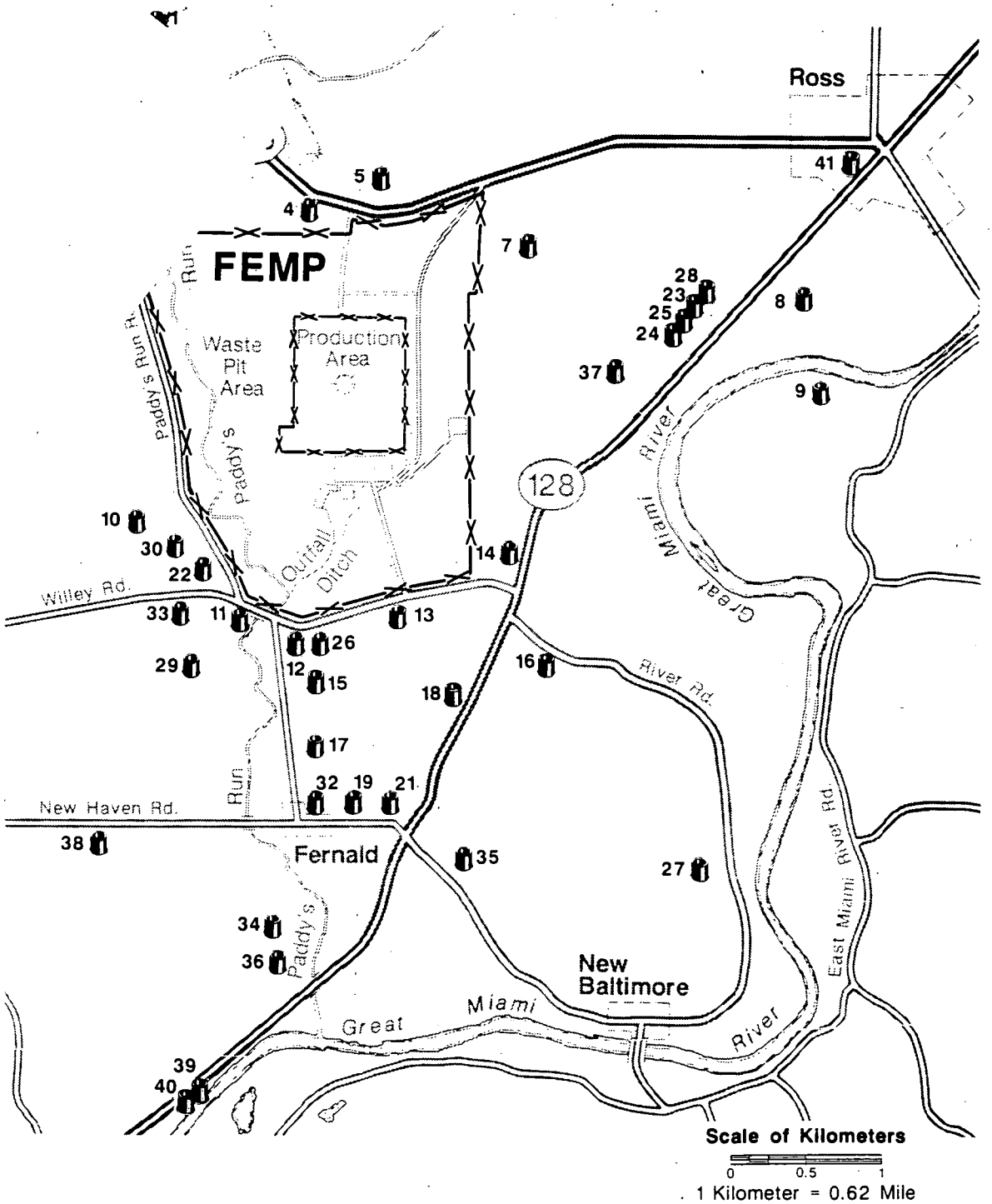
Figure 11-4. Environmental Surveillance Groundwater Monitoring Wells



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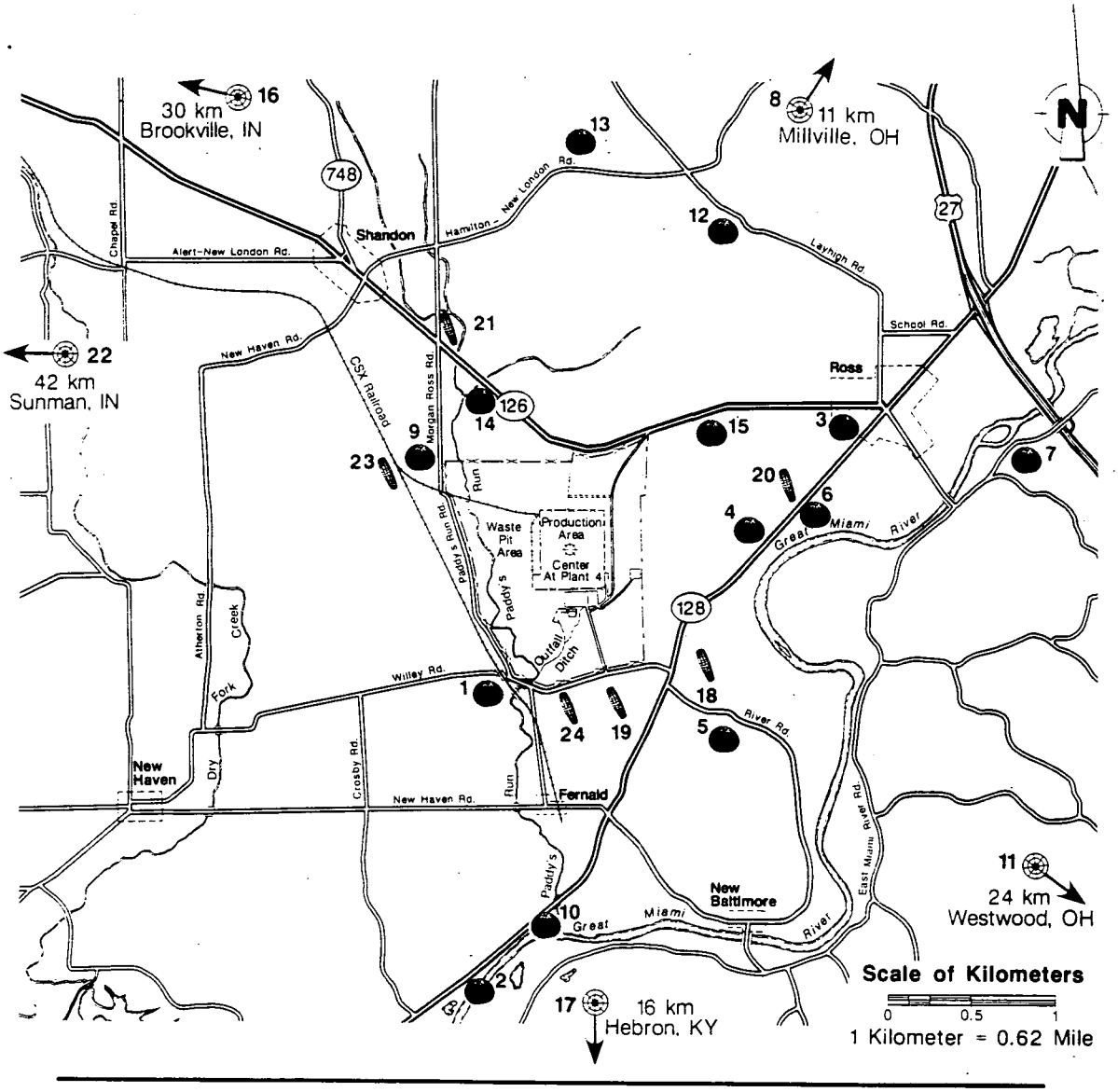
Sampling Location

