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VOLUME I

Fernald Environmental Management Project

SITEWIDE
CERCLA QUALITY ASSURANCE PROJECT PLAN

Sections 1 through 16

Prepared by

Westinghouse Environmental Management Company of Ohio

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NOTICE TO SCQ REVIEWERS

- THE DOCUMENT IS CONTAINED IN FIVE VOLUMES
  - VOLUME I GLOSSARY AND SECTIONS 1 through 16
  - VOLUME II APPENDICES A through K
  - VOLUMES III, IV, AND V THE FEMP LABORATORY ANALYTICAL METHODS MANUAL
- A LIST OF THE ANALYTICAL METHODS IN IN VOLUMES III, IV, AND V IS PROVIDED IN table 9-1, APPENDIX A.

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

U.S. DEPARTMENT OF ENERGY
FERNALD OFFICE

SITEWIDE
CERCLA QUALITY ASSURANCE PROJECT PLAN

APPROVALS:

U.S. DEPARTMENT OF ENERGY MANAGER, FERNALD OFFICE	Date
U.S. DEPARTMENT OF ENERGY REMEDIAL PROJECT MANAGER	Date
U.S. ENVIRONMENTAL PROTECTION AGENCY REGION V REMEDIAL PROJECT MANAGER	Date
U.S. ENVIRONMENTAL PROTECTION AGENCY REGION V REGIONAL QUALITY ASSURANCE MANAGER	Date

Prepared by

Westinghouse Environmental Management Company of Ohio

4 March 1992

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ATTACHMENT I
FEMP LABORATORY ANALYTICAL METHODS MANUAL

VOLUME III
METHODS FOR ORGANIC COMPOUNDS, RCRA CHARACTERISTICS, AND METALS

Method	Method No.
General Laboratory Requirements	FM-GEN-0010
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry	FM-ORG-0010
Aromatic Volatile Organic Compounds by Gas Chromatography/Photoionization Detection	FM-ORG-0020
Chlorinated Pesticides/PCBs by Gas Chromatography	FM-ORG-0030
Organophosphorus Pesticides by Gas Chromatography	FM-ORG-0040
Volatile Organic Compounds by Gas Chromatography Purge and Trap	FM-ORG-0050
Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry	FM-ORG-0060
Herbicides	FM-ORG-0070
Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry-Drinking Water	FM-ORG-0100
Toxicity Characteristic Leaching Procedure	FM-MISC-0010
Corrosivity	FM-MISC-0020
Ignitability	FM-MISC-0030
Reactivity	FM-MISC-0040
Metals by Graphite Furnace Atomic Absorption	FM-INO-0010
Metals by Atomic Absorption Spectrometry, Flame Technique	FM-INO-0020
Metals Analysis by Inductively Coupled Plasma	FM-INO-0030
Mercury Analysis by Cold Vapor (Atomic Absorption Spectrometry)	FM-INO-0040

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ATTACHMENT I
FEMP LABORATORY ANALYTICAL METHODS MANUAL
(cont.)

VOLUME IV
METHODS FOR CONVENTIONAL PARAMETERS

Method	Method No.
Cyanide (Total) Titrimetric	FM-CON-0010
Cyanide (Total) Spectrophotometric, Semiautomatic	FM-CON-0015
Soil pH	FM-CON-0020
Nitrogen, Nitrate/Nitrite (Colorimetric, Automated, Cadmium Reduction)	FM-CON-0030
Nitrogen, Nitrate/Nitrite (Spectrophotometric, Cadmium Reduction)	FM-CON-0040
Conductivity	FM-CON-0050
Total Kjeldahl Nitrogen	FM-CON-0060
Total Organic Carbon	FM-CON-0080
Alkalinity (Titrimetric)	FM-CON-0090
Alkalinity (Colorimetric)	FM-CON-0100
pH (Electrometric)	FM-CON-0110
Chloride (Colorimetric, Automated Ferricyanide)	FM-CON-0120
Sulfide	FM-CON-0130
Ammonia	FM-CON-0140
Hexavalent Chromium (Cr^{6+})	FM-CON-0150
Temperature	FM-CON-0160
Chloride (Titrimetric,Mercuric Nitrate)	FM-CON-0170
Oil and Grease (Infrared)	FM-CON-0175
Oil and Grease (Gravimetric Only)	FM-CON-0180
Percent Solids (Moisture)	FM-CON-0190
Total Petroleum Hydrocarbons Infrared	FM-CON-0200
Total Dissolved Solids	FM-CON-0210
Phosphorus Analysis Single Reagent Method	FM-CON-0220
Surfactants (MBAS)	FM-CON-0250

VOLUME IV (cont.)

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Method	Method No.
Phenolics, Total Recoverable (colorimetric, Automated 4-AAP with Distillation)	FM-CON-0260
Phenolics, Total Recoverable (Spectrophotometric Manual 4-AAP with Distillation)	FM-CON-0270
Sulfate (Colorimetric, Automated, Methylthymol Blue)	FM-CON-0280
Sulfate (Turbidimetric)	FM-CON-0290
Fluoride	FM-CON-0300
Total Organic Halides	FM-CON-0320
Color	FM-CON-0330
Oxidation-Reduction Potential	FM-CON-0340

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ATTACHMENT I
FEMP LABORATORY ANALYTICAL METHODS MANUAL
(cont.)

VOLUME V
METHODS FOR RADIOMETRIC AND GEOTECHNICAL PARAMETERS

Method	Method No.
Isotopic Plutonium in Water by Alpha Spectrometry	FM-RAD-0010
Radium-228 in Water and Air Filters by Beta Counting	FM-RAD-0040
Radium-226 in Water by Emanation/Scintillation Counting	FM-RAD-0050
Radium-226 in Soil/Sediment, Milk, and Air Filters by Emanation/Scintillation Counting	FM-RAD-0060
Lead-210 in Water by Beta Counting	FM-RAD-0070
Isotopic Thorium in Milk, Vegetation, Soil/Sediment, Water and Air Filters by Alpha Spectrometry	FM-RAD-0080
Isotopic Uranium in Vegetation, Milk, Water and by Air Filters by Alpha Spectrometry	FM-RAD-0100
Isotopic Uranium in Soil/Sediment by Alpha Spectrometry	FM-RAD-0110
Uranium in Water, Soil/Sediment, and Air Filters by Pulsed-Laser Phosphorimetry	FM-RAD-0120
Gross Alpha and Gross Beta Radioactivity in Water and Gross Beta Radioactivity in Air Filters by Proportional Counting	FM-RAD-0130
Radioanalysis of Soil/Sediment, Air Filters, Milk and Water by Gamma Spectrometry	FM-RAD-0140
Soil Classification (Lab)	FM-GTT-0011
Soil Classification (Visual)	FM-GTT-0012
Transporting Samples	FM-GTT-0013
Wet Preparation of Samples	FM-GTT-0014
Dry Preparation of Samples	FM-GTT-0015
Moisture Content	FM-GTT-0021
Moisture Content (Microwave)	FM-GTT-0022
Moisture Correction (Oversize)	FM-GTT-0023
Specific Gravity	FM-GTT-0024

VOLUME V (cont.)

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Method	Method No.
Volume-Weight Relationships	FM-GTT-0025
Grain Size Analysis	FM-GTT-0031
Atterberg Limits	FM-GTT-0032
Shrinkage Limit	FM-GTT-0033
Standard Proctor	FM-GTT-0041
Modified Proctor	FM-GTT-0042
Maximum (Relative) Density	FM-GTT-0043
Minimum (Relative) Density	FM-GTT-0044
Consolidation	FM-GTT-0051
Unconfined Compression	FM-GTT-0061
Direct Shear (Controlled-Displacement Method)	FM-GTT-0062
Direct Shear (Controlled-Stress Method)	FM-GTT-0063
Triaxial Compression (UU)	FM-GTT-0064
Triaxial Compression (CU)	FM-GTT-0065
California Bearing Ratio	FM-GTT-0066
Permeability (Constant Head)	FM-GTT-0071
Permeability (Triaxial)	FM-GTT-0072
Btu Content (Solids)	FM-GTT-0082
Ash Content	FM-GTT-0083
Organic Content	FM-GTT-0084

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GLOSSARY

GLOSSARY

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ACRONYMS

- A -

A	Acid extractables
AA	Atomic Absorption
ACBM	Asbestos-Containing Building Materials
AEC	Atomic Energy Commission
AEDE	Annual Effective Dose Equivalent
ALARA	As Low As Reasonably Achievable
AnaLIS	Analytical Laboratory Information System
ANSI	American National Standards Institutes
ARAR	Applicable or Relevant and Appropriate Requirement
ASAP	Automated Sampling and Analysis Program
ASI	Advanced Sciences, Inc.
ASL	Analytical Support Level
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AVGRRF	Average Relative Response Factor

- B -

BNB	BioDeNitrification
BFB	BromoFluoroBenzene
B/N	Base Neutrals
BNA	Base Neutrals Analysis
BNAE	Base-Neutral and Acid Extractable organic

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- C -

CAA	Clean Air Act
CADD	Computer Aided Design and Drafting
CAM	Continuous Air Monitor
CAR	Corrective Action Report
CCB	Calibration Control Blank
CCC	Calibration Check Compounds
CCS	Contract Compliance Screening
CCV	Continuing Calibration Verification
CDROM	Compact Disks Read Only Memory
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	Calibration Factor
CFR	Code of Federal Regulations
CIS	Characterization Investigation Study
CIT	Colorimetric Indicator Tubes
CLP	Contract Laboratory Program (U.S. Environmental Protection Agency)
COLIWASA	Composite Liquid Waste Sampler
CRDL	Contract-Required Detection Limit (in the CLP)
CRHT	Contract-Required Holding Time
CRQL	Contract-Required Quantitation Limit (in the CLP)
CRR	Contract-Required Recovery
CTM	Contract Technical Monitor
CV	Coefficient of Variation
CVAA	Cold Vapor Atomic Absorption methods for mercury analysis
CWA	Clean Water Act

- D -

DBC	DiButylChlorendate
DCAR	Deviation and Corrective Action Report

ACRONYMS (cont.)

3200

- D -

DCR	Document Change Request
D&D	Decontamination and Decommissioning
DDR	Data Deficiency Reports
DFTPP	Decafluorotriphenylphosphine
DI	De-Ionized (water)
DMR	Discharge Monitoring Report
DMSRD	Data Management System Results Database
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQ	Data Quality
DQO	Data Quality Objective
DR	Deviation Report
DVP	Data Validation Plan
DVT	Data Validation Team

- E -

ECD	Electron Capture Detector
EC&QA	Environmental Compliance and Quality Assurance Section
EDP	Electronic Data Processing
EPDM	Ethylene-Propylene-Diene Monomer
EG&G	EG&G, Inc.
EPA	U.S. Environmental Protection Agency
EP Tox	Extraction Procedure Toxicity
ERA	Executive Resource Associates, Inc.
ERMA	Environmental Resource Management and Analysis
ERMC	Environmental Restoration Management Contractor
ETS	Effluent Treatment System

ACRONYMS (cont.)

3200

- F -

FACTS	Fernald Analytical Computerized Tracking System
FEMP	Fernald Environmental Management Project
FFCA	Federal Facility Compliance Agreement
FID	Flame-Ionization Detector
FLAMM	FEMP Laboratory Analytical Methods Manual
FPM	FEMP Project Manager
FR	Federal Register
FS	Feasibility Study
FO	Fernald Office (U.S. Department of Energy)
FSDCP	Field Sampling/Data Collection Package
FSP	Field Sampling Plan
FTAAS	Flame Technique Atomic Absorption Spectroscopy

- G -

GC	Gas Chromatography (or Chromatograph)
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/FID	Gas Chromatography/Flame Ionization Detector
GC/MS	Gas Chromatography/Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption

- H -

HMT	Hazardous Materials Table
HSL	Hazardous Substance List
HWMU	Hazardous Waste Management Unit

ACRONYMS (cont.)

3200

- I -

ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma (spectroscopy)
ICS	Interference Check Sample
ICV	Initial Calibration Verification
ID	IDentification
IDL	Instrument Detection Limit
IR	InfraRed
IS	Internal Standards
IT	International Technology Corporation

- L -

LAACC	Large-Area, Activated-Charcoal Collector
LCS	Laboratory Control Sample
LLD	Lower Limit of Detection
LSA	Low Specific Activity
LSC	Laboratory Services Contract

- M -

MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
MPX	Multiple Processing Technology
MOSA	Methods of Soil Analysis
MS	Mass Spectroscopy (or Spectrometer)
MSA	Method of Standard Additions
MS/MSD	Matrix Spike/Matrix Spike Duplicate

ACRONYMS (cont.)

3200

- M -

MTE	Measuring and Testing Equipment

- N -

NCP	National Contingency Plan (for Oil and Hazardous Substances Pollution)
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIDA	National Institute on Drug Abuse
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NTU	Nephelometric Turbidity Units

- O -

OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OJT	On-the-Job Training
ORO	Oak Ridge Operations (or Office)
OSHA	Occupational Safety and Health Administration (or Act)
OU	Operable Unit

ACRONYMS (cont.)

3200

- P -

PCB	PolyChlorinated Biphenyls
PE	Performance Evaluation
PIC	Pressurized Ionization Chamber
PID	Photo-Ionization Detector
PP/ROD	Proposed Plan/Record of Decision
PSP	Project-Specific Plan
PVC	PolyVinyl Chloride

- Q -

QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control

- R -

RA	Remedial Action
RAM	RadioActive Material
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDL	Required Detection Limit
REMP	Radiological Environmental Monitoring Program
RF	Response Factor
RGC	Reactivity Group Code
RI	Remedial Investigation
RIC	Reconstructed Ion Chromatograph
RI/FS	Remedial Investigation/Feasibility Study

ACRONYMS (cont.)

3200

- R -

RIS	Relational Interface System
ROD	Record of Decision
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RQL	Required Quantitation Limit
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RSE	Removal Site Evaluation
RvA	Removal Action

- S -

SA	Spike Added
SARA	Superfund Amendments and Reauthorization Act
SAR/CR	Site-wide Analysis Request/Custody Record
SAS	Sample Analysis Selection (or Summary)
SCQ	FEMP Sitewide CERCLA Quality Assurance Project Plan
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compound
SQL	Structure Query Language
SR	Sample Result
SRPD	Self-Reading Pocket Dosimeter
SSR	Spike Sample Result
SVOA	Semi-Volatile Organic Analysis (or Analytes)
SWMU	Solid Waste Management Unit

ACRONYMS (cont.)

3200

- S -

SWQ	Site-Wide Quality

- T -

TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
TLD	ThermoLuminescent Dosimeter
TOC	Total Organic Carbon
TOX	Total Organic Halogens (or Halides)
TQM	Total Quality Management
TSCA	Toxic Substance Control Act

- U -

UST	Underground Storage Tank
UV/VIS	UltraViolet/Visible Spectrum

- V -

VOA	Volatile Organic Analysis (or Analytes)
VOC	Volatile Organic Compound

ACRONYMS (cont.)

3200

- W -

WEMCO	Westinghouse Environmental Management Company of Ohio
WTP	Water Treatment Plant

- X -

XRF	X-Ray Fluorescences

*****

ABBREVIATIONS

3200

- A -

Ag	silver
As	arsenic

- B -

Ba	barium

- C -

cc	cubic centimeter(s)
Cd	cadmium
cm	centimeter(s)
CN	cyanide
Co	cobalt
cpm	counts per minute
Cu	copper
Cr	chromium

- D -

dpm	disintegrations per minute

ABBREVIATIONS (cont.)

3200

- E -

Eh	redox potential

- F -

F	fluoride
ft	foot or feet

- H -

H	hydrogen
Hg	mercury

- I -

in.	inch or inches

- K -

kg	kilogram(s)

ABBREVIATIONS (cont.)

3200

- M -

m	meter(s)
Ma	milliampere(s)
Mg	magnesium
min	minute(s)
msl	(feet above) mean sea level
mg/L	milligram(s) per liter
mL	milliliter(s)
m/min	meters per minute
mrem	millirem(s)
mrem/h	millirem per hour
mV	millivolt(s)
m/z	Ratio of mass (m) to charge (z) of ions measured by GC/MS

- μ -

μmhos/cm	micromhos per centimeter
μg	microgram(s)
μg/g	microgram(s) per gram
μg/L	microgram(s) per liter

- N -

N/A	not applicable
nCi	nanocuries
ng	nanogram
ng/μL	nanogram(s) per microliter
N/K	not known

ABBREVIATIONS (cont.)

3200

- O -

O	oxygen

- P -

Pb	lead
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pH	hydrogen-ion concentration of acidity or alkalinity
ppb	parts of billion
ppm	parts per million
ppt	parts per trillion
Po	polonium

- R -

Ra	radium
Rn	radon

- T -

Th	thorium

ABBREVIATIONS (cont.)

3200

- U -

U	uraniun

- V -

V	vanadium

- Z -

Zn	zinc

- % -

%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation

*****

TERMINOLOGY

3200

Accuracy. The closeness of a measured value to the accepted true value.

Administrative Record. Official repository for information documenting progress of programs and projects aimed at remediation of FEMP. Contents of the administrative record are determined by DOE and are accessible to the public.

Analytical Batch. A group of twenty or less FEMP samples analyzed as a group, relative to instrument calibration checks, quality control samples, etc.

Analytical Support Level. Level of defined quality assurance/quality control parameters to assure data are satisfactory for their intended use

Associated Data/Results. Data or results related to a particular QC check or analysis. Association may be: (1) sample specific (holding time, (2) method specific for samples with the sample delivery group (calibrations), (3) constituent specific for samples of the same matrix in the SDG, or (4) a combination of (2) and (3).

Associated Samples. Samples related to a particular QC analysis (e.g., for an initial calibration, all samples run under the same calibration curve).

Aquifer. A geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring

Audit. An in-depth review of an entire program, including an evaluation of the associated quality assurance program and procedures, effectiveness of their implementation, and review of associated documentation (synonymous with system audit)

Calibration. Establishment of an analytical curve using the appropriate number of standards and based on response versus concentration.

Capillary Water. Water held as a film around soil particles and in tiny spaces between particles in the unsaturated zone. Surface tension is the adhesive force that holds capillary water in the soil.

Carrier. Quantity of nonradioactive material of chemically identical behavior to the analyte(s) of interest, added to the sample to minimize loss of the radioactive species during sample processing.

CERCLA-Covered. Programs or projects at FEMP that generate data or perform functions required by the CERCLA program to fulfill requirements of the NCP or consent agreement.

TERMINOLOGY (cont.)

3200

CERCLA-Driven. Items or activities at FEMP required by the NCP or the Consent Agreement.

Channel. Bed where a natural stream of water runs; a long gutter, groove, or furrow

Chemical Yield. Amount of carrier recovered compared to amount added (used to correct the final analytical result).

Confined Aquifer. An aquifer that is overlain by a confining bed. The confining bed has a significantly lower hydraulic conductivity than the aquifer.

Consent Agreement. A written agreement entered into by the U.S. Department of Energy and the U.S. Environmental Protection Agency in April 1990 and as amended September 1991 that specifies actions to be taken at FEMP, including defining Operable Units (OU); conducting Removal Actions (RA), Remedial Investigations (RI), and Feasibility Studies (FS); preparing Records of Decision (ROD); and implementing Remedial Design (RD) and Remedial Actions (RA). The goal of the consent agreement is remediation of FEMP.

Contaminant. Any physical, chemical, biological, or radiological substance or matter that has an adverse affect on air, soil, or water.

Contractor. Organization contracted directly to DOE to function in a specific capacity at FEMP and reports to DOE or to a designee of DOE. Contractors currently include the prime contractor, the RI/FS contractor, and the RD/RA contractor.

Data Package. See Sample Delivery Group.

Data Qualifiers. Specifically defined letters, groups of letters, and symbols used by data validators to qualify the useability of data.

Designated FEMP Quality Assurance Organization (DFO). The quality assurance group of a the prime operating contractor designated by DOE to be responsible for oversight of QA functions of contractors and subcontractors on site. The Designated FEMP Quality Assurance Organization may utilize Quality Assurance Resources of other contractor and subcontractor organizations to fulfill its duties.

Designee. Individual designated to perform a function in place of the defined responsible individual. The designation of authority to a designee must be documented in the project record and must include the scope and length of time the designation is in effect.

TERMINOLOGY (cont.)

3200

Deviation. A departure from a specified requirement. Can be a condition in which a characteristic of an item does not conform to prescribed limits, a required document is not available or is inadequate, a regulatory requirement was violated, or a procedure does not yield desired results. A nonconformance.

Duplicate. May be a second analysis (or count) of the same sample (duplicate analysis) or identical analyses of two samples that were obtained from a single sample (duplicate sample).

Electro-Fishing. A fresh-water fish sampling method that uses a pulsating direct current electro-shocker between 300 and 30,000 ohms to stun fish for collection

Feasibility Study. See Remedial Investigation/Feasibility Study.

Field Blank. Blanks handled as nearly the same as feasible as samples in the collection process and intended to identify contaminants that may have been introduced in the field (e.g., by sampling equipment).

FEMP. The DOE Fernald Environmental Management Project, formerly a uranium processing plant named Feed Materials Production Center. Consists of a 1050 acre site and potentially affected off-site areas.

FEMP Administrative Record Coordinator. Prime operating contractor representative designated by DOE as responsible for maintaining, updating, and tracking the contents of the Administrative Record and associated files.

FEMP Controlled-Document Coordinator. Prime operating contractor representative or designee responsible for issuing, tracking, and distributing revisions to controlled documents at FEMP.

FEMP Health and Safety Organization. Prime operating contractor group responsible for radiological and industrial safety of FEMP workers. The FEMP Health and Safety organization may utilize expertise and resources of other contractors and subcontractor organization to fulfill its duties.

FEMP or Project Manager. FEMP individual (usually an employee of a direct or prime contractor to DOE) responsible for execution and completion of a project.

FEMP or Project Contact. FEMP individual designated to maintain project liaison with laboratory or other subcontractor personnel during the course of a project.

TERMINOLOGY (cont.)

3200

FEMP Sampling and Analysis Managmenet Coordinator. Prime operating contractor representative responsible for coordinating data quality objective definition, technical review of project-specific plans, issuing sample numbers, coordinating site laboratory services, preventing redundancy in sampling and analysis, and overall coordination of sampling and analysis activities on site.

Fluid. Any material or substance that flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state

Formation. A body of consolidated or unconsolidated rock characterized by a degree of lithologic homogeneity that is prevailingly, but not necessarily tabular and is mappable on the earth surface or traceable in the subsurface

Formation Fluid. Fluid present in a formation under natural conditions as opposed to introduced fluids such as drilling mud

Fully Penetrating Well. A well drilled to the bottom of an aquifer, constructed in such a way that it withdraws water from the entire thickness of the aquifer

Gaining Stream. A stream or section of stream, the flow of which is being increased by inflow of ground water (that is, effluent with respect to ground water). The hydraulic head of the stream surface has a lower potential than the surrounding ground-water environment, so ground water is discharged to the stream.

Ground Water. (1) The supply of fresh water under the earth's surface that forms a natural reservoir. (2) Water at or above atmospheric pressure which is below the land surface in the zone of saturation. (3) Water in a saturated zone or stratum beneath the surface of land or water.

Gully or Rill. Miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage. A rill is of lesser depth and can be smoothed over by ordinary tillage.

Hazardous Substance. Any material that poses a threat to human health and/or the environment as defined in 40 CFR 300.5. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. Any substance designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States or if otherwise emitted to the environment.

TERMINOLOGY (cont.)

3200

Hazardous Waste. Any waste or combination of wastes that pose a substantial present or potential hazard to human health or living organisms because such wastes are nondegradable or persistent in nature, or they can be biologically magnified, or they can be lethal, or because they may otherwise cause or tend to cause detrimental cumulative effects. Also a waste or combination of wastes of a solid, liquid, contained gaseous, or semisolid or that may cause or contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, taking into account the toxicity of such waste, its persistence and degradability in nature, its potential for accumulation or concentration in tissue, and other factors that may otherwise cause or contribute to adverse acute or chronic effects on the health of persons or other organisms. [ed. Hazardous wastes as defined here as those wastes listed by EPA or meeting characteristics specified by EPA in their criteria pursuant to the Resource Conservation Recovery Act (RCRA). Disposal treatment or storage of hazardous wastes can only take place in a site or facility issued a permit by EPA or a state.]

Holding Time. For validation purposes, the time from sample collection to laboratory analysis.

Hydraulic Conductivity. A coefficient of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity.

Laboratory Control Sample (LCS). A sample equivalent to internal or external control samples that may be prepared by the same laboratory performing the analyses or by a reference laboratory or agency.

Laboratory Project Manager. Individual employed by a laboratory who is responsible for overseeing the analysis and reporting of all samples from FEMP for a particular program or project. Also responsible for day-to-day liaison with the FEMP project contact.

Leachate. Liquid that has percolated through solid waste and dissolved soluble components. Any liquid including any suspended components in the liquid that has percolated through or drained from waste materials.

Losing Stream. A stream or section of stream that is influent with respect to ground water (i.e., there is a net loss of stream water to the ground-water system). The hydraulic head of the stream surface has a greater potential than the surrounding ground-water environment, so the stream water contributes recharge to the aquifer.

Lower Limit of Detection (LLD). Minimum count rate that can be routinely detected (radionuclide analyses).

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TERMINOLOGY (cont.)

Matrix Spike. Introduction of a known concentration of a spiking substance into a sample to provide information about the effect of the sample matrix on the digestion and measurement method and on the accuracy of the result.

Method Blank. A blank usually prepared with the same reagents and put through the same processing as the samples.

Minimum Detectable Activity (MDA). Smallest quantity of a radionuclide that can be detected in a sample with a 95 percent confidence level.

Monitoring Well. A well installed in a selected location and screened at a specific depth to allow monitoring of chemical and hydraulic parameters.

Open-Channel Flow. Flow with a free surface within definable, continuous-channel boundaries. Flow in a stream, river, or unconfined flow in a conduit.

Overland Flow. Water flowing on the land surface without the ordinary constraint of definable, continuous channel boundaries. Most commonly refers to the flow resulting when rainfall rates exceed surface infiltration rates. This is also called rainfall-excess overland flow. May also include flood flows, also termed channel-excess flows. One characteristic of overland flow is that it is ephemeral.

Partially Penetrating Well. A well constructed in such a way that it draws water directly from a fractional part of the total thickness of the aquifer. The fractional part may be located at the top or the bottom or anywhere in between the aquifer.

Piezometer. A bored, drilled, or driven shaft or a dug hole with a depth greater than the largest surface width; a shaft or pit dug or bored into the earth, generally cylindrical, and often walled with bricks or tubing to prevent earth from caving in with its main purpose being to monitor ground water elevation or pressure; or a nonpumping well used to measure the elevation of the water table or potentiometric surface.

Ponding. Standing water on soils in closed depressions. The water can be removed only through percolation or evapotranspiration.

Precision. A measure of the repeatability of an analysis or measurement. Measurements that are repeatable within small limits are said to be precise.

TERMINOLOGY (cont.)

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Process Wastewater. Any water that, during manufacturing or processing, comes into direct contact with or results from the production of or use of any raw material, intermediate product, finished product, byproduct, or waste product.

Program. In the context of this SCQ, a defined set of ongoing activities, such as routine monitoring, that will be continued in basically the same format for an indeterminate length of time (e.g., the CERCLA Program, Environmental Compliance Monitoring Ground-Water Program, and Environmental Monitoring Program). Programs are subject to the same substantive requirements regarding sampling and analysis as projects. However, the converse may not be true. Because projects may be subsets of programs, all project requirements also apply to programs.

Project-Specific Plans. Scoping documents required for any program or project. Project-specific plans for FEMP sampling and analysis activities should include elements defined in Section 6 of the SCQ. Project-specific plans may include work plans, field sampling plans, health and safety plans, and standard operating procedures.

Project. In the context of this SCQ, a defined set of activities pursued towards a defined final conclusion. Examples of projects at FEMP include the remedial investigation/ feasibility studies for each operable unit, removal site evaluations, and removal actions. A project may be included within a program.

Raffinate. Aqueous solution and impurities (dissolved and suspended solids) resulting from the process of converting uranium ore and other source material to uranyl nitrate.

Reagent Blank. See Method Blank.

Recharge. A process, natural or artificial, by which water is added to the saturated zone of an aquifer. A recharge area is where water reaches the ground water by surface infiltration.

Recharge Area. An area in which there are downward components of hydraulic head in the aquifer. Infiltration moves downward into deeper parts of an aquifer in a recharge area.

Record of Decision (ROD). A public document that explains which cleanup alternatives will be used at a National-Priorities-List site. The ROD is based on information and technical analysis generated during the remedial investigation/feasibility study and consideration of public comments and community concerns.

TERMINOLOGY (cont.)

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Redox Potential. Potential for oxidation and reduction of elements in water. A measure of aqueous electron concentration controlled by reactions involving elements present in more than one oxidation state.

Relative Percent Difference (RPD). A measure of precision using results from duplicate analyses.

Remedial Action. Those actions consistent with permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment.

Remedial Design. A phase of remedial action that follows the remedial investigation/ feasibility study and includes development of engineering drawings and specifications for a site cleanup.

Remedial Investigation/Feasibility Study (RI/FS). Consists of two distinct but related studies usually performed concurrently. The remedial investigation is intended to gather data necessary to determine the types and extent of contamination at a superfund site and assess risk to human health and the environment posed by identified contamination. The feasibility study identifies and screens cleanup alternatives and produces a detailed analysis of the technology and costs of remedial alternatives.

Removal Action. Short term, immediate actions taken to address releases of hazardous substances that require expedited response.

Removal Site Evaluation. A study conducted to determine whether a site poses an imminent or potential hazard to human health and the environment requiring initiation of a removal action.

Rill. See Gully.

Runoff. (1) Precipitation discharged into stream channels from an area. Surface runoff is water that flows off the surface of the land without sinking into the soil. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water. (U.S. Soil Conservation Service) (2) Any rain water, leachate, or other liquid that drains overland from any part of a facility.

TERMINOLOGY (cont.)

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Sample Delivery Group (SDG). A group of samples, usually fewer than 20, received over a period of up to 14 calendar days. Data from all samples in an SDG are contained in one data package. SDG is synonymous with data package in that the results from the samples in the SDG are (usually) reported in the one package.

Sampling Activity. Total of a number of steps required to be completed to collect a single sample.

Sampling Event. Collection of a sample from a single location for a specific project.

Sampling Round. Collection of samples from one or more locations for a specific project during a specified time period for a similar purpose.

Saturated Zone. The zone in which the voids in the rock or soil are filled with water at a pressure greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer.

Seep. An area where water oozes from the earth. A surface expression of the water table. A small spring with little or no discernable flow.

Significant Condition Adverse to Quality. A condition, if left uncorrected, could significantly impact the quality of a measurement or program.

Site. "...shall include all areas within the property boundary of FMPC and any other areas that received or potentially received released hazardous substances, pollutants, contaminants, or hazardous constituents. The term shall have the same meaning as 'facility' as defined by Section 101(9) of CERCLA, 42 U.S.C. §9601(9)." (Consent Agreement, April 9, 1990)

Slag. Waste solids derived from the molten processing of uranium metal.

Spring. Where water flows without artificial aid from the subsurface to the surface. A surface expression of the water table.

Standard. (noun) In context of equipment calibration, something set up and established by authority as a rule for the measurement of a parameter (e.g. concentration, length, temperature, mass). (adj) A regularly and widely used method (e.g. standard operating procedure), material (e.g. standard gauge), or calculation (e.g. standard deviation).

Stream. Any body of flowing water or other fluid.

TERMINOLOGY (cont.)

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Subcontractor. Organization that performs a service for FEMP while contracted to a prime contractor of the Department of Energy and that reports to the prime contractor.

Surface Water. Water that is open to the atmosphere and subject to surface runoff

Surveillance. Spot checks of program implementation to determine conformance to specified requirements. Equivalent to EPA performance audit.

Teflon. A fluorocarbon plastic manufactured by the DuPont Corporation. In this document, teflon refers to any fluorocarbon plastic.

Tracer. A small quantity of a (usually) pure radionuclide, different than those of interest, but expected to behave similary (i.e., is added to a sample to determine the effect on processing and derive a correction factor if necessary).

Tremie Line Method of Grouting. A method of inserting grout into a borehole to ensure that there are no void spaces. A hose or pipe is inserted into a borehole to within five feet of the bottom of the opening. Grout is pumped through the hose or pipe. As the borehole fills, the tremie line is retracted at approximately the same rate as the hole is filling.

Unconfined Aquifer. An aquifer in which there are no confining beds between the zone of saturation and the surface. There will be a water table in an unconfined aquifer. Water-table aquifer is a synonym.

Unsaturated Zone. The zone between the land surface and the water table. It includes the root zone, intermediate zone, and capillary fringe. The pore spaces contain water at less than atmospheric pressure, as well as air and other gases. Saturated bodies, such as perched groundwater, may exist in the unsaturated zone.

Water Table. The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing shallow wells extending a few feet into the zone of saturation and then measuring the water level in those wells.

Well. (1) A hydraulic structure which, when properly designed and constructed, permits the economic withdrawal of water from a water-bearing formation. (2) A bored, drilled or driven shaft, or a dug hole with a depth greater than the largest surface dimension (hole is deeper than it is wide). (3) Any shaft or pit dug or bored into the earth, generally of a cylindrical form and often walled with bricks or tubing to prevent the earth from caving in.

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SECTION 1

Section 1

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INTRODUCTION

The Fernald Environmental Management Project (FEMP) is owned by the U.S. Department of Energy (DOE) and is a former uranium processing facility. The current mission of FEMP is waste management and environmental restoration; and, as such, it is subject to a wide range of environmental statutes and regulations.

DOE entered into a Federal Facilities Compliance Agreement (FFCA) with the U.S. Environmental Protection Agency (EPA) in 1986 (U.S. Department of Energy, 1988) to bring the site into compliance with the Resource Conservation and Recovery Act (RCRA) and the Clean Water Act (CWA).

Since then, FEMP was designated a Superfund site and, therefore, is on the National Priorities List (NPL) for environmental cleanup as mandated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Inclusion of FEMP on the NPL in 1989 necessitated implementation of a new agreement between DOE and EPA, so the two parties entered into a Consent Agreement in April 1990, which was amended in September 1991.

The EPA requires that environmental monitoring and measurement programs mandated or supported by EPA contain a centrally managed Quality Assurance (QA) program. Parties generating data under such a program shall be required to implement procedures that ensure precision, accuracy, completeness, and representativeness of the data and documentation thereof (U.S. Environmental Protection Agency, 1991).

1.1 PURPOSE

Collection and analysis of environmental samples is an integral part of fulfillment of the site mission and compliance with environmental regulations. A single sample of a specific medium from a specific location may be capable of providing data for a number of investigation, restoration, waste management, and regulatory uses. Therefore, it is necessary that investigation sampling and analysis be conducted to provide useable, valid data of known quality so that use across programs is possible, and the level of uncertainty associated with such use is known.

The Sitewide CERCLA Quality Assurance Project Plan (SCQ) program was developed for FEMP environmental sampling and analysis, with a twofold purpose: (1) establish

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minimum standards of performance for operational and analytical activities, and (2) ensure that standards are followed by parties covered by the program as defined in Section 3.

This document, the SCQ, is a revision of the quality assurance project plan prepared for the FEMP Remedial Investigation/Feasibility Study, which fulfills requirements of the 1986 Federal Facilities Compliance Agreement between DOE and EPA. Inclusion of FEMP on the NPL resulted in a subsequent decision to modify the RI/FS Quality Assurance Project Plan to encompass all site programs generating environmental data, ensuring useability of the data for the FEMP CERCLA program. The SCQ integrates CERCLA requirements into applicable sampling activities at FEMP, consistent with EPA recommendations to consolidate QA requirements and documents whenever possible (U.S. Environmental Protection Agency, 1989a).

1.2 SCOPE

The SCQ was developed to direct environmental sampling and analysis to support ultimate remediation of the site. To this end, ongoing and future environmental projects at FEMP shall comply with Quality Assurance/Quality Control (QA/QC) requirements specified herein. The following projects are included in FEMP activities and covered by of the SCQ.

- **Remedial Investigation/Feasibility Study (RI/FS)** - Consists of two distinct but related studies conducted at Superfund-designated sites and usually performed concurrently. During the remedial investigation, data is gathered to determine types and extent of contamination at the site and to assess risk to human health and the environment posed by identified contamination. The feasibility study results in identification of cleanup requirements and a detailed analysis of the technology and costs of remedial alternatives, which are used to formulate the record of decision. (See Glossary terminology.)

- **Removal Site Evaluations (RSE)** - Assessment of the need for a removal action required by ongoing or threatened release of contaminants that may adversely impact public health or the environment without immediate response

- **Removal Actions (RvA)** - Short-term immediate actions that address releases of hazardous substances requiring an expedited response

- **Remedial Design (RD)** - Engineering phase that follows the record of decision when technical drawings and specifications are developed for subsequent remedial action at an NPL site

- **Remedial Actions (RA)** - Construction or implementation phase that follows remedial design of selected cleanup alternative at an NPL site

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Other programs and activities at FEMP requiring collection and analysis of samples under SCQ criteria include the following.

- RCRA ground-water monitoring
- RCRA closures
- Clean Air Act (CAA) monitoring, including stack monitoring for National Emissions Standards for Hazardous Air Pollutants (NESHAP) compliance
- Clear Water Act (CWA)
- Safe Drinking Water Act (SDWA)
- National Environmental Policy Act (NEPA)
- Toxic Substances Control Act (TSCA)
- Radiological Environmental Monitoring Program (REMP)
- Underground Storage Tank (UST)
- Routine environmental surveillance required by DOE orders
- Construction

The SCQ is designed to ensure that work performed for environmental programs and supporting activities at FEMP are of adequate quality to fulfill project-specific Data Quality Objectives (DQO) (Appendix C). The organization, objectives, functional activities, and specific QA/QC activities associated with the CERCLA program at FEMP are presented. Basic requirements for sampling, sample handling and storage, chain-of-custody records, and laboratory and field analyses are specified in the sections and appendices of the SCQ.

Data generated under this project are intended to fulfill defined needs of DOE, EPA, the Ohio Environmental Protection Agency (OEPA), and the public. DQOs and requirements for meeting and verifying DQOs are included as part of the SCQ. Sampling efforts implemented under the SCQ are designed to accomplish the following.

- Assess environmental conditions in air, soil, ground water, and surface water.
- Aid in identifying areas requiring immediate removal actions.

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- Assess variability in the measurement process along with sources and magnitude of variation in results generated.
- Provide a means of determining whether a sampling program meets DQOs.
- Identify areas requiring remedial action.

QA/QC procedures herein were evolved considering applicable DOE orders, professional technical standards, regulatory requirements, regulations, guidelines, and specific project goals and requirements. The following documents were considered in the development of the SCQ.

- ***Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*** (U.S. Environmental Protection Agency, 1983).
- ***Superfund Remedial Design and Remedial Action (RD/RA) Guidance*** (U.S. Environmental Protection Agency, 1986).
- DOE Order 5700.6B and 5700.6C, Quality Assurance (U.S. Department of Energy, 1986a and 1991).
- DOE order 1430.1, Managing the Department of Energy's Scientific and Technical Information (U.S. Department of Energy, 1986b).
- ***Data Quality Objectives for Remedial Response Activities*** (U.S. Environmental Protection Agency, 1987).
- ***Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) Under CERCLA*** (U.S. Environmental Protection Agency, 1988).
- ***Content Requirements for Quality Assurance Project Plan.*** (Tsai, 1989).
- ***Final Standard - Quality Assurance Project Plan Content Document.*** (U.S. Environmental Protection Agency, 1989b).
- DOE Order 2321.1, Auditing of Programs and Operations (U.S. Department of Energy, 1990).
- ***Quality Assurance/Quality Control Guidance for Removal Activities*** (U.S. Environmental Protection Agency, 1990a).
- ***Model Quality Assurance Project Plan.*** (U.S. Environmental Protection Agency, 1991).

