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SITEWIDE CERCLA QUALITY ASSURANCE PROJECT PLAN VOLUME II APPENDICES A THROUGH K SEPTEMBER 22, 1992

DOE-FN/EPA

450
REPORT

3882

VOLUME II

Fernald Environmental Management Project

SITEWIDE CERCLA QUALITY ASSURANCE PROJECT PLAN

APPENDICES A through K

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for the

United States Department of Energy
Fernald Office

22 September 1992

VOLUME II

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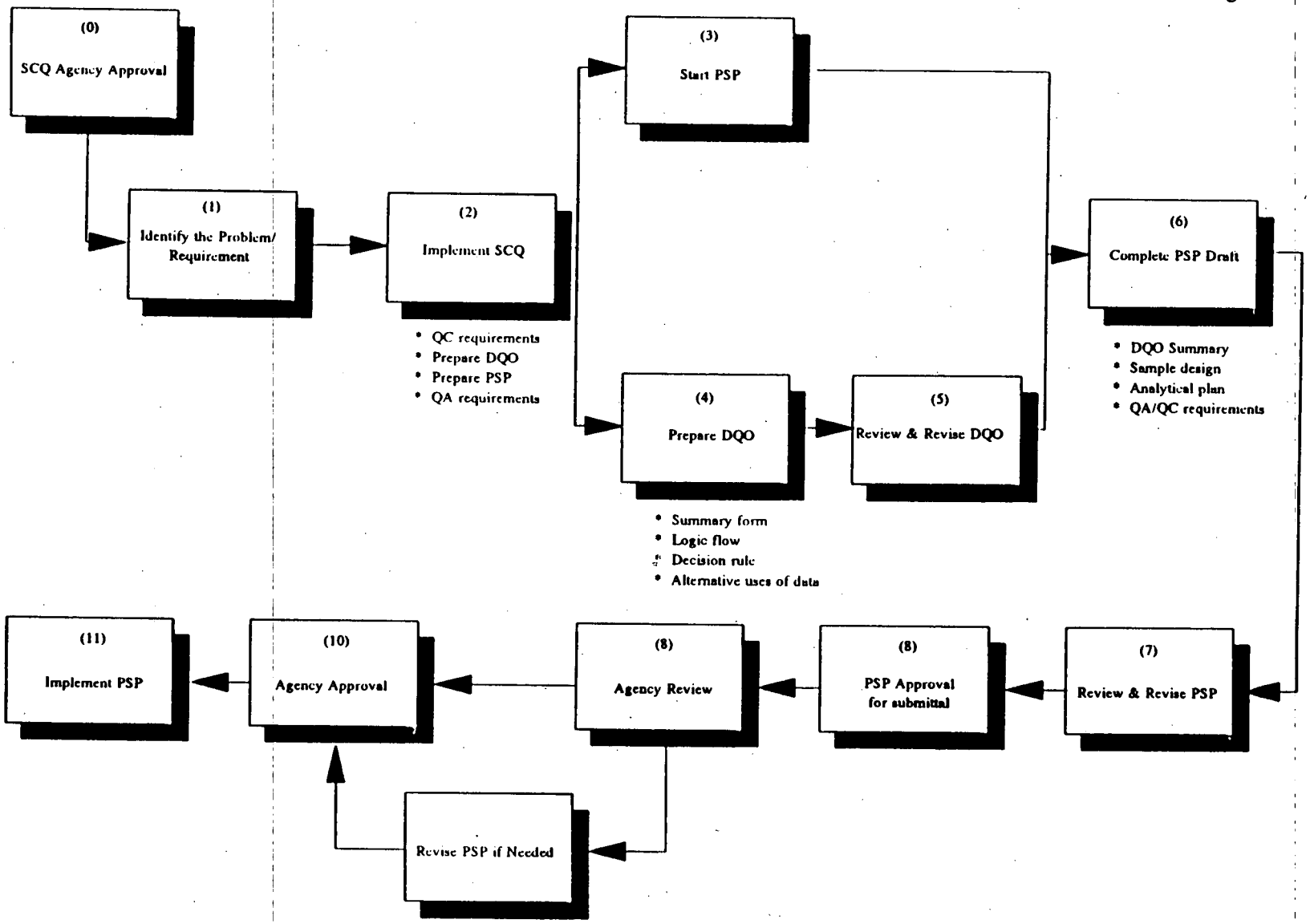