Plant Perimeter

Production Area Perimeter

1588

Figure 11-5. Produce Sampling Locations



LEGEND

Sampling Locations:
- Cash Crop
- Garden Produce

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

Figure 11-6. Fish Sampling Locations

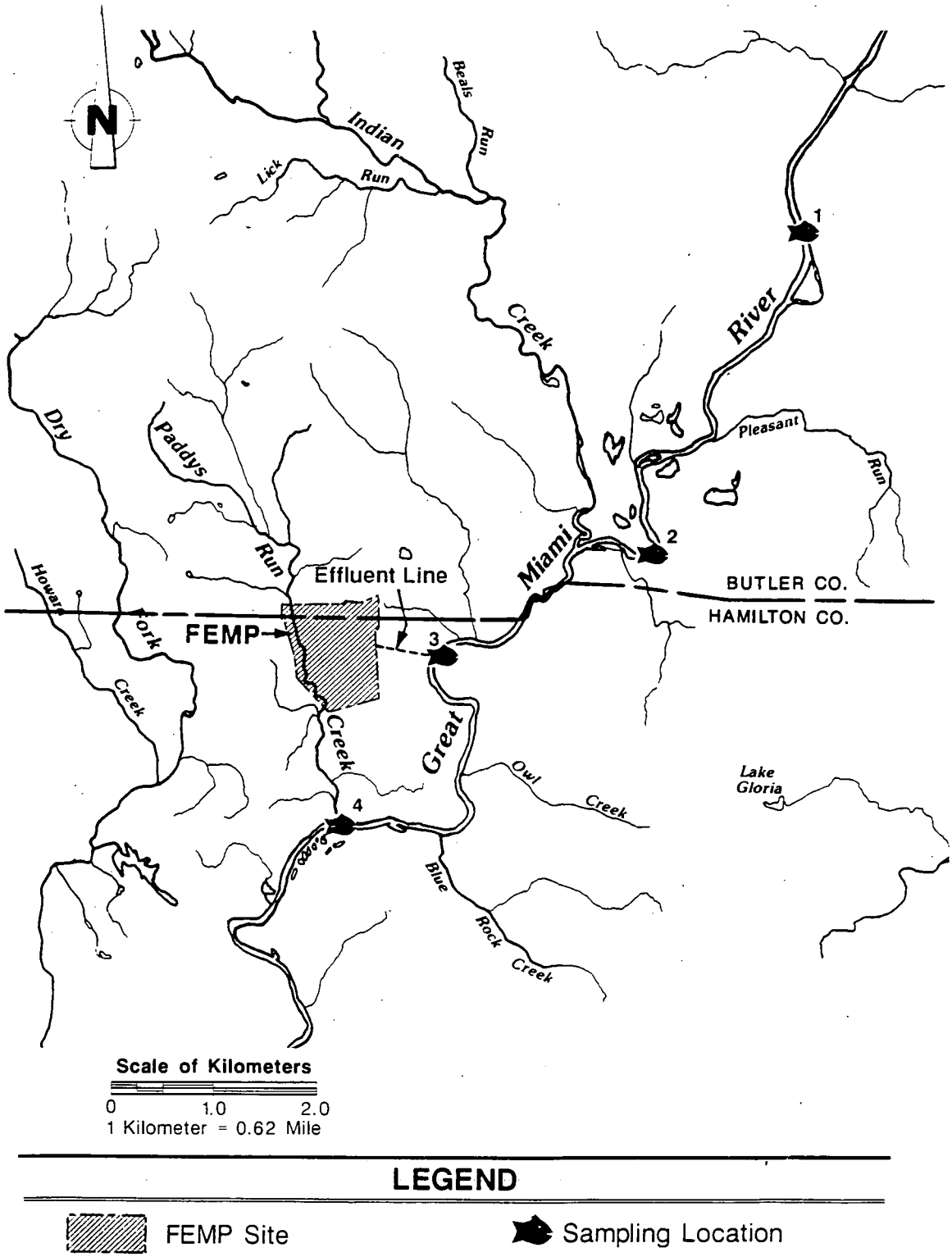


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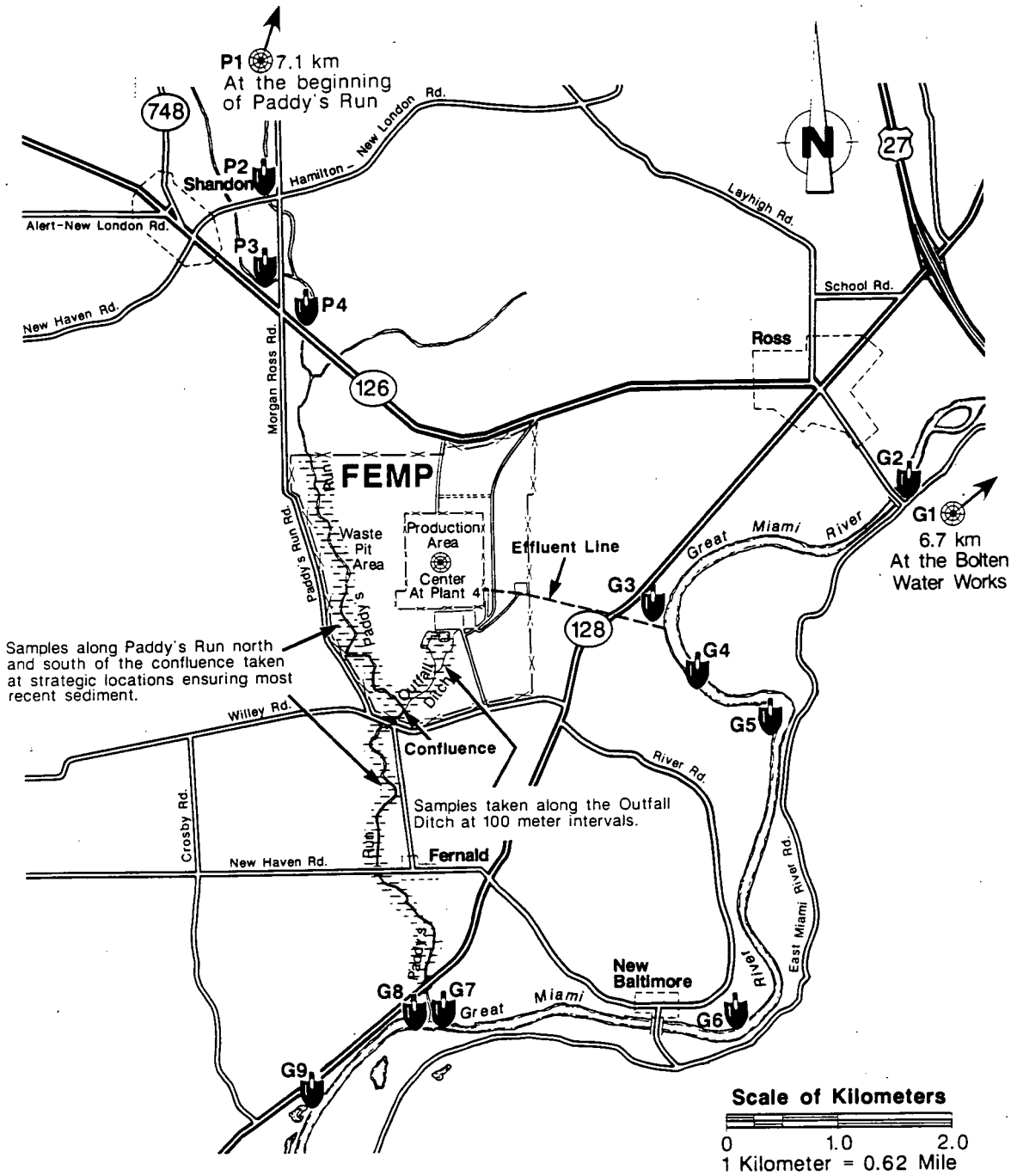
Figure 11-7. Sediment Sampling Locations



LEGEND

Single Sampling Location

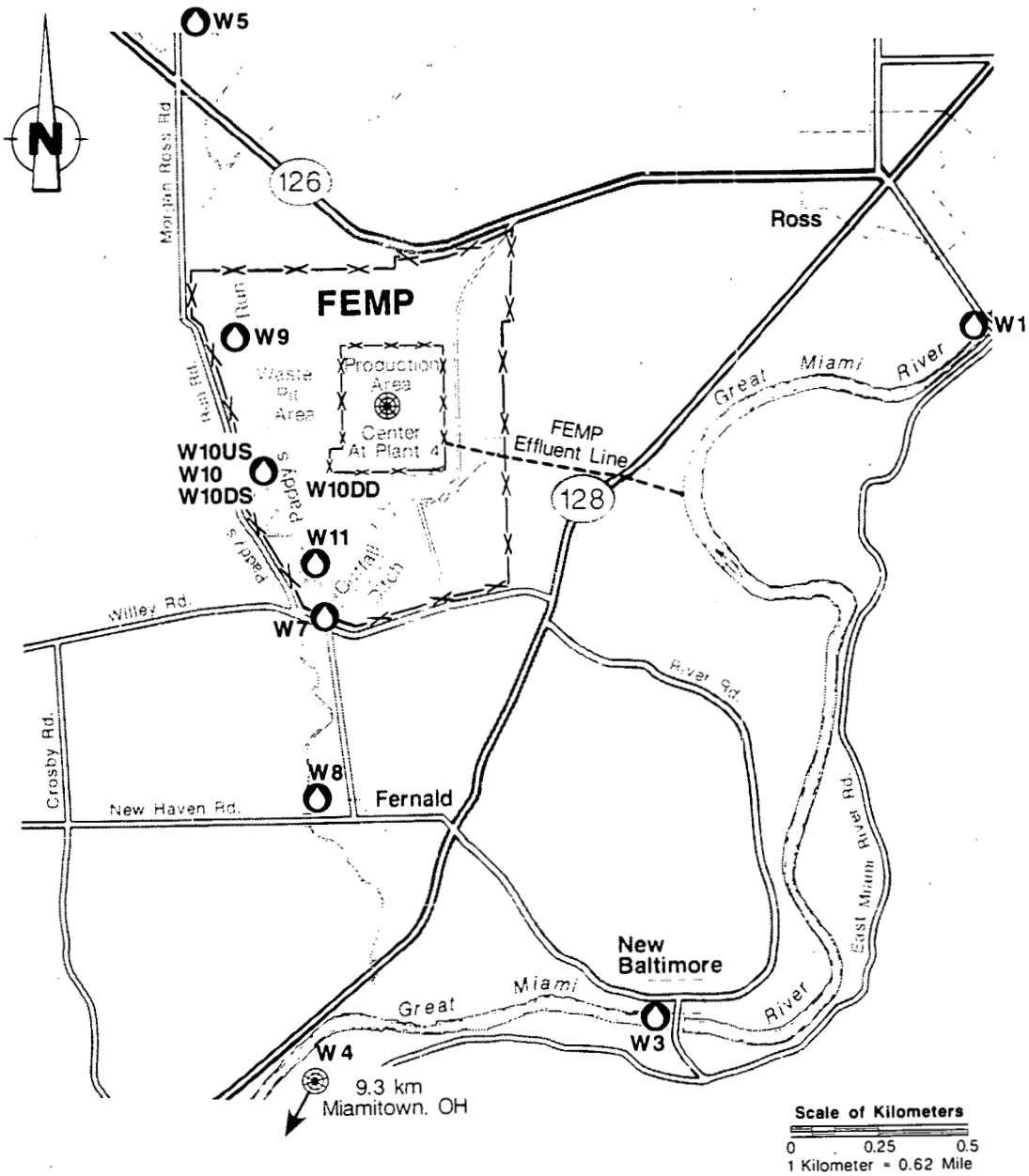
Distance from Center of Production Area to Sampling Locations off Map