- *Guidance for Data Useability in Risk Assessment* (U.S. Environmental Protection Agency, 1991b).

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In addition the requirements of the SCQ shall be consistent with the intent of other DOE orders that pertain to environmental sampling and analysis.

The SCQ provides for document changes in response to evolving program needs as new projects are implemented at FEMP. The SCQ is intended to be a dynamic document, that meets current site needs while retaining the flexibility to respond to advances in analytical methods, field techniques, operating procedures, and changes in the FEMP mission.

Techniques and procedures are appropriately referenced and, as improvements are proposed and accepted, change requests will be drafted and distributed for comment or approval. References to EPA guidance documents, journal articles, textbooks, and FEMP contractor methods and guidelines are an integral part of this document. Referenced documents are available to users and reviewers as public documents or upon request to the DOE Fernald Office. Referenced DOE orders are available in the FEMP library.

1.3 USE OF THE SCQ

The FEMP SCQ is not a standard quality assurance project plan. It differs from the typical CERCLA RI/FS quality assurance project plan because of the complex and diverse nature of the activities and waste sources at the site. The SCQ is a cross between a quality assurance program plan and a quality assurance project plan. The SCQ provides overall sitewide quality assurance planning for sampling and analysis activities planned or ongoing at FEMP. These activities include non-CERCLA environmental monitoring as noted in subsection 1.2.

The SCQ for sampling and analysis has two primary uses: (1) it is a requirements document that shall be complied with for environmental sampling and analysis, and (2) it is a working-level document providing standardized procedures for common field activities that can be incorporated into Project Specific Plans (PSP) (subsection 1.5). Requirements for planning, implementation of plans, and assessment of activities are included in the SCQ so that it may be used like a QA program plan as defined by EPA (1980). The SCQ also fulfills the requirements of a QA project plan as defined by EPA (1983) except the portions that refer to specific samples.

Planning requirements are identified in Sections 2, 3, and 4; Appendices C, E, and F; and, to a lesser degree, Sections 5, 6, and 7. Implementation requirements are set forth in Sections 5, 6, 7, 8, 9, 10, and 13 and Appendices I, J, and K. Assessment requirements are defined in Sections 11, 12, 14, and 15; Appendices D and F; and, to a lesser degree, Section 4 and Appendix E.

Geotechnical analyses and measurements are conducted on soils, sludge, and waste for treatability studies and engineering design purposes. Analyses and measurements conducted for treatability studies are bound to the requirements of the SCQ. Analyses and measurements for engineering design shall be conducted according to the applicable method in Attachment I at a laboratory facility that has been audited and approved by FEMP. However, engineering data that will not be used for environmental decision making, as determined through the DQO process, are excluded from other administrative requirements of the SCQ. 3200

1.4 ASSOCIATED DOCUMENTS

1.4.1 Laboratory Analytical Methods

Attachment I to the SCQ provides standardized methods for analyzing samples for a wide range of parameters of interest to FEMP. Included in each analytical method are the precision, accuracy, comparability, and reporting requirements applicable to the intended use of the data.

1.4.2 Project Specific Plans

Project-specific supplements to the SCQ shall be generated for each project requiring sampling and analysis. PSPs shall serve as comprehensive work plans that include the following information.

- Historical information relevant to the specific project
- Assessment of existing data
- Identification of data needs and quality requirements through the DQO process described in Appendix C
- Sample collection points and how they were chosen
- Methods for collecting data either by reference to the SCQ or through incorporation of specific procedures
- Analytical methods to be used and corresponding analytical support levels (Section 2)

PSPs may also include the following.

- RI/FS work plan addenda for each operable unit

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- Removal action work plans
- RCRA closure plans
- RCRA ground-water quality assessment plans
- Radiological environmental monitoring plans
- Regulatory permits

PSPs shall be scoped as required by the specific regulatory or program requirements. Additional details for preparation of PSPs are provided in Section 6. Subsection 1.7 outlines the relationship between the SCQ and PSPs.

1.4.3 Health And Safety Plan

Health and safety requirements, in accordance with 29 CFR 1910 and 1926, are documented in the site health and safety plan (Westinghouse Materials Company of Ohio, 1990). Although some of the instruments used in health and safety monitoring are also used for environmental screening, the requirements of this document do not apply to health and safety monitoring. Requirements for generation of project-specific health and safety plans are included in the site health and safety plan.

1.5 IMPLEMENTATION OF THE SCQ

A problem or a required data collection effort must be identified as the first step in implementing the SCQ. Figure 1-1 in Appendix A is a flow chart that summarizes and simplifies the steps involved in implementing the SCQ, which are as follows.

1. Identify a problem or meet a requirement for collection and analysis of environmental data.
2. Identify applicable SCQ requirements.
3. Initiate generation of the PSP.
4. Define DQOs.
5. Review and revise DQOs.
6. Complete the PSP.

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7. Review and revise the PSP.

8. Submit PSP for agency review.

9. Revise PSP if necessary.

10. Receive agency approval of PSP.

11. Implement PSP.

The DQO process (Appendix C) focuses on providing data that are useful for the purposes of the data collection effort. The process results in preparation of a logic flow statement (including a decision rule or potential subsequent actions) to be kept on record and a DQO summary form to be included in the PSP. All potential uses of data shall be considered when preparing DQOs. For example, samples collected from domestic drinking water wells as part of DOE requirements may also be used in a planned risk assessment. This could result in choosing a different laboratory analytical method than if the data were used only for DOE environmental monitoring.

Section 6 of the SCQ requires that a PSP be prepared for each sampling activity. A PSP is a combination of a standard QA project plan and a CERCLA work plan that incorporates requirements of the SCQ. Preparation of the PSP can be started simultaneously with preparation of DQOs, but the DQO process must be completed before the PSP can be completed. Based on DQOs, the PSP shall specify the following requirements.

- **Sample Design**
  - Number of samples
  - Sample collection points
  - Frequency of sample collection
  - Collection method
- **Analytical Method**
  - Target parameters
  - Detection limits
  - Analytical support level

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- **QC Requirements**
  - Field
  - Laboratory
  - Data validation
  - Data management

After a draft PSP is prepared, it shall be reviewed by the FEMP sampling and analysis management coordinator or designee, the designated FEMP QA organization, and groups potentially affected by the activity. The review serves the following purposes.

- Provide a detailed technical review to ensure that accepted scientific and engineering practices and standardized or approved approaches are specified.
- Ensure integration and coordination of individual activities of each PSP with overall FEMP restoration goals.
- Reduce duplication of sampling efforts.
- Improve the use of data for multiple purposes.
- Provide consistency to sample collection efforts.

PSPs, as part of 1991 amended Consent Agreement activities, shall be reviewed and approved by EPA prior to implementation (Section 3). PSPs generated to fulfill requirements of the consent decree with the state of Ohio shall be reviewed and approved by Ohio Environmental Protection Agency and EPA.

The draft PSP shall be revised until approved by DOE for agency review. Based on agency review comments, the PSP shall be revised until approved. Upon receipt of agency approval, the PSP shall be implemented according to the schedule developed as part of the plan. Implementation of the PSP shall consist of the following major steps, which are illustrated in the flow chart in Figure 1-2 (Appendix A).

- Sample collection and field work
- Laboratory analysis
- Data validation

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- Data management
- Data interpretation and analysis
- Reporting results
- Decision for action on problem or compliance with requirement

There are feedback loops in the PSP between data validation and laboratory analysis and between data interpretation/analysis and DQO preparation. Data validation can result in a requirement for the laboratory to re-analyze a sample because of failure to comply with QC requirements. In extreme cases, re-sampling may be required.

Sometimes data analysis and interpretation results in the realization that a different use of data may be required than originally intended. The DQO process shall then be reviewed to determine if the data are suitable for the new purpose.

1.6 REFERENCES

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SECTION 2

Section 2

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PROJECT DESCRIPTION

FEMP is owned by the U.S. Government and was formerly a uranium processing facility known as the Feed Materials Production Center. The Westinghouse Environmental Management Company of Ohio (WEMCO) is currently the prime operating contractor to DOE at FEMP.

2.1 SETTING AND SITE HISTORY

2.1.1 Setting

FEMP is located in a rural area of southwestern Ohio approximately 18 miles northwest of downtown Cincinnati, Ohio, and 8 miles southwest of Hamilton, Ohio. The FEMP site comprises 1,050 acres bounded by State Highway 126 to the north, Willey Road to the south, Paddys Run Road and the Chesapeake and Ohio Railroad to the west, and a power transmission line right-of-way to the east (U.S. Department of Energy, 1988). The plant area occupies approximately 136 acres in the center of the DOE property. The villages of Fernald, New Baltimore, Ross, New Haven, and Shandon are located within a few miles of the plant (Figure 2-1, Appendix A) (U.S. Department of Energy, 1990a).

Ground elevations at FEMP range from approximately 700 feet above mean sea level (msl) along the northern boundary to approximately 550 feet msl where Paddys Run leaves the property near the southwest corner. Natural surface runoff at the plant is generally east to west into Paddys Run, which flows south to the Great Miami River. Runoff from the northeast corner of FEMP drains into a small, intermittent tributary of the Great Miami River. Surface runoff within most of the former plant production area is captured in a storm-sewer system that discharges to a storm-water retention basin. After solids have been allowed to settle out of the collected runoff, water from the basin is discharged along with treated waste water to the Great Miami River through an effluent line permitted under the National Pollutant Discharge Elimination System (NPDES) provisions of the Clean Water Act (U.S. Department of Energy, 1990a).

Before construction of the storm-water retention basin, storm flows in excess of the capacity of the main effluent line were discharged to the storm-water outfall ditch. These runoff events are suspected of contributing significant amounts of contaminants from the main plant area to the surface water system (U.S. Department of Energy, 1990a).

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Directly underlying most of FEMP are glacial drift deposits (also referred to as glacial overburden) ranging from zero to approximately fifty feet in thickness. The drift is composed primarily of poorly sorted, clay-rich till with various interbedded glaciofluvial (glacial stream), lacustrine (lake), and loess (wind blown) deposits of lenticular geometry (U.S. Department of Energy, 1990a).

Underlying the glacial drift are extensive valley-fill outwash deposits of medium- to well-sorted sands and gravels averaging about 150 feet in thickness under FEMP. The outwash overlies well-indurated shale and limestone bedrock. The outwash under the plant is separated into an upper and lower unit by a clay-rich lacustrine deposit, locally referred to as blue clay, which ranges from zero to about 20 feet in thickness (U.S. Department of Energy, 1990a). A generalized cross section of the subsurface in the FEMP area is included in Figure 2-2 in Appendix A.

Ground water is present in perched aquifers composed of coarser, better-sorted lenses within the glacial drift and in coarse fill below buildings and along utility lines. Ground-water flow within the drift is discontinuous and may be subject to extreme seasonal fluctuation. The upper 20 to 30 feet within the outwash is unsaturated; and the remainder forms the Great Miami Aquifer, which has been designated a sole-source aquifer by the EPA. Under the plant area, the Great Miami Aquifer is separated into an upper and lower unit by the blue clay. The upper portion is unconfined and receives recharge from Paddys Run (a losing stream) and the storm-water outfall ditch, as well as the overlying drift. The lower portion is semi-confined and, probably, is primarily recharged by leakage through the blue clay (U.S. Department of Energy, 1990a).

Ground-water users in the area surrounding FEMP draw primarily from the Great Miami Aquifer. The most significant usage is by the Southern Ohio Water Company, which operates a series of radial collector wells east of FEMP. Ground water is also produced from private wells at the plant for remedial process and sanitary purposes. Other ground-water users include production facilities to the south of FEMP, residents around the plant, and other private and commercial users (U.S. Department of Energy, 1990a).

In the area around FEMP, the portion of the Great Miami River that is not affected by the Southwest Ohio Water Company collector wells is a discharge area under normal hydrologic conditions. The lower portion of Paddys Run between New Haven Road and the Great Miami River is a gaining stream during part of the year and a losing stream at other times. Paddys Run is also a gaining stream where its bed is on the clay-rich glacial overburden (north of the K-65 area), as evidenced by small seeps and springs along its banks and tributaries.

The Great Miami River is a losing stream where drawdown induced through pumping of Southwest Ohio Water Company collector wells reduces the aquifer head below the stream

level. Paddys Run is a losing stream between the K-65 area and approximately New Haven Road. It loses flow to the aquifer along other stretches during periods of low flow. 3200

2.1.2 Production History

The U.S. Atomic Energy Commission, predecessor to DOE, began construction of the Feed Materials Production Center (now FEMP) in 1951 and began operations there in 1952. Operations consisted of foundry and other processes to convert natural uranium ore concentrates and recoverable, recyclable residues into uranium metal and compounds. The primary function of the plant was production of metallic uranium fuel cores and uranium compounds for use in U.S. defense programs.

In addition to the primary uranium products, small amounts of thorium were produced. The site currently serves as the thorium repository for DOE, where a variety of thorium materials are stored in long-term storage facilities. During the 1950s, pitchblende ores containing uranium, Ra-226, and daughter products were processed at the site.

A variety of chemicals (e.g., nitric acid, anhydrous hydrogen fluoride, magnesium metal, metal cleaning solvents, coolants, and lubricating oils) were used in the production processes. As a result of these operations, various types of liquid and solid matrix wastes were generated. These wastes can be broadly categorized as hazardous, non-hazardous, radioactive, and mixed (hazardous wastes with radioactive material).

Many solid and liquid wastes were stored or disposed of on site. Radium-bearing wastes from pitchblende processing were stored in two concrete silos in a waste storage area northwest of the main plant area (Figure 2-3 in Appendix A). Metal oxide wastes were stored in a third silo. A fourth silo was constructed, but remains unused. Uranium metal production wastes were placed in pits in the waste storage area, and an on-site landfill was operated to dispose of solid waste. Construction debris was disposed of on site separately from the waste storage area, as was fly ash from the boiler plant.

Releases of contaminants from FEMP to environmental media have been noted during past investigations (U.S. Department of Energy, 1990a). These releases include runoff to the storm-water outfall ditch and Paddys Run; discharges of uranium to the Great Miami River; and releases and spills of uranium-bearing materials, solvents, and other material to soils on the plant property. Affected media include perched ground water (radionuclides and volatile organic materials), ground water in the Great Miami Aquifer (radionuclides and volatile organic compounds), surface water and sediments in Paddys Run and the Great Miami River (radionuclides), and, possibly, aquatic and terrestrial biota. It is also suspected that air emissions contributed to both on-site and off-site deposition of radionuclides. More detailed descriptions of site history and previous investigations are included in paragraph 2.2.3.

2.2 REGULATORY ISSUES

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2.2.1 Federal Facilities Compliance Agreement

DOE Oak Ridge Operations entered into a Federal Facilities Compliance Agreement (FFCA) with EPA pertaining to FEMP (then Feed Materials Production Center) on 18 July 1986 pursuant to Executive Order 12088 (43 Federal Register 47707). The FFCA set forth compliance with existing environmental statutes and implementing regulations. Key elements of the Federal Facilities Compliance Agreement include bringing the site into compliance with the Resource Conservation and Recovery Act (RCRA) and the Clean Water Act (CWA) and initiating a Site Remedial Investigation/Feasibility Study (RI/FS).

2.2.2 Consent Agreement

The Feed Materials Production Center was added to the National Priorities List (NPL) in 1989. A Consent Agreement outlining activities and schedules to be performed in order to remedy the site condition was entered into by DOE and EPA in April 1990. This agreement was revised in September 1991. Key elements of the agreement include incorporation of the FFCA as an attachment, recognizing that significant previous work was conducted, grouping the site into five Operable Units (OU) for characterization and remediation (Figure 2-4, Appendix A), adding a sixth sitewide OU to ensure protection of human health and the environment, and setting a schedule for activities from completion of the RI/FS for each OU through signing of a Record of Decision (ROD).

OUs are groupings of sites suspected of past releases of contaminants to the environment based on similarity of use, process, proximity to other sites, or type of potential contaminant. OUs requiring characterization and remediation at FEMP are described in the 1991 amended Consent Agreement as follows.

- **OU-1** - Waste pit area. Waste pits 1 through 6, clearwell, burn pit, berms, liners, and soil within the OU boundary as approved in the RI/FS work plan addendum

- **OU-2** - Other waste units. Fly ash piles, other southfield disposal areas, lime sludge ponds, solid waste landfill, berms, liners, and soil within the OU boundary as approved in the RI/FS work plan addendum

- **OU-3** - Production area. Production area and production-associated facilities and equipment, above- and below-grade improvements, structures, equipment, utilities, drums, tanks, solid waste, waste product, thorium, effluent lines, K-65 transfer line, waste-water treatment facilities, fire training facilities, scrap metals piles, feedstocks, and coal pile

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- **OU-4** - Silos 1 through 4. Silos 1, 2, 3, and 4; berms; decant tank system; and soil within the OU-4 boundary as approved in the RI/FS work plan addendum

- **OU-5** - Environmental media. All potential migration pathways, including ground water, surface water, soil not included in the definitions of OUs 1 through 4, sediments, flora, and fauna

- **Comprehensive Sitewide Operable Unit** - Evaluation of selected remedies and removal actions for OUs 1 through 5 to ensure that they are protective of human health and the environment on a sitewide basis as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan (NCP) (for Oil and Hazardous Substances Pollution), and applicable EPA policy and guidance.

A remedial investigation/risk assessment report and a proposed plan and record of decision shall be completed for the comprehensive site-wide operable unit if no additional action is necessary to protect human health and the environment. If additional action is necessary, a sitewide feasibility study and proposed plan and record of decision shall be prepared to address those concerns.

2.2.3 Operable Unit Descriptions and Histories

2.2.3.1 OU-1. Approximately 480,000 cubic yards of waste material were disposed of in units comprising OU-1. The bulk of solid waste was disposed of in pits 3 (245,000 cubic yards), 4 (57,6000 cubic yards), and 5 (101,000 cubic yards). Approximately 3,700 cubic yards of water are in pit 5 (748,000 gallons) and 7,700 cubic yards of water are in the clearwell (1,550,000 gallons) (U.S. Department of Energy, 1991a).

Since the beginning of uranium production operations in 1952, on-property storage facilities at FEMP have been used for the storage of low-level radioactive wastes generated by the chemical and metallurgical processes utilized at the facility. These wastes have been deposited in one of six waste pits, a clearwell, or burned in a burn pit. The following six pits, clearwell, and burn pit make up the 37.7 acres identified as OU-1 (Figure 2-5, Appendix A).

- **Waste Pit 1** - Constructed in 1952, excavated to a maximum depth of 17 feet into an existing clay lens, and lined with additional clay obtained from the burn pit. A portion of the clay liner is reported to be up to four and one-half feet thick on the bottom and one and one-half to two feet thick on the sides. The surface area of waste pit 1 is 82,693 square feet. It holds an estimated 33,676 cubic yards of buried waste consisting of neutralized waste filter cake, fly ash, 55-gallon drums, scrap graphite, brick scraps, sump liquor, sump cake, and depleted slag (by-product from the chemical reaction between uranium tetrachloride and magnesium).

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Within these materials is an estimated 115,352 pounds of uranium. The presence of a large (but unknown) quantity of drums in waste pit 1 was evident in photographs taken during the years of active pit operation. The photographs indicate that most drums were empty, but the origin and nature of materials stored in these drums is unknown. The general consistency of waste pit 1 contents is semisolid to saturated eight feet below the pit surface (U.S. Department of Energy, 1991a).

In 1959, waste pit 1 was backfilled and covered with clean soil.

- **Waste Pit 2** - Constructed in 1957, excavated to a maximum depth of 17 feet into native clay at the site of a small pond east of waste pit 1, and lined with compacted native clay. The surface area of waste pit 2 is 44,896 square feet. It holds an estimated 18,478 cubic yards of buried waste consisting of neutralized waste filter cake, graphite, fly ash, 55-gallon drums, brick scrap, sump liquor, sump cake, depleted slag, and a large quantity of concrete and other construction rubble.

  An estimated 2.66 million pounds of uranium and 890 pounds of thorium are contained within the materials in waste pit 2. The general consistency of the pit contents indicates semisolid and wet conditions eight feet below the pit surface.

  In 1964, the pit was taken out of service, backfilled, and covered with clean soil. Waste pit 4 is overgrown with grass and is fairly level with a gentle slope toward a drainage ditch running along the east side of waste pit 4 (U.S. Department of Energy, 1991a).

- **Waste Pit 3** - Constructed in 1959 by excavating about 27 feet into the glacial drift and adding a clay layer along the pit walls. The surface area of waste pit 3 is 241,373 square feet. It holds an estimated 237,053 cubic yards of buried waste consisting of lime-neutralized raffinate, raffinate concentrate, slag, slag leach residues, filter cake, fly ash, lime sludge, and 55-gallon drums. Within this material are an estimated 288,041 pounds of uranium and 881 pounds of thorium. Wet-to-saturated conditions exist eight feet below the pit surface (U.S. Department of Energy, 1991a).

  Waste pit 3 was taken out of service as a wet pit in the fall of 1968. Subsequently, only dry material was added until 1977. At this point, the pit was taken completely out of service, backfilled, and covered with clean soil. Waste pit 3 is overgrown with grass and is fairly level. The western side of the pit slopes steeply down to the perimeter fence and road and a gentle slope extends toward a drainage ditch running along the east side of the burn pit.

- **Waste Pit 4** - Constructed in 1960 and excavated similarly to waste pit 3 to a depth of 24 feet using a clay layer approximately two-feet-thick along the pit walls. The

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surface area of waste pit 4 is 83,799 square feet. It holds an estimated 53,706 cubic yards of buried waste consisting of process residues, filter cake, slurries, raffinates, scrap graphite, noncombustible trash, asbestos, 55-gallon drums, and an estimated 23,500 pounds of barium chloride. The general consistency of the contents indicates semisolid and wet-to-saturated conditions nine feet below the surface.

Within these materials is an estimated 6.7 million pounds of uranium and 136,000 pounds of thorium metal (in 55-gallon drums). Samples collected from borings exhibited levels of barium in the parts-per-thousand range resulting in a mixed-waste classification for waste pit 4.

In 1986, the pit was covered with clean soil and graded for surface water diversion. An earthen berm surrounds the pit to retain surface water runoff. In December 1988, an interim RCRA cap consisting of compacted clay overlain by a 45-mil-thick Hypalon, reinforced chlorosulfinated polyethylene liner was installed on waste pit 4 (U.S. Department of Energy, 1991a).

- **Waste Pit 5** - Constructed in 1968, excavated to a depth of about 30 feet, and lined with a 60-mil-thick Royal Seal, ethylene-propylene-diene monomer elastomeric membrane. The surface area of waste pit 5 is 161,103 square feet. It holds an estimated 98,841 cubic yards of waste consisting of solids from neutralized raffinate, slag leach slurry, sump slurry, and lime sludge. In addition, the effluent tower was collapsed into the pit and is estimated to contain 8,000 pounds of steel and 64,000 pounds of concrete (U.S. Department of Energy, 1991a). Within these materials are an estimated 111,737 pounds of uranium and 37,445 pounds of thorium.

  Waste pit 5 was taken out of service in 1987 but remains open. It is partially covered with an estimated 750,000 gallons of water ranging in depth from three feet near the west end to zero feet over one-third of the length of the pit to the east. During routine inspections, occasional liner-joint failures and tears occurring at the surface were noticed and ascribed to weathering effects (Weston, 1987). Corrective action consisted of gluing the seam and patching tears.

- **Waste Pit 6** - Constructed in 1979, excavated similarly to waste pit 5 to a depth of 24 feet, and lined with an ethylene-propylene-diene monomer elastomeric membrane. The surface area of waste pit 6 is 32,400 square feet. It holds an estimated 11,556 cubic yards of waste consisting of green salt (uranium tetrafluoride), filter cake, slag, process residues, and asbestos. Within these materials is an estimated 1.9 million pounds of uranium.

  The pit was taken out of service in 1985 but remains open. The surface is presently covered with up to two feet of standing water. The surface elevation of the water varies depending on the amount of rainfall and evaporation rates. A removal action

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to prevent airborne migration of exposed materials by pushing them below the water surface was completed in December 1990. Minor tears of the liner above the water line have been observed and repaired.

- **Burn Pit** - Constructed in 1957 at the site previously used to excavate the clay liner material for waste pits 1 and 2. Depth of the burn pit varies because of the sloping bottom used for access during excavation and disposal operations. Maximum depth is believed to be about 20 feet. Boundaries are no longer discernible from the boundaries of covered waste pit 4, but the burn-pit area is assumed to be bounded by waste pits 2, 3, 4, and 5. The surface area of the burn pit is approximately 21,724 square feet. It holds an estimated 9,074 cubic yards of waste consisting of burned laboratory chemicals including pyrophoric and reactive chemicals, waste oils, and other low-level contaminated combustible materials such as wooden pallets.

  The burn pit is fairly level and overgrown with grass. A ditch two to three feet deep cuts across the area on the west side and drains toward waste pit 2.

- **Clearwell** - Constructed at the time of waste pit 1 excavation, the clearwell currently receives surface water runoff from the surfaces of waste pits 1, 2, and 3 and excess impounded storm water from waste pit 5.

  Before March 1987, the clearwell was used as a final settling basin for process water that passed through waste pits 3 and 5 before discharge to the Great Miami River. Water of varying depth remains in the clearwell at all times. The depth of sediment remaining in the clearwell is presently estimated at 11 feet.

2.2.3.2 <u>OU-2</u>. OU-2 consists of the solid waste landfill (containing approximately 18,000 cubic yards of waste), the south lime sludge pond (approximately 11,500 cubic yards), the north lime sludge pond (approximately 5,000 cubic yards), the inactive fly ash disposal area (approximately 50,000 cubic yards), the active fly ash pile (approximately 38,000 cubic yards), and southfield (approximately 125,000 cubic yards of construction rubble) (U.S. Department of Energy, 1991b).

- **Solid Waste Landfill** - Located in the northeast corner of the waste storage area, the facility is organized into five individual cells that comprise approximately one acre. The waste volume is believed to be approximately 16,000 to 18,000 cubic yards consisting of cafeteria waste, rubbish, and other types of wastes from nonproduction areas. Materials reported to have been accepted in the past include nonburnable and nonradioactive sanitary wastes generated on property, nonradioactive construction-related rubble, and double-bagged and bulk quantities of nonradioactive asbestos. Construction rubble placed in the landfill and the soil used to cover exposed wastes may have been contaminated with radionuclides.

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Use of the landfill was halted in early 1986. The five existing cells were covered with soil as they were filled to capacity. A soil cover was placed over the five cells and the adjacent disposal area, forming the topographic setting shown in Figure 2-6 (Appendix A). Currently, sanitary wastes and general refuse are being collected for shipment and disposal at approved off-site locations.

As part of the on-going remedial investigation at FEMP, additional samples of the solid waste landfill were collected and analyzed by the Toxicity Characteristic Leachate Procedure (TCLP) to determine whether the wastes exhibit toxicity characteristics defined in 40 Code of Federal Regulations (CFR) 261. Results will be reported in 1992.

- **South Lime Sludge Pond** - An unlined pond in the southeast corner of the waste storage area (Figure 2-7; Appendix A) with approximate surface dimensions of 150 by 250 feet. Borehole log information indicates the depth of the south pond to be approximately 11.5 feet. Spent lime sludge from the FEMP water treatment plant operations (lime/alum sludge and boiler plant blowdown) was pumped to the pond and allowed to settle. The sludge volume is estimated to be approximately 11,500 cubic yards and the volume of berm material is estimated to be 2,800 cubic yards. The pond was inactive for a number of years but was re-activated recently and currently receives spent lime sludge. It is now overgrown with grass and shrubs.

- **North Lime Sludge Pond** - An unlined pond (Figure 2-7, Appendix A),about 150 by 250 feet in size, that contains an estimated 5,000 cubic yards of spent lime sludge (lime/alum sludge and boiler plant blowdown) pumped from the FEMP water treatment plant operations. The volume of berm material is estimated to be 1,100 cubic yards. The height of the berm surrounding the north pond is lower than the height of the south pond. The depth of the lime sludge in the north pond ranges from five to seven feet. This pond is partially covered with water (estimated to be a maximum of 150,000 gallons) that ranges from one to seven feet in depth. The actual volume of water varies, depending on plant operations and precipitation. As with the south pond, spent lime sludge was, until recently, pumped to the north pond and allowed to settle. This pond is now approximately 90 percent full. The total volume of lime sludge in both the north and south ponds is estimated to be 16,500 cubic yards.

- **Inactive Fly Ash Disposal Area** - Located approximately 2,000 feet southwest of the production area (Figure 2-8, Appendix A). A sampling program was recently conducted in the area, but the results have not been reported yet. The following observations were made based on previously existing data.

  - The northern portion of the inactive fly ash disposal area is on top of an old drainageway leading to Paddys Run. A borehole was advanced to a depth of

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about 26 feet before reaching undisturbed soil. Approximately one foot of clay was found in this undisturbed interval with sand located under the clay.

- The west/southwest portion of the inactive fly ash disposal area is on a slope just north of the running track/firing range. A boring in this area was advanced to a depth of 34 feet before reaching undisturbed soil.

- Assuming over 2,500 to 3,500 tons of fly ash were generated per year over a 38-year operating period with a density of 80 pounds per cubic foot, a total of 88,000 cubic yards of fly ash is estimated to exist in the active fly ash pile and inactive fly ash disposal area. This may be an overestimation of the actual volume because some fly ash was disposed of in the burn pit and in waste pit 3 in OU-1. However, this information is the most reliable and current estimate of the total volume of fly ash under the stated assumptions.

- Historical photographs indicate that disposal activity ceased between 1964 and 1968, therefore an estimate of 50,000 cubic yards for the inactive fly ash disposal area is reasonable based on available data.

- Elevated levels of uranium were found during sampling activity performed in the Characterization Investigation Study (CIS) (Weston, 1987). It is suspected that waste oils containing uranium were sprayed on the pile as a dust suppressant. Approximately 1,000 kilograms (kg) of uranium is estimated to have been present in the oils used as a dust suppressant (Weston, 1987).

- Building rubble such as concrete, gravel, asphalt, masonry, and steel rebar were also reportedly discarded in this area.

- **Active Fly Ash Pile** - Located just east of the running track/southfield, on the opposite side of the south construction road and west of the storm sewer out-fall ditch (Figure 2-9, Appendix A). The estimated volume of the active fly ash pile is about 38,000 cubic yards.

  In current as well as past operations, fly ash from the coal-fired boiler plant is loaded into dump trucks and taken to the fly ash disposal site. In the past, contaminated waste oils were periodically sprayed on the fly ash pile as a means of dust control (Weston, 1987). This is believed to be the reason for elevated levels of radiological contaminants found in surface samples.

- **Southfield** - Boundaries of the southfield and the volume of waste therein have not been defined. Historical photos and borehole logs were used to estimate boundaries, waste volume, and area. Based on aerial photographs from 1954 and 1957 showing where fill activity occurred, the boundary of the southfield assumed for the initial

screening of alternatives and feasibility study is (shown in Figure 2-10, Appendix A). The area covers approximately 11 acres and contains 125,000 cubic yards of disposed materials (U.S. Department of Energy, 1991b). 3200

The southfield was reportedly used as a burial site for construction rubble (including debris from razing the old administration building) that may have contained low levels of radioactivity.

2.2.3.3 OU-3. The former production area and additional suspect areas comprise OU-3. The plan of investigation for OU-3 is currently being prepared and is scheduled to be submitted to EPA for review in June 1992. The following suspect areas (Figure 2-11, Appendix A) are being addressed.

- Area within the east buffer zone
- Clearwell to manhole 175 pipeline
- Fire training area
- Flagpole area near the old administration building site
- Sewage treatment plant/incinerator area
- K-65 slurry line
- Main effluent line
- Rubble mound west of the K-65 silos
- Rubble mound south of the K-65 slurry line
- Rubble area in the northeast corner of the pit area

Four quadrants were defined within the former production area in order to logistically focus the investigations. These include a number of drummed-waste storage areas and are described as follows along with their main components.

- **Southeast Quadrant** - Plants 4, 5, 6, 7; main electrical substation; and site garage
- **Southwest Quadrant** - Plants 2, 3, and 8, general sump, pilot plant, and laboratory
- **Northwest Quadrant** - Plant 1 and drum storage pad

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- **Northeast Quadrant** - Plant 9, decontamination and decommissioning facility, maintenance building, boiler plant, tank farm, and metal scrap pile (U.S. Department of Energy, 1990b)

2.2.3.4 OU-4. OU-4 consists of special facilities with waste characteristics requiring potential application of singular technologies to effect final remediation. Specifically, OU-4 consists of the K-65 silos (1 and 2), metal oxide silos (3 and 4), piping and tanks below the silos; and the earthen embankment that provides structural support for silos 1 and 2.

Wastes in silos 1 and 2 contain about 11,200 kg of uranium and 1.6 to 3.7 kg of radium. Silo 3 may contain about 18,000 kg of uranium and an unknown mass of thorium and radium. Available evidence suggests that silo 4 was never used for waste storage (U.S. Department of Energy, 1990c).

2.2.3.5 OU-5. Environmental media that represent potential pathways or environmental receptors presently or potentially affecting FEMP activities are included in OU-5. OU-5 media are linked to the four source-control OUs (1 through 4) but are not primary sources of contamination. There are no waste disposal or process units associated with OU-5 (U.S. Department of Energy, 1990d). The following media are included in OU-5 studies.

- Surface water and sediments of the Great Miami River, Paddys Run, and the storm-water outfall ditch; dynamics of contaminant transport within and between these media, and the interaction of contamination in these media with ground water in the regional aquifer and with aquatic communities

- Ground water throughout the FEMP study area and the impact of ground water contamination on other media

- Soils not included in other OUs including soils outside the production area (OU-3), other controlled areas of the site, and suspect areas outside the FEMP boundary

- Flora and fauna in the area including terrestrial vegetation and animals, aquatic communities in the Great Miami River and Paddys Run, local agricultural products, wetlands, and threatened and endangered species

- Ambient air as an environmental pathway but not as a medium requiring direct remediation (U.S. Department of Energy, 1990d)

2.2.3.6 Comprehensive, Sitewide Operable Unit. Sitewide evaluation of selected remedies and removal actions for OUs 1 through 5 to ensure that they are protective of human health and the environment on a sitewide basis as specified by CERCLA, the NCP, and applicable EPA policy and guidance. This OU was added to the Consent Agreement when it was revised in September 1991.

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2.2.4 Remedial Investigation and Feasibility Studies

RI/FSs are conducted to collect data required for EPA and DOE to choose remedial actions sufficiently protective to mitigate excessive risks to human health and the environment from FEMP (U.S. Department of Energy, 1990d). RI/FSs for each of the OUs are currently underway to determine the nature, extent, and threat of past releases and to conduct baseline risk assessments, evaluation of remedial alternatives, and detailed evaluation of preferred alternatives.

2.2.5 Contaminants of Concern

The primary contaminants of concern that may be present in the OUs are as follows.

- **OU-1** - radionuclides, trace metals, and volatile organic compounds
- **OU-2** - radionuclides and trace metals
- **OU-3** - radionuclides, trace metals, volatile organic compounds, semi-volatile organic compounds, pesticides, PolyChlorinated Biphenyls (PCBs), acids, and fuel and lubricating oils
- **OU-4** - radionuclides and trace metals
- **OU-5** - all contaminants of concern in OUs 1 through 4

2.2.5.1 <u>OU-1</u>. Approximately 5.3 million Kg of uranium; 80,000 Kg of thorium; and an unknown quantity of asbestos, barium, fluoride, magnesium, and various other organic (tetrachloroethane, 2-butanone, acetone, methylene chloride, PCBs) and inorganic (arsenic, cobalt, copper, silver, vanadium) constituents are present in OU-1. Based on the transport characteristics, volume, and toxicity, uranium is the primary contaminant of concern (U.S. Department of Energy, 1991a).

Releases to the environment from OU-1 have occurred. The surface soils, glacial overburden, and ground water beneath the waste pits are contaminated. The principal environmental concern associated with OU-1 is contaminant migration and transport in surface and ground water. Following is a brief description of Remedial Investigation results reported to date.

- **Surface Soils** - U-238 concentrations in surface soils are elevated east of pits 1 and 2 and around the perimeter of pit 6. Several locations within the waste pit area have concentrations above 35 picocuries per gram (pCi/g) and at some locations as high as 10,900 pCi/g. The majority of sampling locations show Th-232 concentrations ranging between 1 and 5 pCi/g. Locations associated with elevated U-238 activity

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show Th-232 concentrations ranging from 5 to 15 pCi/g. The areal extent of Ra-226 concentrations above background levels of 1.5 pCi/g is quite low.

Surface soil samples collected within OU-1 during the RI/FS were mostly from the north and northwest perimeter of the waste pit area, which was not covered under the CIS program. Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, and U-238 appear consistently in these samples. The observed concentrations for radium are at or slightly above background levels. Uranium and thorium concentrations are above background with concentrations ranging from 1.0 to 62.0 pCi/g for uranium and 0.6 to 13.6 pCi/g for thorium (U.S. Department of Energy, 1991a).

- **Subsurface Soils** - Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, and U-238 were consistently detected in subsurface soil samples from OU-1. The concentration ranges for these radionuclides in pCi/g are: 0.4 to 1,210 for Ra-226, 0.5 to 160 for Ra-228, 0.6 to 22.9 for Th-228, 0.6 to 710 for Th-230, 0.6 to 33.1 for Th-232, 0.6 to 112 for U-234, and 0.6 to 320 for U-238. These data do not include results from sampling conducted in late 1991.

  Uranium is present in higher concentrations than the other radionuclides in the upper 15 feet of the glacial drift. Radium and uranium concentrations in glacial outwash samples are generally within background levels. Thorium concentrations are within or slightly above background levels (U.S. Department of Energy, 1991a).

- **Surface Water** - Analytical results of surface water samples collected at 12 locations along drainageways within OU-1 indicate presence of radionuclides in the storm water runoff from the waste pits.

  Most radionuclides are present at background concentrations. Total uranium concentrations range from 54 to 9,318 micrograms per liter (μg/L). Concentrations of U-234 and U-238 in two samples exceed the DOE Concentration Guide (DCG) limit of 500 picocuries per liter (pCi/L) for U-234 and 600 pCi/L for U-238. The samples contain 597 and 653 pCi/L of U-234 and 2,840 and 2,506 pCi/L of U-238. Radium was detected in only one surface water sample at a level of 6.1 pCi/L. Thorium was not detected in the samples.

- **Sediments** - Sediment samples were not collected within OU-1 during the remedial investigation. However, several drainage ditches within OU-1 were sampled during the CIS program.

  Review of CIS data indicates widespread uranium contamination in most of the drainage ditches. A sample from a drainageway that flows parallel and adjacent to the south berm of waste pit 5 contains U-238 activity concentrations ranging from 46 to 728 pCi/g. The radium and thorium concentrations are low in all the drainageway

samples with concentrations ranging from nondetectable to slightly above detection limits (approximately 1 pCi/g). Samples from a shallow drainageway flowing north and south over the burn pit area contain U-238 activity concentrations ranging from 170 to 408 pCi/g. Samples from a minor drainageway flowing east of pit 4 contain U-238 activity concentrations ranging from 96 to 746 pCi/g (U.S. Department of Energy, 1991a). 3200

- **Ground Water** - Perched ground water in the glacial drift is heavily contaminated with uranium. The highest concentration of uranium, 15,330 μg/L of total uranium, was detected on the south edge of waste pit 4. Leakage from the waste pits is suspected of being the contamination source in the eastern ground water plume.