Plant Perimeter

Production Area Perimeter

1588

Figure 11-8. Surface Water Sampling Locations

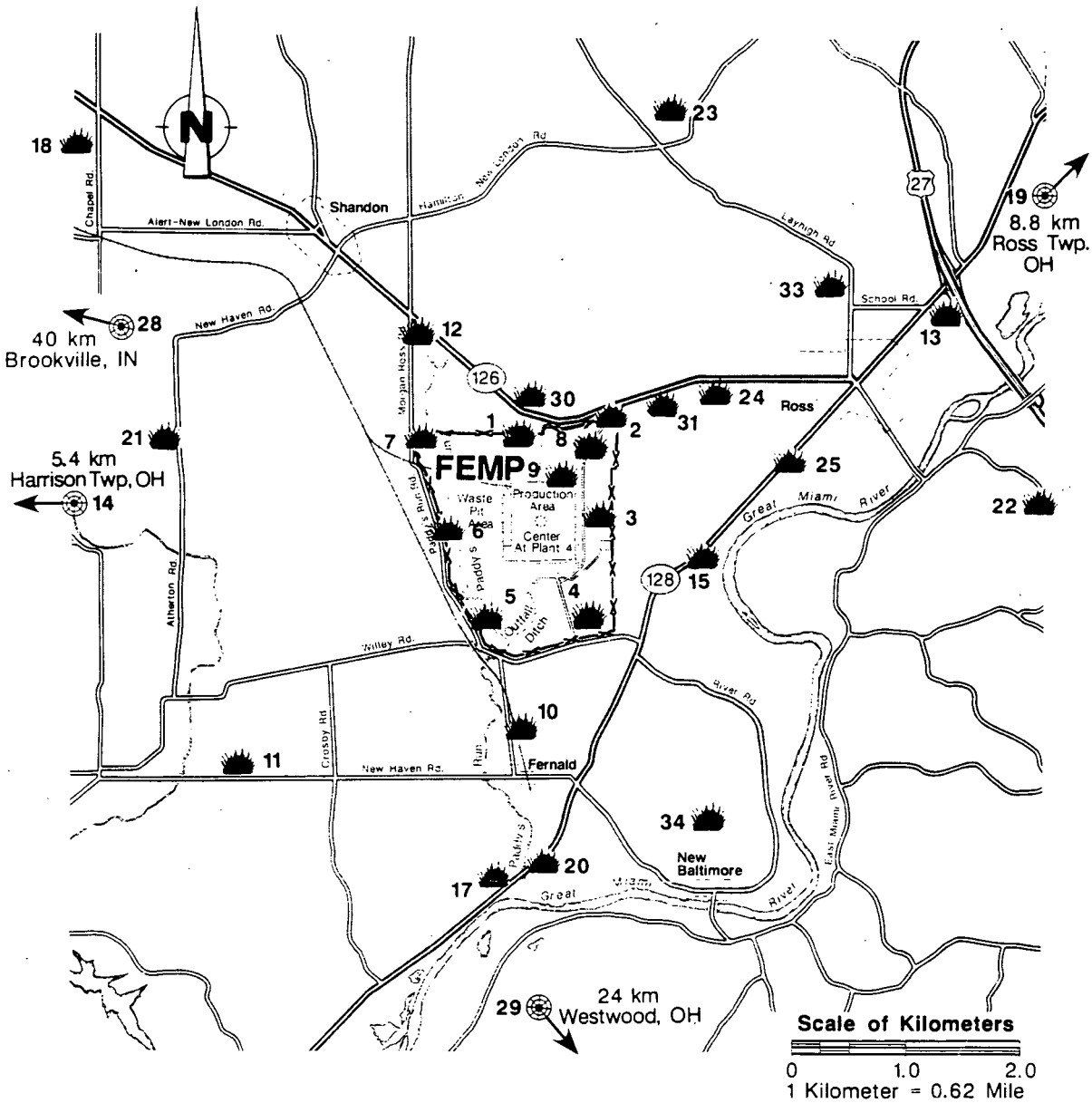


LEGEND

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

1588

Figure 11-9. Soil and Grass Sampling Locations



LEGEND

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

1588

11.0 FEMP ENVIRONMENTAL MONITORING PROGRAM DESCRIPTION (cont.)

11.5 Laboratory Procedures

Routine liquid and airborne effluent monitoring samples and environmental surveillance samples that are collected at FEMP are analyzed either onsite at FEMP or offsite at contract laboratories. Table 11-3 lists applicable laboratory procedures. Table 11-4 lists the routine effluent monitoring and environmental monitoring samples that are collected at FEMP as well as the requested analyses on each sample, the FERMCO analytical procedure or the offsite laboratory contract number, and the FERMCO responsible group or subcontractor.

Table 11-3. Environmental Monitoring Program Implementing 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

Procedure #	Procedure Title
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
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
EM-AD-007	Split Sampling
EM-AD-008	Chain of Custody and Request for Analysis

Procedure #	Procedure Title
EM-AD-009	Performance of Statistical Studies for Routine Environmental Surveillance Data
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
EM-GW-011	Groundwater Exceptions Tracking Procedure
EM-GW-012	Verification Protocols
EM-GW-013	Well Wizard Dedicated Pump Usage
EM-RM-001	FEMP Air Monitoring
EM-RM-002	Logkeeping Procedure
EM-RM-003	Sediment Sampling
EM-RM-004	Reporting Airborne Emissions and Releases
EM-RM-005	Fish Sampling

Procedure #	Procedure Title
EM-RM-006	Produce Sampling
EM-RM-007	Milk Sampling
EM-RM-008	FEMP Well Sampling
EM-RM-009	Surface Water Sampling
EM-RM-010	Environmental Direct Radiation Monitoring
EM-RM-011	Environmental Radon Monitoring
EM-RM-012	Soil and Grass Sampling
EM-RM-013	Calibration, Maintenance, and Inspection of REM Instruments/ Equipment
EM-RM-014	Real-Time Environmental Radon
EM-RM-016	Estimating Radiological Pathway Data
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
FD-1000	SCQ
Analytical Laboratories	
AnL-QAP	Analytical Laboratories QA Plan

Procedure #	Procedure Title
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

Procedure #	Procedure Title
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
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

Procedure #	Procedure Title
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
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

Procedure #	Procedure Title
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
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

Procedure #	Procedure Title
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

Table 11-4. Effluent Monitoring and Environmental Surveillance Sample Analyses

Sample Matrix (Frequency)	Requested Analysis	FERMCO Procedure or Lab Contract No.	Resp. Group/ Subcontractor
Envr. Air (Weekly)	Uranium Gross Beta Particulates	Method 8004 Method 8004 Method 8008	Bioassay Bioassay Bioassay
Envr. Air (Annually)	Full Rad	TBA	Contract Lab
Stack Air (Quarterly)	Uranium Particulates	Method 3002 Method 3003	Inorganic Lab Inorganic Lab
Air Effluent (non-radiological)	Coal: moisture ash BTU sulfur volatile	D3173-73 D3174-82 D2015-77 D3177-575 D3175-77	Quality Lab Quality Lab Quality Lab Quality Lab Quality Lab
Domestic Well (Monthly)	Uranium	Method 8003	Bioassay
Surface Water (Weekly) Rad Analyses	Uranium	Method 8003	Bioassay Lab
Surface Water (Weekly) Non-Rad Analyses	Nitrate-Nitrogen pH	Method 3051 ESH-P-34-001	Inorganic Lab Inorganic Lab
Surface Water (Monthly)	Ra-226, Ra-228	ESH P-34-013	Bioassay Lab
Surface Water (Semi-Annually)	Cs-137 Sr-90 Tc-99	TBA	Contract Lab
Liquid Effluent (Daily)	Uranium Gross Alpha Gross Beta	ESH-P-34-004 Method 8001 Method 8002	Bioassay Bioassay Bioassay

Sample Matrix (Frequency)	Requested Analysis	FERMCO Procedure or Lab Contract No.	Resp. Group/ Subcontractor
Liquid Effluent (Monthly Composite)	Ac-277, K-40, Np-237, Pb-210, Pu-238, Pu-239,240, Th-228, Th-230, Th-232	TBA	Contract Lab
	Ra-226, Ra-228	Method 4002	Isotopic Lab
	Tc-99	Method 4007	Isotopic Lab
	U-234, U-235, U-236, U-238	Method 9048	Isotopic Lab
Liquid Effluent (Quarterly Composite)	Cs-137, Ru-106, Sr-90	TBA	Contract Lab
Liquid Effluent Non-Rad Analyses	Fecal Coliform	Method 43-M-1005	WTP
	pH	Methods 3003, 9013	Inorganic Lab
	Oil and Grease	Method 1001	Inorganic Lab
	TSS	ESH-P-34-014	Inorganic Lab
	Cr+6	Method 1026	Inorganic Lab
	Total Chromium	Methods 1025, 9021, 9032	Inorganic Lab
	Total Copper	Methods 1029, 9032	Inorganic Lab
	Total Nickel	Methods 1028, 9032	Inorganic Lab
	Total Silver	Methods 1055,9032	Inorganic Lab
	Total NH_3-N	Method 3001	Inorganic Lab
	Total NO_3-N	Method 3051	Inorganic Lab
	Total Fluorides	Method 3039	Inorganic Lab
	DO	Method 43-M-1002	WTP
	Residual Chlorine	Method 43-M-1003	WTP
	Cyanide	P.O. 8-9800	NET
	Lead	Methods 1060, 9020, 9032	Inorganic Lab
	BOD	Method 43-M-1000	WTP

Sample Matrix (Frequency)	Requested Analysis	FERMCO Procedure or Lab Contract No.	Resp. Group/ Subcontractor
Groundwater - Surveillance Wells (Quarterly)	Uranium	Method 8003	Bioassay
	pH	P.O. 8-9800	NET
	Metals (Ag, As, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Na, Ni, Pb, Se, Zn)	P.O. 8-9800	NET
	NO_3-N	P.O. 8-9800	NET
	Sulfate	P.O. 8-9800	NET
	Chloride	P.O. 8-9800	NET
	VOC	P.O. 8-9800	NET
	TOC/TOX	P.O. 8-9800	NET
	Alkalinity	P.O. 8-9800	NET
	TDS	P.O. 8-9800	NET
	Spec. Conductivity	P.O. 8-9800	NET
	Carbonate	P.O. 8-9800	NET
	Bi-Carbonate	P.O. 8-9800	NET
Produce (Annually)	Uranium	TBA	Contract Lab
Beef (Annually)	Th-228, Th-230, Th-232, U-234, U-235, U-238, Pu-239, Pu-240	TBA	Contract Lab
Fish (Annually)	Uranium	TBA	Contract Lab
Milk (Monthly)	Uranium	TBA	Contract Lab
Milk (Annually)	Full Rad (Ra-226, Ra-228, Sr-90, Th-228, Th-230, Th-232, U-234, U-235, U-236, U-238, Total U	TBA	Contract Lab
Soil (Annually)	Uranium	TBA	Contract Lab
Grass (Annually)	Uranium	TBA	Contract Lab

Sample Matrix (Frequency)	Requested Analysis	FERMCO Procedure or Lab Contract No.	Resp. Group/ Subcontractor
Grass (Annually)	Total Uranium	TBA	
Sediment (Annually)	Ra-224, Ra-226, Ra-228, Th-228, Th-230, Th-232, Total Uranium	TBA	Contract Lab
Air (radon)	Radon	P.O. 618993	Terradex Labs
Direct Radiation (Quarterly)	TLD	SP-P-32-011, SP-P-32-015, SP-P-32-019	ES & H

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The compliance status is being tracked by the Site Commitment Tracking System.

EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Liquid Effluent Monitoring				
2a, Section 2.0	All liquid effluent streams *should** be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in the Environmental Monitoring Plan.	2.1	*RTP -P&R ES&H - EMC	Complete. In addition, Essential Element 2f relates to this requirement.
2b, Section 2.0	Liquid effluents from DOE controlled facilities that have the potential for radioactive contamination *should** be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	2.1	*ES&H -EMC RSO - Utilities	Complete. SOP-43-C-324, "Sampling FEMP Water Supplies."

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2c, Section 2.1	Facility operators *should** provide monitoring of liquid waste streams adequate to: 1. demonstrate compliance with the requirements of DOE 5400.5, Chapter II, paragraphs 1a, 1d, 2a, and 3, 2. quantify radionuclides released from each discharge point, and 3. alert affected process supervisors of accidents in processes and emission controls.	2.5, 11.1	*RSO - Utilities ES&H - EMC	Complete. SOP-43-C-324, "Sampling FMPC Water Supplies."
2d, Section 2.1	When continuous monitoring or continuous sampling is provided, the overall accuracy of the results *should** be determined (±% accuracy and the % confidence level) and documented in the Environmental Monitoring Plan.	2.6.1.4	*RSO -LSD ES&H -EMC	Complete.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2e, Section 2.1	Provisions for monitoring of liquid effluents during an emergency *should** be considered when determining routine liquid effluent monitoring program needs.	2.5	*RTP -P&R ES&H -EMC	Complete. Present monitoring systems are sufficient to monitoring during accident conditions. Provisions for liquid effluent monitoring during accidents or emergencies are included in the procedures for operation of the FEMP Emergency Operations Center (EOC).
2f, Section 2.2	The selection or modification of a liquid effluent monitoring system *should** be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample collection system(s), treatment system(s), and final release point(s) of the effluents.	2.3, 2.4	*ES&H -EMC RTP	Complete. Current monitoring systems meet or exceed the NPDES permit and Environmental Monitoring Program requirements. As noted in WEMCO:EM:92-300 dated 8/31/92, these requirements have also been included in the SCQ, Appendix K.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2g, Section 2.2	For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a preoperational assessment *should** be made and documented in the Environmental Monitoring Plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.	2.1, 2.1.3.6, 2.3, 2.4	*RTP -P&R ES&H - EMC	Complete. These requirements are satisfied by the process of preparing the NPDES permit application.
2h, Section 2.2	The performance of the effluent monitoring systems *should** be sufficient for determining whether effluent releases of radioactive material are within the Derived Concentration Guides specified in DOE 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that Order.	2.1.3, 2.6	*ES&H -EMC RTP - P&R	Complete, as described in the EMP, Chapter 2. As noted in WEMCO:EM:92-300 dated 8/31/92, these requirements have also have been included in the SCQ, Appendix K.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2i, Section 2.2	The required detection levels of the analysis and monitoring systems *should** be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.	2.6	*RSO -LSD ES&H -EMC	Complete, as described in the EMP, Chapter 2. As noted in WEMCO:EM:92-300 dated 8/31/92, these requirements have also have been included in the SCQ, Appendix K.
2j, Section 2.2.2	Sampling systems *should** be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.	2.5	*ES&H -EMC	Complete.
2k, Section 2.2.3	Continuous monitoring and sampling systems *should** be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.	2.5.1	*RSO Main-tenance	Complete. See FMPC-718, "Measuring and Test Equipment Calibration and Control."
2l, Section 2.2.3	Sampling and monitoring systems *should** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	2.5	*RSO Main-tenance	Complete. See FMPC-718, "Measuring and Test Equipment Calibration and Control."