  The 2000-series wells are screened across the water table of the Great Miami Aquifer. Contaminants from the heavily contaminated glacial drift have infiltrated from the perched ground water zones to the Great Miami Aquifer. Concentrations of uranium above background (approximately 2 μg/L) have been detected in 2000-series wells, the highest concentration being 78.8 μg/L.

  Uranium concentrations in 3000-series wells are also elevated. Concentrations more than ten times background have been detected, the highest being 110.0 μg/L.

  At the deepest levels of the aquifer, monitored by the 4000-series wells, uranium concentrations do not exceed background levels (U.S. Department of Energy, 1990a).

- **Biological Resources** - The investigation of biological resources conducted during the Remedial Investigation revealed that there is uptake of radionuclides by both plants and animals within OU-1.

  Total uranium concentrations in samples of vegetation roots collected in OU-1 ranged from 1.8 to 31.3 pCi/g. Other radionuclides were detected in concentrations either below detection limits or at background levels.

  A composite macro-invertebrate sample from Paddys Run at a site near OU-1 contained 6.4 pCi/g of total uranium. A crayfish sample had 4.4 pCi/g of total uranium. Other radionuclide concentrations in the samples are below detection limits.

2.2.5.2 <u>OU-2</u>. Primary contaminants of concern for OU-2 include uranium and cadmium from the solid waste landfill and fly ash piles; uranium and thorium at the lime sludge ponds; and uranium, thorium, and cadmium in the southfield. Various other organic and inorganic materials have been detected in source materials from these areas, but current data indicate that these constituents have not migrated from the source area.

- **Solid-Waste Landfill** - Contains the highest diversity of organic and inorganic chemicals among OU-2 sites. A large variety of organic compounds, including PCBs

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(aroclors 1242, 1248, and 1254), polynuclear aromatic hydrocarbons (benzo[a]pyrene and benzo[b]fluoranthene), other volatile organics (1,1,1-trichloroethane and benzene), semivolatile organics (naphthalene and phenol), and common laboratory contaminants (acetone, methylene chloride, and di-n-butyl phthalate) were all detected in samples of waste from the landfill. Cadmium, zinc, U-234, U-235, and U-238 were also detected in the source at concentrations above available background levels (U.S. Department of Energy, 1991b).

Chemicals detected above blank and background concentrations in both the source and perched ground water were cadmium, U-234, and U-238. Concentrations of cadmium detected range from 0.007 to 0.0128 parts per million (ppm). Concentrations of U-234 detected in perched ground water beneath the solid waste landfill range from 1.2 ± 0.4 pCi/L to 4.6 ± 0.7 pCi/L. U-238 concentrations detected range from 1.0 ± 0.3 pCi/L to 3.9 ± 0.6 pCi/L.

An apparent southerly to southeasterly perched ground water gradient exists beneath the solid waste landfill. The potentiometric surface of the perched ground water appears to intersect the base of the landfill, indicating that the landfill is a possible source of contamination for the perched ground water.

Surface water and sediment samples were taken in the drainage channel north of the solid-waste landfill. Concentration of U-234 detected at the bottom of the drainage channel directly north of the landfill is 6.1 ± 0.9 pCi/L and U-238 concentration is 9.7 ± 1.4 pCi/L. Bis(2-ethylhexyl)phthalate and 2-propanone were detected in the associated blank and in the surface water sample, indicating that the contaminants were probably introduced during laboratory analysis.

U-238 concentration of sediment samples taken in the portion of the drainage channel north of the solid waste landfill range from 2.90 ± 1.80 pCi/g to 6.80 ± 1.30 pCi/g. Because of U-234 and U-238 concentrations detected in surface water and sediment samples taken from the drainage channel, the landfill may be a minor source of surface water and sediment contamination through its surface water runoff from or seepage through the southern bank of the drainage channel.

- **Lime Sludge Ponds** - The north and south lime sludge ponds contain a similar variety of chemicals. Organic compounds detected in the ponds include: phenol, acetone, bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and methylene chloride. Radionuclides detected at concentrations greater than background levels in the lime sludge are Th-230, U-234, U-235, and U-238 (U.S. Department of Energy, 1991b).

  Chemicals detected at concentrations above background levels in both the lime sludge ponds and perched ground water were Th-230, U-234, and U-238. Concentrations of U-234 detected in the perched ground water beneath the lime sludge ponds range from

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1.4 ± 0.4 pCi/L to 9.5 ± 1.5 pCi/L. U-238 concentrations range from 1.7 ± 0.5 pCi/L to 9.7 ± 1.5 pCi/L. The highest concentrations of U-234 and U-238 were measured southwest of the lime sludge ponds. The highest concentration of Th-230 (1.6 ± 0.6 pCi/L) was measured in well 1041 in the east berm of the south pond.

An apparent southwesterly perched ground water gradient exists beneath the lime sludge ponds. The potentiometric surface of the perched ground water apparently intersects the base of the lime sludge ponds. The perched ground water zone beneath the lime sludge ponds appears to extend continuously beneath the production area. The potentiometric surface of the perched water table appears to reside within the lime sludge ponds, suggesting the presence of a ground-water mound.

Organics detected in the lime sludge ponds were not detected in perched ground water beneath the ponds suggesting that these organics are contained within the lime sludge ponds or bound in the surrounding glacial overburden.

Calcium and magnesium are primary components of lime sludge and the increased levels of these constituents in the perched ground water in the vicinity of the lime sludge ponds indicate release from the ponds into the environment.

- **Active Fly Ash Pile** - Chemical analyses of constituents in the active fly ash pile were performed for RCRA metals (barium and chromium), volatile organics, and radionuclides in composites and surface soil samples. Analyses for inorganic and PCB constituents are being conducted on additional samples collected during 1991 and will be reported in 1992 (U.S. Department of Energy, 1991b).

Organics detected in the active fly ash pile were acetone, 2-butanone, chloroform, methylene chloride, and 1,1,1-trichloroethane. In addition to these constituents, Pb-210, Ra-226,Th-230, U-234, U-235, and U-238 were detected at above background levels in the active fly ash pile.

Neither inorganic nor PCB analyses were performed on samples taken in the active fly ash pile. The concentrations of these constituents were assumed to be similar to those in the inactive fly ash disposal area. The only inorganic chemicals detected at above background concentrations in the inactive fly ash disposal area were cadmium and lead. Results of more recent sampling have not been reported.

Chemicals detected at concentrations above background levels in both the active fly ash pile and perched ground water were U-234, U-238, and cadmium. U-234 concentrations detected in the perched ground water beneath the active fly ash pile range from 4.5 ± 1.0 pCi/L to 6.6 ± 1.2 pCi/L. U-238 concentrations from 4.0 ± 1.0 pCi/L to 6.9 ± 1.1 pCi/L. U-234 and U-238 were detected in well 1048, located north of the active fly ash pile. Cadmium was detected at a concentration of 0.003 to

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0.0069 ppm in well 1048. Elevated levels of uranium detected in the active fly ash pile indicated possible migration of the source contamination to the underlying perched ground water. Possible transport mechanisms include surface water runoff and seepage through the northern slope of the active fly ash pile migrating vertically through the weathered glacial overburden into the perched ground water.

Chemicals detected at concentrations above background levels in both the active fly ash pile and adjacent surface waters were Ra-226, total uranium, and lead. Concentrations of total uranium measured in samples taken from a drainage channel north of the active fly ash pile are 14.0 ± 2.0 μg/L. Ra-226 was detected at a concentration of 1.5 ± 0.3 pCi/L in samples from a drainage channel immediately west of the active fly ash pile. Lead was detected at a concentration of 0.036 ppm in samples from the same location. Detection of total uranium, Ra-226, and lead in surface water samples from locations adjacent to the active fly ash pile indicates probable migration of contamination from the pile via the surface water media.

Ra-226 and total uranium were detected at concentrations above background levels in both the active fly ash pile and adjacent sediments. RA-226 concentrations range from 0.6 ± 0.1 pCi/g and 2.9 ± 0.3 pCi/g. Concentrations of total uranium range from 4.5 ± 1.2 μg/g and 51.8 ± 8.3 μg/g. Detection of Ra-226 and total uranium in sediment samples from a location adjacent to the active fly ash pile indicates that the active fly ash pile is a probable source of contamination to adjacent sediments.

- **Inactive Fly Ash Disposal Area** - Comparison of both chemicals and radionuclides in the inactive fly ash disposal area to concentrations detected in blanks and background samples reveals PCBs (aroclors-1242, 1254, and 1260), cadmium, lead, Pb-210, Ra-226, Ra-228, Th-230, U-234, U-235, and U-238 as chemicals of potential concern at the source (U.S. Department of Energy, 1991b).

Chemicals detected at concentrations above background levels in both the inactive fly ash disposal area and perched ground water were cadmium, U-234, and U-238. U-234 concentrations detected in the perched ground water beneath the inactive fly ash disposal area range from 3.7 ± 0.6 pCi/L to 7.4 pCi/L and U-238 concentrations range from 2.1 ± 0.4 pCi/L to 3.6 ± 0.7 pCi/L.

Total uranium concentration is 40.0 ± 6.0 μg/L in samples from surface water in a drainage channel west of the northwest section of the inactive fly ash disposal area that empties into Paddys Run. Presence of total uranium indicates probable migration of contamination from the inactive fly ash disposal area via surface water media.

Ra-226, Ra-228, and U-238 were detected at concentrations above background levels in both the inactive fly ash disposal area and adjacent sediments. Maximum measured concentrations of Ra-226 and Ra-228 are 0.9 ± 0.1 pCi/g in nine samples from

locations southwest of the inactive fly ash disposal area in an east/west-oriented drainage channel that empties into Paddys Run. Two sediment samples taken in the drainage channel west of the inactive fly ash disposal area during the Weston CIS have U-238 concentrations ranging from 4 pCi/g to 9 pCi/g. Detection of uranium in sediment samples from locations adjacent to the inactive fly ash disposal area indicates that the disposal area is a probable source of contamination to adjacent sediments.

PCBs (Aroclors 1242, 1254, and 1260) were detected in the source at concentrations ranging from 5.70 to 290.0 ppb. PCBs were not detected in perched ground water, surface water, or sediments beneath and adjacent to the inactive fly ash disposal area, indicating that the PCBs have been contained within the source or bound in the surrounding glacial overburden.

- **Southfield** - Southfield is a large, heterogeneous site that overlaps the inactive fly ash disposal area. Chemicals and radionuclides detected in southfield at concentrations exceeding available background levels were PCBs (aroclors 1242,1254, and 1260), methylene chloride, cadmium, mercury, Sr-90, Pb-210, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, and U-238 (U.S. Department of Energy, 1991b).

  Chemicals detected at concentrations above background levels in both the southfield and perched ground water are cadmium, Th-228, Th-230, U-234, and U-238. Well 1046, located at the northern boundary of the southfield, has a Th-228 concentration of 1.1 ± 0.5 pCi/L and a Th-230 concentration of 1.0 ± 0.5 pCi/L. U-234 concentrations detected in the perched ground water beneath the southfield range from 2.0 ± 0.5 pCi/L to 2.8 ± 0.5 pCi/L. U-238 concentrations range from 1.9 ± 0.4 pCi/L to 2.3 ± 0.5 pCi/L. Cadmium was detected at a concentration of 0.008 ppm in well 1046. Elevated levels of uranium and cadmium detected in the southfield indicate possible migration of source contamination to the underlying perched ground water via vertical transport through the weathered glacial overburden.

  Organics (methylene chloride and aroclors 1242, 1254, and 1260) detected in the southfield were not detected in the perched ground water beneath the southfield. This suggests that these organics have been contained within the southfield or bound in the surrounding glacial overburden.

2.2.5.3 <u>OU-3</u>. OU-3 contaminants of concern include uranium, thorium, radium, technetium, magnesium, manganese, molybdenum, selenium, vanadium, and volatile organic compounds, all of which have been identified in perched ground water. Numerous other trace metals; asbestos; PCBs and other organic materials; and inorganic ions such as nitrate, sulfate, and fluoride have a high potential for being present based on the production history of the site. However, uranium is the predominant contaminant found in OU-3 (U.S. Department of Energy, 1990b).

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The RI/FS work plan addendum for OU-3 is being prepared and will be submitted to EPA in June 1992.

2.2.5.4 OU-4. The primary radioactive constituents of silos 1 and 2 are Ra-226, Rn-222, Th-230, and U-235 (0.71 weight percent). The majority of the material is silica and metallic compounds (U.S. Department of Energy, 1990c).

Radon and elements resulting from its decay (daughter products, progeny) are the nuclides of concern from a health and environmental perspective. It has been determined that radon is diffusing out of the silos via cracks and structural joints. Radon and its daughter products are relatively mobile and capable of migrating through air and water (U.S. Department of Energy, 1990e). To date, there is no evidence that other contaminants have migrated into the environment from the silos. The diffusion of radon into the berms indicates that berms and subsoils may contain elevated levels of Pb-210 and Po-210 that resulted from the decay of radon that diffused into the berm. There may have been leakage from the existing leachate collection system beneath the silos into the surrounding soils. Sampling of the berms and soil beneath the silos has been conducted and results will be reported in 1992. A removal action to mitigate release of radon gas from silos 1 and 2 to the environment was conducted in late 1991. The removal action consisted of installing a layer of bentonite clay over the silo contents to prevent direct contact with the atmosphere. Permeability of bentonite is sufficiently low that radon gas should decay to solid daughter products before it can migrate through the clay layer.

Silo 3 contains a very small amount of Ra-226, silica, Th-230, U-235 (0.71 weight percent), and other metal oxides. Its contents are not a significant radon source, and, because of its dry, powdery consistency, it is not believed to be a source of contaminant migration to surrounding and underlying environs. It is, however, still a source of radioactivity and a potential airborne contaminant hazard because it is dry and powdery.

2.2.5.5 OU-5. OU-5 is not a source area, therefore contaminants of concern are extrapolated from other sources. Uranium contamination of ground water has been identified in the waste pit, production area, along the southern boundary of FEMP, and along Paddys Run Road. Volatile-organic-compound contamination has been confirmed below the waste pits and along Paddys Run Road. The contamination along Paddys Run Road is suspected to be from a source other than FEMP (U.S. Department of Energy, 1990d). It is being investigated by industries situated along Paddys Run Road under an agreement with the Ohio Environmental Protection Agency. Volatile organic contamination from on-site sources is currently being investigated.

Additional contaminants of concern may be identified during the ongoing RI/FSs. Newly identified contaminants will be individually addressed during site investigation or remediation or through use of indicator chemicals (U.S. Environmental Protection Agency, 1989).

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2.2.6 Other Regulatory Issues

In addition to compliance with CERCLA, FEMP shall also comply with other regulatory requirements including DOE Orders, RCRA, the Clean Air Act, CWA, NPDES, Safe Drinking Water Act, National Environmental Policy Act (NEPA), Toxic Substances Control Act, Pollution Prevention Act of 1990, and Underground Storage Tank requirements of the Ohio State Fire Marshall. It is the intent of FEMP to meet or exceed the substantive requirements of each of these regulations.

DOE entered into a consent decree with the state of Ohio on 2 December 1988 that outlined specific actions to characterize and manage hazardous waste in accordance with RCRA and to protect waters of the State as required by CWA. The decree arose in response to allegations by the State that DOE and National Lead of Ohio violated various provisions of both state and federal laws and regulations. Amendments to the consent decree were proposed in December 1990 specifying additional actions to comply with RCRA.

Revision 2 (28 June 1991) of the RCRA Part A Permit Application identified 47 Hazardous Waste Management Units (HWMU) at FEMP. FEMP will continue to operate seven HWMUs under the RCRA Part B application (October 1991). One of the HWMUs, the barium chloride salt treatment facility, has been closed. The remaining 39 HWMUs will be closed in accordance with closure plans currently under review or the schedules provided by FEMP to the Ohio Environmental Protection Agency 27 August 1991.

Individual HWMU closure plans will specify sampling and analysis necessary to evaluate potential contamination of the surrounding environment resulting from hazardous waste management activities. Seven HWMUs to be closed are land-based units (surface impoundments, landfills, and land treatment units) that are subject to RCRA ground-water monitoring requirements. The other HWMUs, which are not defined as land-based, will not be subject to ground-water monitoring requirements unless it is determined that contaminants have been released that could result in ground-water contamination.

Wastes generated at FEMP are subject to waste determination and characterization. These evaluations are based on a combination of process knowledge and sampling and analysis. RCRA hazardous waste characterizations and determinations will follow the current FEMP Waste Analysis Plan as required by Ohio Administrative Code 3745-54-13.

Stack monitoring is conducted under the Clean Air Act. Because there is no present production at FEMP, laboratory hoods and the boiler plant are the main areas affected by these regulations.

Water discharges from FEMP to the Great Miami River through the main plant effluent line, including collected storm water runoff, fall under CWA. Discharges shall be maintained

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within limits specified in the site NPDES permit. Contributing outfalls shall meet their own requirements to ensure that the final composite stream remains within limits.

Because of the population size served by the plant potable water system, monitoring for coliform bacteria and various other constituents defined by Safe Drinking Water Act shall be performed on a routine basis.

As part of the environmental restoration of FEMP, underground storage tanks are being removed and necessary remediation performed as required by the Ohio State Fire Marshall. Reports of findings and conclusions are provided to EPA and the state of Ohio.

2.3 PROJECT OBJECTIVES

2.3.1 Specific Objectives

Specific objectives of an environmental sampling and analysis project shall be specified in Project-Specific Plans (PSP). Examples of project objectives are included in Table 2-1 (Appendix A).

2.3.2 Intended Data Usages

The intended use of acquired data is to assess the nature of the site and the degree and extent of potential problems resulting from past activities, evaluate the potential hazard to human health and the environment, evaluate remedial actions, choose and implement preferred remedial actions, and monitor plume migration and the effectiveness of remedial actions. Data partially fulfilling these requirements have been collected in previous and ongoing studies. Use of these data and identification and collection of additional data needs will fulfill the intent of the 1991 amended Consent Agreement and the stated site remediation objectives of DOE.

2.3.3 Data Quality Objectives

Data Quality Objectives (DQO) are qualitative and quantitative statements that specify the quality of data required to support decision making. Because they are based on end use of the data to be collected, different uses require different levels of data quality. There are five FEMP-defined analytical levels that will be assigned depending on intended use of the data and the Quality Assurance/Quality Control (QA/QC) methods required to achieve the desired level of quality. These levels are analogous to the 1987 EPA-defined DQO levels 1 through 5 (U.S. Environmental Protection Agency, 1987). However, because radionuclides comprise a large proportion of the analyses supporting FEMP programs and projects and because these radionuclide analyses have been used and verified by DOE and DOE contractors for many years, it is appropriate to address these measurements as standard. Therefore, in order to

maintain consistency in definition of DQO levels and to avoid confusion between EPA and DOE/EPA programs, DQO levels at FEMP will be referred to as Analytical Support Levels (ASL) A through E. 3200

QA/QC requirements for ASLs are provided in Table 2-2 (Appendix A). End data users prescribe ASLs for data to develop DQOs as specified in Appendix C. Analytical methods for use for each ASL are defined in Attachment I. Data validation requirements are specified in Appendix D. Following are definitions of A through E levels of quality.

ASL A (Qualitative Field Analysis) - Provides the most rapid (real or short time) results. ASL A is often used for health and safety monitoring at the site, preliminary comparison to Applicable or Relevant and Appropriate Requirements (ARAR), initial site characterization to locate areas for subsequent and more accurate analyses, field screening of samples to select those for fixed laboratory analysis, and engineering screening of alternatives (bench scale tests). These types of data include those generated on site through the use of Photo- or Flame- Ionization Detectors (PID or FID), pH, conductivity, alpha and beta-gamma friskers, or radiological wipe samples. Analogous to EPA DQO Level 1.

Example: Field screening for alpha, beta, and gamma radiation conducted with portable field equipment provides real time qualitative analysis for the presence or absence of radioactive isotopes.

Example: Field screening for chemical gases in the well bore of ground-water monitoring wells using Photo-Ionization Detectors provides real time qualitative analysis for presence of volatile organic compounds (e.g., benzene, toluene).

ASL B (Semi-Quantitative/Quantitative and Qualitative Analyses) - Provides more quality control checks than ASL A and results may be qualitative, semi-quantitative, or quantitative. ASL B can be assigned when rapid turnaround results are needed. FEMP-specified analytical protocols in Attachment I shall be used. There are two sublevels available for specifying QA/QC, data reporting, and data validation requirements.

Sublevel 1 specifies QA/QC, data reporting, and data validation requirements for FEMP-specified analytical protocols, which are similar to those used for ASLs C and D, but with different QA/QC sample type and frequency, quality control criteria for acceptance ranges, and requirements for data packages.

Sublevel 2 specifies user-defined and special requirements. The data user shall specify QA/QC, data reporting, and data validation requirements based on intended data use and regulatory requirements. Specific requirements shall be defined in PSPs.

Methods may range from more sophisticated screening techniques to fully defined methods similar to ASL C or D for radiological and nonradiological parameters, but with reduced

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QA/QC frequency and data reporting requirements for more rapid turnaround times. Also included in ASL B are standard methods (e.g., EPA 500-series drinking water methods with QA/QC requirements different than those specified for ASLs C and D) and conventional parameter analysis in support of regulatory requirements such as NPDES permit monitoring.

Example: Measurement of gross alpha and beta radioactivity in water in compliance with the Safe Drinking Water Act to provide information on drinking water quality.

Example: Determination of volatile halogenated organic compounds (e.g., chloroform) in water by purge and trap gas chromatography without second column confirmation, with a limited suite of field and laboratory QC samples, and a minimal data package.

ASL C (Quantitative with Fully Defined QA/QC) - Provides data generated with full QA/QC checks of types and frequencies specified for ASL D according to FEMP-specified analytical protocols for radiological and nonradiological parameters. The analytical methods are identical to ASL D for QA/QC sample analysis and method performance criteria. However, the data package does not typically contain raw instrument output but does include summaries of QA/QC sample results. ASL C may be used when analyses require a rigid, well-defined protocol, but where other information is available, so that a complete raw data package validation effort is not required. Laboratories shall be required to retain, in the project file, raw instrument data required to upgrade ASL C reports to ASL D.

Example: Analysis of total uranium by the fluorimetric method with a full set of QA/QC samples as specified for ASL D. A summary data package is provided including QA/QC sample performance without raw instrument output. A limited level of data validation is required because only the summary forms need review.

Example: Determination of volatile organic compounds in soil by purge and trap gas chromatography/mass spectrometry with a full complement of QA/QC samples as specified for ASL D. A summary data package is provided including QA/QC sample performance without raw instrument output. A limited level of data validation is required because only the summary forms need review.

ASL D (Confirmational With Complete QA/QC and Reporting) - Provides data generated with a full complement of QA/QC checks of specified types and frequencies according to FEMP-specified analytical protocols for radiological and nonradiological parameters. The data package includes raw instrument output for validation of ASL D data. It may be used to confirm data gathered at ASLs B and C and when full validation of raw data is required.

Example: Analysis of total uranium by the fluorimetric method, with a full set of QA/QC samples per analytical batch (See Glossary terminology.) with analytical results and the full raw data package reported from the laboratory.

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Example: Determination of volatile organic compounds in soil or water by purge and trap gas chromatography/mass spectrometry with a full complement of field and laboratory QA/QC samples. A complete raw data package is provided and validated for the analyses.

ASL E (Non-Standard) - Analyses by non-standard protocols that often require method development or validation (e.g., when exacting detection limits or analysis of an unusual chemical compound are required). ASL E methods may be significantly different from those specified for ASLs B, C, or D data. New methods may be developed for ASL E data to allow for parameters or matrices that cannot be analyzed using existing standard methods. This could be caused by interferences, analyses performed outside of accepted requirements for existing methods, or new methods developed to meet site-requirements or project-specific requirements that cannot be met by existing analytical methods.

Example: Analysis or evaluation of a geotextile material for suitability to use as a component of a remedial action at the site. Existing evaluation methods may not be adequate to evaluate site-specific needs so development of a new method is required.

Example: Determination of organic compounds (e.g., benz(a)anthracene) in drinking water at sub-part per billion levels by special method on-column injection gas chromatography/mass spectrometry with selective ion monitoring detection and a full suite of field and laboratory QA/QC samples as required for ASLs C and D data. A complete raw data package may be required for validation.

The useability of data is determined by DQO requirements. ASL A data are considered as "good" as level D data if in compliance with DQOs.

2.4 TARGET PARAMETERS

Attachment I contains analytical methods that are currently expected to be used. PSPs will cite existing methods in Attachment I or specify requirements for new methods needed for ASL E data to analyze for specified target parameters. Target parameter lists and quantitation limits for methods currently in the FLAMM are summarized in Table 2-3 (Appendix A).

Target parameters for each project shall be identified in PSPs. Criteria used to determine target parameters for source areas and each potential migration pathway shall include a waste inventory of processes contributing to the source; previous source area sampling results; sampling results of potentially upgradient sources; past monitoring data; indicator chemical determination based on mobility, toxicity, and persistence in the environment; and requirements of specific regulatory programs. Total uranium will generally be included as a target parameter for migration pathway sampling based on results of historical sampling.

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2.5 SAMPLE NETWORK DESIGN AND RATIONALE

The sample network design and rationale shall be specifically described in PSPs. The description shall include the method and justification for determining sampling locations, number of samples to be collected, frequency of sampling, sampling methods, Quality Assurance samples, and degree of confidence that DQOs will be met. Whether sampling locations are determined by judgmental, random, or systematic method shall be justified based on DQOs.

A background sampling plan for naturally occurring constituents in soils has been submitted to EPA and Ohio Environmental Protection Agency for review. The purpose of the plan is to determine background ranges for metals, cyanide, and radionuclides in the FEMP area (U.S. Department of Energy, 1991c).

Three off-site locations northwest and west of FEMP have been identified as primary background sampling sites. These locations are not likely to have been affected by contaminants migrating from FEMP because of the surface and ground water hydrology and prevailing wind directions. The areas were historically used for agricultural purposes prior to construction of FEMP. Each location will be evaluated based on property owner interviews, proximity to potential pollutant sources, and historical data. If a location is found to be unacceptable, an alternate location will be evaluated. Samples will be collected at various depths from four borings at each location, and background levels of the parameters will be determined from their distribution in these samples.

2.6 PROJECT SCHEDULE

A schedule for completion shall be included in each PSP. Elements to be included are the anticipated start date, duration of each project phase including field work, laboratory analysis, data validation, data assessment and interpretation, and submittal of interim and final reports. Thirty calendar days shall be allowed for each phase of regulatory review, and thirty days shall be allowed for comment resolution and resubmittal of documentation by FEMP.

Schedules for major deliverable items for each OU and for the site as a whole are included in Figures 2-12 through 2-17 (Appendix A). These schedules are for reference only, and the 1991 amended Consent Agreement or addenda should be consulted for official schedules.

2.7 REFERENCES

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SECTION 3

Section 3

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PROJECT ORGANIZATION AND RESPONSIBILITIES

Lead agency responsibilities under the National Contingency Plan (NCP) for Oil and Hazardous Substances Pollution at the FEMP lie with the DOE Fernald Office (FO). Under a 1990 Consent Agreement entered into by DOE with the EPA and amended in 1991, DOE agreed to identify, characterize, and remediate environmental contamination at and originating from FEMP.

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. One aspect of TQM is evaluation of the likely impact of an action before it is implemented. TQM encourages cooperation between personnel and agencies in a controlled solution of environmental problems and delegates responsibility for the quality of a task to individuals performing the task.

TQM at FEMP is performed by teams with oversight by DOE, the DOE prime operating contractor, and subcontractor personnel and resources. Six main factors, other than technical requirements, shall be addressed in sampling and analysis project scoping. A list of the factors follows.

- **Personnel Protection** - FEMP is committed to a "Total Safety Attitude." Methods for performing work shall minimize the probability of an accident and keep hazard exposure to an acceptable level in accordance with EPA, Occupational Safety and Health Administration, and Nuclear Regulatory Commission requirements through the use of personal protective equipment and safe work practices. Exposure to potentially harmful conditions or materials shall be As Low As Reasonably Achievable (ALARA).

- **Protection of the General Public and the Environment** - The total-safety-attitude policy is extended to protection of the general public. Activities at the site shall be performed with primary consideration given to protection of human health and the environment.

- **Meeting Data Quality Objectives** - Objectives of data collection activities shall be defined prior to initiation of those activities. Data shall be collected in a manner consistent with specified data quality objectives. Documentation shall be adequate for DOE, EPA, or a third party to be able to evaluate and confirm compliance with those objectives.

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- **Waste Minimization** - Activities shall be planned to prevent unnecessary generation of waste, including consideration of sample location selection, sample collection methods, parameters to be analyzed, use of screening analyses where applicable, and prudent use of materials. Generated wastes shall be handled in an environmentally sound and safe manner.

- **Timeliness** - Every attempt shall be made to meet schedule commitments, perform activities safely, and produce useable data within a reasonable time frame.

- **Cost Effectiveness** - Activities shall be performed to maximize production of useful, valid information and minimize expenditures.

3.1 PROJECT MANAGEMENT

Remediation activities of the FEMP environment are conducted by DOE and regulated by EPA and the Ohio Environmental Protection Agency (OEPA). Responsibilities of each group are defined in the 1991 amended Consent Agreement, the Federal Facility Compliance Agreement, the consent decree with OEPA, or other agreements between DOE and the regulatory agencies. Organizational and management structures showing the relationships among regulatory agencies and FEMP are shown in Figures 3-1 and 3-2 (Appendix A).

3.1.1 U.S. Environmental Protection Agency

The EPA Remedial Project Manager (RPM) is responsible for day-to-day oversight, review of documents, and interactions with FEMP personnel. The RPM is also responsible for distributing deliverables to appropriate reviewers within EPA and transmitting and resolving comments with DOE. Additional responsibilities are outlined in the 1991 amended Consent Agreement. The EPA administrator is ultimately responsible for resolution of disputes as specified in the 1991 amended Consent Agreement.

3.1.2 Ohio Environmental Protection Agency

OEPA has review and comment responsibility for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents as stated in the 1991 amended Consent Agreement. OEPA also has jurisdiction over Resource Conservation and Recovery Act (RCRA) activities.

3.1.3 U.S. Department of Energy

DOE FO is responsible for day-to-day site management, program decisions, interpretation of DOE orders, interaction with regulatory agencies, milestone compliance, and transmission of deliverables. The hierarchy within DOE FO includes a site manager and deputy, manager of

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environmental affairs, DOE RPM for the Remedial Investigation/Feasibility Study (RI/FS), and managers for each operable unit.

The DOE FO manager reports directly to DOE headquarters in Washington, D.C. Procedures for site operations are outlined at headquarters level through DOE orders and guidance and are interpreted and implemented at the FO level.

DOE has delegated independent quality assurance assessment duties to the quality assurance department of the FEMP prime operating contractor. This designated FEMP QA organization may utilize QA resources of other contractor and subcontractor organizations to fulfill its duties. The designated FEMP QA organization has direct access to DOE FO management through the upper management of the prime operating contractor.

3.1.4 Contractors

FEMP is a Government-owned/contractor-operated facility. Each DOE contractor at FEMP has an internal management structure defined in contractor-specific documents. There may be several levels of subcontractors to the contractors to provide services in any area. However, completion and quality of subcontracted work is the direct responsibility of the respective contractor.

The following contractors currently provide services to DOE for FEMP. Specific organizations are listed in Table 3-1, Appendix A.

3.1.4.1 <u>Prime Operating Contractor</u>. The prime operating contractor is responsible for day-to-day operation of the site, including operation of all facilities, services, and utilities.

The FEMP sampling and analysis management coordinator is responsible for coordinating DQO development, technical review and approval of PSPs, preventing redundant sampling and analysis, assigning sample numbers to projects, and coordinating sample handling and laboratory services.

DOE has assigned radiological and industrial health and safety duties to the FEMP prime operating contractor. The FEMP health and safety organization may utilize expertise and resources of other contractor and subcontractor organizations to fulfill its duties.

The FEMP administrative records coordinator is a member of the prime operating contractor organization and is responsible for environmental sampling and analysis records coordination as specified in Section 4.

The FEMP controlled document coordinator is responsible for maintaining controlled documents, coordinating document change requests, distributing revisions, and maintaining a list of controlled documents and holders of those documents.

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A contract technical monitor has been assigned by the prime operating contractor to integrate RI/FS and remedial design activities with those of the prime operating contractor. Contract technical monitor duties shall consist of reviewing contracts and specifications between the prime contractor and other contractors to ensure compliance with the Sitewide CERCLA Quality Assurance Project Plan (SCQ) and other site regulations.

3.1.4.2 **RI/FS Contractor.** The RI/FS contractor is responsible for day-to-day execution of the FEMP RI/FS program and performs data-collection and interpretation activities pertaining to the program. Additional duties include evaluation of remedial alternatives, and responsibility for initial preparation of remedial investigation, feasibility study, and other reports specified in the 1991 amended Consent Agreement.

3.1.5 Subcontractor Requirements

Contractors and subcontractors are required to comply with applicable site procedures, policies, and the SCQ. This requirement shall be included in all contracts between contractor and subcontractor. Subcontractors shall document that personnel are technically qualified to perform designated tasks and will comply with site QA and health and safety requirements. Provisions shall be made to update subcontracts predating the SCQ to be consistent with new requirements. Failure of a subcontractor to comply with the SCQ or other contractual requirements may be viewed as a breach of contract and grounds for contract termination.

Subcontractor analytical laboratories performing sample analyses covered by the SCQ shall perform work in accordance with SCQ requirements. Exceptions shall be approved by DOE on a case-by-case basis. Compliance shall be determined during surveillance and audits described in Section 12.

3.1.5.1 **Procurement of Subcontractors.** Contractors shall use a documented, DOE-approved system for procuring subcontractors. When required by the 1991 amended Consent Agreement (e.g., adding a laboratory to the approved list), EPA shall be notified prior to employing new subcontractors for 1991 amended Consent Agreement activities.

3.1.5.2 **Analytical Laboratory Subcontractors.** Procurement of laboratory subcontractors for analyzing environmental samples shall be strictly controlled. Only laboratories that have a demonstrated capability to provide the level of data quality required for a program or project shall be employed. Minimum elements of analytical services procurement shall include the following.

- Demonstrated ability to perform the analyses required at a specified capacity
- Ability to handle the types of material to be analyzed including applicable licenses and permits

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- Implementation of required quality elements verified through an on-site, pre-award audit conducted by FEMP
- Successful analysis of performance evaluation samples
- Verification of continuing satisfactory performance through audits by FEMP and performance evaluation sample analysis
- FEMP notification to the EPA Region V RPM of intent to use a laboratory
- Upon EPA request, provision of audit and performance evaluation data
- Opportunity for EPA to perform their own audit of the laboratory

Performance evaluation samples may be provided by FEMP or may be part of an ongoing program such as the EPA contract laboratory program. FEMP-supplied performance evaluation samples shall be traceable to standards purchased from EPA, the National Institute of Standards and Technology, or equivalent.

DOE will prepare a list of approved laboratories (Table 3-2, Appendix A) that documents the following information for each laboratory.

- Laboratory facility locations
- Types of analyses the laboratory is approved to perform by analytical support level
- Types of samples the laboratory is qualified to handle
- Capacity or available equipment of the laboratory
- Date last audited
- Period of performance for FEMP

The FEMP prime operating contractor shall maintain an up-to-date list of analytical laboratories approved for FEMP analyses. A current list of laboratories used for FEMP projects is provided in Table 3-2 (Appendix A). Only laboratories meeting performance requirements specified in Appendix E shall be included on the list. If a subcontractor owns more than one laboratory, only those included on the list may perform FEMP work.

Listed laboratories have successfully analyzed performance evaluation samples for the required time period and have been audited by FEMP. Additions or deletions of laboratories to the list shall be based on audits and analysis of performance evaluation samples by the

designated FEMP QA organization or FEMP Site Laboratory Integration Committee. When laboratories are added to the list, DOE will notify EPA and the list shall be modified accordingly. If a laboratory will no longer be used by FEMP, an ending date of performance will be added and the laboratory listing will remain to aid investigators evaluating historical data. 3200

FEMP shall notify EPA of its intent to add a laboratory to the list after the laboratory has demonstrated its ability to fulfill performance requirements. The laboratory shall be designated "proposed for approval." EPA may accept FEMP laboratory performance data and approve the laboratory, conduct an audit in cooperation with FEMP, or conduct their own audit. Analyses performed by the laboratory between the time of FEMP approval and EPA acceptance shall be considered "at risk". When the laboratory is accepted by EPA, "at risk" data shall be accepted.

If the laboratory does not pass the EPA audit, data considered "at risk" shall remain so if corrective actions are pending, or the data may be rejected outright.

If a laboratory that has performed work for FEMP is disqualified from performing further work, it shall remain on the list with the period of performance indicated for reference.

3.2 QUALITY ASSURANCE MANAGEMENT

DOE, EPA, OEPA, and their respective subcontractors are responsible for QA management as shown in Table 3-3 (Appendix A) and described in paragraphs 3.2.1, 3.2.2, and 3.2.3.

3.2.1 DOE

DOE FO has overall responsibility for QA activities at FEMP and may delegate all or part of this responsibility to a contractor quality assurance staff designated the FEMP QA organization.

The designated FEMP QA organization (prime operating contractor quality assurance department) is independent of direct job involvement and day-to-day operations and has direct access to DOE FO management to resolve QA disputes (independent assessment). The QA organization is responsible for the following QA management functions.

- Conducting audits and surveillance to verify that the QA program is implemented in compliance with sitewide and project-specific requirements, DOE orders and guidance, and EPA regulations

- Verifying and approving corrective actions

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- Auditing compliance with training procedures
- Review and signature approval of plans, procedures, drafts, and final documents

The manager of each project is responsible for QA within its scope (self assessment). An individual may be designated the QA officer for a project and be responsible for verifying training, conducting audits and surveillance, data validation, and verifying compliance with requirements.

Project-specific plans shall receive both technical and quality reviews and approvals (Figure 3-3 and Table 3-3, Appendix A). The FEMP project manager is responsible for development of PSPs in accordance with guidelines of the SCQ and for ensuring review and approvals prior to implementation. The FEMP sampling and analysis management coordinator is responsible for technical review of PSPs, including coordination of data quality objective development, preventing redundant sampling, assigning sample numbers, and coordinating sample handling and laboratory services. The applicable DOE and prime operating contractor operable unit managers are responsible for PSP approval.

If the FEMP project manager is part of an organization other than the prime operating contractor, the contract technical monitor is responsible for reviews and approvals by affected groups. The designated FEMP QA organization is responsible for QA review and approval of PSPs and for providing technical comments consistent with recommendations of ANSI/ASQC-E4-19xx (1991). The FEMP health and safety organization is responsible for reviewing and approving PSPs for consistence with site safety requirements.

3.2.2 EPA

EPA Region V is responsible for review and approval of the SCQ. Requests to modify the SCQ or other EPA-approved documents shall be transmitted by DOE to the EPA RPM, who is responsible for distributing change requests to appropriate reviewers.

The following EPA organizations have quality assurance responsibilities as indicated.

- The EPA Region V Regional Quality Assurance Manager is responsible for approval of the SCQ.
- The EPA Region V Quality Assurance Section is responsible for SCQ review and for recommending approval or disapproval of the plan to the Regional Quality Assurance Manager.
- The EPA Region V Central Regional Laboratory is responsible for external laboratory audits and is jointly responsible with the EPA Region V Central District Office for external field audits. (See Section 12 for audit requirements and responsibilities.)