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2m, Section 2.2.4	Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) *should** be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.	2.5	*ES&H - EMC RSO - Utilities	Sampling systems are adequate to support the operation of the system. As noted in WEMCO:EM:92-300 dated 8/31/92, these requirements have also have been included in the SCQ, Appendix K.
2n, Section 2.2.4	Offline liquid transport lines *should** be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.	2.5	*RSO - Utilities ES&H -EMC	Complete. MMICS now requires automatic sampling tubes to be replaced each month.
2o, Section 2.3.2	If continuous monitoring/ sampling and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances *should** be documented in the Environmental Monitoring Plan.	2.5, 11.1.1	*ES&H -EMC RSO -Utilities	Continuous monitoring and recording of liquid effluent flow is performed at Outfall 4002. No automatic monitoring and recording of flow is performed at Outfall 4002, as explained in Section 11.1.1.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2p, Section 2.3.7	Sampling/monitoring lines and components *should** be designed to be compatible with the chemical and biological nature of the liquid effluent.	2.5, 11.1.1	*ES&H - EMC RSO	The sampling/monitoring lines and components are compatible with the chemical/biological constituents of the FEMP liquid effluent discharge, and satisfy the requirements imposed by the NPDES permit terms and conditions.
2q, Section 2.4	The output signal instrumentation, monitoring system recorders, and alarms *should** be in a location that is continuously occupied by operations or security personnel.	2.5	*RSO -Utilities	This requirement applies presently only to FEMP pH instrumentation. WEMCO:EM:92-023 dated 3/10/92 describes the location of the monitoring alarms at the Water Treatment Control Panel, which is manned by the Water Plant Operator.
2r, Section 2.5	To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems are required, they *should** have alarms set to provide timely warnings.	2.5.1, 11.1.2	*ES&H - EMC	Not applicable at the FEMP. There are not continuous monitors for radionuclides.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
2s, Section 2.6	As they apply to the monitoring/sampling of liquid effluents, the general quality assurance program provisions described in Chapter 10 of this guide *should** be followed.	2.7	*Quality Assurance	Refer to Section 10.6 of the EMP. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Airborne Effluent Monitoring				
3a, Section 3.0	All airborne emissions from each facility (DOE site) *should*[*1] be evaluated and their potential for release of radionuclides assessed. Based on this assessment, decisions *should*[*2] be made regarding necessary effluent monitoring systems and the rationale *should*[*3] be documented in the site Environmental Monitoring Plan. The potential for emissions *should*[*4] include consideration of the loss of emission controls while otherwise operating normally.	3.5, 3.6, 3.6.1, 3.6.2, 3.7.1, 3.7.2, and 3.7.4	*ES&H -EMC *RTP - P&R	Complete. The evaluation criteria are consistent with the requirements of 40 CFR 61 Subpart H (NESHAP). The permitted point sources of air emissions are described in the EMP Section 3.5. The results of the assessment, consistent with NESHAP, are included in the NESHAP annual report.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3b, Section 3.0	Airborne emissions from DOE controlled facilities that have the potential for causing doses exceeding 0.1 mrem (effective dose equivalent) to a member of the public under realistic exposure conditions from emissions in a year *should** be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	3.7.1 and 3.7.2	*RTP - P&R ES&H -EMC	Complete. The FEMP monitors potential releases that may cause a dose to the most exposed member of the public that exceeds 0.1 mrem/year from any point source.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3c, Section 3.1	The criteria for monitoring listed in Chapter 3 of this guide, *should** be used to establish the airborne emission monitoring programs for DOE controlled sites.	3.7.1 and 3.7.2	*ES&H - EMC RTP -P&R	The criteria used in the airborne effluent monitoring program at the FEMP are based on requirements contained in 40 CFR 61 Subpart H and Subpart Q, as well as those included in DOE Order 5400.5.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3d, Section 3.3	For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a preoperational assessment *should** be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.	3.7.1	*RTP - P&R ES&H -EMC	Complete. These requirements have been added to the SCQ, Appendix K. Each new or modified facility is reviewed for compliance with NESHAP and DOE 5400.5 criteria, whether it is to be permitted by the State of Ohio, or is to be submitted for approval as a CERCLA removal or remedial action.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3e, Section 3.3	The performance of the airborne emissions monitoring systems *should** be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE 5400.5.	3.1	*ES&H -EMC RTP P&R	Complete. All monitoring systems satisfy requirements contained in 40 CFR 61 Subpart H, and are consistent with the limits/requirements specified in DOE Order 5400.5.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3f, Section 3.3	Sampling and monitoring systems *should** be calibrated before use and recalibrated anytime they are subject to maintenance or modification that may affect equipment calibration.	3.7.1	*ES&H -EMC RSO	Complete. FMPC-718, "Measuring and Test Equipment and Control," implements this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3g, Section 3.3	Sampling and monitoring systems *should** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	3.7.1	*ES&H - Instrumentation Group	Complete. FMPC-718, "Measuring and Test Equipment and Control," implements this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3h, Section 3.3	Provisions for monitoring of airborne emissions during accident situations *should** be considered when determining routine airborne emission monitoring program needs.	3.7.4	*ES&H -EMC -Emergency Prepared-ness	Complete. Current monitoring systems are sufficient to monitor point source emissions during accident or emergency conditions, as described in Section 3.7.4.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3i, Section 3.3.2	Diffuse sources (i.e., area sources or multiple point sources in a limited area) *should*[*1] be identified and assessed for their potential to contribute to public dose and *should*[*2] be considered in designing the site emissions monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g.,10%) of the dose to members of the public resulting from site operations *should*[*3] be identified, assessed, documented, and verified annually.	3.4.3 and 3.7.2	*RTP ES&H -EMC	Diffuse sources, as well as the resulting emissions and dose are identified in the NESHAP Annual Report.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3j, Section 3.4	Airborne emission sampling and monitoring systems *should** demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.	3.7.1 and 3.8	*ES&H -EMC	Normal practice at the FEMP has been to obtain analysis of filters removed from the stack monitor systems within 24 hours of removal. This is considered timely, especially in light of the fact that the total emissions from all point sources at the site provide a very low level of dose to the most exposed member of the public under the current site operating mode. Because this dose may increase as CERCLA remedial activities grow in scope, a requirement to complete the analysis within a 24-hour period will be added to the RAEQAPjP.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3k, Section 3.5.2	To the extent practicable, samples *should** be extracted from the effluents from a location and in a manner that provides a representative sample using multiport probes if necessary.	3.7.1	*ES&H -EMC	This action is complete. The sampling equipment to be used at any point source discharge for which continuous monitoring is required will satisfy 40 CFR 61 Subpart H requirements.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
31, Section 3.5.8	Where a significant potential (greater than once per year) exists for approaching or exceeding a large fraction of the emission standard (e.g., 20%), continuous monitoring *should** be required.	3.7.1	*RTP -P&R ES&H -EMC	Complete. The FEMP meets the requirements of 40 CFR 61 Subpart H.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3m, Section 3.5.8.3	The design of radioiodine monitors will be such that replacement of sorbent and filter *should** not disturb the geometry between the collector and detectors.	3.7.1	*ES&H -EMC	Not applicable to the FEMP, since no materials are present at this site that offer the potential for release of radioiodine.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3n, Section 3.6	To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in Chapter 3) are required, they *should** have alarms set to provide timely warnings.	3.7.1	*ES&H -EMC	The RAEQAPjP will be revised to document current FEMP practices. Implementing procedures will be developed, as necessary.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead Participant	FEMP/Compliance Implementation Status and Supporting Documentation
3o, Section 3.7	As they apply to the monitoring of airborne emissions, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.	3.10	*QA	See Section 10.6 of the EMP.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Meteorological Monitoring				
4a, Section 4.0	Each DOE site *should** establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distance to critical receptors.	4.3 and 4.5	ES&H -EMS	**Action Required:** Program development and implementation plan required by November, 1992. Complete.
4b, Section 4.0	The scope of the program *should** be based on an evaluation of the regulatory requirements, the meteorological data needed for impact assessments, environmental surveillance activities, and emergency response, considering the mathematical procedures, models, and input data requirements necessary for computing atmospheric transport and diffusion computations and performing dose assessments.	4.4	ES&H -EMS	**Action Required:** The current program is required to provide meteorological data for site impact assessments, emergency response, and other needs. A formal evaluation to document compliance with regulatory requirements will be conducted by 11/30/92. Address data validation with respect to "input" data requirements for models and codes used. Develop procedures, as necessary. Complete.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4c, Section 4.0	The program *should** be documented in a meteorological monitoring section of the Environmental Monitoring Plan in compliance with DOE 5400.1.	4.0	*ES&H -EMS	**Action Required:** Continue procedural development. Complete. Close-out letter WEMCO:EM:92-436, dated November 25, 1992 states EM-RM-20, "Meteorological Tower Maintenance," and EM-RM-021,"Meteorological Computer and Data Management" fulfills this requirement.
4d, Section 4.0	For data from an offsite source to be acceptable, the data *should** be representative of conditions at the DOE facility and provide statistically valid data consistent with onsite monitoring requirements.	4.5.4	ES&H -EMS	**Action Required:** Determine whether or not data from offsite source is representative of site conditions. Evaluation must be documented. Procedures must be developed, as necessary. Complete. Close-out letter WEMCO:92:394, dated October 30, 1992 states documentation was provided to document that the Cincinnati Airport data is representative.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4e, Section 4.0	Specific meteorological information requirements for each facility *should** be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of the site to other DOE facilities.	4.3	ES&H -EMS	Complete. EM Plan, Section 4.3.
4f, Section 4.0	Meteorological information requirements for facilities *should** be sufficient to support environmental monitoring and surveillance programs.	4.5	ES&H -EMS	Complete. EMP sets forth requirements based on needs for meteorological data.
4g, Section 4.1.2	The meteorological monitoring program for each DOE site *should** provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.	4.4	ES&H -EMS	Complete. Procedure EM-RM-021 on Meteorology Program computer and data management fulfill this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4h, Section 4.1.2	Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based *should** be evaluated and the evaluation results documented.	4.4	ES&H -EMS	**Action Required:** Provide a written evaluation of any assumptions used for modelling. Complete. Close-out letter WEMCO:92-432, dated November 25, 1992 states that the general assumptions and acceptance criteria for models that use meteorological data onsite for regulatory compliance, emergency response, and dose estimation were provided.
4i, Section 4.1.2	Meteorological programs for sites where onsite meteorological measurements are not required *should** include a description of climatology in the vicinity of the site and *should** provide ready access to representative meteorological data.	N/A	N/A	Applies only if no onsite program is specified.
4j, Section 4.1.3	Potential release modes, distances from release points to receptors, and meteorological conditions *should** be considered in assessments for DOE facilities required to take onsite measurements.	4.4.1 and 4.4.2	ES&H -EMS	Complete. EMP provides documentation.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4k, Section 4.4	Meteorological measurements *should** be made in locations that, to the extent practicable, provide data representative of the atmospheric conditions into which material will be released and transported.	4.5.1	ES&H -EMS	Trees near existing meteorology tower may affect the 10-meter instruments, limiting the representativeness of the measurements (Memo: WMCO: Site-Wide Compliance: 91-335). Final decision pending. **Action Required:** Provide reference to any additional supporting documentation and final disposition. Complete. Close-out letter WEMCO:EM:92-433, dated November 25, 1992 states that this has been evaluated. Three alternatives to address this problem were given. DOE/FN has not reached a decision.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
41, Section 4.4	The instruments used in the monitoring program *should** be capable of continuous operation in the normal range of atmospheric conditions at the facility.	4.5.2	ES&H -EMS	Meteorological data recovery exceeded 90% during 1988, 1989, and to date in 1991. Two months of data were lost during 1990. A recommendation has been made to erect a second meteorological tower. A second tower would reduce the likelihood of data loss (Finding RWME-90-11-16-B; Memo: WMCO:Site-Wide Compliance:91-335). **Action Required:** Pending DOE resolution. Provide reference to any additional supporting documentation and final disposition. Complete. Close-out letter WEMCO:EM:92-433, dated November 25, 1992 states that this has been evaluated. Three alternatives to address this problem were given. DOE/FN has not