- The EPA Region V Central District Office is jointly responsibility with the EPA Region V Central Regional Laboratory for external field audits. 3200

3.2.3 OEPA

The OEPA reviews and comments on the SCQ and addenda. OEPA also evaluates the SCQ for completeness relative to tasks for which the state has primacy including RCRA, the Clean Air Act, and the Clean Water Act. State involvement and concurrence is vital to achieving the goal of an integrated environmental program at FEMP.

3.3 ANALYTICAL LABORATORY RESPONSIBILITIES

Analytical laboratories providing services for FEMP are responsible for compliance with the requirements of their specific contract, Appendix E, and Attachment I. Laboratory performance will be evaluated on an ongoing basis through use of audits (Section 12) and performance evaluation samples (Appendix E).

3.4 FIELD RESPONSIBILITIES

Field responsibilities for contractors and subcontractors shall be explicitly defined in project-specific plans that include project management requirements, field personnel qualifications, sample handling specifications, and data management and interpretation requirements. Responsibilities for PSP implementation are described in Figure 3-4 (Appendix A).

Independent assessment of field activities is performed by the Environmental Compliance and Quality Assurance Department of the prime operating contractor. Surveillance reports shall be made to the responsible FEMP project manager, who shall resolve discrepancies or problems.

Field responsibilities for ongoing routine RI/FS activities are assigned as follows (Table 3-1).

- The RI/FS project manager is responsible for planning and providing personnel and subcontractors to conduct the work. The RI/FS field supervisor shall oversee each phase of work, and field teams shall implement plans.

- The RI/FS drilling subcontractor to the RI/FS contractor shall perform drilling; soil sampling; and well construction monitoring, development, and completion.

- Self assessment is provided by the RI/FS contractor QA personnel.

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- The contract technical monitor of the prime operating contractor coordinates RI/FS activities with other prime operating contractor activities; ensures support for identifying utilities, gaining access to controlled areas, providing change-out facilities and clothing, and health and safety; provides decontamination facilities; and coordinates with other FEMP field teams.

Non-routine RI/FS, routine RCRA ground-water sampling, RCRA waste characterization sampling, and radiological environmental monitoring is performed by the Environmental Monitoring Section of the prime operating contractor which includes ground water programs, site-media sampling, and radiological environmental monitoring program groups.

- Self assessment is provided by the Environmental Monitoring Technical Support Group.

- The analytical section of the prime operating contractor provides technical and sample handling support.

- The utilities section of the prime operating contractor performs routine Clean Water Act and Clean Air Act sampling with technical and sample handling support from the analytical section of the prime operating contractor.

Field (or sampling) teams report to field activity leaders, who in turn report to the FEMP project manager.

Sample shipping and analytical laboratory services are handled by a FEMP project contact who is a member of the FEMP sampling and analysis management coordinator's organization and acts as a liason between the analytical laboratory and project personnel.

Field (or sampling) teams are responsible for performance of field activities under supervision of a team leader as specified in PSPs. Field activity leaders coordinate field teams involved in a specific activity for a specific project.

3.5 REFERENCES

U.S. Department of Energy and U.S. Environmental Protection Agency. 1986. Federal Facilities Compliance Agreement. U.S. Department of Energy, Oak Ridge Operations, Feed Materials Production Center, Fernald, Ohio, and U.S. Environmental Protection Agency Region V.

U.S. Department of Energy and U.S. Environmental Protection Agency. 1991. Consent Agreement as Amended Under CERCLA Sections 120 and 106(a). Administrative Docket Number: V-W-90-C-057. U.S. Department of Energy, Feed Materials Production Center, Fernald, Ohio, and U.S. Environmental Protection Agency Region V.

SECTION 4

SECTION 4

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QUALITY ASSURANCE OBJECTIVES

The overall objective of Quality Assurance (QA) for environmental sampling and analysis at FEMP is to provide results in compliance with Comprehensive Environmental Response, Compensation, and Liability Act and other regulations listed in Section 1. This section presents specific objectives for the level of the quality control effort; accuracy, precision, and sensitivity of analytical data; and data completeness, representativeness, and comparability.

Details for attaining QA objectives for environmental sampling and analysis programs are described herein. These include field quality assurance samples; analytical quality control samples; training requirements; records administration; document control; and requirements for completeness, representativeness, comparability, precision, accuracy, and sensitivity.

A successful QA program must establish controls over planning, implementation, and assessment of data collection activities. Because of the site-wide nature of this document and the magnitude of FEMP environmental projects, it is necessary to detail requirements to attain QA objectives beyond precision, accuracy, representativeness, comparability, and completeness. Adequate training of sampling and analysis personnel, document control, defining types of field and analytical QA/QC checks, and records management are necessary to fulfill QA objectives. Although administrative in nature, they are required to achieve validated data and reasonable access to the data. These NQA-1 program-plan-type elements are included to ensure data comparability and prevent duplication of efforts in site projects.

Specific procedures for sampling, chain of custody, laboratory instrument calibration, laboratory analysis, data reporting, internal quality control, surveillance/audits, preventive maintenance of field equipment, and corrective actions are described in other sections of the Sitewide CERCLA QA Project Plan (SCQ).

Responsibility for overall direction, implementation, and maintenance of the QA program rests with the designated FEMP QA organization (Section 3) as does verification of program implementation through audits and surveillance.

4.1 LEVEL OF QUALITY CONTROL

Data generated shall be of known quality and in compliance with Data Quality Objectives. Data shall be traceable, technically accurate and legally defensible, and have definable characteristics.

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Traceability is a legal requirement that provides a documented trail beginning with requirements for data and ending with effective use of the data. Elements that provide traceability include defined data quality objectives, documented collection and measurement techniques, sample and data custody records, and original and final data used to support decisions.

Legal defensibility requires that data generated be scientifically defendable (i.e., accurate, precise, and representative). Complete files of generated data and supporting documentation sufficient to support litigation are required.

Fundamental mechanisms for achieving established quality goals can be categorized as prevention, quality assessment, and correction and include the following.

- Prevention of errors by planning and careful selection and training of skilled, qualified personnel
- Quality assessment through a program of audits and surveillance to supplement continual informal review
- Correction of processes to prevent recurrence of conditions adverse to quality
- Incorporation of new processes as they develop to increase quality

The SCQ has been prepared to guide attainment of these goals. It describes the QA program to be implemented and the Quality Control (QC) procedures to be followed by DOE and its contractors during the course of remediation of FEMP. The SCQ also describes the project organization structure and specifies the procedures, documentation requirements, sample custody requirements, acceptance criteria, and audit and corrective action provisions to ensure that operations and activities meet the intent of regulatory requirements.

4.1.1 Type and Frequency of Field Quality Assurance Samples

Field QA samples include the following.

- Trip blanks
- Field blanks
- Equipment rinsate samples
- Preservative blanks
- Container blanks

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- Duplicate samples
- Split samples
- Spiked samples
- Materials blanks (e.g., cleaning solutions)

Collection of field QA samples is based on Data Quality Objectives. Requirements and justification for collection of field QA samples per sampling round shall be documented in Project-Specific Plans (PSP). Appendix K summarizes requirements for field QA samples including frequencies. The rationale for selection of specific field QA samples and minimum requirements for use follow.

NOTE

A sampling "round" constitutes collection of samples from one or more locations for a specific project during a specified time period for a similar purpose. (See Glossary terminology.)

- Trip blank analyses are used to determine whether conditions encountered during sample container shipment and handling have affected sample quality. Trip blanks are prepared by the sample coordinator or container supplier and transported to the field with other sample containers. A trip blank is prepared by pouring organic-free or de-ionized water into a forty-milliliter (mL), or larger, Volatile Organic Analysis (VOA) bottle and sealing it with a teflon-lined septum lid. Trip blanks are required whenever ASL C or D samples are collected for Volatile Organic Analysis and may be specified for analyses for ASLs B and E. Definitions of ASLs are provided in Section 2. In addition to Volatile Organic Analysis samples, trip blanks may be specified for other parameters if technically justified.

- Field blank analyses are used to determine whether the sample collection process or conditions at the collection site have affected sample quality. Field blanks are prepared by the sampling team at the sample location by pouring organic-free or de-ionized water into appropriate containers for each constituent analyte. Field blanks are specified for ASLs C and D and some B and E analyses.

- Equipment rinsate sample analyses are used to determine effectiveness of decontamination procedures. Rinsate samples are prepared by the sampling team at the decontamination site. A final rinse from the decontamination process is collected in appropriate containers, one for each constituent analyte. In addition to sampling frequencies specified in Appendix K, when visibly contaminated equipment is cleaned,

a sample is collected. Rinsate samples are specified when cross-contamination caused by improperly cleaned equipment is a concern and may be appropriate for ASLs A through E analyses. Rinsate samples are specified for ASLs C and D. 3200

- Preservative blank analyses are used to determine the quality of sample preservatives. Preservative blanks are prepared by a sample coordinator or field sampling team in a controlled environment by pouring organic-free or de-ionized water into an appropriate sample container along with the preservative specified in Section 6. Preservative blanks may be specified for ASLs B, C, D, and E analyses.

- Container blank analyses are used to determine quality and integrity of containers used in matrix sampling. Container blanks are prepared by the sampling coordinator or field sampling personnel in a controlled environment. Unpreserved sample containers are submitted to the laboratory, where an extract from the container is prepared and analyzed for parameters of interest. Container suppliers provide QA information on batches of pre-cleaned containers if requested. In some cases, additional container blanks may be necessary. Container blanks may be necessary when unsealed containers are used, container custody seals and associated documentation is not available, or locally cleaned containers are used. Use of container blanks is appropriate for ASLs B, C, D, and E analyses. Container blank usage is described in detail in the sample handling paragraphs of Section 6.

- Duplicate sample analyses are used to evaluate precision of analytical laboratory performance and sample collection techniques. Duplicate samples are prepared by field sampling teams at sampling locations by evenly distributing sample media between two or more sets of containers. Each duplicate sample is assigned a unique identification number and sent to the same laboratory as the original samples, providing an intra-laboratory comparison of results. If duplicate samples are required for a non-fluid matrix, the compositing method or rationale for assuming homogeneity of the matrix shall be presented in PSPs. Duplicate samples are appropriate for ASLs A through E and required for ASLs C and D.

- Split sample analyses are used to evaluate accuracy of analytical laboratory and field sample handling practices. Split samples are prepared by field sampling teams at sampling locations by evenly distributing sample media between two or more sets of sample containers. Split samples are assigned the same number as the actual samples and sent to a separate laboratory for analyses, providing results for inter-laboratory comparison. When a non-fluid matrix split sample is collected, the compositing procedure or justification for assuming homogeneity of the matrix shall be presented in the work plan. Split samples are most commonly used for ASLs C, D, and E.

- Field spike control samples are used to determine precision and accuracy of analytical laboratory performance. These are prepared in a laboratory environment and

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transported to the sampling site for numbering and shipment to the laboratory with the remaining field samples. If required, field spike control samples are included once every sixty days or at least once per project, more frequently if appropriate, or when accuracy of a particular laboratory is in question. Intended use of field spike control sample analytical data shall be stated in the PSP, and quantitative requirements for accuracy by chosen analytical method shall be justified. Field spike control samples may be specified for ASLs B through E.

- Materials blanks are samples of material used in construction, decontamination, or other activity (e.g., drilling fluids, annular sealants, cleaning solutions) that are retained for quality control purposes in case unexpected contaminants are detected in related media. A material blank shall be collected in a controlled environment from each solution or mixture of materials (e.g., cleaning solutions and drilling fluids) that have the potential to introduce contamination not otherwise present in the media being sampled. These samples shall be clearly marked as retained samples and placed in an archive for future analysis if an anomalous contamination is identified upon review of sample analysis. Material blanks may be analyzed at any ASL.

4.1.2 Type and Frequency of Analytical Quality Control Samples

The following types of QC samples shall be analyzed as applicable for analytical methods in Attachment I. Types of QC samples required for specific analytical methods are based on ASLs. They are discussed in Section 9 and Attachment I. Internal QC checks are specified in Section 10. Analytical QC samples appropriate for ASL E and user-defined ASL B analyses shall be described in PSPs.

Frequency of QC sample collection and analysis may be increased but shall not be less stringent than that specified in Table 2-2 (Appendix A) or Attachment I unless so specified in a PSP. An analytical batch is defined in the Glossary terminology.

- Laboratory Control Samples (LCS), such as reference standards, may be certified reference material or a control matrix spike with analytes representative of target analytes. LCS results shall be compared to established control limits for accuracy and bias to determine useability of data. LCSs are not performed for organic analytes.

- A method blank (e.g., reagent blanks, preparation blank) is a volume of the analyzed matrix to which reagents used in sample processing are added in the same volumes or proportions required by the method. Method blanks are submitted to the full analytical procedure and used to assess background contamination levels in the laboratory. Guidelines shall be established for acceptance or rejection of analytical data based on the level of contamination in the blank.

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- A matrix spike is an aliquot of a sample spiked with a known amount of target analytes for the purpose of monitoring laboratory accuracy. Matrix spikes shall be analyzed when commercially available, certifiable standards exist appropriate to the method used if quantity of sample permits. (Examples of methods not requiring matrix spikes include pH and flash point.) For determination of trace metals by atomic absorption and inductively coupled plasma methods, post-digestion (analytical spikes) shall be analyzed for every sample injection to assess matrix interference.

- Matrix duplicate/replicate or matrix spike duplicates are used to assess the matrix effect on method precision. A matrix duplicate/replicate is an intra-laboratory split and spiked sample used in organic analyses.

- Surrogate spikes are used to assess matrix interferences in individual organic samples. A surrogate is an organic compound not normally found in the environment that is similar to target analytes in chemical composition and behavior relative to the method. A surrogate is added to each analytical and QC sample (organics only) prior to analysis. Surrogate spikes can also be used for radionuclide samples.

- Blind and double blind QC samples are used for long term assessment of accuracy and precision of the analysis or operator. Blind samples are submitted so the analyst knows it is a QC sample but does not know the analyte concentration. Double blind samples are submitted so the analyst is not aware it is a QC sample and does not know the analyte concentration. Types of blind and double blind QC samples include LCSs, spikes, and duplicates/replicates. Some types of these QC samples are included in requirements for certain methods at frequencies specified in Appendix K or the PSP. If additional types or frequencies of these QC samples are required they will be specified in the PSP.

- Intercomparison study samples are supplied by an external source to a series of laboratories. Results are evaluated against the expected value and against results from other participating laboratories. If available, a FEMP laboratory shall participate in at least one study for the analytes it is contractually permitted to analyze.

4.2 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSIS

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analyses is to meet QC acceptance criteria of analytical protocols. The accuracy and precision objective for each major measurement parameter for FEMP are pertinent to laboratory methods. Specific information on accuracy, precision, and sensitivity is presented in Section 14.

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Standard operating procedures shall be written for laboratory analyses and shall include required accuracy, precision, and sensitivity specifications for the analyses. Procedures for field equipment to measure pH, conductivity, redox potential (Eh), temperature, dissolved oxygen, and alkalinity are outlined in Section 6 and Appendix K. Accuracy and precision requirements for field screening analyses are also provided in Section 6.

4.2.1 Analytical Precision

To assess precision of an analytical method, instrument, or laboratory analysis, a routine program of duplicate or replicate analysis shall be established. Results of these analyses are used to calculate relative percent difference (defined as 100 times the absolute difference of each data set, divided as the average of the data set) for duplicate, matrix spike duplicates, or replicates. (See Section 14 for further explanation and the equation for evaluating relative percent difference). The data set relative percent difference may be used to generate precision control charts for organic and inorganic laboratories.

Range analysis may be used to evaluate the precision or reproducibility of radiological data derived from methods for which performance data are not currently available. Statistical range analysis is used to calculate the expected mean range and control limits for a replicate or duplicate result and assess whether the result is "in control." A range analysis result that lies within three standard deviations of the mean is considered in control. Range analysis results greater than three standard deviations from the mean are considered to be "out of control." Results that are out of control may be re-analyzed as required by the method, or results may be flagged or qualified for use during data validation.

4.2.2 Laboratory Accuracy

To assess accuracy of a chemical method or a chemical laboratory analyst, analytical results of method blanks, matrix spike/matrix spike duplicate, field blanks, and container blanks shall be assessed along with a periodic program of sample spiking. The results of sample spiking are used to calculate percent recovery, which is the quality control indicator for accuracy. Percent recovery is defined as 100 times the observed spike sample result or concentration minus observed sample result or concentration divided by amount of spike added to the sample. Percent recovery of matrix spikes is used to generate accuracy control charts. Percent recovery is calculated from the equation in Section 14.

Range analysis may be used to evaluate the accuracy of radiological data. Statistical range analysis is used to calculate the expected mean range and control limits for a replicate or duplicate result and assess whether the result is "in control." A range analysis result that lies within three standard deviations of the mean is considered in control. Range analysis results greater than three standard deviations from the mean are considered to be "out of control." Results that are out of control may be re-analyzed as required by the method, or results may be flagged or qualified for use during data validation.

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4.2.3 Sensitivity of Analysis

The QA objective with respect to sensitivity is the achievement of specified method detection limits and quantitation limits. These limits depend on instrument sensitivity and matrix effects associated with the analysis. Therefore, it is important to monitor and take into account sensitivity to ensure data quality.

Analytical methods are provide in Attachment I, the FEMP Laboratory Analytical Methods Manual, which includes descriptions of the sensitivity of the analyses. Instrument sensitivity is monitored by the analysis of method blanks, calibration check samples, and laboratory control samples.

4.3 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

4.3.1 Completeness

Completeness can be defined by the percentage of total useable points from the set of total data points collected, analyzed, and available. A formula for estimating completeness is presented in Section 14. Data points may not be useable if sample holding times were exceeded, quality control criteria were not met, and it is not possible to re-analyze the sample. Also, data points may not be useable if sample bottles were damaged during shipment to the laboratory. Completeness is expected to be at least 90 percent for FEMP.

If sufficient valid data points are not obtained to meet project objectives, the valid data obtained shall be used and additional sampling and analysis may be considered to meet project objectives.

Example: Fifty soil samples are collected and analyzed. After data validation, forty four data points are determined to be valid. Completeness is estimated as (44/50) x 100 = 88 percent. Completeness was not achieved.

4.3.2 Representativeness

Representativeness is a qualitative parameter based on professional judgement that reflects the design of the sampling program, standard operating procedures, the proper selection of sampling locations, and collection of a sufficient number of samples. Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at sampling points, or an environmental condition.

For FEMP, representativeness is addressed through selection of appropriate sample locations and design of adequate procedures. The goal is to obtain samples representative of the specific matrix (solids, liquids, and air) so that sampling performance can be evaluated.

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Example: The objective is to obtain data that is representative of the worst case releases from an outfall. The sampling program includes sampling at times when outfall contaminant concentrations are expected to be highest.

4.3.3 Comparability

Comparability is a qualitative parameter that expresses the degree of confidence that data are equivalent for a specific parameter or group of parameters. Comparability is especially important at FEMP where data are collected during multiple sampling efforts using multiple laboratories. The ability to compare data sets is particularly critical when a set of data for a specific parameter is applied to an action level or other criterion.

Example: Ground-water quality data collected during RI/FS and during RCRA ground-water monitoring use comparable collection and analysis methods. Resultant data are therefore comparable.

4.4 TRAINING, RECORDS ADMINISTRATION, AND DOCUMENT CONTROL

The following elements are required to achieve QA objectives described in the SCQ.

- Field activity requirements (Section 5)
- Sampling requirements (Section 6)
- Sample custody (Section 7)
- Calibration procedures and frequency (Section 8)
- Analytical procedures (Section 9)
- Internal quality control checks (Section 10)
- Data reduction, validation, and reporting (Section 11)
- Performance and system audits (Section 12)
- Preventive maintenance (Section 13)
- Specific routine procedures to assess data precision, accuracy, and completeness (Section 14)

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- Corrective actions (Section 15)
- Quality assurance reports to management (Section 16)

Three additional QA planning elements are important to achieving QA objectives: training, records administration, and document control. These additional elements are described in paragraphs 4.4.1, 4.4.2, and 4.4.3.

4.4.1 Training

FEMP contractors and subcontractors shall use personnel that have appropriate education, training, and experience to perform an assigned task. Requirements for types of training, frequency, and curricula are specified in DOE orders, PSPs, and by FEMP policy. Personnel qualifications and training needs shall be identified and documented. Training shall be performed in accordance with formally planned, executed, and documented training activities. Special training required to achieve project-specific objectives shall be identified in PSPs. The following site-level and job-specific training is specified for FEMP activities.

4.4.1.1 Site Training. Site-level training requirements involve a broad range of activities and are determined by the nature and location of the work or task. The 40-hour compliance training program conducted at FEMP prepares hazardous waste personnel to maintain and operate the facilities at Fernald in a safe, efficient, and environmentally sound manner. The program emphasizes compliance with EPA, Ohio Environmental Protection Agency, DOT, and OSHA regulations as well as DOE orders. It provides personnel with a consistent level of training to respond in a prompt and effective manner if abnormal or emergency situations occur. Because of the complexity of the FEMP site, it is of utmost importance that personnel receive training at this level to understand the intertwined relationships among the agencies and regulatory bodies. Specific training classes are identified in Table 4-1, Appendix A.

4.4.1.2 Job-Specific Training. Job-specific training shall be conducted for personnel who are scheduled to perform certain designated tasks. These tasks may include, but are not limited to, the following.

- Nondestructive examination and inspection techniques
- Environmental sampling methods
- Field and analytical laboratory sample analysis
- Data reduction and analysis
- Sample packaging and shipping requirements

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- Conducting QA surveillances and audits
- Installing boreholes, wells, and piezometers
- Implementing change proposals
- Conducting field tests
- Change control procedures
- Quality assurance requirements

4.4.1.3 Implementation. The FEMP prime operating contractor is responsible for verifying that required site training at FEMP is implemented (Section 3), including training for subcontractor personnel. Instructors shall be technically qualified by experience or training to present the topic of instruction. Training shall be conducted in accordance with approved lesson plans and shall include testing and on-the-job training as appropriate. Training shall be completed before an individual may perform sampling or support activities. Job-specific training is the responsibility of the organization conducting the work (including contractors and subcontractors). The organization shall verify the individual's education and experience to determine that the assigned task is within the realm of capability of the individual. Documentation of experience shall be provided for project files.

Before an untrained individual is allowed to perform an unfamiliar task, the following requirements shall be completed as a minimum.

- Reading the standard operating procedure for the task or duty and understanding it sufficiently to pass a written test if required
- Observing the task being done by a trained and qualified worker
- Performing the task under supervision of a trained and qualified individual until completion of formal training.

4.4.1.4 Documentation. Training shall be conducted in accordance with approved lesson plans and shall include testing and on-the-job training as appropriate. Personnel training documentation shall include the following as a minimum.

- Name of trainee
- Job title of trainee
- Name of trainer

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- Training subject
- Baseline training requirements (regulatory and FEMP)
- Training dates
- Training results (pass or fail)
- Required frequency of training
- Educational and job experience requirements
- On-the-job training received

4.4.2 Records Administration

Records may be stored in on-site, laboratory, and off-site project files. A records management system in accordance with the requirements of this section and DOE Order 1324.3 (1984) Files Management, shall be established at record-keeping locations that cover preparation, control, and retention of project-related records. Records control shall include receipt from sources, transmittals, and transfer to storage. Retention shall include receipt at the storage areas, indexing and filing, storage and maintenance, and retrieval from storage.

The Administrative Record is a subset of the site central files, and contains all data used to support CERCLA decision making. The FEMP Administrative Record Coordinator is responsible for maintaining the evidence files as part of the Administrative Record, and for maintaining files of all other environmental sampling and analysis files, that could be used to support future decisions.

4.4.2.1 Record Preparation. Hard-copy records shall be legible, accurate, and complete; indexed to permit quick and accurate identification of items or activities to which they apply; and authenticated by preparer's signature and completion date. Electronic records (e.g., magnetic diskettes, magnetic tapes, Compact-Disk Read-Only Memory (CDROM) shall be stored in duplicate. Each diskette, tape, or other data medium shall be identified by a unique identifier. A hard-copy index of contents shall be maintained in project files.

When appropriate, corrections may be made to records by authorized personnel (e.g., originating personnel/organization, QA personnel). Corrections shall be made by drawing a single line through the incorrect information on hard copies, making the correct entry, and initialing and dating the revised entry. Electronic files in the archives shall be write-protected. If changes to an electronic file are required, both the original and the back-up copies shall be replaced entirely.

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4.4.2.2 Records Control. Control over current projects shall be accomplished using a filing system based on subject and task, which will effectively segregate records from different contractors into identifiable and retrievable files. Program and project records shall be controlled as follows.

Incoming Records - Includes project-related correspondence, data, sketches, logs, authorizations, or other information.

1. The FEMP project manager or designee shall mark original with receipt date.

2. The FEMP project manager or designee shall determine who will review the materials and route copies of the material to that person.

3. As soon as practical, incoming correspondence originals shall be placed in project files.

4. If correspondence is required by project personnel for reference, a copy shall be marked as such and routed accordingly.

5. Quality-related correspondence shall be routed to the designated FEMP QA organization.

6. Communications relative to FEMP that are initiated by third parties (e.g., media, interested individuals, and groups) are referred directly to designated DOE representatives unless otherwise directed by the DOE site manager.

Outgoing Records - Includes externally (i.e., external to the specific project) transmitted correspondence, reports, drawings, and sketches.

NOTE

As a minimum, correspondence shall be signed by the originator and, if joint signatures are desirable, appropriate managers. QA correspondence is signed by a representative of the designated FEMP QA organization. Correspondence issued by DOE contains appropriate DOE signatures.

1. Outgoing records shall be reviewed, approved, and signed prior to transmittal as required.

2. Routing information shall be attached to office copy of project correspondence.

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3. Records transmitted between the site and remote locations shall be protected from damage and loss during transfer (e.g., copying prior to shipment and hand carrying).

4. Transmittal letters shall be numbered and traceable and copies of attachments filed with transmittal letters unless otherwise indicated. Each FEMP contractor and subcontractor shall have a DOE-approved system for numbering transmittal letters.

4.4.2.3 Records Retention. All validated data supporting FEMP CERCLA decisions shall be submitted to the Administrative Record. Copies of all other environmental sampling and analysis files shall be submitted to the FEMP Administrative Record Coordinator for inclusion in the central files. Following receipt of information from external sources and issuance of reports, associated records (including those generated by subcontractors) shall be placed in the central files, as required.

Files shall also include correspondence, data, and references supporting entries into the Administrative Record; supporting documentation for CERCLA-driven programs; and supporting documentation for CERCLA-covered programs. Documents exempt from the Freedom of Information Act (e.g., personal dosimetry, urinalysis, and medical records) are specifically excluded from these requirements. Each FEMP contractor and subcontractor shall maintain project files as appropriate.

Records shall be identified by source and date of receipt. Files shall be identified by project, subject, and task. Files shall also be identifiable by keywords in a central file data base management system.

Records Facility - Files shall be located in an area that, at a minimum, provides the following.

- Suitable environment to prevent record deterioration, damage, and loss
- Controlled access
- Steel file cabinets
- Protection against excess moisture and temperature extremes
- A record review area if practical

Records Handling - Files and records contained in project files shall be maintained by designated personnel who are responsible for the following.

- Review of incoming records for original receipt date (as specified in paragraph 4.4.2.2) prior to filing

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- Indexing
- Filing in labeled folders or binders as applicable
- Maintaining sign-out sheet

Records Index - A numbered index for each project file shall be prepared and maintained in the project records storage area. The index shall list individual file numbers and identify records therein and may be part of an electronic data-base management system with appropriate backup.

4.4.2.4 Off-Site Project Files. Record storage off-site (e.g., at analytical laboratories) shall be as secure as and similar to the project on-site file. Upon completion of the project phase, off-site files shall be transferred to and integrated with on-site files.

Laboratories shall maintain record systems for documents pertinent to testing performance that provide record control and retention similar to that outlined in paragraphs 4.4.2.2 and 4.4.2.3 for on-site office files.

4.4.2.5 Final Disposition. Upon completion of the project phase, the original or certified copies of data and records shall be transferred to DOE. With approval from DOE, laboratory data files and records may be microfilmed for archive storage at any time during a project.

If requested to transfer original files to DOE, laboratories may retain copies of project data and records for their files unless specifically prohibited in writing at the time of the request.

4.4.3 Document Control

Documents and drawings shall be prepared, reviewed, approved, revised, and distributed in accordance with the requirements of the following subparagraphs. Documents and drawings that are controlled shall be identified as such and updated as required. Uncontrolled documents and drawings are issued once and not updated. Document listings shall be maintained by each FEMP contractor and subcontractor for quality-related documents, project-specific documents and drawings, computer graphics, maps, and other controlled documents.

A FEMP-controlled document list shall be maintained by the controlled-document coordinator of the FEMP prime operating contractor. This list shall identify holders of all controlled document copies, including the SCQ. All subcontractors, specifically including analytical laboratories, shall be given a minimum of one controlled copy of the SCQ at the time of document approval or new contract issuance as appropriate. Distribution of document revisions shall be conducted by the FEMP controlled-document coordinator. Maintenance of

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individual controlled copies shall be the responsibility of the document holder and shall be an auditable requirement.

4.4.3.1 Preparation, Review, and Approval of Documents and Drawings. Prior to implementation or use, documents and drawings shall be reviewed and approved by signature and date. Documents and drawings requiring DOE approval shall be reviewed and approved by designated personnel before submittal to DOE. Copies of documents or drawings released for any purpose before they have gone through the complete review and approval process shall be dated and marked "PRELIMINARY" for drawings and "DRAFT" for documents.

Each FEMP contractor and subcontractor shall have a documented process for preparation, review, and approval of documents and drawings under their cognizance. This process shall include the following.

- Standardized document and drawing format
- Identification of required reviewers
- Review process including documented resolution of reviewer comments
- Procedure for obtaining required approvals and authorization to issue
- Periodic review

FEMP sitewide documents shall be reviewed and commented upon by each affected FEMP contractor.

4.4.3.2 Changes to Documents and Drawings. Changes to approved plans and procedures may be necessary during the course of project performance. Review and approval of changes to documents shall be in accordance with requirements of the original document. Organizations approving the original document shall also approve changes. Changes shall be approved prior to implementation. Each FEMP contractor and subcontractor shall have a written procedure for initiating changes to documents and drawings under their responsibility.

Revisions shall be submitted for review/approval with approval sheets as appropriate. Review/approval of other documents, if not documented on re-issued approval title sheets, shall be documented in another manner [e.g., associated Document Change Request (DCR) approval signature blocks] to attest to review and approval in accordance with requirements of the original document.

Document Change Requests - A DCR (Form 4-1, Appendix B) is the only means of initiating a change or revision to the SCQ. Review and approval of DCRs ensure compliance

with requirements of the original document before they are implemented. DCRs that involve changes to analytical laboratory activities shall be reviewed by applicable laboratory organizations. At a minimum, the DOE FO Quality Assurance officer, FEMP project manager, designated FEMP quality assurance organization representative, and FEMP laboratory manager (for laboratory changes) shall review the DCR. 3200

Oral approval may be requested from other signers if necessary. If the other signers orally consent to the DCR being signed for them, the FEMP project manager or designated FEMP QA organization manager may sign their own name in the other person's signature space and write "for" before the person's title below the signature space.

DCR Procedure - The DCR shall be completed in the following manner.

1. The originator shall complete the DCR through the CONTENT OF CHANGE section and forward it to the designated FEMP QA organization for evaluation.

2. The designated FEMP QA organization manager shall review the DCR and resolve any disagreements with originator.

3. Upon concurrence, the FEMP controlled document coordinator shall assign a request number and enter it in REQUEST NO. space.

4. The FEMP controlled document coordinator shall enter pertinent information in the DCR status and tracking log, which shall include the following information.

   - DCR number
   - Originator
   - Request date
   - Subject matter
   - Affected document
   - Section numbers
   - Approval date for each signer
   - Date of distribution to each document holder
   - Issue date of revised document pages

5. The FEMP controlled document coordinator shall make copies of the DCR and forward them to applicable FEMP contractor organizations with a request for review and comments. An informational copy will be sent to the DOE-FO RPM. 3200

6. If a receiver refuses to sign the DCR, that person shall communicate to the FEMP project manager the reasons for not signing.

7. The FEMP project manager shall coordinate resolution of the disagreement. If a decision is made not to proceed with the DCR, the FEMP project manager shall notify the DOE FO and those who signed the DCR. An appropriate entry to this effect shall be made in the DCR log.

8. The FEMP controlled document coordinator shall receive signed DCRs from reviewers and record dates in the DCR status and tracking log.

NOTE

The effective date of change and issuance of the DCR is dependent on DOE completing the section of the DCR specifying EPA notification, EPA approval, or immediate implementation.

9. The FEMP controlled document coordinator shall forward the signed DCR to DOE FO for signature and transmittal to EPA for signature.

NOTE

EPA signature is required for primary documents of the (1991 consent). EPA approval is not required for non-EPA-approved secondary documents of the 1991 amended Consent Agreement. The EPA shall be advised of any modification to documents that received EPA comments.

10. The FEMP project manager shall coordinate resolution of external FEMP comments and obtain required internal FEMP approvals.

11. The FEMP controlled document coordinator shall issue DCR to holders of controlled copies of the SCQ upon completion of FEMP external approval process.

12. Changes described in the DCR shall be implemented by the applicable organization on the date specified in the EFFECTIVE DATE space.

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4.4.3.3 Revision of Documents and Drawings. Documents may be revised by either a complete revision (the entire text is replaced) or a limited revision. (Only a few pages are changed, added, or deleted) the document table of contents shall be revised if affected by either a limited or complete revision. Each FEMP contractor and subcontractor shall have a written procedure for revising documents and drawings under their cognizance.

Complete revisions of the SCQ shall be indicated by a sequential number (i.e., Revision 1, 2, 3) and a date on the cover and title page as well as each page of the document.

A limited revision (only a few pages are changed, added, or deleted) shall have the current revision number with a decimal number indicating the change (i.e., Revision 1.1, 1.2, 1.3) and the new date only on the changed or added pages and the affected pages of the table of contents. Revised information shall be indicated by notation on the page. Added page numbers shall be the same as the page immediately preceding the added page with a decimal number added (i.e., Page 1.1 of 10, 1.2 of 10, 1.3 of 10).

Drawings, Computer Graphics, and Map revisions shall, as a minimum, be denoted by displaying a consecutive revision number, revision date, and review/approval signatures in the appropriate manner. Distribution shall be made to users who require current information to perform their work.

4.4.3.4 Distribution. Controlled documents and drawings shall be distributed to personnel as needed. The FEMP controlled document coordinator is responsible for controlled distribution of the SCQ. Each FEMP contractor and subcontractor is responsible for controlled distribution of documents under their responsibility. Delegation of distribution activities shall be documented.

Distributed documents shall be identified by a copy control number unique to each recipient. Each organization responsible for controlled distribution shall maintain a distribution list containing name of document, control number, and copy holder name and mailing address. If controlled documents and drawings become obsolete or are no longer needed, instructions for their return to the Controlled Document Coordinator for appropriate disposal shall be issued to copy holders. Each returned document shall be logged into the document tracking log.

An uncontrolled issue of a document shall be so identified on the copy in a conspicuous manner.

NOTE

> It may not be practical to identify drawings, graphics and maps with a copy control number. If not, they shall be identified in some other manner.

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Distribution of Revisions - Distribution of DCR document/drawing revisions and addenda shall be made to original-issue copy holders in the same manner. The transmittal of revisions/ addenda shall include instructions for revision inclusion and disposition of superseded material. Each limited revision (paragraph 4.4.3.3) shall be transmitted by a revision log sheet that lists revised pages for that revision. The log sheet shall be filed in front of the revised document section. A record of document transmitted, recipient, and transmittal date shall be maintained in the tracking log.

Incorporation of Changes - Each controlled document copyholder who receives an approved DCR shall insert it in the SCQ until revised document pages incorporating the DCR changes are received. Upon receipt of changed pages, they shall be incorporated in the SCQ and the DCR shall be removed.

4.5 REFERENCES

U.S. Department of Energy. 1984. Directive DOE 1324.3. Files Management.

SECTION 5

Section 5

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FIELD ACTIVITIES

Policies and guidelines for field activities that do not involve physical sample collection are provided in this section and include the following.

- Daily Logs (subsection 5.1)
- Field Activity Policies (subsection 5.2)
    - Drilling (paragraph 5.2.1)
    - Monitoring Well/Piezometer Design, Installation, and Abandonment (paragraph 5.2.2)
    - Monitoring Well Development (paragraph 5.2.3)
    - Monitoring Well Maintenance (paragraph 5.2.4)
    - Aquifer/Permeability Testing (paragraph 5.2.5)
- Geophysical Surveys (subsection 5.3)
    - Borehole Geophysical Logging (paragraph 5.3.1)
    - Surface Geophysical Surveys (paragraph 5.3.2)
- Field Radiological Contamination Surveys (subsection 5.4)

General procedures for these activities are contained in Appendix J. Detailed procedures shall be documented in Project-Specific Plans (PSP) as a supplement to the Sitewide CERCLA Quality Assurance Project Plan (SCQ). Each field procedure shall specify reasons or uses for the activity, methods to be used, applicable material specifications, and documentation requirements specific to that activity.

Minimum requirements for field activities in this section and in Appendix J may be incorporated into PSPs by reference to this SCQ. Surveillance and audits shall be conducted in accordance with requirements specified in Section 12 and with PSP requirements. Information obtained from site exploration activities shall be recorded and filed as specified in subsection 5.1.

5.1 DAILY LOGS

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Required documentation of field investigations and testing include a daily field log (Form 5-1, Appendix B) maintained for activities of each project. The daily log shall incorporate the following.

- Applicable subsurface logs
- Test data forms
- Piezometer/well installation forms
- Field collection forms
- Photographs
- Chain-of-custody records

Requirements for this field activity documentation are in Section 6 and for chain-of custody records in Section 7.

Field personnel shall keep a daily log of project activities. It shall be a written record of activities and measurements conducted on a given date and may include daily field activity logs, boring logs, well-construction logs, media-specific sampling logs (Form 5-2, Appendix B), photographs, and sketches. The log shall be in a bound book with sequentially numbered pages or on pre-printed, individual, sequentially numbered loose log forms as specified by the PSP. Daily log entry requirements are specified in Appendix J.

Activity-specific logs (e.g., subsurface boring logs, water sampling logs, sediment sampling logs) shall be generated to document field activities as specified in Section 6 and in Appendix K. These logs are considered part of the daily log. At least weekly, copies of daily log forms shall be sent by field personnel to the FEMP project manager or representative and others as required in PSPs.

NOTE

> Information in activity-specific logs shall not duplicate but rather support other required documentation.

Originals of field records shall be maintained in the project central file. During performance of the field program, the FEMP project manager or representative shall maintain copies of field records and store them separately from the originals. These copies will provide adequate documentation of work activities if originals are destroyed, lost, or stolen.

5.2 FIELD ACTIVITY POLICIES

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The following policies for field activities are supplemented by general procedures in Appendix J and project-specific procedures in PSPs.

5.2.1 Drilling

The nature, arrangement, thickness, and extent of subsurface strata can be determined by implementing a well-designed drilling program. Number, location, and depth of borings and type of sampling and testing required are dependent on intended use of the data generated.

The type of drilling method selected for a particular project at FEMP depends on intended use of the borehole and samples collected. Ability to acquire data of sufficient quality for intended use and personnel health and safety are the primary factors considered when choosing a drilling method. The justification for choosing a particular drilling method shall be clearly set forth in PSPs.

Descriptions of various drilling methods are presented in Driscoll (1986) and Aller, et.al. (1989). Drilling methods that might be considered for use at FEMP include cable tool; hollow-stem auger; drive casing; spin casing; direct mud rotary; air rotary with casing driver; air rotary with a swing-out, under-reaming bit and casing advancer; and reverse-air or mud rotary.

Historically boreholes for monitoring well installation at FEMP were drilled using cable-tool or hollow-stem auger methods. Good samples can be collected with both these methods. However, the cable tool method is slow relative to other available methods, and the hollow-stem auger method is not applicable to deep drilling or drilling through consolidated material or large boulders.

Drilling operations shall be conducted so a minimum of contaminants are introduced into the environment or spread between zones. Surface casing shall be set when a potentially contaminated zone is drilled prior to reaching the target zone. When drilling through areas where near-surface contamination is indicated through past use or during screening of samples while drilling, surface casings shall be grouted in place and made a part of the permanent installation. In outlying areas not suspected of being contaminated, large diameter temporary casings shall be advanced as necessary for bore-hole control.

Consistent with FEMP policy of waste minimization, the chosen drilling method shall require the least possible fluids and generate the fewest possible cuttings and the least waste.

The plant potable water system shall be the source of water for drilling operations at FEMP. The quality of any other water source used shall be documented through analysis of samples by FEMP prior to use.

The FEMP project manager shall approve additives used in drilling fluids prior to use. Before an additive is approved, a sample shall be analyzed for parameters of interest and the results reviewed for potential impact on the objectives of the data-collection program. Use of additives is discouraged.

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Sumps dug for containment of drilling fluid are prohibited except where absolutely necessary and shall have prior approval by necessary regulatory agencies. Above-ground mud pits, drums, or plastic-lined structures are normally used for containment of drilling fluids and cuttings.

As specified in Appendix J, drilling equipment shall be decontaminated before each use to prevent contamination of the borehole and after each use to prevent off-site transport of contaminants.

A qualified geologist, hydrogeologist, or geological engineer shall be responsible for operations at each drilling site and shall be on hand when a borehole is being advanced. This person-in-charge is also responsible for logging activities at the site including, but not limited to, drilling and sampling activities, footage drilled, materials used, sample descriptions, well installation activities, and unusual occurrences. Subsurface boring logs (Appendix J) shall be generated for each boring.

The FEMP project manager is ultimately responsible for securing permits required by state, local, or on-site authorities. As part of the permit process, underground and above ground utilities shall be identified so they do not pose a danger to drilling operations. Copies of permits and other appropriate documentation shall be posted on site when drilling operations are conducted.

5.2.2 Monitoring Well/Piezometer Design, Installation, and Abandonment

NOTE

See Glossary for definition of terminology.

Existing monitoring well locations and depths at FEMP were selected to allow monitoring of chemical and hydraulic properties. They were primarily constructed according to procedures in the EPA-approved ***Remedial Investigation/Feasibility Study Quality Assurance Project Plan*** (U.S. Department of Energy, 1988) and included borehole installation by the cable-tool method; four-inch-diameter, 316-stainless-steel casing and screen; annular seal of bentonite grout; and locking protective casing.

Piezometers at FEMP were originally installed to determine the occurrence and distribution of saturated zones within the glacial drift (perched aquifers). The piezometers were drilled and installed by the hollow-stem auger method and constructed of two-inch-diameter,

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schedule-40 Poly Vinyl Chloride (PVC) casing and screen. The hollow-stem auger method is also commonly used to install monitoring wells, and PVC casing and screen are chemically compatible with most constituents of concern at FEMP except for certain organics (Aller, et.al., 1989). Quality assurance/quality control (e.g., decontamination of well materials and drilling equipment, containment of cuttings, and documentation of construction) was maintained throughout the installation of these piezometers. Consequently, it was determined that water-quality samples collected from the piezometers could yield qualitative data for constituents unaffected by the well material, so wells currently referred to as piezometers at FEMP are used as monitoring wells.

Wells installed in accordance with the requirements of the SCQ for collecting ground-water quality data are referred to as monitoring wells. Wells installed purely for the collection of ground-water-level and hydraulic data are referred to as piezometers, regardless of drilling method or construction material. For clarity, the term "well" includes ground-water sampling or measuring points such as four-inch diameter monitor wells, above-ground and surface-finished piezometers, and former production wells.

New drilling and well construction shall be done in accordance with the requirements of Appendix J.

A four-digit numbering system is used to identify wells at FEMP. The first digit refers to the hydrogeologic zone and the last three digits refer to location. Wells in the 1000-series are screened within the glacial drift. Those in the 2000-series are screened across the water table in the regional aquifer (Great Miami Aquifer) and those in the 3000-series within the regional aquifer immediately above the clay interbed when present and at a comparable depth when this layer is absent. The 4000-series wells are the deepest and are screened at the base of the regional aquifer (Figure 2-2).

Applicable Appendix J requirements shall be followed to ensure quality control of well design, installation, and successful completion of field drilling investigations for obtaining hydrogeological and future water quality information.

Installation and use of dedicated ground-water sampling equipment is encouraged when either of the following conditions exist.

- High concentrations of contaminants are present at a well site, making handling and decontamination of sampling equipment a problem
- Well accessibility is a problem.

Equipment that may be dedicated to a sampling location are specified in Appendix J.

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Improperly abandoned wells can serve as a pathway for pollutants to migrate from one zone to another. Proper well abandonment is necessary to maintain a credible monitoring program. Objectives of proper well abandonment include the following.

- Eliminate physical hazards
- Prevent ground-water contamination
- Conserve aquifer yield and hydrostatic head
- Prevent intermixing of subsurface waters (Aller, et.al., 1989)
- Comply with reasonable property owner requests

Factors to be considered in well abandonment and procedures for abandoning a well are provided in Appendix J.

5.2.3 Well Development

Wells must be properly developed to yield accurate aquifer test results and ground-water samples representative of aquifer conditions. A qualified geologist, hydrogeologist, or geological engineer shall be present during well development activities and shall be responsible for documenting aspects of the process. Procedures for developing wells are provided in Appendix J.

5.2.4 Well Maintenance

It is necessary to maintain ground-water wells in order to extend the life of the wells and to provide representative levels and samples of the ground water surrounding the wells. Therefore, a regular inspection program for FEMP wells shall be developed. Maintenance shall be performed on a case-by-case basis pursuant to the results of the inspection program specified in Appendix J. The following aspects of well maintenance shall be addressed.

- Well evaluation
- Redevelopment
- Maintenance check lists
- Well head protection

Well maintenance activities are the responsibility of the FEMP prime contractor, who shall conduct a maintenance survey of ground water wells and evaluate well maintenance concerns

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such as water quality, structural integrity, and well-head protection. Existing ground water wells shall be evaluated prior to use to assess whether the status will allow for collection of representative ground water samples. The assessment process is detailed in Appendix J.

Well maintenance activities shall comply with applicable regulatory and site requirements. Well maintenance procedures are provided in Appendix J.

Prior to performing maintenance activity at a designated location, subcontractors shall submit to FEMP for approval a work plan as specified in Appendix J. The plan shall be in a standard format specified in the contract statement of work for ground water monitoring programs.

5.2.5 Aquifer/Permeability Testing

This paragraph defines requirements and provides guidelines for hydraulic tests to characterize certain properties of hydrogeologic units (i.e., hydraulic conductivity, transmissivity, and storage coefficient). A decision to conduct an aquifer test for each project shall be made in accordance with guidelines in the PSP. Guidelines for determining test type, location, and objectives for each project shall be specified in the PSP. Methods for testing aquifer/permeability are provided in Appendix J.

Equipment used in the test shall be based on approximations of properties of interest from previous drilling and testing data.

Tests shall be designed and managed by a hydrogeologist with demonstrated experience in conducting the specified test in a similar environment. Data obtained during field hydraulic tests may include the following.

- Static water level
- Pumping well water discharge rate or volume of water displaced
- Drawdown or pressure versus time for pumping and wells
- Water temperature, pH, dissolved oxygen, redox potential, and specific conductance
- Test interval

Hydraulic conductivity (K) is a measure of the capacity of a hydrogeologic unit to conduct water through a given cross-sectional area under saturated conditions. The greater the value of hydraulic conductivity, the greater the capacity of the unit to conduct water. The transmissivity (T) of an aquifer is defined as the ability of the aquifer to transmit water through its entire thickness and is equal to hydraulic conductivity (K) times the saturated

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thickness of the aquifer (b). Transmissivity is equal to integration of hydraulic conductivity over depth Z or:

$$T = \int K(Z)dz.$$

Specific yield is the ratio of water volume drained by gravity per unit volume of porous media under atmospheric pressure. The storage coefficient of an aquifer is the volume of water in storage released from an aquifer column of unit cross section under a unit decline of head. In confined aquifers, water released from storage is the result of aquifer compression and water expansion in response to pressure differentials introduced during pumping.

5.2.5.1 Slug Tests. Slug tests are a quick and inexpensive method of estimating the hydraulic conductivity or transmissivity near the screened zone of the well. The method to be used for conducting and analyzing slug tests shall be based on project-specific considerations including, but not limited to, expected and observed aquifer response, degree of confinement, thickness of saturated zone, well construction, and ability to handle evacuated fluids.

Analysis of slug test data is based on a modification of well-known ground-water flow equations (i.e., Theis, 1935, equation or subsequent modifications remove). Several authors have presented analytical solutions for analysis of slug test data. Most solutions require a semi-logarithmic plot of data collected: dimensionless head (logarithmic scale) or residual head (logarithmic scale) versus time (arithmetic scale).

Hvorslev (1951) was one of the first researchers to publish techniques of analysis of either constant or slug (falling head) tests in near-surface saturated soils. Cooper, et.al. (1967) and Papadopoulos, et.al. (1973) developed a set of type curves for analyzing slug test data, particularly for tests run in materials that are confined (under artesian pressure). Bouwer and Rice (1976) and Bouwer (1978) developed a technique for analyzing slug test data collected from completely or partially penetrating wells in unconfined aquifers.

Pressurized slug test methods have been developed for testing extremely low conductivity (10^{-8} cm/sec or lower) materials (Bredehoeft and Papadopoulos, 1980). The advantage of the pressurized slug technique is the reduced time required to perform a test in tight formations. This method involves creating an instantaneous pressure surcharge on drawdown in the test zone, then closing a valve in the well. Based on rate of decay of the pressure slug and geometry of the test zone, transmissivity, hydraulic conductivity, and storage coefficient may be calculated.

5.2.5.2 Aquifer Pumping Tests. Aquifer pumping tests, commonly referred to as pump tests, are used to determine hydraulic properties of water-bearing zones. Pump tests

influence a larger area and provide results that are often more representative of the overall aquifer characteristics than slug tests. Every pump test should be considered unique. Methods of test conduct and analysis, as well as instrumentation, shall be specified in PSPs.

Aquifer characteristics that may be obtained from pumping tests include hydraulic conductivity (K), transmissivity (T), and specific yield (S_y) for unconfined aquifers and the storage coefficient (S) for confined aquifers.

Equipment, personnel, and time commitments needed to conduct pumping tests are greater than those required for slug tests. Briefly, a pumping test consists of pumping one well and recording the drawdown in the pumping well and in other nearby observation wells.

There are several types of pumping tests, the most common being the constant-rate discharge test (Todd 1980). Variable-rate tests are also employed under some conditions. Although analysis is more complicated, any sort of temporal variations in flow rate can be accounted for by assuming the law of superposition holds true, usually a valid assumption. The most widely used variable-rate tests are the step-drawdown test, the constant-head test, and the air-lift pump test (Kruseman and DeRidder, 1976).

Another useful technique is injection testing. Injection tests, both constant and variable rate, are analytically identical to pumping tests except for consideration of flow into, rather than a withdrawal from, an aquifer. Data quality is similar.

Injection tests are commonly used in the petroleum industry (Earlougher, 1977), and numerous applications exist in environmental investigations. Water sampling for geochemical characterization of an aquifer shall be conducted prior to application of this technique. Injection water shall be free of suspended solids and of equal or higher quality than ground water at the test site. Injection tests require special permission from EPA and the Ohio Environmental Protection Agency, which shall be obtained prior to scoping the test.

One major advantage of injection tests is that contaminated ground water is not removed from the formation and, thus, is not a disposal or safety problem. A potential disadvantage of the injection test is that, in certain cases, the injection well may have to withstand some induced hydraulic pressure. The injection rate shall be kept low enough to prevent raising the water level above the top of the well casing to prevent leakage of injected fluid on the ground surface.

Numerous sources provide additional information on constant-rate pumping tests. Driscoll (1986) presents many suggestions on how to perform the test. Walton (1970), Todd (1980), and other references, such as Kruseman and DeRidder (1976), provide analytical techniques and example problems of pumping tests conducted under different geologic conditions.

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Design of the test well is an important consideration in aquifer testing. In some cases, an existing well may be pumped. When conditions permit, a well can be designed and constructed specifically for the test. Under ideal circumstances, the test well is screened throughout the thickness of the aquifer to be tested (a fully penetrating well) using a standard well screen with openings sized to the aquifer material. However, under some circumstances, a partially penetrating well screened in a specific portion of the aquifer may be preferable.

The well should be filter-packed in unconsolidated, fine-grained aquifers to prevent sand production. It should be correctly sealed from overlying and underlying units that are not to be directly pumped and so that leakage along the well annulus cannot occur. Such leakage can interfere with data interpretation. The completed test well should be developed so that influences related to drilling and well construction are minimized. Proper development of the well may prevent unexpected variations in the pumping rate during the test that can lead to inconsistent drawdown data. Standard well construction techniques are discussed in Driscoll (1986).

The location and number of observation wells depend on several factors including the following.

- Whether the designated aquifer is confined or unconfined
- Thickness of the aquifer
- Inferred anisotropy of the aquifer
- Location of screened interval of pumping well relative to total aquifer thickness
- Location of aquifer boundaries and whether positive (lake or stream) or negative (impermeable boundaries)
- Logistic and economic considerations

Any number of observation wells may be considered. A number of guidelines for location of observation wells are presented in the Ground Water Manual (U.S. Department of Interior, 1981) and Kruseman and DeRidder (1976). The layout of the observation wells shall be included in pumping test plans.

As a general rule for tests performed in both confined and unconfined aquifers, observation wells are screened or completed in a substantial portion of the aquifer thickness in approximately the median depth of the test zone. In some cases, special tests require that observation wells be selectively completed in several depth zones in order to accurately determine aquifer characteristics such as anisotropy and vertical hydraulic conductivity.

Selection of location for an observation well relative to a pumped well is partially dependent on whether the aquifer is confined. Suggestions for the location of observation wells for four hypothetical situations follows. 3200

- For most aquifers with fully penetrating pumped wells, observation wells are located at a distance estimated by using the Theis (1935) formulation, which is described by Walton (1970). Assumed aquifer parameters are used to determine a location that will give the amount of drawdown required for proper analysis.

- For thin confined aquifers with fully penetrating wells, the nearest observation well is located at least 25 feet from the pumped well and, for unconfined aquifers, observation wells are generally located 15 to 100 feet from the pumped well.

- In thick isotropic aquifers with a partially penetrating pumped well, observation wells are located one and one-half to two times the aquifer thickness from the pumped well.

- For thick anisotropic aquifers with a partially penetrating well, observation wells are located a minimum distance from the pumped well equal to twice the thickness of the aquifer times the square root of the ratio of the horizontal to the vertical hydraulic conductivity.

Duration of the test is determined by project needs and aquifer response. One test for determining adequacy of data is if log-time versus drawdown for the most distant observation well begins to plot as a straight line on semi-log graph paper. There are several exceptions to this rule of thumb, so criteria for termination of the test shall be defined in the PSP.

Numerous techniques of analysis have been developed to evaluate data collected from constant-discharge aquifer pumping tests. Many of the analyses use the graphical curve-matching technique, which involves matching of theoretical type curves to plot log drawdown versus log time from observation wells. Other analyses rely on other graphical techniques such as application of a straight line to plots of drawdown versus log time. Verified aquifer test analysis software is available and should be considered for use.

Theis (1935) developed a theoretical formula that related lowering of the potentiometric level in an aquifer caused by constant withdrawal of water to the transmissivity of the aquifer. This classic formulation has been widely used to predict water level response in aquifers resulting from specified pumping stresses. Several authors have described the use of this formula in estimating transmissivity and storage coefficient from aquifer test data: Lohman (1972), Walton (1970), Todd (1980), and Freeze and Cherry (1979). The method involves superimposing the Theis solution (or "type" curve) on a log-log plot of drawdown-versus-time data from a test well. Data from the "match point" are used to solve two algebraic equations that give the value of transmissivity (T) and storage coefficient (S). Hydraulic conductivity (K) may be computed by dividing T by aquifer thickness (b). The same aquifer

parameters can also be determined from a semi-log plot of drawdown versus time for either the pumped well or observation wells. Analytical data analyzed using the Cooper and Jacob (1946) method, when plotted as described, compares with Theis's T, S, and K values. 3200

Knowledge of area hydrogeology and type of aquifer conditions is essential for correct analysis of test data. For example, bounded aquifers produce straight-line trends by the Cooper and Jacob (1946) method that may yield apparent transmissivity values that are too low.

Since the development of the Theis equation, several other formulas have been published that attempt to describe response of certain aquifers to a constant pumping stress. Hantush (1956) developed a formula and a corresponding set of type curves for an aquifer overlain and/or underlain by a confining bed that has significant storage and experiences vertical flow when the adjacent aquifer is pumped. Hydraulic characteristics of the confining unit can be calculated using the set of Hantush type curves.

Another commonly used set of type curves developed by Boulton (1954, 1963) may apply when the tested aquifer is unconfined and exhibits a phenomenon known as delayed yield, which is a result of drainage retardation caused by capillary tension. Nueman (1972, 1975) also developed a set of type curves for the response of unconfined aquifers to pumping, but he used different assumptions concerning the physical processes in effect. In practice, Nueman and Boulton curves have been shown to give similar results.

5.3 GEOPHYSICAL SURVEYS

Understanding the subsurface hydrogeologic and geochemical conditions at FEMP can be enhanced by geophysical surveys. Specific techniques used are dependent upon project-specific data quality objectives.

There is currently a wide variety of geophysical instruments on the market and the field is in a stage of rapid innovation and improvement. Specific instruments and methods shall be chosen based on physical surroundings, size and shape of expected targets, anticipated fluid properties, degree of saturation, and desired resolution. Instruments and methods shall be specified in PSPs. Minimum quality assurance/quality control measures for borehole logging and surface surveys are discussed in paragraphs 5.3.2.1 and 5.3.2.2.

5.3.1 Borehole Geophysical Logging

Borehole geophysical methods are used to acquire information about the following subsurface geological characteristics.

- Formation breaks

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- Thickness of individual beds
- Porosity
- Nature of borehole and formation fluids
- Identification of high-permeability zones
- Depth of penetration of drilling fluids
- Borehole size

Some commonly used geophysical methods include spontaneous potential, resistivity, natural gamma, neutron density, and calipers. Certain methods (e.g. neutron density) require use of a radioactive source, which requires special handling methods.

Basic requirements for performing and documenting subsurface geophysical logging activities are presented in Appendix J. Suites of logs shall be generated depending on the geologic environment, borehole fluids, information desired, borehole size, and resolution. A number of excellent references exist on the use of borehole geophysics including Dresser Atlas Division (1975), Schlumberger (1972), and Sengel (1981).

The PSP shall specify the following.

- Logging subcontractor
- Suite of logs to be run and boreholes to be logged
- Tool size
- Borehole preparation
- Special source material handling requirements
- Document formats
- Resolution desired
- Logging speed
- Frequency of quality control runs

A minimum of one quality control duplicate run shall be made with each tool used on each logging project. The FEMP project manager shall ensure that necessary permits and operator licenses or certifications are acquired and current. 3200

5.3.2 Surface Geophysical Surveys

Surface geophysical methods provide subsurface information without the need for excavation of surface materials. The following methods are commonly used during environmental investigations.

- Seismic refraction and seismic reflection
- Gravimetric surveys
- Electrical resistivity
- Ground-penetrating radar
- Ground conductivity
- Magnetometry
- Metal detectors

Information provided includes delineation of contaminant plumes, identification of high permeability zones, location of disposal areas and subsurface anomalies, and identification of subsurface utilities.

Surface geophysics may be used for a variety of purposes including screening of an area for possible contamination, locating potential disposal areas, identifying subsurface excavation or boring sites, locating abandoned wells, and characterizing the local geology. Surface geophysical methods are subject to interferences such as buildings, metal fences, power lines, subsurface utility lines, and natural variations in mineralogy.

The nature of the designated site and the information desired shall be evaluated before choosing a surface geophysical method. The field of surface geophysics is currently in a state of development with new methods and advances on established methods geared towards the environmental industry becoming commonplace.

An expert on surface geophysics should be consulted during the scoping phase of the project if use of this tool is anticipated. A number of excellent references are available on the use of surface geophysics including Costello (1980); Micham, Levy, and Lee (1984); Mooney (1981); and Zohdy, Eaton, and Mabey (1974).

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Requirements for performing and documenting surface geophysical surveys are presented in Appendix J. PSPs shall specify the method and instruments to be used, grid spacing, speed at which survey is to be conducted, information desired, and frequency of duplicating lines for quality control purposes. A minimum of five percent of the total linear distance of the survey shall be duplicated. Provisions for verifying interpretations through use of borings or excavations shall be included.

Project-specific log forms shall be maintained with information recorded as specified in Appendix J.

Operators shall be trained in use of equipment, and training shall be documented in project files as specified in Section 4. Instruments shall be operated in accordance with manufacturer instructions. If these instructions are not used, a complete description of variations along with justification shall be provided in the PSP, or the situation shall be presented as a variance as specified in Section 15.

5.4 FIELD RADIOLOGICAL CONTAMINATION SURVEYS

Radiological contamination surveys at FEMP are conducted to determine personnel protection requirements, monitor for or detect releases of radioactive materials, and screen samples for laboratory analyses for gross characterization of areas or materials for the presence of radiological contaminants. These include sitewide field surveys conducted during the remedial investigation/feasibility study.

Surveys are conducted in accordance with DOE Orders 5400.5 and 5480.11 in support of activities such as decontamination and decommissioning of facilities and equipment, construction, and release detection. Radiological contamination surveys in support of Comprehensive Environmental Response, Compensation, and Liability Act activities include health and safety monitoring in the field and screening of samples to determine need for laboratory analysis, laboratory licensing requirements, and shipping and packaging requirements. Such surveys are conducted in the field to characterize an area, a facility, or equipment for contamination.

Requirements for health and safety contamination surveys are included in FEMP Health and Safety Department procedures. Requirements for screening of samples are included in Section 6 and Appendix K. Requirements for radiological surveys follow.

Contamination survey techniques at FEMP shall be based on standard nuclear industry techniques combined with process knowledge of potential contaminants at the site. Field radiological contamination surveys may include loose alpha and beta/gamma surveys and fixed alpha and beta/gamma surveys.

Loose contamination is defined as radiological contamination, including soils and sediments, that can be readily removed from a surface by collecting a smear sample. Surveys are performed for area characterization, determining level of personnel protection required, ensuring that vehicles and packages meet Department of Transportation requirements (Section 6), and identifying free releases. 3200

Fixed contamination is defined as radioactive contamination that has become part of the structure being surveyed at conditions prevailing at the time of the survey. Fixed contamination cannot be measured with smear samples; it must be measured directly from the material of interest.

Total contamination of a material or structure is defined as the sum of loose and fixed contamination. Direct survey techniques are used to measure the amount of total activity on various surfaces.

Scoping requirements for radiological contamination surveys shall be documented in PSPs and shall include the following.

- Regulatory driver or other reason for conducting survey
- Types of radiation expected
- Types of measurement equipment plus calibration and operating requirements
- Types of samples to be collected (e.g., smears, surface soil, sediment)

The following applies to instruments used for radiological field screening.

- Instruments used shall be calibrated at least semi-annually and after any adjustments or repairs. Response shall be checked daily using a source of known activity.
- Field survey procedures shall include the type of instrument specified, specifications for geometry used, maximum speed allowable for the specific instrument, and maximum allowable background for given lower limits of detection.
- The lower limit of detection for instruments used shall be determined so that a 95-percent confidence level is achieved.
- The type of material surveyed shall determine the survey technique used.
- Survey methodology and techniques shall be outlined in PSPs.

5.5 REFERENCES

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SECTION 6

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Section 6

SAMPLING REQUIREMENTS

Sampling projects at FEMP are specified based on project objectives coupled with a review and evaluation of existing data for the site vicinity. Sampling projects may include collecting the following samples.

- Aqueous Samples (subsection 6.2)
- Solid Matrix Environmental Samples (subsection 6.3)
- Gaseous Matrix Samples (subsection 6.4)
- Biological Samples (subsection 6.5)
- Miscellaneous Samples (subsection 6.6)

Subsection 6.7 specifies requirements for field storage and shipment of samples. Subsection 6.8 specifies requirements for decontamination.

Currently used procedures for sampling activities at FEMP that generate data for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program are provided in Appendix K. Additional procedures may be submitted to provide detailed information on applicable sampling activities.

Minimum requirements for sampling activities described in this section and in Appendix K shall be incorporated into Project-Specific Plans (PSP). Requirements above and beyond those included in the Sitewide CERCLA Quality Assurance Project Plan (SCQ) shall also be described in PSPs along with appropriate programmatic and background information required for the specific project PSPs may be incorporated into the Sitewide CERCLA Quality Assurance Project Plan (SCQ) by reference.

Surveillance and audits described in Section 12 shall be conducted to confirm that SCQ and PSP requirements are fulfilled.

Definitions of acronyms, abbreviations, and terminology may be found in the Glossary.

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6.1 PROJECT-SPECIFIC PLANS

PSPs shall be developed as required for each project that includes sampling and analysis performed at FEMP. These plans include details applicable to the specific project for which they are written and shall be in a form that can be used on a day-to-day basis by project personnel.

6.1.1 Plan Requirements

The following items shall be considered when developing PSPs.

- Regulatory requirement (or other reason for sampling) and Data Quality Objectives (DQO)
- Anticipated uses for analytical data
- Probable sources, environmental fate, potential transport routes, and contaminants of concern
- Summary of previous monitoring
- Method for determining sampling locations (including background) and justification (Section 2)
- Location and number of monitoring stations to be sampled including background stations
- Media to be sampled and variation in space and time
- Frequency of sampling
- Suspected and known hazards
- Methods for collecting samples
- Number of samples to be collected and reason
- Quality assurance samples
- Volume of samples to be collected and reference
- Additional quality control checks

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- Types of field analyses and reasons (Section 2)
- Methods of preservation, storage, and shipment
- Procedures for and precautions during sampling with reference
- Type and kind of laboratory analyses (Section 2 and 9)
- Forms to be used and requirements for tracking field activities
- Sample tracking procedures (chain of custody) (Section 7)
- Decontamination procedures
- Project schedule

PSPs shall ensure that collected samples are representative of the media sampled and that the number of samples collected is sufficient to achieve PSP quality objectives.

DQOs are quantitative and qualitative statements that specify the quality of data required to support decision making (U.S. Environmental Protection Agency, 1987). Intended use of the data is the driving consideration in the formulation of DQOs. Screening data from Analytical Support Levels (ASL) A and B analyses are used most often at FEMP. However, parameter-specific data for ASLs C, D, and E are necessary for many types of risk assessment, characterization, and treatability analyses. ASLs are discussed in detail in Section 2.

EPA guidance has been used to develop a process for defining DQOs for projects at FEMP. A description of this process and the DQOs for ongoing projects at FEMP are provided in Appendix C. Support documentation for DQOs becomes part of project files.

6.1.2 Preparation and Implementation of Project-Specific Plans

PSPs shall be approved as specified in Section 3 prior to use. The following guidelines shall be applied to preparation of PSPs.

- Define project-specific DQOs based on intended use of the data and the ASL.
- Develop rationale for sample collection that will achieve DQOs.
- Determine and describe sample collection locations.
- Define overall scope of the study including sampling procedures, equipment, sample handling requirements, and shipping procedures.

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- Determine and describe potential hazards presented by the type of sample collection activities and identify the safety precautions and practices outlined in the FEMP Sitewide Health and Safety Plan or in the project-specific addenda to the plan.

- Determine and identify equipment and materials necessary to perform required sampling activities and field analyses.

- Specify calibration requirements for field equipment in accordance with the National Institute of Standards and Technology or the American Society for Testing and Materials if available. Otherwise specify manufacturers instructions and calibration procedures or provide specific variations in the PSP in accordance with Section 8.

- Specify appropriate documentation of calibration performance.

- Identify appropriate field collection sampling reports pertinent to the particular sampling activity.

- Determine and specify appropriate sample labeling requirements that will include, at a minimum, an identification of the project, sample number, sampling date and time, parameters to be analyzed, preservatives to be added, and sampler's initials as specified in Section 7.

- Identify complete chain-of-custody documentation (Section 7) from the time of collection to final disposition that must accompany samples sent to a laboratory for analysis.

- Specify decontamination procedures for sampling activities in accordance with decontamination requirements in Section 5.

- Specify preservation and storage requirements for samples as required in Appendix K.

- Specify sample packaging and shipping requirements in accordance with Appendix K.

- If a technology or method not previously used at FEMP will be implemented during a project, include the following in the PSP.

    - Reason technology or method was chosen

    - References or other data confirming that the technology or method is sufficient to support data needs

    - If the technology/method replaces one previously used, reason for the change and a document change request as specified in Section 4

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- If the technology/method replaces one previously used, a means for comparing results of the old and new technology/method
- Procedure for implementation of technology/method by reference after EPA approval

- Define data validation requirements for ASLs B and E data.
- Specify Quality Assurance/Quality Control (QA/QC) samples to be collected and protocols to be followed.

Sampling locations may be selected on the basis of judgmental, random, or systematic sampling. Judgmental samples may be collected for any purpose as long as the purpose is documented in detail in the PSP (U.S. Environmental Protection Agency, 1989a). Geostatistical methods for systematic and random sample location and quantity selection are documented in references such as U.S. Environmental Protection Agency (1989a), Davis (1973), Gibbons (1990), Gilbert (1987), Westat Research, Inc. (1989), and Krumbein and Graybill (1965).

Rationale for sample location and quantity shall be described in the PSP, and support documentation shall be maintained in project files. A combination of professional judgement and random or systematic sampling is normally used.

Sample collection forms shall be completed for activities and are considered part of the daily log (Section 5). Specific information about sampling location and collection shall be recorded on the forms as well as the following minimum information.

- Project identifiers
- Sample location
- Description of sampling points (e.g., east bank of Miami River 500 feet upstream of confluence with Paddys Run)
- Sampling date or dates
- Start and finish time of sampling activity and sample collection times
- Weather conditions including significant changes during the activity
- Sample numbers
- Description of sample containers (e.g., three 40-mL glass vials)

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- Analysis parameters
- Preservation methods including refrigeration
- Field measurements including replicate measurements
- Visual description of samples
- Unusual occurrences (e.g., "semi-volatile sample could not be collected because of insufficient recovery of well" or "truck passed while sampling stirring up significant volume of dust upwind of sample collection site")
- Sampling team members
- Types and identification numbers of equipment used

Matrix-specific requirements are described in individual sampling sections.

6.2 COLLECTION OF AQUEOUS SAMPLES

NOTE

See Glossary for definitions of terminology.

Aqueous samples include natural and waste waters. Ground water and surface water are defined for the purpose of this document as natural waters. Water collected after use or in storm sewers are considered waste waters. The following are specific matrices sampled at FEMP.

- Ground water from monitoring wells, piezometers, and private wells
- Surface water from the Great Miami River, Paddys Run, other natural above-ground bodies of water, and the storm-water outfall ditch
- Waste water from manholes, the sewage treatment plant, and any other point in the plant waste-water system
- Other waste water, specifically water collected in the storm-water retention basins prior to discharge

Samples shall be collected for analytical parameters in order of stability. The order of sample collection is provided in Appendix K.

6.2.1 Field Analytical Procedures for Natural Water Samples

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Temperature, pH, and specific conductance shall be measured in the field and documented on ground-water and surface-water sample collection forms. Other measurements including dissolved oxygen, alkalinity, and redox potential may be specified for certain projects. Determinations shall be performed either in the well or on unpreserved samples. Surface-water measurements may be collected directly from the surface-water body. Ground-water field measurements may also be taken in situ (downhole) to avoid changes that might occur if the sample is removed from the well.

Procedures for measurements of temperature, pH, specific conductance, dissolved oxygen, alkalinity, and redox potential (Eh) are provided in Appendix K.

6.2.2 Ground-Water Sampling

Ground-water sampling is currently being conducted at FEMP for the following projects and programs.

- CERCLA Remedial Investigation/Feasibility Study (RI/FS) under the 1991 amended Consent Agreement
- Resource Conservation and Recovery Act (RCRA) Environmental Compliance Ground-Water Monitoring Program
- Radiological Environmental Monitoring Program (REMP)
- Safe Drinking Water Act

The scope of the CERCLA RI/FS ground-water sampling program is defined in the RI/FS Work Plan as amended (U.S. Department of Energy, 1988, and amendments). Requirements of the environmental compliance ground-water monitoring program are included in the group procedures and RCRA Ground-Water Quality Assessment Program Plan (Westinghouse Materials Company of Ohio, 1991). REMP requirements are defined in DOE Order 5400.1 1988 and in REMP procedures.

Other activities that may require ground-water sampling at FEMP include, but are not limited to, the following.

- Removal actions
- Removal site evaluations
- Remedial design

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- Underground storage tank compliance activities
- Solid Waste Management Unit characterization (RCRA facility investigations)
- RCRA closure of hazardous waste management units

6.2.2.1 Water Level Measurements. Ground-water elevation data are used to monitor aquifer storage, estimate rate and direction of ground-water movement, define recharge/discharge relationships relative to surrounding features, estimate baseflow to streams, and calculate the volume of water in a borehole or well. Procedures for collecting water-level data from wells including water-level measurements prior to sampling are provided in Appendix K.

6.2.2.2 General Ground-Water Sampling Requirements. The primary technical consideration in ground-water sampling is to obtain a representative sample of the ground-water body at the well location. Additionally, ground-water sampling at FEMP must meet certain requirements in order for subsequent data to be used by the CERCLA program. Procedures for collecting ground-water samples are provided in Appendix K. Additional requirements specific to a project may be included in PSPs.

6.2.2.3 Parameter-Specific Sampling Procedures. Ground-water samples are collected from monitoring wells and piezometers for volatile organic compounds, acid and base-neutral extractable compounds, total and dissolved metals, general chemistry, and radionuclide parameters in accordance with procedures provided in Appendix K.

6.2.2.4 Sampling Ground-Water from Private and Other Production Wells. Private water wells near FEMP have been sampled as part of FEMP programs, including the REMP and RI/FS. DOE has authorized sampling of private wells by FEMP personnel when requested, and they may be sampled during a routine project or at request of the property owner. Data collected from private wells may be qualified for certain uses. Procedures for collecting water samples from private or other production wells are included in PSPs. Other procedures are provided in Appendix K.

6.2.3 Surface Water Sampling

Surface-water sampling is currently being conducted at FEMP. Samples from Paddys Run and the Great Miami River are collected routinely in accordance with National Pollutant Discharge Elimination System (NPDES) requirements as part of routine monitoring. Samples have also been collected in support of RI/FS.

Procedures and practices are described in Appendix K for collection of water samples from streams, ponds, lakes, rivers, springs, and seeps. Two different techniques are used for

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collecting surface water samples: grab sampling and composite sampling which are discussed in Appendix K.

6.2.4 Waste-Water Sampling

Waste-water sampling is regulated by the Ohio Environmental Protection Agency (OEPA) under the Clean Water Act. As such, data are collected in accordance with permit-specific requirements. Samples are also collected for DOE environmental monitoring purposes and to fulfill requirements of the 1986 Federal Facility Compliance Agreement.

6.2.4.1 Purpose of Data Collection Activity. NPDES is a statutory requirement under Title IV, Section 402, of the Clean Water Act. Regulatory authority is provided under 40 CFR 122. This system requires that point source discharges into the nation's waterways have a permit that stipulates allowed limits for certain pollutants entering a particular body of water. The Feed Materials Production Center was issued an NPDES permit renewal (number 1I000004*BD) on 12 February 1990 that expires on 9 February 1995. The permit covers two outfalls to receiving streams and five internal monitoring points located throughout FEMP including remediation process-related waste water, storm water, and sanitary-waste water. The permit is based on both technology-based and water-quality-based limitations depending on water-quality goals of OEPA and the best available technology for treating waste waters specific to an industry. Permitted discharges are as follows.

- 1I000004001: manhole 175; outfall effluent to the Great Miami River
- 1I000004002: spillway outfall from the storm-water retention basin to Paddys Run
- 1I000004601: sewage-treatment-plant effluent part stream after disinfection
- 1I000004602: general sump effluent part stream to manhole 175
- 1I000004604: storm-sewer, lift-station effluent part stream to manhole 175
- 1I000004605: effluent part stream from biodenitrification effluent-treatment system to manhole 175
- 1I000004606: storm-water retention basin pump station effluent part stream to manhole 175

NPDES includes a self-monitoring program to ensure compliance with permit limits. The program consists of sampling waste water, analyzing it for regulated parameters, and reporting results in a monthly discharge monitoring report, which is the end use of the data for FEMP. However, OEPA collects these data plus data from other facilities discharging into waters of the state and uses it to track and regulate water quality in Ohio.

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In addition to NPDES requirements, FEMP routinely monitors waste-water discharges on a per-work-shift basis. These data become part of the waste-water treatment plant records. Uranium data are reported monthly to EPA as required under the Federal Facility Compliance Agreement attachment to the 1991 amended Consent Agreement.

FEMP has an ongoing program of sampling, analyzing, and reporting as required by its NPDES permit, the Federal Facility Compliance Agreement, and DOE. A sampling schedule is developed for the year by the Environmental Compliance and Quality Assurance Department to ensure that, over the course of time, the reported data provide an accurate picture of the volume and nature of waste-water flow in the permitted discharges.

Sampling and analysis requirements are regulated pursuant to 40 CFR 136. The FEMP permit defines the applicable regulation as that version of 40 CFR in effect on 1 July 1989, the effective date of the permit.

The Utilities Section is responsible for sample collection and for operation and maintenance of monitoring equipment such as continuous pH monitors and flow meters. The section is also responsible for operation of automatic samplers and for ensuring that proper techniques are used for grab sample collection when an automatic sampler is not or cannot be used.

The FEMP sampling and analysis management coordinator is responsible for disseminating samples to appropriate laboratories in compliance with specified sample custody and preservation requirements. Ultimately the department is responsible for analysis of samples including proper use and calibration of analytical equipment and implementation and verification of documented QA/QC requirements.

6.2.4.2 <u>Field Procedures</u>. The NPDES permit requires that effluent be monitored continuously for pH at every permitted sampling location except the general sump and for flow when a discharge occurs at each sampling location. Meters are in place to fulfill both permit requirements. Procedures for collecting flow meter information for each NPDES outfall that requires total daily flow reports are provided in Appendix K.

An NPDES sampling plan has been developed and is on file with OEPA. The plan identifies samples to be collected weekly under NPDES and contains information relative to location, type of container, number and volume of samples, type of analysis, preservation method, and lab destination. The basic requirements for NPDES sampling are specified in Appendix K.

FEMP participates in a quality assurance program under the authority of Section 308 (a) of the Clean Water Act. Periodically, samples of the same type of normally tested constituents are sent to FEMP for analysis. Analysis is performed and findings reported to EPA or their designated contractor in accordance with instructions provided with the samples. Results are compared to the true values to determine accuracy of FEMP laboratory analyses.

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6.2.4.3 Additional Sources of Information. Sampling procedures are governed by 40 CFR 136. FEMP standard operating procedures are implemented for waste-water sampling and analysis and are available upon request from the DOE Fernald Office. References of importance are as follows.

- *Manual of Sampling, Analytical, and Reporting Procedures for Wastewaters.* (Ohio Environmental Protection Agency, 1976).
- *Standard Methods for the Examination of Water and Wastewater.* (American Public Health Association, 1989).
- *Annual Book of Standards.* Part 23, "Water; Atmospheric Analysis" (American Society for Testing and Materials, 1991).