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4m, Section 4.4.1	Wind measurements *should** be made at a sufficient number of altitudes to adequately characterize the wind at potential release heights.	4.5.1	ES&H -EMS	**Action Required:** Provide auditable documentation regarding meteorological tower setup. Complete. Close-out letter WEMCO:92:EM:92-374 provides this information.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4n, Section 4.4.2	If instruments are mounted on booms extending to the side of a tower, the booms *should** be oriented in directions that minimize the potential effects of the tower on the measurements. The instruments *should** be at least two tower diameters from the tower, but should be three to four tower diameters from the tower.	4.5.2	ES&H -EMS	All instruments mounted in this fashion are more than two diameters from the tower. **Action Required:** Provide auditable documentation regarding meteorological tower setup. Complete. Close-out letter WEMCO:92:EM:92-374 provides this information.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4o, Section 4.6	The meteorological monitoring program *should** provide for routine inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system at a minimum, based on the calibration frequency recommendations of the manufacturers.	4.5.2 and 4.6	ES&H -EMS RSO -Facility Engineering and Mainten-ance	Data is inspected on a daily basis by the site meteorologist. Calibration is done on a semi-annual basis, scheduled automatically by the MMICS system. The calibrations are performed according to the manufacturer's calibration manuals. Data inspections, etc., will be documented in Site-Wide Compliance department procedure. **Action Required:** Continue procedure development. Complete. Close-out letter WEMCO:EM:92-436, dated November 25, 1992 states EM-RM-20, "Meteorological Tower Maintenance," and EM-RM-021,"Meteorological Computer and Data Management" fulfills this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4p, Section 4.6	Inspections, maintenance, and calibrations *should** be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations *should** be kept and maintained as permanent records.	4.6	ES&H -EMS RSO -Facility Engineering and Mainten-ance	**Action Required:** Develop procedure(s) to implement the requirements. Complete. Close-out letter WEMCO:EM:92-436, dated November 25, 1992 states EM-RM-20, "Meteorological Tower Maintenance," and EM-RM-021,"Meteorological Computer and Data Management" fulfills this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4q, Section 4.6	The instrument system *should** provide data recovery of at least 90% on an annual basis for wind direction, wind speed, those parameters necessary to classify atmospheric stability, and other meteorological elements required for dose assessment.	4.5.2	ES&H -EMS	Meteorological data recovery exceeded 90% during 1988, 1989, and to date in 1991. Two months of data were lost during 1990. A recommendation has been made to erect a second meteorological tower. A second tower would reduce the likelihood of data loss (Finding RWME-90-11-16-B; Memo: WMCO:Site-Wide Compliance:91-335). Final decision pending. EM-RM-020 and EM-RM-021 provide the means to ensure that the 90% rate is exceeded. The implementation of the Meteorology Program includes inventory of back-up equipment.
4r, Section 4.7	The topographic setting of a facility and the distances from the facility to points of public access *should** be considered when evaluating the need for supplementary instrumentation.	4.3.3	ES&H -EMS	Complete. The EMP provides an assessment of topographic assumptions and lists assumptions.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4s, Section 4.7	If meteorological measurements at a single location cannot adequately represent atmospheric conditions for transport and diffusion computations, supplementary measurements *should** be made.	4.3	ES&H -EMS	Complete. EMP specifies justification as to why supplemental measurements are not necessary. However, essential element 4l and 4q relate to this requirement.
4t, Section 4.8	A site-wide meteorological monitoring program *should** be established at each multi-facility site to provide a comprehensive data base that can be used for all facilities located within the site.	N/A	N/A	Applies only to multi-facility sites.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
4u, Section 4.11	As they apply to meteorological monitoring, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.	4.6	*QA **Total Quality is Everyone's Responsi-bility	See Section 10.6 of the EMP. EM Plan defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Environmental Surveillance				
5a, Section 5.0	An evaluation *should** be conducted and used as the basis for establishing an environmental surveillance program for all DOE controlled sites. The purpose of the surveillance program is to characterize the radiological conditions of the offsite environs and, if appropriate, estimate public doses related to these conditions, confirm predictions of public doses based on effluent monitoring data, and, where appropriate, to provide compliance data for all applicable regulations. The results of this evaluation *should** be documented in the site Environmental Monitoring Plan.	5.2	ES&H -EMS	Complete. The EM Plan provides the basis for the surveillance program and describes the activities required to characterize the site and estimate dose to the public, where applicable.
5b, Section 5.0	The environmental surveillance program for DOE-controlled sites *should** be conducted in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	5.0	ES&H -EMS	Implementation of Orders in progress. Section 5 of this matrix represents current compliance status. Refer to EM Plan, Chapter 11 and Table 11-3 for list of current implementing procedures.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5c, Section 5.1	The criteria for environmental surveillance programs listed in Chapter 5 *should** be used for establishing the environmental surveillance program for DOE controlled sites. Additional site-specific criteria *should** be documented in the site Environmental Monitoring Plan.	5.2.1, 5.3, 5.3.1, 5.5, 5.5.2, 5.6.8, and 5.6.9	ES&H -EMS	Complete. The EMP sets forth the criteria.
5d, Section 5.1.1	The need for environmental sampling and analysis *should** be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne). This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations *should** be documented in the site Environmental Monitoring Plan.	5.2	ES&H -EMS RTP	Complete. Data, references, and site-specific criteria for the selection of samples, instruments and sampling locations are documented in the EM Plan.
5e, Section 5.1.1	A critical pathway analysis (radionuclide/media) should* be performed, documented, and referenced in the Annual Site Environmental Report.	5.2	ES&H -EMS	Complete. Critical pathway analysis information can be found in the ASER.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5f, Section 5.1.1	If the projected dose equivalent from inhalation of particulates exceeds the criteria of Chapter 5, particle-size analysis of the emission *should** be conducted at least annually.	3.7.2	ES&H -EMC RTP EP	Complete. Dose does not exceed the criteria of Chapter 5 of the guide, therefore, a particle size study is not needed.
5g, Section 5.1.2	Further provisions *should** be made, as appropriate, for the detection and quantification of unplanned releases to the environment of radioactive materials, including radionuclides that may be transported by stormwater runoff, flooding, or resuspension of ground-deposited material.	5.3.3	*Emergency Operations ES&H	The site addresses this requirement; however, a formalized procedure should be developed. **Action Required:** Continue development of applicable procedures.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5h, Section 5.2	For all new or modified facilities coming on-line, a preoperational assessment *should** be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.	5.7	*Construction RSO RTP ES&H	**Action Required:** EM will develop a procedure on identifying changes that affect the Environmental Monitoring Program. It shall be due by November 92. Also, 2g and 3f relate to this essential element. Complete. Close-out letter WEMCO:92:EM-391, dated November 2, 1992 states that SSOP-076, "Reviewing the Environmental Monitoring Program," was written to address controlling changes to the Environmental Monitoring Program.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5i, Section 5.2	Calibration of dosimeters and exposure rate instruments *should** be based on traceability to NIST standards.	5.5.6	ES&H	Onsite dosimetry laboratory is DOELAP and NAVLAP certified. **Action Required:** Provide supporting documentation or reference. Complete. Close-out letter WEMCO:IRS&T:92-221, dated August 26, 1992 states thats NAVLAP accreditation for dosimetry is not required by DOE and has not been sought at the FEMP. A copy of the "Feed Material Production Center DOELAP Certification of Accreditation" was attached to the close-out letter.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5j, Section 5.2	Gross radioactivity analyses *should** be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.	5.5.6	ES&H -EMS -GWM	Gross analyses are still reported at FEMP. **Action Required:** Evaluate necessity for gross analysis. Update existing procedure to reflect EMP gross analyses request / rationale. This commitment, EMP:92:0048, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-402, dated November 2, 1992 states that an evaluation of the use and necessity of gross radioactivity analysis within the Radiological Environmental Monitoring Program (REM) was performed and that the REM is in compliance with this guidance.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5k, Section 5.2	The overall accuracy (±% accuracy) *should** be estimated, and the approximate Environmental Detection Limit at a specified % confidence level for environmental measurements of beta-gammas, alphas, and neutrons, as appropriate, *should** be determined and documented.	5.5.6	*ES&H RSO -LSD	**Action Required:** Ensure that this requirement is reflected in the appropriate implementing procedures. This commitment, EMP:92:0049, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-419, dated November 6, 1992 states an evaluation of the accuracy and confidence levels of environmental measurements was performed by Radiological Environmental Monitoring (REM) Program.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
51, Section 5.2	Sample preservation methods *should** be consistent with the analytical procedures used.	5.5.4	*ES&H -EMS -GMW RSO -Utilities Services	**Action Required:** Examine the use of preservatives with regard to routine surface water environmental surveillance samples. This commitment, EMP:92:0050, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-409, dated November 3, 1992 states that documentation was submitted that verifies that the preservation methods currently employed by the Utilities Department for surface water samples comply.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5m, Section 5.2	All environmental surveillance techniques *should** be designed to take a representative sample or measurement of the important radiation exposure pathway media.	5.5.3	ES&H -EMS -GWM	**Action Required:** Evaluate sampling technique with respect to representativeness of sample or measurement. This commitment, EMP:92:0051, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-410, dated November 3, 1992, states that documentation was submitted that verifies that sampling techniques currently utilized by the Environmental Monitoring Program are representative of the media being sampled.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5n, Section 5.2.1	Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem EDE from emissions in a year) *should** take into account the half-life of the radionuclides to be measured and *should** be documented in the site Environmental Monitoring Plan.	5.5.2	ES&H -EMS	Complete. Sampling frequencies take into account the half-life of the radionuclide measured. EM Plan provides documentation.
5o, Section 5.2.1	"Background" or "control" location measurements *should** be made for every significant radionuclide and pathway combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem EDE from emissions in a year) for which environmental measurements are used in the dose calculations.	5.5	ES&H -EMS -GWM	**Action Required:** Provide rationale for control station criteria. This commitment, EMP:92:0052, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-393, dated October 30, 1992 states that documentation was submitted that verifies the control locations used at the FEMP in the Environmental Monitoring Program comply with these DOE guidance criteria.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5p, Section 5.2.1	An annual review of the radionuclide composition of effluents or emissions *should** be made and compared with those used to establish the site Environmental Monitoring Plan. Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, *should** be documented in an approved revised site Environmental Monitoring Plan.	5.7	ES&H -EMS RTP	**Action Required:** Develop annual review guidelines or procedure and schedule. It shall be due by November 30, 1992. Complete. Close-out letter WEMCO:EM:92-435, dated November 25, 1992 provided a copy of EM-RM-019, "Comparison of Reported Annual Releases to Determine the Applicability to the Environmental Surveillance Program."

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX

Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5q, Section 5.2.2	The air sampling rate *should** not vary by more than ±20%, and total air flow or total running time *should** be indicated; air sampling systems *should** be leak-tested, flow-calibrated, tested, and inspected on a routine basis at a minimum, using the calibration frequency recommendations of the equipment manufacturers.	5.6.1	ES&H -EMS -Instrument Section	**Action Required:** Investigate and incorporate this requirement into an existing procedure or develop a new procedure. This commitment, EMP:92:0055, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-392 states that an approved procedure, EM-RM-013, "Calibration, Maintenance, and Inspection of REM Instruments/Equipment" was written.
5r, Section 5.2.3	State and local game officials *should** be consulted when selecting appropriate protected species to sample.	5.6.6	ES&H	There is a question as to whether or not there are currently endangered species at the FEMP. Futher investigation is necessary.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5s, Section 5.2.4	DOE Operations Office and contractor staff *should** ensure that groundwater monitoring plans are consistent with State and regional EPA groundwater monitoring requirements under RCRA and CERCLA to avoid unnecessary duplication. DOE Operations Offices and contractor staff *should** consult with State and regional EPA offices, as needed, to ensure that the requirements are incorporated into the Radiological Monitoring Plan.	5.6.2	*ES&H -GWM	Groundwater Implementation Plan states FEMP groundwater monitoring requirements. Avoidance of all duplication is not possible due to DOE/EPA agreements. **Action Required:** Review Groundwater Implementation Plan and ensure that it fulfills the EMP requirements. Develop implementing procedures as necessary. Update the Plan as necessary. Ensure that the Plan is consistent with State and regional EPA groundwater requirements under CERCLA and RCRA. These commitments, EMP:92:0056 and EMP:92:0057, were extended to November 6, 1992 per WEMCO:EM:92-306. Complete as of 12/92 -"The FEMP Comprehensive Groundwater Monitoring Program."