Analysis procedures used in FEMP laboratories for testing waste water are developed from specific methods provided in the Attachment I. The method reference for each analyte is identified in the method.

6.3 SOLID MATRIX ENVIRONMENTAL SAMPLES

6.3.1 Surface Soil Sampling

Surface soil samples are from soils that can be collected with manually operated, hand-held tools and that usually occur within three feet of the land surface. As part of routine monitoring, samples are collected by FEMP prior to excavation in order to characterize the soil for presence of hazardous or radioactive constituents. Surface soil samples have also been collected as part of the RI/FS. Procedures for collecting samples are provided in Appendix K.

6.3.2 Sediment Sampling

Sediments are materials that have been transported from their place of origin by fluid action and redeposited. Stream sediments are of the most interest at FEMP. Sediment sampling in Paddys Run and the Great Miami River is conducted for routine characterization. Sediments have also been analyzed as part of the RI/FS. Specific sampling stations are documented in PSPs. Procedures for collecting sediment samples are provided in Appendix K.

6.3.3 Subsurface Soil Sampling

Subsurface soil samples have been collected as part of preliminary studies and for the RI/FS. Additional samples will probably be collected as part of long-term monitoring and for remedial design/remedial action purposes.

Methods are provided in Appendix K for collecting and screening subsurface soil samples for radioactive contamination. Instructions for determining which samples should be analyzed for radiological parameters are included. 3200

The methods describe the technique for screening subsurface soils for intermediate and high-energy gamma-ray emitters. The screening level is chosen for instrument gross-count rates that exceed the background count rate by three standard deviations when the sample is counted in a low-background area. Screening may be performed with gamma-sensitive instrumentation capable of detecting the desired level of contamination (e.g., a portable multi-channel analyzer with associated sodium iodide detector). Screening shall be performed with field instruments specified in PSPs.

6.3.4 Drum Sampling

Drums are commonly used to store RCRA, non-RCRA, and mixed wastes at FEMP. Drum samples have been and continue to be collected to determine whether material is RCRA-controlled waste. If it is RCRA-controlled waste, additional sampling is completed to evaluate treatment/disposal options.

PSPs describe objectives for drum sampling, representative drum selection criteria, analytical testing requirements, statistical analyses for drum sample testing (e.g., confidence levels), and disposal requirements. Basic requirements for sampling are provided in Appendix K.

6.3.4.1 <u>RCRA Controlled Waste Determination</u>. The following process is based on information supplied in the FEMP Waste Analysis Plan, which was prepared in accordance with requirements of Ohio Administrative Code (OAC) 3745 and 40 CFR 264, 268, and 270.

FEMP is operating under a proposed amended consent decree between DOE, the state of Ohio, and the Westinghouse Environmental Management Company of Ohio. The parties to the consent decree have agreed to a schedule for RCRA characterization of waste materials stored on site. Wastes have been divided into groups based on the following definitions.

- **Backlogged Waste** - Waste generated and inventoried on or before 30 June 1990
- **Newly Identified Backlog Waste** - Waste generated prior to 30 June 1990 but not inventoried until after 30 June 1990
- **Newly Generated Waste** - Waste generated after 30 June 1990

RCRA characterizations are being completed according to the schedule agreed upon in the proposed amended consent decree. A quarterly report is submitted to OEPA that identifies all hazardous waste streams characterized under the consent decree.

Information is collected to accomplish the following tasks. Acquiring this information may require sampling and analysis. 3200

- Characterize hazardous and chemical properties of each waste stream and assign applicable hazardous-waste codes.
- Ensure proper handling and storage of waste.
- Evaluate pre-acceptance conditions for receipt of waste from on-site and off-site sources.
- Determine applicable land disposal restriction information for each hazardous waste stream.

The following four generic categories of waste constitute the majority of hazardous waste presently generated at FEMP. Examples of these categories are included.

- **Closure and CERCLA-Controlled Wastes** - Soil samples, drill cuttings, well development water, water used for decontamination, sampling and decontamination equipment, personnel protective gear, contaminated soils and ground water, contaminated facilities (e.g., demolition material, process equipment)
- **Maintenance and Construction Wastes** - Scrap metals, wires, wood, and other construction debris and rubble; excavated soils; waste hydraulic and lubricating oils; cleaning solvents; boiler residues; floor sweepings; used rubber parts and products; paints and painting equipment; and off-specification commercial products
- **Underground Storage Tank Removals**
- **Miscellaneous Activities** - Wastes, disposable equipment, and personnel protective gear

The procedure for determining hazardous waste relies on process knowledge supplemented by analytical data and is described in the FEMP Waste Analysis Plan. The first step of the procedure is evaluation of the accuracy of process knowledge and whether it is sufficiently conclusive to make the waste determination.

When process knowledge is deficient, either more information shall be requested or a request for waste stream sampling and analysis shall be processed as described in Appendix K. After completion of sampling and analysis, results shall be evaluated and RCRA waste codes assigned as warranted.

For each waste stream, a table shall be prepared that lists the waste stream name, physical state, hazardous waste codes, the basis for the hazard listing, waste source, land ban status, and FEMP material and source code. This table shall be submitted to OEPA quarterly to update the ongoing waste determination process taking place at FEMP under terms of the proposed amended consent decree. 3200

6.3.4.2 Containerized Waste. Hazardous waste is stored at FEMP in containers such as 55-gallon steel and polyethylene drums and 85-gallon steel overpack drums. Containers may be constructed of carbon steel, stainless steel, polyethylene-lined carbon and stainless steel, and polyethylene. However, waste storage containers are not limited to these types.

Prior to placing waste in a container, compatibility of material with the container is verified by comparing analytical data or process knowledge to compatibility information for the container. Samples may require analysis prior to selection of a container to determine compatibility. Most of the waste generated at FEMP is compatible with carbon steel or stainless steel containers.

Containerized wastes are stored in designated hazardous-waste storage areas at FEMP. Two categories of waste characterization data are used to determine the appropriate storage area.

- Physical state and presence of free liquids
- Chemical constituency and compatibility

Presence or absence of liquids is determined by visual inspection of the waste or application of process knowledge.

Chemical constituents within each waste are determined to ensure that wastes stored in a unit are compatible with each other and with the unit construction. To prevent incompatible wastes from being stored together, a reactivity group code is assigned to each waste stream.

6.3.4.3 Waste Categorization. Because of the large number of drums at FEMP, representative samples are taken from selected drums containing waste from a particular stream. Drum sampling protocols are described in Appendix K. The drums are then categorized based on waste characteristics as follows.

- **Backlog Waste** - RCRA-Controlled, non-RCRA-Controlled, and mixed waste that has been stored on-site for a long period of time. Selection of drums from a backlog lot is based on process knowledge, waste stream type, and random sampling techniques that ensure representative samples.
- **Newly Generated RCRA-Controlled Waste** - Waste streams currently being generated on site that fall under RCRA jurisdiction. These streams are sampled at a

frequency that ensures availability of accurate, current data for timely disposition of the waste. Sampling strategy depends on the rate of waste production and inherent stream variability. Drums are sampled before being transported to a warehouse to limit drum handling. 3200

NOTE

Composite sampling of large waste streams may be specified to reduce analytical effort.

- **Newly Generated Non-RCRA-Controlled Waste** - Waste currently being generated on site that is not covered under requirements for RCRA waste streams and have little potential of becoming RCRA-covered waste are determined by internal record keeping based on process knowledge and analysis. These sampling requirements vary widely and are specified in PSPs.

6.4 GASEOUS MATRIX SAMPLES

Air sampling conducted at FEMP includes stack sampling for compliance with the Clean Air Act, radon sampling as part of the REMP, general area air sampling for radiological health and safety monitoring, and monitoring for specific organic and inorganic contaminants while conducting field activities. Data may be used for modeling contaminant transport, determining compliance with National Emissions Standards for Hazardous Air Pollutants (NESHAP), determining exposure levels, and determining respiratory protection requirements.

6.4.1 Clean Air Act Monitoring

Stack sampling is done at FEMP to measure radionuclide emissions. Stacks with a potential for delivering a dose of 0.1 mrem effective-dose equivalent in one year to any individual, or as required by permit, shall be monitored and inspected at least weekly to meet requirements of the Clean Air Act, 40 CFR 61 and DOE 5400.5. Stack sampling methods are provided in Appendix K.

Analysis of the FEMP boiler plan emissions for sulfur dioxide (i.e. SOx and NOx), nitrogen oxides, carbon monoxide, and opacity is conducted in compliance with the Clean Air Act as administered by the state of Ohio. Sulfur and heat content of coal used in the boiler plant are measured on a regular basis. Nitrogen oxides are controlled through use of electrostatic precipitators. Emission factors are based on the results of stack testing conducted in 1988. Opacity is monitored continuously with automatic equipment while the boilers are in operation (U.S. Department of Energy, 1991b).

6.4.2 Radon Sampling

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Federal regulations (40 CFR 61 and 192) impose limits on the emission of radon gas from a variety of sources either owned or operated by DOE. Measurement of radon flux density using a passive charcoal collector is often the method of choice for determining radon emissions from these sources (40 CFR 61, method 115). Method 115 also references an EPA document written by Hartley and Freeman that describes the large-area, activated-charcoal collector in detail and gives general field methods for its use.

These methods provide instructions for collection of samples to determine long-term Rn-222 concentrations in air under ambient outdoor conditions as described in Alter and Fleisher (1981), and Terradex Corporation.

As radon and radon progeny decay, the resulting alpha particles produce radiation-damage tracks in thin plastic films exposed to air. The film detector is mounted inside the bottom of a plastic shield and a special filter is installed over the mouth of the cup to filter out radon daughters, dust, and dirt so that only radon gas enters the cup. Detectors are chemically treated after exposure to make tracks visible. The number of tracks in a specified area is directly proportional to the integrated alpha exposure from decay of radon to which the detector was exposed. The detection range is from 0.2 to 20,000 pCi/L per month for outdoor measurements.

Methods include collecting samples of ambient air and soil gas. Two basic types of sampling are used in radon measurements: gas bag samples and soil gas samples (radon flux). Gas bags provide integrated samples of ambient radon in air while soil gas accumulators provide samples of radon in emanated soil gas. Instantaneous air samples may be collected using an evacuated SC-6 scintillation cell.

Sampling procedures are provided in Appendix K and are in accordance with DOE Order 5480.1, 10 CFR 20, and U.S. EPA standard 40 CFR 192. The type of track-etch radon detector shall be selected for effectiveness and cost.

6.4.3 General Area Air Samples

Routine air sampling is performed to measure levels of airborne radioactive material in order to properly characterize areas in accordance with DOE Order 5480.11 and to establish a basis for determining respiratory protection requirements. Sampling is accomplished as specified in Appendix K procedures.

Continuous air monitors are used to provide real-time air monitoring as required by DOE Order 5480.11. There are several different types of continuous air monitors in use at FEMP and each must be operated in accordance with applicable documented procedures. These instruments are usually used as warning devices and do not normally produce useable data

for the FEMP CERCLA program. However, instruments equipped with strip charts may be used for tracking ambient airborne levels of radioactive contaminants.

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6.4.4 Monitoring for Organic and Inorganic Contaminants in the Field

Air is monitored to screen for organic analysis in the field and to protect the health and safety of workers and surrounding populations from organic and inorganic contaminants. Procedures for air monitoring are provided in Appendix K.

6.4.5 DOE-Required Air Monitoring for Off-Site Exposure

Air sampling at a selected site is done to characterize air-related contaminant exposures. At a minimum, sampling results shall be adequate for predictive short-term and long-term modeling as described in the ***FEMP Environmental Protection Implementation Plan*** (U.S. Department of Energy, 1991). When long-term inhalation exposures are required, an air sampling program of sufficient temporal scale to encompass the range of meteorological and climatic conditions potentially affecting emissions is necessary. It must also be of sufficient spatial scale to characterize associated air concentrations at potential exposure points. Sample results shall be representative of the long-term exposure points.

Potential exists for exposure to air particulates from past and present releases directly from the facility and from re-suspension of materials following deposition. Uranium is the primary particulate constituent of concern, so particulate air sampling is important to the environmental surveillance program at FEMP and enables compliance with dose limits.

Selection of the type of air monitoring depends on emission sources to be investigated as well as exposure routes to be evaluated. For example, if dust inhalation is an exposure pathway of concern, the monitoring equipment shall be capable of collecting respirable dust samples.

Location for air samplers are based on DOE requirements, public concern, control location, and special studies. Justification of additional monitoring stations or omission of existing stations shall be documented. Indicator locations should not be placed in valleys, near structures that could affect measurements, in areas of different geology, or where altitude differs significantly (150 meters). At least one control air monitoring station shall be maintained and monitored at the same frequency as the indicator stations.

Frequency of air sample exchange shall allow time for a sufficient volume of air to pass through the sampler to reach the required sensitivity. Frequency also depends on the required speed of data retrieval and shall be site-specific. Determining factors shall be documented in environmental surveillance files (DOE/EH-0173T, Summary 5v).

Site-specific meteorological conditions shall be obtained or recorded during the air sampling program with sufficient detail and quality assurance to substantiate air sampling results.

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These data can be used to determine sampling locations and frequencies. Meteorological characteristics are necessary input for air transport and flow modeling. Meteorologic monitoring shall be completed to assess potential off-site impacts for releases of airborne contamination. Assessments may be completed for actual or projected releases (including accidental). Necessary data will be obtained from on-site instrumentation.

Types of instruments considered for use include wind speed, wind direction, ambient and dew-point temperature, precipitation, and barometric pressure measuring devices. Sensors and on-site measurement locations will be selected in accordance with the PSP and DQOs. Procedures for collecting samples are provided in Appendix K.

6.5 BIOLOGICAL SAMPLING

Biological sampling is conducted at FEMP to evaluate radiological parameters (e.g., uranium) in selected flora and fauna. RI/FS biological sampling has been completed, and Miami University has completed a biological and ecological sampling and analysis study. Documents available to the public provide a detailed discussion of biological activities completed during these studies.

Ongoing biological sampling at FEMP is conducted for milk, fish, produce, game, meat, and grass. Procedures and requirements for collecting samples of milk, fish, soil and grass, and farm and garden produce are provided in Appendix K, or shall be included in PSPs. Future biological studies may be implemented to assess the following conditions.

- Difference between biological parameters at a site relative to a control area
- Biological (flora/fauna) contamination
- Quantify risks to human health from contamination in the food chain
- Quantify risks to ecological receptors

Target compounds shall be identified based on on-site contaminants of concern that are studied to assess effects of site contamination on flora and fauna. A list of these compounds is compiled based on a review of ground-water, surface-water, and air test data relative to Applicable or Relevant and Appropriate Requirements (ARAR) and ambient water quality criteria. ARARs for soil and sediment do not currently exist. An approach for assessing toxicity in these media shall be addressed in PSPs as applicable. Detailed methodology for comparison is presented in U.S. Environmental Protection Agency (1989e).

A preliminary field survey shall be conducted by qualified biologists or similarly qualified individuals prior to PSP development to collect preliminary data regarding flora and fauna in

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the study area. Information is obtained by mapping vegetation, animals observed, tracks, burrows, and aquatic habitats. Photographic documentation shall be compiled to support survey findings.

FEMP and the surrounding area consist of terrestrial and aquatic habitats. Numerous field methods exist for collecting and assessing effects of contamination on flora and fauna within these habitats. They vary widely depending upon the study purpose. For example, stressed vegetation can be assessed using color infrared aerial photography for a broad analysis or by physical collection and observation for a more localized scale. Consequently, specific methodologies shall be addressed in the PSP depending on the purpose. Procedures for sample processing and handling shall also be described in the PSP.

Two types of testing are commonly used to evaluate effects of hazardous substances on flora and fauna: (1) bioassay (or toxicity tests) and (2) analytical laboratory chemical tests. Usually, bioassay tests consist of subjecting living organisms to site-specific chemical conditions (e.g., waste water) to compare before and after states.

Analytical laboratory chemical tests consist of analyzing plant or animal tissue for target compounds. Procedures for tissue analysis, for the most part, shall be adapted from current EPA procedures for examination of solid waste. Neither bioassay or analytical laboratory chemical test methods for biological samples are approved by the EPA. Test methodologies shall be specified in PSPs.

6.6 MISCELLANEOUS SAMPLES

A variety of media samples are collected at FEMP to characterize radiological, chemical, and metal contaminants to determine handling and disposal requirements. Samples are non-biased and collection processes are similar for ASLs A through E. Other sampling conducted for health and safety monitoring and personnel exposure calculations are covered in detail in health and safety plans and procedures and are not discussed in detail here.

6.6.1 Sample Requests and Collection Requirements

Sampling of miscellaneous media (soil, water, sediment, construction rubble, waste streams) is performed for various purposes including the following.

- Pre- or post-construction and demolition projects
- Characterization of on-site conditions
- Renovation projects

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- Site emergency response activities
- Support of site regulatory programs
- Support of site remediation programs
- On-site routine environmental media sampling
- RCRA characterization of drummed wastes

Media samples shall be collected at sample point locations identified in PSPs. Each sample shall be placed in appropriate sample containers as identified in PSPs and labeled as specified in Section 7. Specific parameters for analysis shall be determined from process knowledge and regulatory guidance.

6.6.2 Sample Collection Requirements

Procedures for collecting solid debris samples from construction, renovation, and demolition (paint chip, wood, concrete, and dust) for radiological and chemical analyses are provided in Appendix K.

6.6.3 Asbestos-Containing Building Materials

Most FEMP buildings were constructed prior to 1970 when Asbestos-Containing Building Materials (ACBM) were commonly used in the construction industry. Asbestos was used for items such as pipe insulation, duct work, fire proofing, sound insulation, boiler insulation, interior cement board, vinyl tile, acoustical ceiling tile coverings, and outer building coverings. Prior to remodeling, renovation, or demolition, samples of potential ACBM shall be collected for analysis and the results used to determine if ACBM is present. If so, results will indicate whether ACBM should be removed or fixed in place, health and safety requirements, and disposal and handling requirements. Sampling for ACBM shall follow requirements of 29 CFR 1910 and 1926.

6.6.4 Poly-Chlorinated-Biphenyl-Contaminated Materials

Materials contaminated with Poly-Chlorinated Biphenyls (PCB) are regulated under the Toxic Substances Control Act program at FEMP consistent with 40 CFR 761. The Act classes materials containing 50 parts per million of PCBs as contaminated. However, at FEMP, materials containing two ppm of PCBs are handled and stored as contaminated. FEMP-regulated, PCB-contaminated materials are separated into three groups as follows.

- Solid non-radiological

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- Solid radiological
- Liquid radiological

There is currently no identified solid nonradiological PCB-contaminated material at FEMP. Other groups of PCB-contaminated material are stored in RCRA warehouses until a disposal option is identified.

Sampling of potential PCB-contaminated materials is not currently planned. However, suspect materials could be identified during future demolition or decommissioning of facilities. Should sampling and analysis be necessary, a material evaluation process shall be defined in a PSP and implemented at that time. Handling of PCBs is consistent with the requirements of 29 CFR 1926.

6.6.5 Worker Protection and Area Classification

Paragraphs 6.6.5.1, 6.6.5.2, and 6.6.5.3 are for information only. Data gathered from the samples discussed are for personnel monitoring. Samples are obtained in accordance with written procedures and access is controlled as appropriate.

6.6.5.1 <u>Personal Radiological Contamination Survey</u>. Radiological contamination surveys at FEMP are conducted to determine personnel protection requirements in accordance with DOE Order 5480.11. The regulatory driver or other reason for sampling and knowledge of types of radiation emitted by contaminants most likely to be encountered shall be considered when scoping radiological contaminant surveys. Material and equipment shall be capable of providing the type and quality of data required to fulfill DQOs.

Personnel radiological contamination surveys are generally self surveys. Instruments and extent of the survey depend on monitoring location and type of contaminant most likely to be present. Personnel radiological contamination surveys include frisking with hand-held instruments and monitoring with automated equipment. Data are recorded only when contamination is found or when personnel injury is involved.

A frisking survey is used when contamination limits of interest are readily detected by available instruments. Depending on the situation, personnel are required to survey either their hands and feet or their whole body. These requirements are spelled out in applicable site procedures.

Methods for use of automated contamination monitoring equipment are dependent on the type of instrument. Instructions for use are described in applicable procedures and taught in FEMP radiation worker training. This type of instrumentation is configured to automatically alarm at contamination exceeding administrative levels.

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6.6.5.2 Radiation Survey Techniques. Radiation surveys measure intensity and type of radiation field emitted from radioactive material. These surveys differ from radioactive contamination surveys in that dose or exposure rates in the area of interest are measured rather than the amount of radioactive material present. This information is used to determine worker safety and shielding requirements, area classification, and radioactive shipment classification. Area radiation surveys are performed with portable instruments and stationary detectors.

Information required prior to performing radiation surveys is similar to that required for radiological contamination surveys including a regulatory or other reason for the survey and knowledge of contaminants most likely to be present.

Stationary area radiation detectors are used to detect relatively high radiation fields and serve to indicate possible criticality accidents. These instruments are maintained as specified by FEMP procedures and are not expected to generate data for the FEMP CERCLA program.

The internal dosimetry program has been developed to comply with requirements of DOE Order 5480.11. Results of internal dosimetry surveys are not expected to be used to support the records of decision. Basic requirements for these programs are included for information purposes only. Additional details may be obtained upon request to the DOE Fernald Office.

Any worker who has the potential of receiving an internal exposure of 100 mrem Annual Effective Dose Equivalent (AEDE) shall be monitored for internal contamination. Monitoring methods used to evaluate internal exposure are designed for each potential exposure condition and may include urine sampling, in vivo measurements, and/or fecal sampling.

The FEMP prime contractor is currently responsible for administering the internal dosimetry program. Detailed program procedures are documented in standard operating procedures. A brief description of these procedures follows.

- **Routine Urinalysis** - The routine urinalysis program is the largest part of the internal dosimetry program and includes workers with a potential for receiving greater than 100 mrem AEDE from exposure to compounds of uranium. Workers submit monthly urine samples for analysis at the FEMP bioassay laboratory, which uses a fluorometric fusion technique. Assuming a worker is exposed to two percent enriched class W uranium, a detection limit for uranium of 0.005 mg/L allows assessment of doses less than 100 mrem AEDE. In addition to monthly samples, workers are required to submit baseline, incident, annual, and termination urine samples.

- **In Vivo Monitoring** - A routine in vivo monitoring program has been implemented for radiation workers. A worker who possesses a ThermoLuminescent Dosimeter (TLD) is scheduled for an annual in vivo examination designed to detect uranium or thorium deposited in the lungs. The detection limit for the lung exam is dependent

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upon the individual's anthropometric characteristics. For an average-sized person at the 95 percent confidence interval for a 1200-second exam, the limit is approximately 2.5 nanocuries (nCi) for U-238, 0.18 nCi for U-235, and 1.0 nCi for Th-232. In addition to the annual exam, radiation workers undergo an in vivo exam when hired and upon termination.

- **Special Internal Dosimetry Programs** - Special monitoring programs are developed on a case-by-case basis and are included in project-specific plans and health and safety plans. Examples of special monitoring projects are the K-65 silo and the thorium overpack. Available data from expected source term and potential for exposure to the workers involved in an operation are used to determine the frequency and extent of special sampling. When mixtures of radionuclides are present, the dose from all radionuclides in the mixture as well as daughter-product activity are considered. The required detection limit for a particular analysis is calculated based on these considerations.

External dosimetry programs are in place to monitor environmental and external personnel radiation exposure. The external dosimetry program is currently run by the prime operating contractor at FEMP. Standard operating procedures for specific parts of the program are available upon request from DOE. TLDs are used to measure whole-body, extremity, and environmental exposures. Self-reading pocket dosimeters are used to monitor worker exposure on a real-time basis. Dosimetry results are used to calculate whole-body and individual organ exposures to beta and gamma radiation. These devices are used as follows.

- **Thermoluminescent Dosimeters** - TLDs may be used to monitor whole-body and environmental exposures. Extremity TLDs, such as ring badges, may be used to monitor exposure to the most exposed body part. TLD badges can be used to differentiate between the types and amounts of radiation to which they were exposed and also to determine whether the badge was exposed to a criticality event. Following are basic requirements for TLD use at FEMP.

  - Personnel entering a radiologically controlled area at FEMP shall wear a personal TLD.

  - Additional personal TLD use may be required by the Radiological Safety Group for purposes such as job-dose tracking.

  - Extremity TLDs capable of detecting exposures greater than 30 mrem may be required by radiological safety when a dose to the extremities is a prime concern.

  - Whole body TLDs shall be capable of detecting exposures greater than five mrem.

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- **Self-Reading Pocket Dosimeters** - These dosimeters continuously monitor exposures on a real-time basis. They are specified when work is conducted in areas where the possibility of acquiring a large dose in a short period of time exists. Pocket dosimeters shall be zeroed before each use and shall be capable of detecting doses to ± 10 percent of actual value.

6.6.5.3 Medical Services. The Medical Service Department provides services to plant personnel that include, but are not limited to, entry examinations, annual examinations, special assessments, emergency medical services, drug screening (Westinghouse and Department of Energy), and medical surveillance.

The department is staffed by trained professionals and equipped to handle daily activities and critical medical emergencies. Except for drug screening, human specimens (blood, urine, fecal) are analyzed on-site. Rarely are human specimens sent to an off-site laboratory; but, if this is necessary, the specimens are packaged, marked, and shipped according to applicable laboratory and U.S. Post Office requirements.

As specified by the National Institute on Drug Abuse, drug screening specimens are obtained, handled, stored, and shipped to an approved laboratory in accordance with strict protocols for chain-of-custody procedure and patient privacy and confidentiality of medical records. The laboratory is responsible for specimen pick-up and disposal.

Human specimens are handled, stored, transported, and disposed of in such a manner as to protect specimen integrity, medical care workers, and the general public and in accordance with Federal, State, and local laws. Standard operating procedures are maintained in the Medical Service Department to provide guidance to personnel on specimen handling.

6.7 FIELD STORAGE AND SHIPMENT OF SAMPLES

Samples collected in response to programs on site shall be classified as either environmental or hazardous substances samples prior to shipment. Classification shall be by personnel identified in the PSP. In general, environmental samples include the following.

- Drinking water
- Natural waters
- Sediment
- Background/control soils

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- Treated municipal and industrial waste-water effluent
- Biological specimens or samples not expected to be contaminated with high levels of hazardous materials

Shipment of samples designated as environmental samples are not regulated by the U. S. Department of Transportation (DOT). However, these samples shall be transported in a manner to preserve their integrity and, if there is any doubt as to the sample classification, it shall be considered a hazardous substance and shipped accordingly.

Materials or samples shipped by FEMP to a laboratory that must have the hazard class determined by laboratory testing and analysis shall be assigned a tentative shipping name, hazard class, and identification number. The materials or samples shall be packaged and labeled based on the FEMP tentative determination of hazard class. The class shall be based on process knowledge of the material and previously acquired information on related materials or samples. It may require classification of samples as hazardous until validated documentation is received verifying that the material is not hazardous.

DOT has regulatory responsibility for the security of hazardous materials transported off site by any means. Regulations for packaging, marking, labeling, and shipping of hazardous substances are issued by DOT and described in 49 CFR 171 through 177.

Radioactive materials samples are, by definition, hazardous and are subject to specific stringent regulations governing their transportation. Radioactive material transportation is regulated by DOT under the Transportation Safety Act of 1974.

Samples collected from process waste-water streams, drums, bulk-storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require a hazardous-material classification for shipment.

The Nuclear Regulatory Commission is responsible for governing transportation of radioactive material. Specifically included in Nuclear Regulatory Commission responsibilities is approval of certain types of packages (type B and fissile). DOE orders require shipment in compliance with applicable DOT and Nuclear Regulatory Commission rules or provision for equivalent public safety. Custody requirements are discussed in Section 7.

6.7.1 Field Storage

In the field, samples shall be kept cool and away from direct sunlight. As soon as samples requiring refrigeration are collected, filtered as necessary, and preserved, they shall be stored in chests packed with artificial icing material to maintain a temperature range of two to six degrees Centigrade. Care should be exercised to avoid breakage of glass containers because

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of rapid, extreme temperature changes. Field personnel shall be responsible for ensuring that sample container lids are secure before storing them in the ice chest.

Samples shall be shipped promptly to the laboratory in accordance with chain-of-custody requirements in Section 7 so that holding times are not exceeded. Samples shipped off site shall be shipped to ensure laboratory receipt within 24 hours of shipment time. Sample containers and shipping containers shall be custody-sealed as specified in Section 7.

6.7.2 Sample Container Preparation

Sample bottles may be purchased pre-cleaned in accordance with EPA SW-846 (1986) specifications with appropriate supplier documentation. Vials for volatile organic compound sample analysis shall be purchased pre-cleaned.

Glass containers for other organic analyses may be purchased pre-cleaned or washed in a controlled environment with a nonphosphate detergent, rinsed with tap water, rinsed with methanol, rinsed with de-ionized water, and allowed to air dry as described in Appendix K.

Plastic containers for metals analyses shall be washed with a nonphosphate detergent, rinsed with tap water and de-ionized water, and then rinsed with dilute nitric acid. Plastic containers for other general chemistry and radiological procedures shall be washed with a nonphosphate detergent and rinsed with tap water and de-ionized water. Container blanks shall be run on containers as specified in Section 4.

If requested, sample bottles may be prepared in the sample coordination area with premeasured amounts of appropriate chemical preservatives and shipped to the field.

6.7.3 Sample Preservation

Methods of preservation are relatively limited and intended to (1) retard biological action, (2) retard hydrolysis of chemical compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing. Some samples collected to support treatability analyses may require special on-site storage conditions (e.g., non-freezing, special refrigeration).

Recommended preservatives for various constituents are given in Table 6-1 (Appendix A). These choices are based on the accompanying references and on information supplied by various quality assurance coordinators. As more data become available, recommended holding times will be adjusted to reflect the new information.

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6.7.4 Sample Classification

6.7.4.1 <u>RCRA and CERCLA Initial Sampling Programs</u>. RCRA and CERCLA programs that require initial sampling of unknown substances specify that samples be shipped in accordance with hazardous materials regulations if process knowledge suggests presence of a substance classified as hazardous.

If process knowledge does not indicate presence of a hazardous substance or if initial tests are for spectrum testing for hazard identification, the samples may be shipped as environmental samples.

6.7.4.2 <u>Routine Sampling</u>. For routine sampling programs, a comparison of past test results are made to the requirements of 49 CFR (1991) to establish the sample classification as environmental or hazardous for shipping purposes.

6.7.4.3 <u>Classification of Samples as Hazardous or Non-Hazardous Substances</u>. Process knowledge, previous sampling results, and field test results (i.e., pH) are used to decide whether a sample should be handled as an environmental or hazardous substance. If it is decided that the sample can be classified as environmental or, if it meets the "reportable quantity" or the "exception for small quantities" definitions of 49 CFR 173 (1991), the samples may be shipped in accordance with the SCQ for sample integrity and chain-of-custody requirements. However, if it is decided that the sample may contain radionuclides, it must be transported as specified in paragraph 6.7.8.

Detailed requirements for handling, packaging, labeling, and transportation of samples are provided in Appendix K.

6.7.5 Environmental Samples

Samples collected and designated as environmental samples in the PSP shall be shipped to maintain sample integrity and chain-of-custody requirements. However, if a hazardous material preservative is added to a sample, the amount of preservative shall not exceed the limit specified in Appendix K.

When samples are dispatched to the laboratory for analysis, separate chain-of-custody and request-for-analysis records shall accompany each set of samples. Procedures for processing sample sets for shipment are provided in Appendix K.

6.7.6 Hazardous Substance Samples

6.7.6.1 <u>Known, Suspected, or Routine Hazardous Substance Samples</u>. If a sample contains a known or a suspected substance listed in the Hazardous Materials Table in 49 CFR 172 (1991) or meets the definition of a hazardous substance but not the exceptions for

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small quantities criteria, the sample shall be handled, packaged, marked and labeled, and shipped as specified for that material. A hazardous substance, for shipping purposes, is a material, including its mixtures and solutions, that meets the following criteria.

- Listed in appendix to 49 CFR 172 (1991)
- Exhibits hazardous characteristics (e.g., flash point)
- In a quantity in one package that equals or exceeds the reportable quantity listed in appendix to 49 CFR 172 (1991)

This definition does not apply to petroleum products that are lubricants or fuels.

6.7.6.2 **Exceptions-for-Small-Quantities Criteria.** This substance category includes flammable liquids; flammable solids; oxidizers; organic peroxides; corrosive materials; poison B and other regulated materials A, B, and C; and radioactive materials that are normally classified as hazardous. However, if they are present in known or suspected quantities that are less than the following limits, a hazardous classification is not required and they are not subject to the requirements of 49 CFR 173 (1991). However the substance-specific guidelines of 49 CFR 173 (1991) do apply. Maximum limits for inner receptacle quantities to meet criteria for exceptions for small quantities are as follows.

- Thirty milliliters for liquids other than poisons
- Thirty grams for solids other than poisons
- One gram for materials classed poison B or subject to poison-inhalation-hazard criteria for shipping documents as described in 49 CFR 172 (1991)
- Activity level less than that specified in 49 CFR 173 (1991) as appropriate for packages containing radioactive material

6.7.6.3 **Exemptions for Treatability Studies.** If an off-site treatability study is planned, the Federal Treatability Study Sample Exception Rule (40 CFR 261) shall be used to collect, store, and transport samples to an off-site laboratory or testing facility provided that the following conditions exist.

- The generator or sample collector uses no more than 1000 kg of any nonacute hazardous waste; 1 kg of acute hazardous waste; or 250 kg of soils, water, or debris contaminated with acute hazardous waste per waste stream per treatment process. However if additional samples are required, the regional administrator or state director may, on a case-by-case basis, grant requests for waste stream limits up to an

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additional 500 kg of nonacute hazardous waste; 1 kg of acute hazardous waste; and 250 kg of soils, water, or debris contaminated with acute hazardous waste.

- The quantity of each sample shipment does not exceed these quantity limitations.
- The sample is packaged so that it will not leak, spill, or vaporize from its packaging during shipment, and the transportation of each sample shipment complies with regulations for shipping hazardous material as specified in Appendix K.
- The sample is shipped to a laboratory or testing facility that is exempt under 40 CFR 261 or that has an appropriate RCRA permit or interim status.
- The generator or sample collector maintains copies of shipping documents, the contract with the facility conducting the treatability study, and records showing compliance with shipping limits for three years after completion of the study.
- The data generator provides all the documentation in its biennial report.

The Federal Treatability Study Sample Exemption Rule is only applicable in states that do not have final authorization (i.e., EPA authorization to manage Superfund sites) or in authorized states that have revised their program to adopt the equivalent regulations under state law. Thus, the states through which these materials pass and the location of the off-site treatability laboratory or testing-facility need to be evaluated relative to the regulations prior to selection/implementation of the study (U.S. Environmental Protection Agency, 1989d).

6.7.7 Packing and Transporting Hazardous Waste Samples

Procedures for handling, packaging, labeling, and shipping hazardous substance samples are provided in Appendix K.

6.7.8 Radioactive Samples

6.7.8.1 <u>Screening Samples for Total Radioactivity</u>. Laboratories shall be licensed to handle radioactive samples. Licensing requirements may be based on the total mass or activity of specific radioactive isotopes or on activity by type of radiation.

Samples suspected of containing radioactive materials shall be screened prior to acceptance for analysis at an off-site laboratory. Samples that contain radioactivity that exceeds the limits of a laboratory license shall not be accepted. Screening may be conducted at the off-site laboratory if the laboratory license covers the sample, or it may be conducted at the FEMP analytical laboratory prior to shipment using the method for radiometric screening to determine total radioactivity in various matrices (Appendix K).

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6.7.8.2 Transporting Radioactive Samples. Most samples collected at FEMP are classified as radioactive for transport purposes. Certain samples may fall into categories for which special packaging and shipping restrictions are mandated.

Regulations limit the total radioactivity (i.e., specific activity times the weight of the package) contained within a package of radioactive material. With respect to type A packages, limits are expressed as two quantities: A1, which refers to the maximum permissible activity for radionuclides in special form, and A2, which refers to normal form radioactive materials. The samples from FEMP fall into the A2 category so the A2 value sets activity limits for sample packages. In cases where contaminated material shipments are designated "Low Specific Activity" (LSA) or "limited quantity," some fraction of the A2 value will normally apply.

Appendix K provides A1 and A2 values cited in 49 CFR 173 (1991) for radionuclides of the uranium decay series. Values for radionuclides not listed in the regulations (e.g., lead-214, bismuth-214, polonium-214) have been assigned in accordance with specifications in 49 CFR 173 (1991).

6.7.9 Low-Specific-Activity Materials

LSA materials include the following.

- Uranium and thorium ores
- Physical and chemical concentrates of these ores (e.g., yellow cake)
- Unradiated natural or depleted uranium or thorium
- Nonradioactive material externally contaminated with radioactivity that is not readily dispersible
- Material in which radioactivity is essentially uniformly distributed and does not exceed certain prescribed concentration limits.

Limits for radionuclides of the uranium decay series beginning with thorium-230 are provided in Appendix K. Generally, these concentrations will not be exceeded in FEMP samples.

Details for shipping LSA materials are described in 49 CFR 173 (1991). The chief advantage of shipping under the LSA category is that shipments are consigned as "Exclusive Use"; that is, under the supervision or direction of a single consignor from point of origin to final destination (49 CFR 173, 1991). When packaged shipments of LSA materials are

consigned as "Exclusive Use", the shipment is exempt from specification packaging, labeling, and marking. Requirements for these shipments are provided in Appendix K. 3200

6.7.10 Limited Quantities of Radioactive Material

Limited quantity shipments of radioactive material shall meet requirements specified in 49 CFR 173 (1991). If activity per package does not exceed 10^{-3} of the A2 quantity of the radionuclide, it shall be exempt from specification packaging and from the associated shipping paper, marking, and labeling requirements. Requirements that apply are listed in Appendix K.

6.7.11 General Requirements for Packaging Radioactive Materials

The type of packaging for a radioactive material shipment depends upon general and specific requirements for the shipping category (type A or type B) in 49 CFR 173 (1991). Unless otherwise specified, shipments of radioactive materials shall comply with requirements listed in Appendix K for types A and B packages.

6.7.12 Marking and Labeling Radioactive Samples

Requirements for marking and labelling packages containing radioactive material are provided in Appendix K. General requirements for shipping documentation and radioactive requirements for shipping papers are specified in 49 CFR 172 (1991) and listed in Appendix K.

6.7.13 Radiation and Contamination Control

Measurements of radiation level (dose rate) and of nonfixed (removable) radioactive contamination shall be conducted on radioactive-material shipments to control exposure to radioactivity. The radiation level is the radiation-dose-equivalent rate expressed in millirem per hour as specified in 49 CFR 173 (1991). Permissible radiation levels are provided in Appendix K for the shipping categories of limited quantity packages, LSA packages, and other packages.
Maximum permissible limits for removable radioactive contamination allowed on a package are specified in 49 CFR 173 (1991) and are summarized in Appendix K.

6.7.14 Transportation of Samples on Public Highways

FEMP contractors and subcontractors that transport samples classified as a hazardous substance over public highways shall comply with applicable Federal and state of Ohio regulations pertaining to transportation of hazardous materials. The only exception to this requirement is when a shipment of radioactive materials is made under DOE auspices and is escorted by personnel specially designated by or under the authority of DOE for the purpose

of national security. The shipment then is exempt from the regulations in 49 CFR 170 through 189 (1991).

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6.8 DECONTAMINATION PROCEDURES

Equipment shall be decontaminated for the following reasons.

- Prevent transfer of contaminants from equipment to sampled media
- Limit cross-contamination between sampling points
- Protect worker health and safety

Decontamination procedures in Appendix K are designed to accomplish these objectives without affecting the integrity of the collected samples. Generation of hazardous waste and excessive volumes of waste solutions are discouraged. Use of improperly decontaminated equipment is prohibited. Non-dedicated sampling equipment shall be cleaned between each use and each sampling point except as described in Appendix K. Dedicated equipment shall be cleaned as necessary.

Cleaning requirements shall be followed by field personnel unless variations have prior approval of the FEMP project manager and Quality Assurance (QA) officer. The reason for the variation, its nature, and the subsequent procedure shall be described in detail in the daily field log and recorded on sampling logs of samples affected.

Equipment shall be decontaminated at a central decontamination area where a water source and a means of containing decontamination solutions is available. If decontamination must be conducted in the field, the circumstances dictating this action shall be documented as specified in Appendix K.

Requirements for decontamination materials are based on those specified in the U.S. Environmental Protection Agency Region IV Standard Operating Procedure (1986b). A similar guidance document is not available for Region V (Craig Thomas, U.S. Environmental Protection Agency, Region V Environmental Sciences Division Laboratory, telephone conversation, 3 January 1991). Variations from use of specified materials shall be recorded on the daily field log and the samples potentially affected shall be indicated.

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SECTION 7

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Section 7

SAMPLE CUSTODY

Sample custody procedures and documentation at FEMP are conducted in accordance with guidelines in the EPA Region V Model Superfund Quality Assurance Project Plan (U.S. Environmental Protection Agency, 1991), which are derived from EPA sample custody or chain-of-custody protocols described in ***NEIC Policies and Procedures***, EPA-330/9-78-DDI-R, revised June 1985. 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.

A sample or evidence file is considered in the custody of a person if any one of the following are true.

- The person has physical possession of the sample or file.
- The sample or file is in view of the person, after being in possession.
- The sample or file is placed in a secure location by the custody holder.
- The sample or file is in a designated secure area.

Environmental samples at Analytical Support Levels (ASL) C and D require complete chain-of-custody documentation. ASLs B and E samples shipped to off-site facilities or that have custody transferred on site also require complete chain-of-custody documentation. ASLs B and E analyses performed at FEMP without custody transfers require completion of field and laboratory documentation as appropriate.

Compliance with sample packaging and shipment requirements in Section 6 and the custody requirements in this section will provide adequate documentation of sample custody from the time of sample collection to final disposition.

7.1 FIELD PROCEDURES

The FEMP project manager is responsible for implementation of sample custody procedures. The Designated FEMP Quality Assurance Organization is responsible for verifying that sample custody procedures are implemented and followed.

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The leader of a sampling team is personally responsible for care and custody of samples collected until they are transferred to a transporter or an analytical or processing facility. The Site-wide Analysis Request/Custody Record (SAR/CR) (Form 7-1, Appendix B) shall be used to transfer custody. The number of persons having sample custody shall be minimized.

Sample containers shall be labeled with a sample number corresponding to a known location and event as specified in paragraph 7.1.3. Sample labels (Form 7-2, Appendix B) shall be completed for each sample using waterproof ink. Labels shall be in two identical parts. After the sample has been collected, label information shall be completed. When the laboratory receives the samples, one part of the label shall be removed from the container and returned to the site with the SAR/CR (Form 7-1, Appendix B) after sample analysis is complete.

The FEMP project manager or designee shall review activities to determine whether proper custody procedures were followed and to decide if additional samples are required.

7.1.1 Sample Tracking and Control Documentation

Sample custody shall be documented from time of collection through disposal. Final disposition of the sample shall be documented. The following records shall be maintained in the chain-of-custody process for sample tracking and control.

- Field log (bound book) with sequentially numbered pages or sequentially printed and numbered daily field activity log forms
- Sample identification and labeling
- Three-part SAR/CR (Form 7-1, Appendix B)

Items 1 and 2 shall be completed for all samples regardless of ASL. Item 3 is required for samples shipped off site or for samples analyzed on site by a party other than the sample collector (i.e., a custody transfer occurs).

7.1.2 Daily Logs

Data collection activities shall be recorded in a field log book or on daily field log forms (Form 5-1, Appendix B). Entries shall describe activities sufficiently for the sampling team to re-construct a particular situation without reliance on memory.

Field log books shall be bound field survey books or notebooks with sequentially numbered pages, preferably with water-resistant paper (standard engineering field book). Log books

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shall be assigned to field personnel. They shall be stored in a secure area when not in use. Each log book shall be identified by a project-specific control number.

Use of daily log forms was approved by EPA for the remedial investigation/feasibility study program (U.S. Department of Energy, 1988). Similar forms are used by other programs at FEMP. Each form shall be sequentially printed and numbered and logged into the data management system (Appendix F). Requirements for daily log entries at FEMP are provided in Section 5.

7.1.3 Sample Identification and Labeling

Samples shall be marked for identification from the time of collection and packaging through final disposition as specified in Appendix K. Marking is generally on a label attached to the sample container (jar, bottle). Sample identification shall include the following information as applicable.

- Project identifier
- Sample number
- Date and time of sample collection
- Sample type (e.g., ground water, surface water, soil, sediment)
- Parameters to be analyzed
- Initials of individuals collecting sample
- Sample preservative

Form 7-2 (Appendix B) is an example of a sample label. An established sample numbering system shall be used for identifying samples according to project, location, and type. Each environmental media sampling point shall be identified using the state planar coordinate system. Numbering systems shall be consistent with the ***RI/FS Sampling Plan***, Volume 1, Introduction (U.S. Department of Energy, 1988), as specified in the Sitewide CERCLA Quality Assurance Project Plan (SCQ), or in established routine sampling program procedures. The numbering system shall be administered by the FEMP sampling and analysis management coordinator.

7.1.4 Request for Analysis

Analysis requests shall be prepared to specify the testing or analyses program required for collected samples using Form 7-1 (Appendix B). Analysis requests shall be confirmed prior

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to sample collection and coordinated by the FEMP sampling and analysis management coordinator. The analysis request shall be hand-carried or telefaxed to a FEMP-approved analytical laboratory (Table 3-1, Appendix A) prior to sample collection for information on required laboratory capacity needs. The laboratory FEMP project manager or representative shall sign the copy and transmit it by telefax to the FEMP project contact, committing laboratory resources to proper, on-time completion of requested analyses. Failure of the laboratory FEMP project manager to respond within one working day shall be interpreted as a lack of capacity, and other arrangements shall be made for sample analysis. Other properly documented communications with subcontractor laboratory personnel may substitute for this procedure if defined in a project-specific plan.

If the laboratory initially contacted cannot perform the analysis, an alternate FEMP-audited and approved subcontractor laboratory shall be chosen by the FEMP project contact. The request-for-analysis process shall be repeated. This process eliminates capacity problems and excessive sample turn-around times. Record the following information from the request-for-analysis process for the project file.

- Project name and number
- Number of samples
- Date samples shipped
- Required report date and turnaround times for testing or analysis
- Contact (with telephone number) for receipt of analytical report and invoices
- Sample identification numbers
- Sample media
- Sample volume collected and preservatives used
- Types of analyses required

Information on the analysis request/custody record shall be consistent with that on sample labels. When a discrepancy exists, the laboratory FEMP project manager or representative shall notify the FEMP project contact immediately. The written discrepancy resolution shall be transmitted from the FEMP project contact to the laboratory within one working day of notification by the laboratory.

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7.1.5 Sitewide Analysis Request/Custody Record

Samples collected at FEMP within the scope of this SCQ shall be accompanied by the SAR/CR (Form 7-1, Appendix B). Instructions for its use are included with the form. The SAR/CR shall be initiated by the sample collector prior to taking samples. It is not complete until samples are processed through the laboratory (on site or off site) and permanently dispositioned.

SAR/CRs shall be pre-numbered and in triplicate. The original copy shall accompany samples to the on-site sample processing laboratory, the second copy shall be submitted to and retained by site sample management personnel; and the third copy shall be retained by the sample collection team leader.

If samples are shipped directly to an off-site laboratory by non-sample processing laboratory personnel, the original copy shall be sent with the samples. An Off-site Custody Transfer Record (OCTR) (part 3 of Form 7-1, Appendix B) (paragraph 7.1.5.1) may be used in conjuction with the SAR/CR for transferring the sample, in which case the sample collectors shall send one copy to the on-site sample processing laboratory for filing.

Samples shall be checked and information on the SAR/CR shall be verified as correct when samples arrive at the on-site sample processing laboratory. Damaged samples or samples for which incorrect or inadequate information is provided shall not be processed through the on-site sample processing laboratory. The on-site sample processing laboratory shall distribute samples to the appropriate analytical laboratory with required custody controls.

Upon final disposition of the samples, copies of the completed form shall be submitted to the FEMP sampling and analysis management coordinator and the sample collection team leader by the on-site sample processing laboratory.

7.1.5.1 <u>Off-Site Custody Transfer Record</u>. Samples shipped to off-site laboratories shall be accompanied by an OCTR in addition to the SAR/CR. OCTRs are specific to individual laboratory services contracts and provide a mechanism for transferring information that applies only to the scope of work for that contract. Upon receipt of an OCTR, the off-site laboratory shall return the form to FEMP as indicated to verify that the samples were received intact. An example of an OCTR is included as part of Form 7-1 (Appendix B).

7.1.5.2 <u>Shipment of Samples Offsite</u>. Samples shipped off site shall be properly packaged for shipment as specified in Section 6 and dispatched to the laboratory for analysis. A separate signed custody record shall be enclosed in a watertight container (e.g., a zipper-lock plastic bag) and shall accompany each sample shipment.

Shipping containers shall be secured with strapping tape and FEMP custody seals and/or locked if appropriate, so that access to the container can be gained only by breaking the seal.

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If samples are sent by common carrier, a bill of lading (waybill) shall be used. Receipts for bills of lading shall be retained as part of permanent custody documentation. If sent by mail, the package shall be certified with a return-receipt requested. It shall indicate who may accept the receipt and that person's location.

Commercial carriers are not required to sign the custody form as long as forms are sealed inside the sample container and the custody seals remain intact.

The person relinquishing custody shall indicate this by signing and dating the form prior to sealing it in the container. Documents such as custody transfer records and commercial carrier waybills are considered part of the custody record and shall be filed together.

Laboratory sample receipt procedures are discussed in paragraph 7.2.1.

Copies of the SAR/CR (the OCTR is part 3 of the SAR/CR) shall be maintained in the analytical laboratory project file. Working project files shall meet the requirements of Section 4 and the project-specific plan.

The original copy of the FEMP SAR/CAR shall be signed by a designated representative of the laboratory and submitted to the FEMP project contact upon final sample disposition or return of samples to FEMP.

7.2 ANALYTICAL LABORATORY

Separate logs shall be maintained for each on-site laboratory group (e.g., the atomic absorption and isotopic laboratories) in the on-site sample processing laboratory. The logs shall provide documentation of sample transfer without distributing SAR/CRs throughout many laboratories. This system allows on-site sample processing laboratory personnel to know where samples are located at all times.

Samples shall not be transferred within on-site analytical laboratories. Upon completion of analysis by one laboratory, the samples shall be returned to the on-site sample processing laboratory. The on-site sample processing laboratory shall log in the samples and redistribute them as necessary.

7.2.1 Custody Within On-Site Laboratories

The sample processing laboratory shall act as the centralized sample processing and tracking organization for on-site laboratories. Samples processed on site shall be delivered to the appropriate laboratory by sample processing laboratory personnel. Each time a sample is transferred, an entry shall be made in the applicable analytical laboratory sample-transfer log.

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7.2.2 Custody Within Off-Site Laboratories

To ensure custody control, each off-site laboratory shall comply with the requirements specified in the custody definition provided in this section. This can be done by employing logs as described in paragraph 7.2.1 or by using custody records with the samples. Maintaining custody of samples within the laboratory shall be verified by surveillance and audit (Section 12).

7.2.3 Off-Site Laboratory Sample Receipt

Within eight hours of sample receipt by a laboratory, the laboratory FEMP project manager or representative shall examine the shipment as follows.

NOTE

> The laboratory FEMP project manager or representative shall notify the FEMP project contact of discrepancies noted during sample receipt by telephone immediately and within twenty-four hours in writing (by telefax if necessary). The laboratory FEMP project manager may telefax the custody record with the problem indicated on it. The FEMP contact shall advise laboratory of disposition to be made of samples within twenty-four hours of notification by telephone or telefax followed in writing. A deviation report shall be required for discrepancies and observations as specified in Section 15.

1. Examine shipping container custody seals for breakage and tampering. Open shipping containers and examine custody seals on sample containers. Record condition of custody seals on the off-site custody record or equivalent.

NOTE

> If sample containers arrive with an incorrect SAR/CR or no SAR/CR, custody has been broken and analysis results can only be used for information purposes. Proceed as specified in steps 10 and 11.

2. Measure temperature of shipping containers holding samples that require refrigeration with a calibrated, standard laboratory thermometer and record temperature on the SAR/CR. Document samples that are outside the temperature range of two to six degrees Centigrade on the SAR/CR and notify FEMP project contact. Store samples until directions for disposition are received.

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3. When a sample is removed from the shipping container, check sample identification on sample container against that listed on the SAR/CR. When discrepancies exist, record that on the SAR/CR and sign and date the notation. Notify FEMP project contact immediately, and store sample until a resolution is received from FEMP project contact.

4. Compare contents of shipping containers to samples documented on custody record. Verify waybill number against that on custody record. When commercial carrier waybill number is not recorded on the custody record, verify with the FEMP project contact that the number on the waybill is identical to that recorded on the field custodian's copy of the custody record. Indicate discrepancies on record and notify the FEMP project contact.

5. Sign and date custody record and attach waybill to it.

6. Record damage to samples on the SAR/CR and set samples aside. Maintain preservation requirements if possible. Notify the FEMP project contact with an estimate of the damage and the cause. The FEMP project manager shall determine whether damaged samples can be used based on data quality objectives. Store the samples until disposition notice is received from FEMP project contact.

7. Assign a unique laboratory tracking number to each sample and affix a label with the number onto each sample container if the FEMP sample number is not used for internal laboratory tracking purposes. Numbers shall be assigned sequentially as samples are coded in. Log sample receipt information, including holding times, test assignments, and anticipated reporting date into laboratory information management system. If sample holding time has been exceeded or cannot be met, notify FEMP project contact. Enter samples in laboratory tracking system with the following information.

   - Project identification number
   - Sample numbers
   - Type of samples
   - Date received in the laboratory

8. Store samples as required in laboratory facility.

9. Process samples through laboratory for analysis based upon designated priorities.

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10. If the custody record does not arrive with the laboratory shipment, notify FEMP project contact and store samples until a resolution is received.

11. If samples arrive with an incorrect custody record, proceed as follows.

    a. If the SAR/CR is incomplete or incorrect, contact FEMP project contact by telephone or telefax and explain the discrepancies followed by written documentation for the project file.

NOTE

Documentation of the discrepancy and its resolution by the FEMP project manager along with appropriate signatures shall be amendments to the SAR/CR.

    b. If information on the SAR/CR cannot be corrected by the FEMP project contact or by field personnel, remove samples from the analysis program.

12. Notify laboratory manager or group leaders of sample arrival.

NOTE

A copy of the SAR/CR shall be submitted to analyzing laboratory and maintained in project files. Another copy of the SAR/CR shall be maintained in FEMP project files. The original SAR/CR shall be returned to FEMP after samples have been consumed or disposed of by the laboratory or returned to FEMP with samples.

7.2.4 Storage

Samples shall be stored and custody retained as prescribed by applicable regulatory and/or method requirements. Samples requiring refrigeration shall be stored in secured, temperature-monitored refrigerators monitored by designated sample custodians.

7.2.5 Initiation of Testing Program

The analysis request process shall be initiated prior to sampling and the SAR/CR sent with samples when they are shipped to the laboratory. When the analysis request is not sent with the sample shipment, sample management personnel shall immediately notify the responsible FEMP project contact for definition of the analysis program.

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The laboratory manager and assigned personnel are responsible for assigning priorities to samples to ensure that holding times are not exceeded during the time needed to process the samples through the laboratory work stream.

7.2.6 Sample Disposal

It is essential to track the final disposition of each sample because of potential liabilities incurred through improper disposal of samples. Therefore, the SAR/CR for the sample shall be completed with the final disposition of the sample. Analysis will confirm if the sample contains non-hazardous or hazardous waste or non-radioactive or radioactive material as defined by the Department of Transportation and the Comprehensive Environmental Response, Compensation, and Liability Act. Non-hazardous and non-radioactive samples shall be disposed of in accordance with standard laboratory practices or returned to FEMP as specified by the FEMP project contact.

The disposition of hazardous and radioactive samples shall be determined on a laboratory contract-specific basis. The majority of these samples will be returned to FEMP prior to determination of final disposition.

When environmental samples are held for re-analysis, proper environmental control and holding time shall be observed. When re-analysis is not anticipated, but samples must be held for a specific time, environmental conditions for storage will not be observed.

When hazardous waste samples are held for re-analysis, they shall be stored according to their hazard classification under the Resource Conservation and Recovery Act, defined environmental conditions, and holding times.

When radiological samples are held for re-analysis or for a specific time, they will be stored in accordance with DOE regulations, individual laboratory licensing requirements, and environmental conditions.

When mixed waste samples are held for re-analysis or for a specific time, they shall be stored in accordance with DOE regulations, their hazard classification under Resource Conservation and Recovery Act, and environmental conditions.

Special arrangements may be necessary for samples maintained longer than six months.

Returned hazardous waste and radiologically contaminated samples shall be transported to FEMP in accordance with 49 CFR 171 through 177 (Section 6). Record disposition on the SAR/CR and file results.

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FEMP shall maintain a sample disposal log defining methods for disposal of FEMP-generated samples. Contracting laboratories shall provide information identifying sample disposal methods to FEMP. Following are examples of sample disposition.

- Consumed in analysis
- Returned to FEMP
- Stored
- Non-hazardous/non-radioactive-contaminated samples disposed of in accordance with standard laboratory disposal practices
- Hazardous waste/radiological-contaminated samples disposed in accordance with standard laboratory disposal practices

A record of disposal methods of samples analyzed at FEMP shall be documented as part of the SAR/CR.

7.3 EVIDENCE FILES

Evidence files for analytical data are maintained at FEMP and contain relevant records, reports, correspondence, logs, field logs, original laboratory data packages, pictures, subcontractor reports, SAR/CRs, and data review reports. All information supporting FEMP CERCLA decisions shall be included in the final evidence file as part of the Administrative Record in accordance with the 1991 amended Consent Agreement.

Evidence files are in custody of the appropriate FEMP project manager responsible for generating the data. They are kept in a locked, secure storage area. The file custodian is the FEMP Administrative Record Coordinator, who controls the central file for all environmental sampling and analysis at FEMP. The final evidence file shall be maintained for at least ten years after remedial activities at FEMP are complete. If DOE decides to discard the files after this time, the 1991 amended Consent Agreement specifies that the files be offered to EPA.

Data generated by subcontractors for FEMP are the property of DOE and shall be maintained under contract at the facility where it was generated. No files shall be discarded without prior written consent of the FEMP project manager. If a storage, security, or other problem is discovered at the facility, files shall be transferred to FEMP.

7.4 REFERENCES

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U.S. Department of Energy. 1988. ***Remedial Investigation and Feasibility Study, Feed Materials Production Center, Fernald Ohio, Work Plan***. Revision 3. Prepared by Advanced Sciences, Inc. for U.S. Department of Energy, Oak Ridge Operations. March 31, 1988.

U.S. Environmental Protection Agency. 1991. ***Region V Model Superfund Quality Assurance Project Plan***. Chicago, Illinois. May 1991.

Westinghouse Environmental Management Co. of Ohio. 1989. ***Chain of Custody for Environmental Samples***. Procedure AnL-01-0049. September 5, 1989.

Westinghouse Environmental Management Co. of Ohio. 1991. ***Packaging, On-Site Movement, and Off-Site Shipment of Material***. Procedure FMPC-0314. December 31, 1991.

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SECTION 8

Section 8

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CALIBRATION PROCEDURES AND FREQUENCY

Measuring and test equipment used in the field and the laboratory shall be controlled by formally prescribed calibration requirements. Equipment shall be of the type, range, accuracy, and precision necessary to provide data compatible with the Analytical Support Level (ASL) (Section 2) specified in applicable Data Quality Objectives (DQO) (Appendix C) or Project-Specific Plans (PSPs). Calibration of measuring and test equipment shall be performed internally using documented and approved procedures. When available, accepted procedures published by the American Society for Testing and Materials, the EPA, the National Institute of Technology, or manufacturer equipment manuals shall be used. Variance from these procedures shall be justified and documented in PSPs.

8.1 RESPONSIBILITIES

Responsibility for calibration requirements and documentation is as follows.

8.1.1 Analytical Laboratory Equipment and Instrumentation

Responsibility for ensuring that calibration requirements are met rests with the laboratory manager, whether on-site or a subcontractor.

Individual laboratory analysts responsible for performing analytical procedures shall maintain required calibration logs.

8.1.2 Field Equipment and Instrumentation

The assigned FEMP project manager or designee shall be responsible for ensuring that field equipment and instrumentation calibration requirements are met as specified in Appendix I, Attachment I, or the applicable PSP.

Field users of calibrated instruments are responsible for inspecting calibration status before using the equipment and documenting the inspection in the calibration log.

8.2 CALIBRATION PROCEDURES

Calibration procedures for measurement and test equipment used in the field and in analytical laboratories shall be specified in the applicable PSP or the Attachment I method. After

identifying the appropriate procedure for calibrating the subject instrument, the source of the procedure shall be recorded and implementation shall be documented in the instrument-specific calibration log. 3200

When available, accepted procedures published by American Society for Testing and Materials, EPA, or the equipment manufacturer shall be used.

8.2.1 Procedure Requirements

The following requirements shall be included in procedures for measurement and test equipment calibration in PSPs.

- A list of field measurement and test equipment to be used on the project by manufacturer, type, and identifier
- Source of the calibration procedure or the procedure itself if not otherwise available
- Identification numbers for equipment requiring calibration. (The number assigned may be the manufacturer serial number, a calibration system identification number, or other equipment-unique identifier.)
- Reference standards with known relationships to nationally recognized standards (e.g., National Institute of Technology) or accepted values of natural physical constants (If national standards do not exist, reference and document the basis for calibration.)
- Standards required for the specified ASL
- Maintenance and inspection requirements prior to use of equipment
- Prescribed intervals for calibrating measurement and test equipment
- Calibration log and minimum information

8.2.2 Calibration Frequency

Frequency of calibration shall be determined based on the following elements.

- Type of equipment
- Inherent stability
- Manufacturer recommendations

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- Values given in national standards
- Intended use
- Instrument response to spot checks with standards
- Instrument response time
- Experience

8.2.3 Calibration Documentation Requirements

Documentation shall be maintained for each piece of calibrated measurement and test equipment to indicate that established calibration procedures have been followed. Calibration records for field equipment shall be retained in project files. Records for laboratory equipment shall be maintained by the laboratory. At a minimum, the following information shall be recorded and available for project use.

- Equipment identification number
- Type and manufacturer of equipment
- Calibration frequency and acceptable tolerances
- Calibration dates, results, and any problems encountered during calibration
- Identification of calibration procedures employed
- Identification of personnel and organization performing calibration
- Dates of maintenance and inspections
- Certification or statement of calibration provided by manufacturer or external agency, if applicable
- Statement of calibration acceptance or failure
- Disposition of equipment that fails calibration

8.2.4 Equipment Failure

Equipment that cannot be calibrated or becomes inoperable during use shall be tagged and removed from service until it can be repaired and recalibrated to the acceptance criteria

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specified in the applicable procedure. Equipment that cannot be repaired shall be permanently removed from the program and replaced.

8.3 FIELD MEASUREMENT AND TEST EQUIPMENT FOR ASLs A AND B

Calibration checks shall be performed on all field instruments before use each day. If the instrument does not meet the criteria specified in Appendix I, Attachment I, or the PSP, use of the instrument shall be discontinued until the unit has been recalibrated.

The responsible FEMP project manager or designee shall maintain a list of field measurement and test equipment used for the collection of project data. The list shall include the following information.

- Identification number
- Description of equipment
- Manufacturer of equipment
- Required calibration frequency
- Number and title of applicable calibration procedure
- Source of procedure

The FEMP project manager or designee shall validate the list for adequacy and review the calibration procedures periodically to ensure adequacy for the specified ASL (Section 2). Procedures for calibration of commonly used field equipment are provided in Appendix I.

8.4 ANALYTICAL LABORATORY INSTRUMENTATION AND EQUIPMENT FOR ASLs B, C, D, AND E

Method-specific calibration requirements are specified in Section 14 of each organic, inorganic, conventional, radiometric, and miscellaneous method in Attachment I. Calibration requirements for geotechnical methods are specified within each Attachment I method as appropriate. Concentrations of the calibration standards are specified in the methods where appropriate. Frequencies for initial and continuing calibration requirements are specified along with the quality control acceptance criteria.

If initial calibrations do not meet acceptance criteria, analyses shall not be performed, corrective action shall be taken, and the calibration standards shall be re-analyzed. If

continuing calibration check samples do not meet acceptance criteria, corrective action shall be taken and the instrument shall be recalibrated. Samples analyzed since the last calibration that met specified criteria shall be re-analyzed. 3200

If deviations from procedures are necessary, the FEMP project contact shall be notified immediately, and documentation of the deviation and the reason for it shall be presented in the final analytical report.

Calibration information shall be documented in the applicable calibration log.

8.4.1 Laboratory Equipment Calibration Schedules

Equipment shall be calibrated at least annually or at the time of a repair that affects the function of the equipment. Equipment requiring calibration schedules includes, but are not limited to, the following.

- Ovens and refrigerators
- Automatic/manual pipettors
- Thermometers
- Laboratory balances

8.4.2 Laboratory Instruments

Schedules shall require calibration at least as frequently as the Attachment I method specifies. Instruments requiring calibration schedules include, but are not limited to, the following.

- Liquid scintillation counting systems
- Alpha spectrometer systems
- Alpha/beta counting systems
- Germanium spectroscopy systems
- Alpha scintillation counting instruments
- Gas Chromatograph/Mass Spectrometer (GC/MS)
- UltraViolet/Visible Spectrum (UV/VIS) spectrophotometer

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- Thermal mass spectrometry
- Gas Chromatography/Electron Capture Detector (GC/ECD)
- Gas Chromatography/Flame Ionization Detector (GC/FID)
- High Performance Liquid Chromatography with UV (HPLC/UV)
- Inductively Coupled Plasma (ICP) spectroscopy
- Flame Technique Atomic Absorption Spectroscopy (FTAAS)
- Graphite Furnace Atomic Absorption (GFAA) spectroscopy
- Cold Vapor Atomic Absorption (CVAA) methods for mercury analysis
- Infrared (IR) spectrometry
- Manual/semi-automated spectrophotometry

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SECTION 9

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Section 9

ANALYTICAL PROCEDURES

Laboratory analytical procedures required for FEMP activities are provided in Attachment I, the FEMP Laboratory Analytical Methods Manual, which is a compilation of standardized analytical methods, identified to date, that will be used by FEMP. As new analytical requirements are identified, additional methods will be added to the Attachment I. Table 9-1 (Appendix A) is a list of the methods currently included in Attachment I.

Specific methods for each analyte, by matrix (i.e., soil, sediment, air, water, biota), are provided in Attachment I to meet Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements of the 1990 Consent Agreement. Additional sources of information relative to analytical methods are in the reference section of Attachment I.

General laboratory quality control procedures that are mandatory for performance of analyses are also incorporated in Attachment I. Certain activities in an integrated program to generate quality data can be classified as management (quality assurance) and others as functional (quality control). The presentation given in Attachment I establishes project requirements that laboratories performing analyses and generating analytical data under the Sitewide CERCLA Quality Assurance Project Plan (SCQ) shall meet.

9.1 CHEMICAL ANALYSIS

Analytical methods (Attachment I) for organic, inorganic, conventional and Resource Conservation and Recovery Act (RCRA) characteristics are based on EPA methods or standard methods if they exist. Sources for the methods include SW-846, Third Edition; EPA Methods 100-600 Series; Standard Methods for the Analysis of Wastewater, 17th Edition; and American Society for Testing and Materials (ASTM) methods.

When selecting methods for SCQ Attachment I, the intent was to include a single method for the analysis of parameters from different regulatory programs when possible. For example, there is one gas chromatography/mass spectrometry method for the analysis of volatile organic compounds that includes target analytes from the CERCLA Target Compound List, the National Pollutant Discharge Elimination System Hazardous Substances List (HSL), and the Resource Conservation and Recovery Act Appendix IX list.

Use of a single analytical method with one set of quality control acceptance criteria will help to increase comparability and interchangeability of data gathered for differing programmatic

purposes. The methods are presented in a standard fifteen-point format, described in the General Requirements Standard Operating Procedure in Attachment I. Deliverable requirements for laboratories performing analyses are described in Section 11. 3200

9.2 RADIOLOGICAL ANALYSIS

Analytical methods (Attachment I) for radiological constituents are based on standard EPA or American Society for Testing and Materials methods if available. If not, methods are based on existing methods from FEMP and other DOE sites that have a long history of analyzing for radiological constituents. Total uranium and thorium may also be analyzed by non-radiological standard methods.

Fewer standard methods are available for analysis of radiological parameters, and established quality assurance/quality control requirements and acceptance criteria are not available for all of the methods. Additionally, detection or reporting limits are not standardized but are specific to method, instrument, and laboratory. Reporting limits can be directly affected by selection of sample size for analysis, instrument and laboratory background radiation levels, and the counting time used to perform the analysis.

DOE regulations require that radiological results be reported to the lowest possible level of detection on the basis that there is no absolutely safe level of radiation exposure. Individual methods shall specify a minimum sensitivity that shall be met when it is known.

Additional study and method validation may be required to provide quality control acceptance criteria and method sensitivities when they are not currently available.

9.3 NATURAL WATERS ANALYSIS

The following field methods for determining properties of natural waters at ASL A are provided in Appendix K.

- pH
- Temperature
- Specific conductance
- Alkalinity

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- Redox potential (Eh)
- Dissolved oxygen content

9.4 GEOTECHNICAL ANALYSIS

Soil samples being analyzed for geotechnical parameters shall utilize the methods specified in Attachment I as applicable. The methods are modified versions of standard methods (primarily American Society for Testing and Materials) when the options have been specified. Exceptions sheets provided in Attachment I define the modifications to the referenced methods.

9.5 ASBESTOS ANALYSIS

Bulk material and filters will be analyzed for asbestos to identify presence and to monitor airborne concentrations. Analyses shall be performed as specified in 40 CFR 762.

SECTION 10

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Section 10

INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

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).

10.1 QUALITY CONTROL CHECKS AND PROCEDURES

QC operations performed to satisfy requirements for Analytical Support Levels (ASL) are defined in specific methods provided in Attachment I, the FEMP Laboratory Analytical Methods Manual.

10.2 INORGANIC QUALITY CONTROL

Types and required frequencies for field and laboratory QC samples for inorganic analyses performed for ASLs B, C, and D are summarized in Table 2-2 (Appendix A). Definitions of the different types of QC samples are provided in Section 4. QC samples for inorganic analyses may include some or all of the following.

- Preparation (method) blank
- Inductively Coupled Plasma (ICP) interference check
- Inductively Coupled Plasma serial dilution
- Matrix spike analysis
- Laboratory replicate sample analysis
- Graphite Furnace analytical (instrument) spike
- Use of Method of Standard Additions (MSA)
- Laboratory Check Samples

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QC acceptance criteria for each of the QC sample types and required corrective actions are specified in the applicable Attachment I method. Data reporting requirements are specified in Section 11. Data validation requirements are described in Section 11 and detailed in Appendix D.

10.3 ORGANIC QUALITY CONTROL

Types and required frequencies for field and laboratory QC samples for organic analyses performed for ASLs B, C, and D are summarized in Table 2-2 (Appendix A). Definitions of the different types of QC samples are provided in Section 4. QC samples for organic analyses may include some or all of the following.

- Preparation (method) blank
- Surrogate spike analysis
- Laboratory replicate sample analysis
- Matrix spike/matrix spike duplicate analysis
- Retention-time window establishment and retention-time shift evaluation
- Method linear range determination
- Endrin/DDT breakdown product evaluation
- Laboratory check samples

QC acceptance criteria for each of the QC sample types and required corrective actions are specified in the applicable Attachment I method. Data reporting requirements are specified in Section 11. Data validation requirements are described in Section 11 and detailed in Appendix D.

10.4 RADIOLOGICAL SAMPLE ANALYSIS QUALITY CONTROL

Types and required frequencies for field and laboratory QC samples for radiological analyses performed for ASLs B, C, and D are summarized in Table 2-2 (Appendix A). Definitions of the different types of QC samples are provided in Section 4. QC samples for organic analyses may include some or all of the following.

- Preparation (method) blank

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- Matrix spike/matrix spike duplicate analysis
- Laboratory check samples
- Laboratory replicate sample analysis

QC acceptance criteria for each of the QC sample types and required corrective actions are specified in the applicable Attachment I method. Data reporting requirements are specified in Section 11. Data validation requirements are described in Section 11 and detailed in Appendix D.

10.5 CONVENTIONAL QUALITY CONTROL

Types and required frequencies for field and laboratory QC samples for conventional analyses performed for ASL B are summarized in Table 2-2 (Appendix A) and are specified, as applicable, in each Attachment I method. Definitions of the different types of QC samples are provided in Section 4.

QC acceptance criteria for each of the QC sample types and required corrective actions are specified in the applicable Attachment I method. Data reporting requirements are specified in Section 11. Data validation requirements are described in Section 11 and detailed in Appendix D.

10.6 FIELD QUALITY CONTROL

The assigned field FEMP project manager is responsible for field activities and QC. Quality Assurance/Quality Control sample requirements for field activities and measurements are specified in Section 5 and Appendix J (field procedures). QC acceptance criteria for each of the QC sample types and required corrective actions are specified in the applicable method in Appendix J. Data reporting requirements are specified in Section 11. Data validation requirements for field activities are described in Section 11 and detailed in Appendix D.

SECTION 11

Section 11

DATA REDUCTION, VALIDATION, AND REPORTING

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The following procedures 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). The Data Validation Plan is described in Appendix D.

11.1 DATA REDUCTION

Data reduction is the process of converting raw data to a useable format beginning with data processing and continuing through review and reporting of results as shown in Figure 11-1 (Appendix A). Data reduction can either be performed by the analyst who obtained the data or by another analyst. Data review begins with the laboratory manager, field supervisor, or designee who verifies that data reduction has been correctly performed. In general, data shall be reduced in one of the following ways.

- Manual computation of results directly on the data sheet or on attached calculation pages
- Input of raw data for computer processing
- Direct acquisition and processing of raw data by a computer

11.1.1 Responsibilities

Data reduction shall be performed by the laboratories analyzing samples or field personnel responsible for obtaining field measurements. The individual analyst shall verify appropriate forms for completeness and correctness of data acquisition and reduction. The certificate of analysis provided with sample results shall ensure that data reduction has been performed properly and that the reported results are correct. Calculations and results for field measurements shall be independently reviewed. The reviewer shall initial and date the applicable field results reporting forms (Sections 5 and 6 and Appendices J and K).

11.1.2 Data Reduction Procedures

Analysis-specific calculations and statistical methods are dependent on the methods provided in the FEMP Laboratory Analytical Methods Manual (Attachment I), which references applicable regulatory requirements and guidance that include the calculations and methods

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shown. Specific data reduction procedures and equations are included in individual analytical methods in Attachment I.

Raw instrumental data shall be reduced to the final data package and certificate of analysis when required in accordance with the following steps.

1. Generate data for a particular sample using a specific analytical instrument. If a sample is tested for several analytes, perform data reduction individually for each analyte unless several analytes can be identified at the same time [e.g., metals by Inductively Coupled Plasma (ICP)].

2. For a particular group of analytes (e.g. metals), gather raw data generated for a particular sample. For example, raw data from ICP, graphite furnace, flame atomic absorption, and cold vapor analyses for a particular sample may be used to generate results sheets for all analytes.

3. Gather results sheets from all sections (metals, wet chemistry, gas chromatography, gas chromatography/mass spectrometry, and radiometrics) and forward them to the laboratory project manager or designee for compilation and generation of certificates of analysis.

Records management shall be in accordance with guidelines in Section 4. Sections 5 and 6 and Appendices J and K provide discussions of reporting and data reduction requirements for field measurements.

11.2 DATA VALIDATION

Data validation is a process performed independently of the laboratory or field personnel generating analytical data. The Data Validation Plan (Appendix D) describes the validation process requirements, responsibilities for performing data validation, and detailed technical requirements for review and qualification (flagging) of the analytical data.

Procedures are included for validation of field data generated for ASL A, conventional parameters data, radiological data, organic analyses by gas chromatography and Gas Chromatography/Mass Spectrometry (GC/MS), and metals analysis by inductively coupled plasma spectroscopy and atomic absorption. Requirements for validation of user-defined ASLs B and E data are mentioned and will be specifically defined in the applicable PSP.

Data qualifiers, or flags, are defined in Appendix D along with the procedures on how they are assigned to the validated data. Data validation criteria are based on the method performance and QC acceptance criteria specified for each method in Attachment I.

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Data validation procedures presented in Appendix D are applicable only to data collected under the Sitewide CERCLA Quality Assurance Project Plan (SCQ). Data collected prior to implementation of the SCQ shall be considered historical data and its validation will be handled on a project-specific basis as outlined in subsection 11.4.

11.3 DATA REPORTING

A certificate of analysis and summary sheets shall be generated by the analytical laboratory. The sheets shall contain information about analytical tests performed, date and condition of sample received, results, methodology, and quality of data reported. Field measurements shall be reported on applicable forms specified in Sections 5 and 6 and Appendices J and K.

Electronic data transfer information shall be generated from a certificate of analysis as specified in Appendix F. Data shall be verified for accuracy by a person other than the one responsible for entering the data. The FEMP project manager or designee shall be responsible for checking and approving the final presentation of reported data to ensure that project-specific requirements are met.

11.3.1 ASL A Data Reporting

Field-generated data reports for ASL A shall include field logs and report forms specified in Sections 5 and 6 and chain-of-custody records specified in Section 7.

11.3.2 ASL B Data Reporting

For ASL B analyses, when methods, performance requirements, and deliverable items are specified by the user, the deliverable data package shall be specified in applicable PSPs.

For predefined ASL B analyses, the deliverable data package shall include, as a minimum, reports of the following applicable analysis results.

- Samples and dilutions
- Method and laboratory blanks
- Laboratory control samples
- Matrix spike/matrix spike duplicate samples
- Laboratory replicate samples
- Surrogate recoveries

11.3.3 ASL C Data Reporting

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The deliverable data package for ASL C analyses shall include, but not be limited to, the following items for the analytical methods to which they apply.

- **All laboratory analyses**
  - Analysis results of samples and dilutions
  - Analysis results of laboratory control samples
  - Analysis results of matrix spike/matrix spike duplicate samples
  - Analysis results of method and laboratory blank samples
  - Analysis results of laboratory replicate samples
  - Injection logs of instruments used
  - Analysis results of initial and continuing calibration samples including calibration curve calculations
  - Internal standards and tracer results
  - Analyst bench notes for conventional, geotechnical, and radiochemical analyses
- **Organic Analyses**
  - Reports of compounds detected in Gas Chromatography (GC) and Gas Chromatography/Mass Spectrometer (GC/MS) analyses including reported retention times, integrated area counts, and compound identification
  - Library search results to tentatively identify non-target analytes in GC/MS analyses
  - Surrogate recoveries
  - Results of GC/MS tuning samples for instruments used
  - Instrument performance results for pesticide/polychlorinated biphenyls degradation check samples

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- **Inorganic Analyses**
  - Analysis reports of spike and post-digestion spike
  - ICP interference check sample results
  - ICP inter-element correction factors
  - Analysis results of serial dilution and method of standard additions if required
  - Low-level detection limit verification of sample results

11.3.4 ASL D Data Reporting

ASL D data packages shall contain the requirements specified in paragraph 11.3.4, and, in addition, copies of raw instrument output including, but not limited to, the following.