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5t, Section 5.3.2	Any changes in the site-specific or generic factors *should** be noted in the Environmental Monitoring Plan and the retired or replaced values preserved for historical purposes.	5.7	ES&H -EMS -EMC -GWM EP RTP RSO	**Action Required:** Develop procedure. This commitment, EMP:92:0058, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:92:EM-391, dated November 2, 1992 states that SSOP-076, "Reviewing the Environmental Monitoring Program," was written to address controlling changes to the Environmental Monitoring Program.
5u, Section 5.6.2	When neutron monitoring is required, the method of measurement *should** be based on the anticipated flux and energy spectrum.	5.6.3	N/A	Complete. Not necessary at FEMP.
5v, Section 5.7.5	The sample exchange frequency for non-particulate sampling should be determined on a site-specific basis and *should** be documented in the environmental surveillance files.	5.6.1	ES&H	Complete. Sample exchange frequencies are documented in the Environmental Monitoring Procedures.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
5w, Section 5.8.2.1	The analytical procedure to be used *should** be considered when choosing a method for preserving milk samples.	5.6.4	ES&H	Complete. Preservatives are not currently required. 5l, above, is related to this essential element, and its outcome may affect this requirement.
5x, Section 5.13	As they apply to environmental surveillance activities, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.	5.7	QA	See Section 10.6 of the EMP. EM Plan defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Laboratory Procedures				
6a, Section 6.0	Laboratory procedures and practices *should** be documented in the site Environmental Monitoring Plan.	6.0 and Table 11-3	RSO - LSD	**Action Required:** Refer to EM Plan Table 11-3 for existing procedures. All required procedures will be developed, as noted in this matrix. Close-out letter WEMCO:AN:92-0059, dated August 31, 1992 states that the procedures cited in Table 11-3 of the draft were in place on August 31, 1991.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6b, Section 6.1.1	Each monitoring and surveillance organization *should** have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process. The system *should** incorporate a method for tracking all pertinent information obtained in the sampling process.	6.2, 6.2.1, and 6.3.1	RSO -LSD	**Action Required:** Each existing analytical method addresses this requirement. Refer to Table 11-3 in EMP for existing procedures. All required procedures will be developed, as noted in this matrix. Close-out letter WEMCO:AN:92-0553, dated September 1, 1992 states that the procedures cited in the EMP table were in place on 8/31/91.
6c, Section 6.1.2	Each laboratory *should** establish and adhere to written procedures to minimize the possibility of cross-contamination between samples. High-activity samples *should** be kept separate from low-activity samples.	6.3.1, and 6.3.2	RSO -LSD	Complete. Cross-contamination prevention is addressed in the format and QA section of all analytical procedures. AnL-01-0035, "Using ANALIS," also addresses this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6d, Section 6.1.2	The integrity of samples *should** be maintained (i.e., minimize degradation of samples by using proper preservation and handling practices that are compatible with analytical methods).	6.3, 6.3.1, 6.3.2, and 6.3.4	RSO -LSD	**Action Required:** Procedure(s) describing the ultimate disposition of samples will be developed. The draft QAPjP also addresses this requirement. Close-out letter WEMCO:AN:92-0569, dated August 31, 1992 states that Procedure 20-C-810, "Disposition of Sample Residues," covers the intent of this EMP requirement.
6e, Section 6.1.3	Specific analytical methods *should** be identified, documented, and used to identify and quantify all radionuclides in the facility inventory or effluent that contribute 10% or more to the public dose or environmental contamination associated with the site.	6.4.1 and 6.5.2	RSO -LSD	Complete. This is addressed in the scope and QC sections of each analytical method. Analyst qualifications are addressed in AnL-01-0054, "Training and Qualifications of Analysts within the WMCO Analytical Laboratories."

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6f, Section 6.1.3	Standard analytical methods *should** be used for radionuclide analyses (when available). Any modification of standard methods *should** be documented.	6.4.1 and 6.5.2	RSO -LSD	Complete. Analytical laboratory procedures are based on standard analytical procedures. New methods and procedures will also address this requirement.
6g, Section 6.1.3	Methods, requirements, and necessary documentation *should** be specified in analytical contracts.	6.9	RSO -LSD	**Action Required:** Develop procedure to address this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6h, Section 6.1.4	All sites that release or could release gamma-emitting radionuclides *should** have the capability (either in-house or outside) of having samples (routine, special, or emergency) analyzed by gamma-ray spectroscopy systems.	6.5.2	RSO -LSD	Onsite capability for evaluation of gamma-emitting nuclides exists currently. **Action Required:** Reference or develop implementing procedure(s). Close-out letter WEMCO:AN:92-0554, dated August 31, 1992 states that Procedure AnL 9120, "Calibration and Operation of a Computer Controlled Spectrometry System," for operation of the newly acquired germanium detector is in review and that the procedure will fulfill the intent of this commitment.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6i, Section 6.1.5	Counting equipment *should** be calibrated using, at a minimum, the calibration frequency recommendations of the manufacturers to obtain accurate results.	6.5.1	RSO -LSD	**Action Required:** Reference or develop implementing procedure(s). Close-out letter WEMCO:AN:92-0555, dated August 31, 1992 states that Procedure AnL-45-0060 has been issued. This procedure covers the instrument performance checks. Calibration procedures are contained in the individual instrument procedures. Calibrations are recorded in instrument logbooks, which are per INPO standards.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6j, Section 6.1.5	Check sources *should** be counted periodically on all counters to verify that the counters are giving correct results.	6.8.2	*RSO -LSD Data Owners	**Action Required:** Reference or develop implementing procedure(s). Close-out letter WEMCO:AN:92-0556, dated August 31, 1992 states that Method 9095, "Calibration of Alpha and Beta Check Sources," fulfills the commitment. The procedure specifies use of sources to check counting instruments.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6k, Section 6.2.2	Samples that are sent offsite for analysis or for laboratory intercomparison *should** be monitored for contamination and radiation levels and *should** be packaged in a manner that meets applicable transportation regulations and requirements.	6.3.1, and 6.3.3	RSO	**Action Required:** Reference or develop implementing procedure(s). Close-out letter WEMCO:EM:92-308, dated August 28, 1992 states that SOP 20-C-810, "Disposition of Sample Residues," has been developed to handle the disposition of sample residues generated at the onsite laboratories and offsite contract laboratories. SOP Method 4013, "Radiometric Screening Method For Determining Total Radioactivity in Various Matrices," is the currently approved procedure used to perform the required monitoring of samples that are shipped to offsite contract laboratories.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
6l, Section 6.13	As they apply to laboratory procedures, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.	6.8	QA **Total Quality is Everyone's Responsi-bility	See Section 10.6 of the EMP. EM Plan defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Data Analysis and Statistical Treatment				
7a, Section 7.0	The statistical techniques used to support the concentration estimates, to determine their corresponding measures of reliability, and to compare radionuclide data between sampling and/or measurement points and times *should** be designed with consideration of the characteristics of effluent and environmental data.	7.4	*ES&H -EMS -EMC RTP	This element is being addressed via the SCQ. **Action Required:** Further development needed. Close-out letter: WEMCO:EM:92-304 dated August 31, 1992 states that EM-AD-009, "Performance of Statistical Studies on Routine Environmental Surveillance Data" EQP-16.01, "EC/QASP - Annual Radioactive Effluent Discharge Report," and EQP-16.02, "EC/QASP -National Pollutant Discharge Elimination System" fulfills this requirement.
7b, Section 7.0	Documented and approved sampling, sample handling, analysis, and data management techniques *should** be used to reduce the variability of results.	7.2	*RSO	**Action Required:** Implementation of the EM Plan in progress.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
7c, Section 7.1	The level of confidence in the data due to the radiological analyses *should** be estimated by analyzing blanks and spiked pseudo samples and by comparing the resulting concentration estimates to the known concentrations in those samples.	7.7	*RSO	**Action Required:** Develop procedures for analyzing QC samples for all instrumentation. Close-out letter WEMCO:AN:92-0549, dated August 31, 1992 states that each analytical method has the required QC included in a separate section. In addition, AnL-10-0034 specifies the preparation and delivery of samples by the QC Subsection.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
7d, Section 7.1	The precision of radionuclide analytical results *should** be reported as a range, a variance, a standard deviation, a standard error, and/or a confidence interval.	7.5.3	*RSO -QC	**Action Required:** Ensure this requirement is incorporated in each analytical method. Closeout letter WEMCO:An:92-0551, dated August 31, 1992 states that the present Laboratory Information System (LIMS) does not have the capacity to report ranges for results. However, WEMCO has had a consultant develop the formulae to the software development personnel to provide ranges for all results. If required, ranges can be provided to customers on a request basis until FACTS is up and running.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
7e, Section 7.1	Data *should** be examined and entered into the data base promptly after analysis.	7.3.1	*RSO	**Action Required:** Develop procedure(s) for data entry. Close-out letter WEMCO:EM:92-307, dated August 28, 1992 states that the commitment has been complete in conjunction with the approval of the Sitewide CERCLA Quality Assurance Project Plan (SCQ). The Data Management Section of the SCQ describes the procedures for data entry.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
7f, Section 7.1	Outliers *should** be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. As each data point is collected, it *should** be compared to previous data, because such comparison can help identify unusual measurements that require investigation or further statistical evaluation.	7.4.4 and 7.4.5	*RSO	**Action Required:** Develop procedures for data validation, approval, and rejection. Close-out letter WEMCO:EM:92-307, dated August 28, 1992 states that the commitment has been complete in conjunction with the approval of the Sitewide CERCLA Quality Assurance Project Plan (SCQ). The Data Validation Section of the SCQ describes the procedures for validating, approving, and rejecting environmental sample analysis results. Currently two major database efforts are currently underway: the development of the Fernald Analytical Computerized Tracking System (FAST) and the RI/FS database (Flow Gemini to Oracle) conversion.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX

Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
7g, Section 7.7	As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.	7.7	*QA **Total Quality is Everyone's Responsi-bility	See Section 10.6 of the EMP. EM Plan defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
Dose Calculations				
8a, Section 8.1.1	Except where mandated otherwise (e.g., compliance with 40 CFR Part 61), the assessment models selected for all environmental dose assessments *should** appropriately characterize the physical and environmental situation encountered. The information used in dose assessments *should** be as accurate and realistic as possible.	8.2.1	*ES&H RTP	Dose calculations are performed at present. **Action Required:** Develop implementing procedure(s). This commitment, EMP:92:0073, was extended to November 6, 1992 per WEMCO:EM:92-306. Complete. Close-out letter WEMCO:EM:92-390, dated November 5, 1992 states a procedure was written (EM-RM-016, "Estimating Radiological Pathway Dose," that fulfills this requirement.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
8b, Section 8.1.1	Complete documentation of models, input data, and computer programs *should** be provided in a manner that supports the annual site environmental report or other application.	8.6	*ES&H RTP	Dose calculations are performed at present. **Action Required:** Develop implementing procedure. Close-out letter WEMCO:EC&QA:92-346, dated August 12, 1992 states that DOE/HQ Memorandum: Raymond F. Pelletier to Distribution, "Field Offices' Calendar Year 1991 Radionuclide Air Emissions Annual Reports for DOE Sites," dated March 12, 1992 outlines specific guidelines for the format and content of the annual report required to demonstrate compliance with the NESHAP standard. Included in the guidance, as well as in the actual NESHAP regulations, are specific guidelines for documentation of input of data, calculation methods, and models employed to develop the reported dose estimate.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
8c, Section 8.1.2	Default values used in model applications *should** be documented and evaluated to determine appropriateness to the specific modeling situation.	8.2, 8.2.2.3, 8.3, and 8.6	*RTP ES&H	Dose calculations are performed at present. **Action Required:** Develop implementing procedure. Close-out letter WEMCO:EC&QA:92-346, dated August 12, 1992 states that DOE/HQ Memorandum: Raymond F. Pelletier to Distribution, "Field Offices' Calendar Year 1991 Radionuclide Air Emissions Annual Reports for DOE Sites," dated March 12, 1992 outlines specific guidelines for the format and content of the annual report required to demonstrate compliance with the NESHAP standard. Included in the guidance, as well as in the actual NESHAP regulations, are specific guidelines for documentation of input of data, calculation methods, and models employed to develop the reported dose estimate.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
8c, Section 8.1.2 (continued)	Default values used in model applications *should** be documented and evaluated to determine appropriateness to the specific modeling situation.	8.2, 8.2.2.3, 8.3, and 8.6	*RTP ES&H	Close-out letter WEMCO:EM:92-300, dated August 31, 1992, states that implementation can occur more properly by incorporating applicable criteria and monitoring requirements within the Sitewide CERCLA Quality Assurance Project Plan (SCQ). The EMP criteria/requirements were placed verbatim in Appendix K of the SCQ to fulfill the action.
8d, Section 8.1.2	When performing human foodchain assessments, a complete set of human exposure pathways *should** be considered, consistent with current methods, and *should** be documented supporting the site Environmental Monitoring Plan.	8.2.1	ES&H	Complete. EM Plan Section 5.1 addresses this requirement.
8e, Section 8.1.2	Surface and groundwater modeling *should** be conducted as necessary to conform with the applicable requirements of the state government and the regional office of the EPA.	8.2.3	ES&H	Complete. Groundwater program currently meets these requirements.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
8f, Section 8.7	The general quality assurance program provisions of Chapter 10 of this guide *should** be followed as they apply to performing calculations that assess dose impacts.	8.6	*QA **Total Quality is Everyone's Responsi-bility	See Section 10.6 of the EMP. EM Plan defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.
Records and Reports				
9a, Section 9.0	DOE officials and DOE Management and Operating Contractors *should** identify and comply with the relevant reporting requirements.	9.2	DOE FERMCO RTP SIA	Complete. EM Plan Table 9-1, describes the applicable reporting requirements.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
9b, Section 9.0	Timely notification of occurrences and information involving DOE and its contractors *should** be made to the appropriate DOE officials and to other responsible authorities.	9.2	DOE FERMCO RTP SIA	See comment above.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
9c, Section 9.0	Auditable records relating to environmental surveillance and effluent monitoring *should** be maintained. Calculations, computer programs, or other data handling *should** be recorded or referenced.	9.1	PCC ES&H RSO RTP	Maintain data as required by FMPC-609. **Action Required:** *Reference supporting documentation and schedule for development of ORACLE and other data handling systems. Develop implementing procedures, as necessary. **Currently archiving hard-copy documents. Review FMPC-609 to ensure that EMP requirements are met. Update procedure(s), as necessary. Close-out letter WEMCO:EM:92-307, dated August 28, 1992 states that the commitment has been complete in conjunction with the approval of the Sitewide CERCLA Quality Assurance Project Plan (SCQ). The Data Validation Section of the SCQ describes the procedures for validating,

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
9c, Section 9.0 (continued)	Auditable records relating to environmental surveillance and effluent monitoring *should** be maintained. Calculations, computer programs, or other data handling *should** be recorded or referenced.	9.1	PCC ES&H RSO RTP	environmental samples analysis results. Currently two major database efforts are currently underway: the development of the Fernald Analytical Computerized Tracking System (FACTS) and the RI/FS database (Flow Gemini to Oracle) conversion. The schedule is attached to the close-out letter. Close-out letter WEMCO:C:92-131, dated August 27, 1992 states that FMPC 609 was reviewed and updated to ensure that EMP requirements were being met.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
9d, Section 9.3	As they apply to records and reporting activities, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.	9.3	QA **Total Quality is Everyone's Responsi-bility	See Section 10.6 of the EMP. EM Plan defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.
Quality Assurance				
10a, Section 10.0	A QA Plan *should** be prepared and included as a section of the Environmental Monitoring Plan and *should** cover the monitoring activities at each site, consistent with applicable elements of the 18-element format in ANSI/ASME NQA-1.	10.1 and 10.2	QA	Complete. See the FEMP QAPD, Section 10 of the EMP, and the SCQ.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
10b, Section 10.1.2	Periodic audits *should** be performed to verify compliance with operational procedures, QC procedures, and all aspects of the QA program.	10.2 and 10.3.9	QA SIA	Complete. See FEMP QAPD, Section 10 of the EMP, and the SCQ.
10c, Section 10.1.2	Audits *should** be performed independently in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited (i.e., supervisors cannot audit their own facilities).	10.2 and 10.3.10	QA SIA	Complete. See FEMP QAPD, Section 10 of the EMP, and the SCQ.
10d, Section 10.1.2	Audit results *should** be documented and reported to and reviewed by responsible management. Follow-up action *should** be taken where indicated.	10.2 and 10.3.9	QA SIA	Complete. See FEMP QAPD, Section 10 of the EMP, and the SCQ.

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EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAM ESSENTIAL ELEMENTS MATRIX				
Reg Guide DOE/EH-0173T Ref #	*Should** Essential Elements	EM Plan Section	*Lead / Participant	FEMP/Compliance Implementation Status and Supporting Documentation
10e, Section 10.1.3	The elements of a QA program *should** be derived from the 18 criteria in ANSI/ASME NQA-1 and those stipulated in 10 CFR Part 5O.	10.1, and 10.2	QA SIA	Complete. See FEMP QAPD, Section 10 of the EMP, and the SCQ.
10f, Section 10.3.2	Radiation measuring equipment, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, *should** be calibrated with standards traceable to NIST calibration standards.	10.3.8	*Users ES&H RSO	Complete. See Section 10.6 of the EMP. The EMP defines Environmental Monitoring QA activities. QA/QC requirements are addressed in each implementing sampling and monitoring procedure.

NOTE: The "Reg Guide" is the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, Jan. 1991, DOE/EH-0173T.

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ABBREVIATIONS

ADM = Administration
DOELAP = Department of Energy Laboratory Accreditation Program
EMC = Effluent Monitoring and Control
EMS = Environmental Monitoring and Surveillance
EOC = Emergency Operations Center
EP = Environmental Programs Division
ES&H = Environmental Safety & Health
GWM = Groundwater Monitoring
LSD = Laboratory Service Department
NAVLAP = National Voluntary Laboratory Accreditation Program
ORACLE = Product name of relational data-base software
PCC = Projection Configuration and Control Division
PCN = Procedure Change Notice
P&R = Permitting and Reporting Department
QA = Quality Assurance
QC = Quality Control
RAEQAPjP = Radionuclide Air Emissions Quality Assurance Project Plan
RSO = Remediation Support Operations Division
RTP = Regulatory and Technology Programs Division
SIA = Systems Integration and Assessments

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ATTACHMENT B

Table B-1. Referenced Data Quality Objectives (DQO)

DQO Number	DQO Title
AR-001	Site Perimeter Radon Sampling
AR-003	Radiological Air Sampling of Stacks
AR-004	Real Time Radon Monitoring - Onsite
AR-006	Routine Radiological Air Monitoring
BL-001	Fish Sampling - Routine Surveillance
BL-002	Grass Sampling - Routine Surveillance
BL-003	Milk Sampling - Routine Surveillance
BL-004	Meat Sampling - Routine Surveillance
BL-005	Produce Sampling - Routine Surveillance
GW-003	Long Term Groundwater Monitoring
GW-006	Sampling at Residences Serviced by Private Groundwater Supply Wells - Metals
GW-007	Sampling at Residences Serviced by Private Groundwater Supply Wells - Radiological
GW-008	Special Request Sampling of Local Property Owner Water Sources
MS-004	Environmental Radiation Dose Measurements
SD-001	Routine Sediment Sampling
SL-003	Soil Sampling - Routine Surveillance
SW-001	Routine Surface Water Sampling of Paddy's Run and the Great Miami River
WS-004	Sampling of Flyash from Active Deposits and Boiler Plant Waste Stream
WW-001	Storm Retention/Emergency Spill Containment Basin (SWRB) Sampling
WW-002	NPDES Compliance Sampling

Note the DQOs are numbered by media sampled. The following are the abbreviations for the media types:

AR - Air
BL - Biological
GW - Groundwater
MS - Miscellaneous
SD - Sediment
SL - Soil
SW - Surface Water
WS - Waste
WW - Wastewater