- Chromatograms
- Total and reconstructed ion chromatograms
- Raw calibration files
- Mass spectra of identified constituents and the library-reference mass spectrum for the compound
- Mass spectra for library-search compounds and the closest spectral matches from the reference library
- Channel-by-channel output for multi-channel radiochemical analyses
- Instrument-specific calibration and performance information if applicable
- Other output files or printouts from instruments used to perform the analyses

Site-specific summary sheets shall be developed for reporting specified deliverable items. The summary sheets shall contain information similar to that specified for report forms in SW-846 (Third Edition, Chapter One) and the EPA contract laboratory program report forms.

11.3.5 ASL E Data Reporting

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ASL E analysis is non-standard, so it is not possible to pre-determine report requirements. Requirements for ASL E analyses shall be specified in the PSP.

11.4 VALIDATION OF HISTORICAL DATA

Data collected prior to sitewide implementation of the SCQ shall be considered historical data and may include, but not be limited to, data collected under the following projects or programs.

- Remedial Investigation/Feasibility Study (RI/FS) Quality Assurance Project Plan
- RI/FS Data Validation Plan (U.S. Department of Energy, 1988a)
- RI/FS Data Management Plan (U.S. Department of Energy 1988b)
- Resource Conservation and Recovery Act interim status monitoring
- Waste-water monitoring related to the National Pollutant Discharge Elimination System
- Routine environmental monitoring for radionuclides

Some historical data were not gathered under an approved quality assurance program plan, or full Quality Assurance/Quality Control (QA/QC) documentation may not be available for all samples and procedures. However, the data may be good for some uses and should not be automatically discounted prior to evaluation.

The following general approach shall be used to validate and assess useability of historical data.

1. Gather available field sampling protocols, data management protocols, analytical results, including supporting QA/QC analysis results, data packages, supporting field records, chain-of-custody documentation, and associated audit and surveillance reports.

2. Obtain available copies of analytical protocols and performance criteria used to perform analyses, including quality assurance project plans and data validation plans in effect at the time of data generation.

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3. Compare results for samples and QA/QC analyses to protocol and method performance criteria in effect at the time data were generated or to data validation criteria of this SCQ if no such protocols are readily available.

4. Review field records, audit and surveillance reports, and training records for personnel performing sampling and analysis.

5. Assign the data set a level of useability that indicates uses the data are suitable for based on the level of performance achieved and the quality of the supporting data package.

If sufficient supporting QA/QC documentation is not available or if the raw data package is not available, a data set may be assigned a more restrictive level of useability than it was originally intended for, or it may be classified as unuseable.

Validation procedures for historical data shall be included in the PSP, and a summary report of data validation shall be prepared. The report shall discuss validation findings and assigned useability of the historical data.

11.5 REFERENCES

U.S. Department of Energy. 1988a. ***Quality Assurance Project Plan, Remedial Investigation and Feasibility Study, Feed Materials Production Center, Fernald Ohio.*** Prepared by Advanced Sciences, Inc., for DOE Oak Ridge Operations. March 1988.

U.S. Department of Energy. 1988b. ***Data Management Plan, Remedial Investigation and Feasibility Study, Feed Materials Production Center, Fernald Ohio.*** Prepared by Advanced Sciences, Inc., for DOE Oak Ridge Operations. March 1988.

U.S. Environmental Protection Agency. 1986. ***Test Methods for Evaluating Solid Waste.*** SW-846, third edition.

U.S. Environmental Protection Agency. 1988. ***Users Guide to Contract Laboratory Program.*** EPA/540/8-89/012.

SECTION 12

Section 12

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PERFORMANCE AND SYSTEM AUDITS

Self-assessments and independent assessments of work processes and operations shall be undertaken to assure quality of performance. Such assessments may include but are not limited to surveillance, audits, inspections, tests, data verification and validation, and peer reviews. Assessments shall include evaluation of compliance with both technical and procedural requirements and may be conducted at any point in the life of a project.

Self-assessment shall be performed by each FEMP organization responsible for conducting environmental sampling and analysis, specifically including subcontractor laboratories.

Independent assessment is the responsibility of the FEMP prime operating contractor. The Designated FEMP Quality Assurance (QA) Organization (Section 3) is responsible for performing the assessment. The designated FEMP QA organization reports directly to the head of the prime operating contractor organization, who in turn reports directly to the DOE site manager.

Performance and system audits of field and laboratory activities shall be conducted to verify that sampling and analysis are performed in accordance with procedures established in the FEMP Sitewide CERCLA Quality Assurance Project Plan (SCQ). At FEMP, performance audits are spot checks of program implementation and are referred to as surveillances, while system audits are in-depth reviews of an entire program and are referred to as audits.

To verify compliance with the SCQ and project-specific requirements, the FEMP project manager and designated FEMP QA organization shall be responsible for scheduling and conducting QA audits and surveillance. Audit results of activities covered by the SCQ are available to the EPA upon request to the DOE Fernald Office (FO). EPA may conduct external audits of FEMP activities covered by the 1991 amended Consent Agreement.

As a minimum, audits shall consist of evaluation of the QA program and procedures, effectiveness of their implementation, and review of associated project documentation. Audits shall cover applicable laboratory activities, field operations and documentation, and final reports. Auditing shall be performed in accordance with the SCQ and applicable Project-Specific Plans (PSP).

As a minimum, surveillance shall consist of monitoring/observing ongoing project activity and work areas to verify item and activity conformance to specified requirements. Surveillance shall be scheduled, planned, and documented.

Potential subcontractor laboratories shall be audited by the Designated FEMP QA Organization (Section 3 and Appendix E). Contracted laboratories shall be audited annually at a minimum and may only perform services for FEMP in the areas audited at the facility. Before a laboratory may handle samples from FEMP, audit team documentation is required specifying that performance in areas related to analysis of FEMP samples is within pre-established specifications. 3200

Subcontractor internal audits (self assessments) shall be performed in accordance with established laboratory manuals and specific attachments as amended by contract with FEMP, which shall be included as part of the project record. System audits shall be performed to evaluate components of the measurement systems to determine their proper selection and use. Performance audits shall be conducted periodically to determine accuracy of the total measurement system or component parts thereof.

Audit and surveillance results of 1991 amended Consent Agreement activities are available to EPA upon request to the DOE FO. External field and laboratory audits may be conducted by EPA, the Ohio Environmental Protection Agency (OEPA), or their respective subcontractors. EPA and DOE may coordinate laboratory audits to streamline manpower requirements and improve response time. External field audits may be conducted by EPA Region V Central District Office or Ohio Environmental Protection Agency as required.

Upon notification to the DOE FO, arrangements will be made with the FEMP Security Department for regulatory agency personnel access to field activities for external audits.

12.1 AUDIT AND SURVEILLANCE PERSONNEL

Technically qualified personnel working under a technically qualified lead auditor shall perform project and laboratory audits. Technical specialists may be assigned to the audit team at the discretion of the lead auditor.

The FEMP project manager or designated FEMP QA organization surveillance personnel shall perform independent project surveillance. Personnel shall be qualified by education or experience to perform the surveillance and technically knowledgeable of the activity being monitored.

Qualification of personnel conducting audits and surveillance shall be documented as part of the project record. Audits and surveillance personnel shall be independent of activities being audited or surveilled.

12.2 SYSTEM AUDITS

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12.2.1 Pre-Audit Activities

Pre-audit activities shall consist of definition of audit purpose, scheduling, identification of subject and scope, selection of audit team and lead auditor, development of audit plan and checklists, and notification of organization to be audited.

Audits shall be scheduled to provide coverage and coordination with ongoing activities and at a frequency commensurate with the status and importance of the activity. Schedules may be revised as necessary and may be supplemented by additional audits as necessary. An example audit schedule is included as Table 12-1.

As with scheduling, when determining activities to be audited, consideration shall be given to ensure adequate coverage of pertinent activities. Scope definition of each audit shall consider the activity status and importance of required validity/acceptability of its product and supporting documentation (e.g., records, reports).

The lead auditor shall develop plans for each audit, assisted as required by team members. Plans shall identify audit scope, applicable requirements, auditing personnel, activities to be audited, organizations to be audited, schedule, and checklist items.

Checklists are audit specific and based on audit requirements and goals. They are designed to document results of the audit. Items requiring review shall be listed on the checklist and checked off as they are audited. Preparation of checklists are the responsibility of the audit team prior to the audit. This preparation not only helps the team decide what the important points of the audit are, it also helps familiarize the team with the audited organization prior to conducting the audit.

The audited group or organization shall be formally notified in advance of the scheduled audit. The notification, as a minimum, shall include the audit date and length, associated meetings, auditing organization, identity of auditors, audit subject, and intended scope. Additional items to be covered in laboratory audits are specified in subsection 12.4.

12.2.2 Audit Conduct

Audits shall be conducted in accordance with written checklists. If portions of the proposed scope as identified on the checklist are not addressed during the audit, this shall be discussed at the closeout meeting and documentation shall be recorded in the audit report.

Pre-audit and post-audit meetings between auditors and audited organization management and personnel shall be held to review the purpose and scope of the audit, establish personnel contacts, and present audit results.

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During an audit and at completion, auditors shall discuss results and findings with individuals audited. It is not necessary to cite minor administrative findings as items requiring corrective action if they can be resolved to the auditors' satisfaction during the audit. Findings not resolved during the course of the audit and findings affecting the overall quality of the project, regardless of when they are resolved, shall be recorded on checklists and included in audit reports.

12.2.3 Post-Audit Activities

Upon completion of an audit, auditors shall prepare and submit a formal report to DOE, management of the audited organization, and the responsible FEMP organization. The report may also be sent to other FEMP project managers, individuals contacted during the audit, and management of applicable FEMP subcontractors. The report shall be prepared as soon as possible after the audit (within 30 days) and contain the following information as applicable.

- Dates of audit
- Identification of participants
- Identification of activities audited
- Audit results
- Description of items requiring corrective action and, if possible, the means of correction
- Directions for audit response in writing

Auditors shall verify completion of required corrective actions by written communication, re-audit, or other appropriate means. After verification and acceptance of corrective actions, the lead auditor or designee shall issue an audit closure report to the same individuals receiving the audit report.

12.3 SURVEILLANCE (PERFORMANCE AUDITS)

12.3.1 Pre-Surveillance Activities

Surveillance shall be scheduled by selecting project activities based on the program schedule defined in the PSP or amendments to the plan. Scheduling may occur on a daily or weekly basis in order to provide adequate activity coverage in response to project task assignments. Actual date and time of a surveillance shall be coordinated with applicable project personnel

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by surveillance personnel. Field activities, sample preparation, handling and shipping, document completion, laboratory analysis, data management, and security items shall be subject to surveillance.

Activity procedures or surveillance checklists shall be prepared by surveillance personnel if applicable. Check lists for conducting routine field surveillance are included in Appendix B (Forms 12-1 through 12-9).

12.3.2 Surveillance Conduct

Personnel conducting surveillance shall follow applicable procedures or surveillance checklists and observe activities as they are being performed. In-process observations of activities shall be documented as they occur along with evaluation of conformance with specified requirements. Surveillance personnel may communicate directly with project personnel during conduct of the surveillance to expedite corrective actions.

12.3.3 Post-Surveillance Activities

Surveillance personnel shall prepare a report documenting surveillance results. Observations identified during the surveillance that do not constitute a nonconformance require a response by the cognizant manager or designee on the surveillance report. Nonconformances identified during the surveillance shall constitute cause to initiate a deviation report and a corrective action report (Section 15). Deviation corrective action report numbers shall be identified and documented in the surveillance report. The surveillance report, when completed and approved, shall be distributed to applicable project personnel.

Surveillance will be considered closed when observations, deviation reports, and corrective action reports have been answered, corrective actions implemented and verified, and no further action associated with the surveillance is required.

The FEMP project manager is responsible for ensuring that corrective action required by audit or surveillance reports is implemented and completed on schedule. If required, DOE or the designated FEMP QA organization is authorized to stop project work until corrective actions have been implemented.

12.4 LABORATORY QUALIFICATION AND SYSTEM AUDITS

An analytical laboratory qualification program shall be mandated to provide assurance that sample analyses, Quality Control (QC) samples, and analytical data reports are in accordance with requirements specified in the SCQ for the Analytical Support Level (ASL) designated for samples being submitted. Prior to contract award, survey and external audit checklists

shall be developed for the pre-award audit to reflect ASL requirements as specified in the SCQ. Example checklists (Forms 12-10 and 12-11) are included in Appendix B. 3200

Certified QA lead auditors shall conduct pre-award surveys and audits at supplier laboratories, assisted by certified auditors or technical representatives.

The laboratory qualification audit shall include, but not be limited to, the following.

- QC verification samples shall be sent to potential suppliers of analytical services and sample analyses shall be evaluated and compared to known values.
- Prior to contract award, surveys shall be conducted at potential supplier facilities. Checklists shall be completed, supplier acceptability determined, and summary reports issued.
- During contract performance, periodic audits shall be conducted at each supplier facility to assure continued acceptable performance (annually, at a minimum). Audit summary reports shall be issued.

12.4.1 Laboratory Capacity

A laboratory shall demonstrate its ability to perform analysis at a specified capacity. ASLs for sample analyses that a laboratory may perform for FEMP shall be specified. Overall capacity of a laboratory shall be based on equipment and personnel available. The laboratory shall supply references demonstrating successful past performance of analyses similar to those required.

12.4.2 Hazardous Materials Handling Ability, Licenses, and Permits

A laboratory shall be qualified to handle samples containing hazardous materials in a safe, efficient manner. Applicable licenses and permits shall be required. Additionally, laboratories receiving samples containing radioactive materials shall be licensed by the Nuclear Regulatory Commission or applicable state agency as required.

Samples shall not be sent to a laboratory if it is not licensed to handle them in terms of total mass or activity.

12.4.3 Quality Requirements

Laboratories shall have an acceptable quality assurance plan that is in accordance with the requirements of the SCQ (paragraph 12.4.6) and shall be audited prior to receiving FEMP samples as follows.

12.4.3.1 Administrative. The following administrative items shall be addressed during audits. 3200

- Documentation of laboratory organizational hierarchy
- QA program
- Assignment of responsibility for establishing, maintaining, and verifying an appropriate QA program
- Facility design for mixed-waste analytical work meeting EPA requirements as applicable
- Tracking system for documents, equipment, parts, and supplies
- Use of current, controlled copies of operating procedures
- Current standards labeled and dated
- Internal chain-of-custody process meeting requirements of Section 7
- Procedures and records for equipment calibration, maintenance, and evaluation
- Facilities for receiving, checking, and storing samples prior to analysis and a routine that ensures compliance with preservation requirements
- Tracking system for samples that ensures holding-time requirements are met
- Process for documenting, reporting, and recording nonconforming items or actions, including corrective actions
- Process for storage that ensures record security including a records tracking system
- System for scheduling and documenting internal audits of the analysis system and its components using checklists and reports and a means of addressing audit findings in a timely manner
- Laboratory copies of the SCQ are properly controlled and up-dated

12.4.3.2 Technical. The following technical items shall be addressed during audits.

- Analyses are performed in accordance with procedural requirements, including calibration and use of proper standards, blanks, and other QC checks

- Demonstration that technical expertise and equipment meet FEMP Laboratory Analytical Methods Manual (Attachment I) methods requirements 3200

- Verification and reporting of analytical results as required

12.4.4 Performance Evaluation Samples

Laboratories shall provide documentation of successful analyses of performance evaluation samples prior to approval for FEMP sample analyses.

Laboratories that perform ASL D analyses shall document successful analyses of the EPA Contract Laboratory Program performance evaluation samples, or equivalent, covering the four previous quarters.

For analyses at other ASLs, performance evaluation samples supplied by FEMP or the EPA Contract Laboratory Program shall be successfully analyzed and documented using Attachment I methods.

12.4.5 Continuing Satisfactory Performance

Implementation of quality requirements shall be continually verified through on-site audits conducted by FEMP annually as a minimum.

Laboratory performance shall be evaluated through data validation (Appendix D) and performance evaluation sample analysis.

12.4.6 Quality Assurance Plan

Analytical laboratories shall be required to have an internal QA plan and applicable standard operating procedures in place that include the following items. Adherence to the elements of the plan shall be documented in audits.

- Laboratory management structure including individual responsibilities
- Documentation of laboratory personnel qualifications
- Documentation of training
- Audit procedures, schedule, and log
- Instrument calibration schedule and log
- Internal chain-of-custody procedures meeting requirements in Section 7

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- Schedule and log of routine equipment maintenance
- Procedure for documenting and reporting nonconformance with laboratory or project requirements
- Records control system
- Document revision and control system

The FEMP SCQ shall be a contract-specified attachment to the laboratory-specific QA plan. Compliance with the SCQ shall be verified through project performance audits.

FEMP audit and performance evaluation data relevant to the laboratory shall be provided to EPA upon request. EPA may choose to conduct their own audit of the laboratory or conduct an audit in conjunction with FEMP.

SECTION 13

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Section 13

PREVENTIVE MAINTENANCE

13.1 PURPOSE

Preventive maintenance is an organized program developed to maintain proper instrument and equipment performance and to prevent instrument and equipment from failing during use. An adequate preventive maintenance program increases reliability of a measurement system.

The requirements of a preventive maintenance program is dependent upon the instruments and equipment used within a laboratory or field program. This section does not attempt to specify instrument or equipment requirements but, rather, sets minimum guidelines for maintenance practices. The field projects and laboratories shall develop and implement a preventive maintenance program that complies with the guidelines presented in this section. Preventive maintenance requirements may be documented in SOPs, Project-Specific Plans (PSP), or in separate preventive maintenance documents.

13.2 SCOPE

The following factors are addressed in the FEMP preventive maintenance program.

- Instruments, equipment, and part thereof that are subject to wear, deterioration, or other change in operational characteristics in the absence of routine maintenance
- Spare parts necessary to minimize down time
- Optimum frequency of maintenance

Analytical laboratories approved for analysis of FEMP samples are required to have Standard Operating Procedures (SOP) for preventive maintenance of each measurement system (including analytical instruments) and necessary support equipment (e.g., refrigerators, ovens). Maintenance activities shall be documented in logs.

Preventive maintenance programs shall include the following at a minimum.

- List of instruments and equipment that require preventive maintenance

- Frequency of maintenance (generally stated in terms of daily, weekly, monthly) considering manufacturer recommendations (which shall be documented in the form of operating manuals) and experience with the particular piece of equipment 3200

- Spare parts list and an up-to-date inventory of spare parts for each instrument or piece of equipment necessary to preclude long down time

- Service contract a necessary

- Items to be checked or serviced during maintenance and directions for performing maintenance

13.3 RESPONSIBILITIES

The laboratory manager is responsible for preparation and documentation of the laboratory program. Specific individuals within the laboratories shall be responsible for implementation of the program and quality assurance personnel shall be responsible for review of activities to verify compliance.

For field projects, the FEMP project manager or designee is responsible for preparation, implementation, and documentation of the program. DOE and the Designated FEMP QA Organization shall approve the field program and review its implementation to verify compliance. Table 13-1 (Appendix A) lists preventive maintenance requirements for commonly used field equipment.

13.4 PREVENTIVE MAINTENANCE PROGRAM DEVELOPMENT

Preventive maintenance activities shall be performed in accordance with approved SOPs or other requirements for each type of equipment or instrument. These activities shall be documented in individual instrument files, which shall include the following.

- Spare parts inventory and use

- External service contracts if applicable

- Records of periodic maintenance performed

Records of maintenance shall be documented in maintenance logs maintained with the instrument or at an instrument storage and service area.

SECTION 14

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Section 14

SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

14.1 FIELD DATA

Field data shall be assessed by the data user for accuracy, precision, and completeness taking into account overall project objectives, background data points, and field Quality Assurance (QA) samples as defined in Section 4. Requirements for field documentation are included in Section 5, 6, and 7. If additional requirements are required for a specific project, they shall be defined in Project-Specific Plans (PSP).

14.2 ANALYTICAL LABORATORY

Analysts, in consultation with the laboratory project manager or designee, are responsible for evaluating recoveries of surrogates and matrix spikes and ensuring precision of duplicates. Quality Control (QC) acceptance criteria for recoveries and relative percent difference are included in the applicable method in the FEMP Laboratory Analytical Methods Manual.

Those recoveries and/or Relative Percent Differences (RPD) that are found to be "out-of-control" according to QC acceptance criteria shall be evaluated using all information pertinent to the recoveries/RPDs in question. Pertinent information includes, but is not limited to, preparation blanks, laboratory control samples, any matrix interferences present, concentration of the spiking compound present in the original sample, homogeneity of the sample, and the matrix of the sample.

Assessment of data precision and accuracy is an integral part of the laboratory data verification process.

After data have been generated by an analyst or instrument, they shall be submitted to a qualified peer (another analyst, group supervisor or equivalent) for review. This initial review is for transcription errors, calculation errors, holding times, and a check for completeness, which shall include the following elements.

- Required samples and analyses have been processed
- Complete records exist for each analyte and associated QC samples

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- Specified procedures have been implemented
- Electronic data packages have been checked for completeness

A secondary review is conducted by the laboratory group supervisor or equivalent, laboratory project manager, or laboratory quality control personnel or equivalent.

A tertiary review is a QA function that is performed on a minimum of five percent of analytical data. This QA review includes technical and editorial QA reviews. All data shall be reviewed by laboratory project manager or designee for accuracy, precision, and completeness prior to transmittal to the data requestor.

14.3 PRECISION

To determine precision of the method, a routine program of duplicate analyses shall be performed (Section 4). The results of the duplicate analyses are used to calculate the RPD, which is the governing QC parameter for precision.

$$\text{RPD } \% = 100 * \frac{(D_1 - D_2)}{(D_1 + D_2) / 2}$$

Where:

D_1 = the larger of the two observed values

D_2 = the smaller of the two observed values

14.4 ACCURACY

Accuracy shall be estimated based on results of laboratory control sample (LCS) analyses or matrix spike recoveries (Section 4). Accuracy is expressed in terms of percent recovery as expressed in the following formulas.

For LCS

$$\text{Percent Recovery} = 100 * \left(\frac{\text{measured value}}{\text{true value}}\right)$$

For matrix spikes

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$$\text{Percent Recovery} = 100 * \left(\frac{C_i - C_o}{C_t}\right)$$

Where:

C_o = value of unspiked aliquot

C_i = value of spiked aliquot

C_t = value of spike added

14.5 COMPLETENESS

Completeness shall be reported as the percentage of all measurements made with results judged to be valid following FEMP data validation (Appendix D). The following formula will be used to estimate completeness.

$$C = 100 * \left(\frac{V}{T}\right)$$

Where:

C = percent completeness

V = number of required measurements judged valid

T = total number of required measurements

If the completeness is less than 90 percent, documentation shall be provided to explain why this QA objective was not met. Impact on the project shall be evaluated.

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14.6 METHOD DETECTION LIMITS

Method Detection Limits (MDLs) represent the minimum concentration of a substance that can be measured and reported (with 99 percent confidence) to be present at a level above zero. Method Detection Limits shall be determined according to procedures specified in Appendix B of 40 Code of Federal Regulations (CFR) 136 and modified by the following.

- Appropriate dilution/concentration factors dictated by sample preparation methods used
- Extract/digestate dilutions necessary to adjust analyte concentrations to linear calibration range of the specific instrument
- Analytical method used

14.7 ADDITIONAL SOURCES OF INFORMATION

American Public Health Association. 1985. ***Standard Methods for the Examination of Water and Wastewater.*** sixteenth edition. New York, NY.

U.S. Environmental Protection Agency. 1973. ***Procedures for Radiochemical Analysis of Nuclear Reactor Aqueous Solutions.*** EPA R4-73-014.

U.S. Environmental Protection Agency. 1976. ***Interim Radiological Methodology for Drinking Water.*** EPA-600/4-75-008. Cincinnati, OH.

U.S. Environmental Protection Agency. 1979. ***Radiochemical Analytical Procedures for Analysis of Environmental Samples.*** EMSL-LV-0539-17. Las Vegas, NV.

U.S. Environmental Protection Agency. 1980. ***Prescribed Procedures for Measurement of Radioactivity in Drinking Water.*** EPA-600/4-80-032. Cincinnati, OH.

U.S. Environmental Protection Agency. 1984. ***Eastern Environmental Radiation Facility Radiochemistry Procedures Manual.*** EPA 520/5-84-006.

U.S. Environmental Protection Agency. 1986. ***Test Methods for Evaluating Solid Waste.*** SW-846, third edition.

SECTION 15

Section 15

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CORRECTIVE ACTIONS

Assessment of project quality may include identifying deviations, correcting the source of the deviations, and verifying that corrective actions have been implemented. Corrective action for problems shall include, to the extent possible, identifying root causes of problems and recommending procedures to prevent their recurrence (American Society for Quality Control, 1991). FEMP staff and observers are encouraged to identify potential problems, and to assist in solving those problems.

Corrective action of some form is required whenever a deviation is noted, including during field activities, laboratory analysis, and during data validation and assessment. Corrective action may range from documenting in project files that the deviation occurred to re-analyzing a sample, to redoing the project. Corrective action to prevent recurrence of deviations may include retraining of personnel, replacing equipment or instruments, or rescoping project objectives.

Corrective actions may be required for two general types of problems: (type 1) analytical and equipment and (type 2) noncompliance. Type 1 problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review. These problems are referred to as deviations at FEMP. A system to report and evaluate deviations and to implement and verify corrective actions has been established in response to DOE requirements. This same system is currently used for environmental surveillances (performance audits), audits (system audits), and other activities when deviations are identified. Subcontractors shall either participate in the FEMP system, which is described in this section and Section 12, or implement a system that meets all of the substantive requirements of the FEMP system.

Corrective actions for type 1 problems can be broadly grouped into three classes.

- Class 1 problems can be corrected by documenting, for future reference, that a deviation occurred. This problem type and the corrective action shall be documented in a Deviation Report (DR) (Form 15-1, Appendix B) as specified in subsection 15.1. The corrective action shall be implemented by the analyst or field technician and approved and verified by the Designated FEMP Quality Assurance (QA) Organization and the FEMP project manager.

- Class 2 problems can be corrected by physical action in the field or laboratory on a real time basis. This problem type and the corrective action require documentation in a DR and completion of a Corrective Action Report (CAR) (Form 15-2, Appendix B)

as specified in subsection 15.2. The FEMP project manager shall implement corrective actions, and designated FEMP QA organization personnel shall verify and approve the actions. 3200

- Class 3 problems require major changes to procedures or QA controls. This problem type and the corrective action required shall be documented in DRs and CARs to meet the intent of the corrective action and prevent recurrence of the deviation. Approval by management of the generating organization, the designated FEMP QA organization, and DOE. Corrective actions requiring changes to EPA-approved documents shall also be reviewed and approved by EPA Region V.

Type 2 problems are the result of noncompliance with contract requirements. When a noncompliance problem is identified (usually during audits), a formal corrective action shall be determined and implemented. The person who identifies the problem shall be responsible for notifying the FEMP project manager. If the problem is analytical in nature and affects regulatory agreements, the information shall be communicated to the EPA. Parties notified of the problem shall also be notified of corrective action implementation.

Corrective actions for type 2 problems can be broadly grouped into class 4.

- Class 4 problems will prevent compliance with consent-agreement schedules or other regulatory requirements. Problems affecting 1991 amended Consent Agreement schedules or other regulatory requirements shall be documented in DRs and CARs. The reasons for the problem, the likely affect on the project, and the recommended corrective action shall be documented in revisions to project-specific plans. Recommended corrective actions shall be reviewed and approved by DOE and applicable regulatory agencies. Corrective actions shall be developed, approved, and implemented as agreed upon on a case-by-case basis.

Interim corrective actions to mitigate hazards to human health or the environment may be implemented as necessary by the FEMP project manager or representative, FEMP health and safety personnel, the designated FEMP QA organization, DOE, Ohio Environmental Protection Agency (OEPA), or EPA.

15.1 DEVIATIONS

A deviation is a deficiency in characteristics, documentation, procedures, or a departure from a requirement that renders the quality of an item, datum, or activity unacceptable or indeterminate. A deviation can be a condition in which characteristics of an item or service do not conform to prescribed limits as follows.

- Unavailability or inadequacy of a required document

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- Failure to fulfill a regulatory requirement
- Failure of a procedure to yield the intended results
- An unapproved variation from the project-specific plan

Variances defined in subsection 15.4 are not deviations.

15.1.1 Responsibility

All FEMP staff and observers are responsible for reporting deviations to the designated FEMP QA organization. Deviations may occur at any point in a program or project. The following personnel shall be especially aware of the possibility of deviations.

- **Project Staff** - During performance of field investigation and testing, supervision of subcontractors, performance of field inspection, and preparation and verification of numerical analyses
- **Laboratory Staff** - During preparation for and performance of laboratory testing, audits, calibration of equipment, sample receipt, and quality control activities
- **Quality Assurance Staff** - During audits, surveillances, and other QA activities

Every person conducting work related to FEMP is responsible for notifying the designated FEMP QA organization of potential deviations by completing sections 1 and 2 of a DR (Form 15-1, Appendix B).

The designated FEMP QA organization is responsible for determining whether a deviation actually occurred and, if so, whether a "significant condition adverse to quality" exists. If appropriate, the designated FEMP QA organization shall ensure that no additional work that is dependent on the nonconforming activity is performed until corrective actions are completed (U.S. Environmental Protection Agency, 1991).

15.1.2 Deviation Reporting

15.1.2.1 <u>**Deviations at FEMP**</u>**.** Deviations at FEMP shall be acted upon as follows.

1. When a condition appears to be a deviation, the initiator shall document the violation and describe the deviation as follows and as applicable.
    - Dates and times of occurrence
    - Project activity

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- Equipment involved
- Source of requirement that was violated
- Potential adverse impact of deviation on quality or completeness of project data
- Effect of deviation on work already performed

2. The initiator shall sign and date the report and forward it to the designated FEMP QA organization for evaluation.

3. Upon receipt of the report, the QA organization evaluator shall determine whether a condition significantly adverse to quality exists. If it does, a CAR (Form 15-2, Appendix B) shall be issued and the responsible FEMP project manager contacted for an explanation of the deviation and the planned disposition.

4. The FEMP project manager shall provide the specified information, including the following, to the QA evaluator.

   - Reason for deviation
   - Impact on the project
   - Corrective actions required to mitigate the impact
   - Steps that will be implemented to prevent a recurrence

5. If the deviation is outside the evaluator's field of technical expertise, an appropriate technical review shall be obtained.

6. The QA evaluator shall determine whether the response, corrective action, and actions to prevent recurrence are adequate and shall notify applicable persons.

7. The QA evaluator shall complete the CAR.

8. If necessary, the FEMP project manager shall arrange for retraining applicable personnel.

9. If all items are found to be satisfactory, the initiator shall notify the responsible FEMP project manager.

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10. If the response is in some way deficient, the initiator shall notify the FEMP project manager and document the deficiency.

11. Steps 2 through 7 shall be repeated, the DR and CAR shall be revised to indicate the deficiency, and it shall be returned to the responsible FEMP project manager.

12. The initiator shall send copies of reports to managers whose projects may be affected by the outcome.

13. The FEMP project manager is responsible for implementing corrective actions as specified in subsection 15.2.

15.1.2.2 <u>**Subcontractor Laboratory Deviations.**</u> Deviations at subcontractor laboratories shall be reported and processed as follows.

1. Deviations identified during subcontractor laboratory operations shall be documented as specified in laboratory procedures approved by the laboratory-specific contract with FEMP or as DRs identified during FEMP-conducted audits.

2. The FEMP laboratory contact shall maintain a log of laboratory deviations and their closures.

3. Incorporate DRs or their equivalent as part of the sample documentation if a sample is potentially affected by the deviation.

4. The laboratory manager or designee shall send copies of documents that identify CARs generated during laboratory activities in support of FEMP together with records of corrective actions to the FEMP contact for review and concurrence prior to DR closure. CARs for laboratory activities shall provide the information specified in Form 15-3 (Appendix B).

15.2 CORRECTIVE ACTION

Corrective action is required to rectify identified conditions that render the quality of process or activity unacceptable or indeterminate. The need for such action may be identified during the following activities.

- Performance and system audits
- Interlaboratory/interfield comparison studies

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- Deviation reporting
- Surveillances and QA program audits

The need for corrective action is based on predetermined limits of acceptability. Corrective actions for field measurements may include the following (U.S. Environmental Protection Agency, 1991).

- Repeat the measurement to check for error.
- Check for proper adjustments for ambient conditions such as temperature.
- Check batteries.
- Check calibration.
- Re-calibrate.
- Replace instrument or measurement devices.
- Stop work if necessary.
- Resample.
- Revise procedures.

Nonconformance (deviation) with established quality control procedures in this Sitewide CERCLA Quality Assurance Project Plan (SCQ) shall be identified and corrected as specified.

Corrective action measures shall be completed in an expeditious manner and verified as adequate as soon as practical. Corrective action completion and verification activities shall be documented.

15.2.1 On-Site Corrective Actions

Perform and verify corrective action for deviations as follows.

FEMP Project Manager

1. Upon receipt of a DR (Form 15-1, Appendix B) and CAR (Form 15-2, Appendix B), or equivalent, initiate and complete the correction no later than the scheduled date. If the scheduled date cannot be met, notify the initiator prior to the due date.

2. When corrective action is accomplished, complete the prescribed section of the CAR and describe the remedies. 3200

3. Sign and date the applicable sections of the CAR.

Evaluator or Designee

1. Verify completion of corrective actions for nonconformances.

2. If actions are satisfactory, sign the original CAR and submit it for entry into the permanent site files.

15.2.2 Off-Site Laboratory Corrective Actions

The subcontractor laboratory project manager is responsible for ensuring the following.

1. Verify completed corrective actions.

2. Log completion date.

3. Notify FEMP contact in writing of deviations that may affect FEMP.

4. Complete a corrective action report equivalent to Form 15-3 (Appendix B).

The FEMP project manager is responsible for ensuring that the effect of corrective actions are considered in data evaluation.

15.3 EVALUATION OF RECURRING DEVIATIONS

When a DR or equivalent is received, the designated FEMP QA organization shall determine if it describes a recurring deviation. If so, the root cause shall be evaluated to determine actions required to prevent further recurrences.

The FEMP QA organization shall notify FEMP project managers of recurring nonconformances that can impact results of their work and shall indicate the corrective action that will be taken.

15.4 VARIANCES

A variance is a pre-approved action performed in a manner different than that specified by the requirements of an approved procedure or drawing. The impact on the quality of work

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performed is evaluated, documented, and approved by the FEMP project manager and the designated FEMP QA organization before prior to implementation. Variances are not deviations.

Variances cannot be generated for items that would result in failure to meet 1991 amended Consent Agreement schedules. A document change request (Form 4-1, Appendix B) shall be completed for this type of change.

Variances are a means of accomplishing on-the-spot changes in project-specific procedures only when necessary for work to proceed. The variance is a one-time change approved only for the specific activity described in the variance documentation and does not result in a revision to project-specific documents.

The person identifying the need for the variance (the initiator) shall process a variance request as follows.

1. Describe the variance in writing including the reason for the variance, the potential impact on the program and, if appropriate, alternatives to the variance.

2. Indicate the intended time and date of variance implementation and the time allotted for comments and resolution.

3. Distribute the variance request to the designated FEMP QA organization, the FEMP project manager or designee, and others involved in creating and approving the original requirement for review.

The reviewers shall proceed as follows.

4. Evaluate the variance request and approve or disapprove the document.

5. If approved, sign and date (including time approval was granted) the request.

6. If disapproved, return document to the initiator indicating reason for disapproval.

The initiator shall then proceed as follows.

7. Evaluate need for a revision to the requested variance and proceed as in steps 1, 2, and 3.

8. When approvals have been obtained, implement the described variance. Under no conditions shall an unapproved variance be implemented.

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In cases where time is of the essence, oral variance approval may be requested from the designated FEMP QA organization, and the FEMP project manager.

9. If oral approval for the variance is given, provide written documentation of approval and the time, date, and location that oral approval was granted in official project documentation within one week after oral approval is granted.

10. Provide the approved variance request to the FEMP project manager for appropriate distribution and inclusion in the project files.

The FEMP project manager shall maintain a log of each variance request including date initiated, date approved or denied, individual responsible for implementing the variance, the implementation date and location, and the affected document and section.

A FEMP change proposal request shall be completed as required.

15.5 REFERENCES

American Society for Quality Control. 1991. ***Quality Assurance Program Requirements for Environmental Programs.*** ANSI/ASQC-E4-19xx. September 1991. Draft.

U.S. Environmental Protection Agency. 1991. ***Model Quality Assurance Project Plan.*** U.S. Environmental Protection Agency, Region V, Office of Superfund.

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QUALITY ASSURANCE REPORTS TO MANAGEMENT

16.1 CONSENT AGREEMENT MONTHLY REPORTS

FEMP is required by the 1990 Consent Agreement to submit monthly reports to the EPA that summarize activities of the preceding month and projected activities. Milestones shall be indicated along with their status. If a milestone is not met, the reason it was not met and a new schedule for completion shall be included in the report. Significant problems and steps taken towards resolution shall also be recorded.

16.2 SUMMARY REPORTS OF QUALITY ASSURANCE ACTIVITIES

The designated FEMP Quality Assurance (QA) organization shall notify project management of field audit and surveillance results, performance of measurement systems, data quality, results of QA activities, and, if applicable, repetitive and significant QA problems through routine distribution of surveillance and audit reports (Section 12), deviation reports, corrective action reports (Section 15), and weekly and monthly activity reports. Records of QA activities within the project shall become part of project files.

The FEMP project manager shall be responsible for variance requests and implementation (Section 15) as well as assessment of the variance effect on final project results. The effects shall be reported on a timely basis to other potentially affected parties.

QA reports shall be distributed to the designated FEMP QA organization manager, the responsible FEMP project manager, and applicable project personnel. The DOE Remedial Investigation/Feasibility Study QA officer shall receive QA reports pertaining to 1991 amended Consent Agreement activities. Reports of activities that significantly affect 1991 amended Consent Agreement requirements shall be distributed by DOE to EPA.

16.3 LABORATORY MANAGEMENT REPORTS

Laboratory managers and quality control coordinators, or equivalent, shall provide periodic reports to FEMP project managers as required for specific projects, including the following as a minimum.

- Assessment of measurement data accuracy and precision

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- Results of performance and system audits of laboratory activities
- Laboratory inter-comparison study of proficiency of sample results (e.g., quality control checks for effectiveness)
- Significant quality problems and their resolutions

Data quality shall be assessed in terms of precision, accuracy, and representativeness and method and matrix detection limits. The status of objectives shall be recorded. If they are not met, an explanation of problems, why they were not resolved, and limitations on data use shall be included.

16.4 FINAL PROJECT REPORTS

The final report for each phase of a program or project, including remedial investigation and feasibility studies reports, shall include a separate QA section that summarizes data quality information collected during the project. A brief description of QA elements implemented within the project, surveillances and audits, significant audit and surveillance findings (findings that could affect data interpretation), and implemented corrective actions shall also be provided. Limitations on data use shall be identified by data users based on results of data validation and specific project requirements. A summary of the applicability of QA elements to data quality objectives and achieved data quality shall be included.