Figure 1-1. Summary Relationship of SCQ and Project Specific Plans

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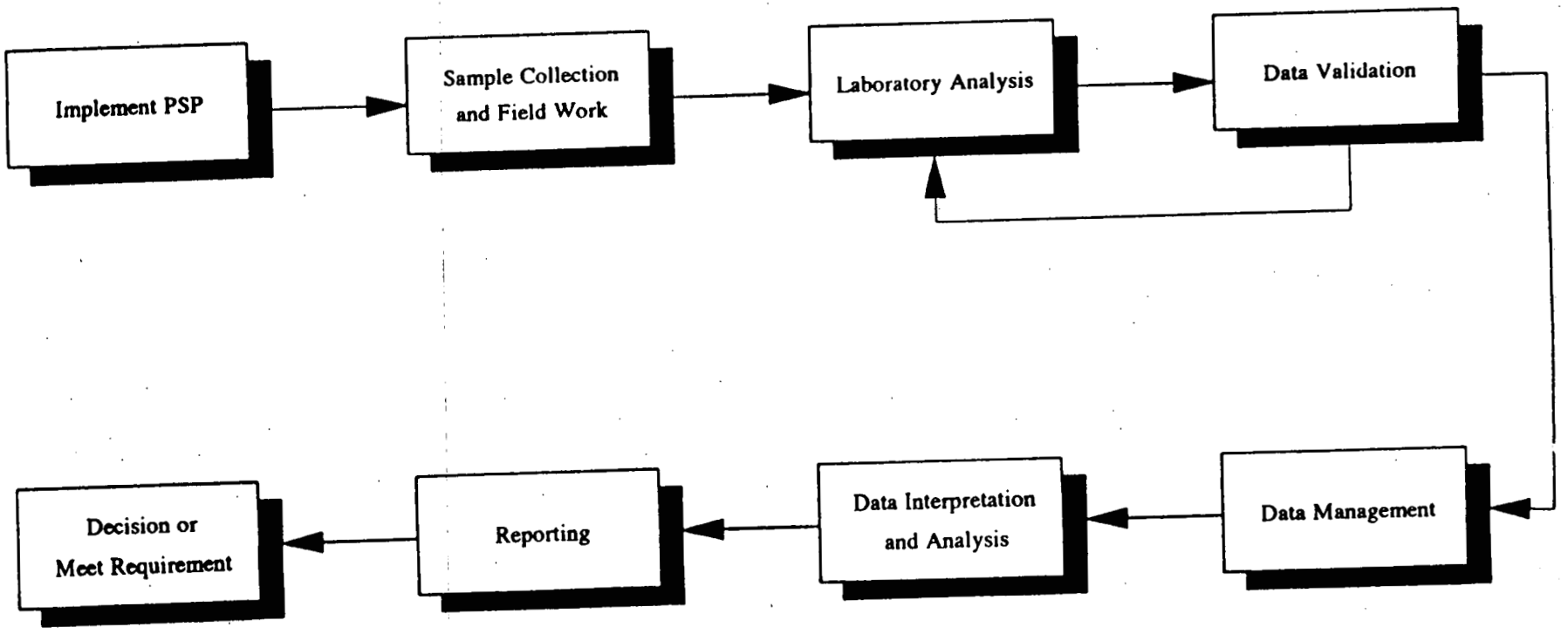

Figure 1-2. Project Specific Plans Implementation

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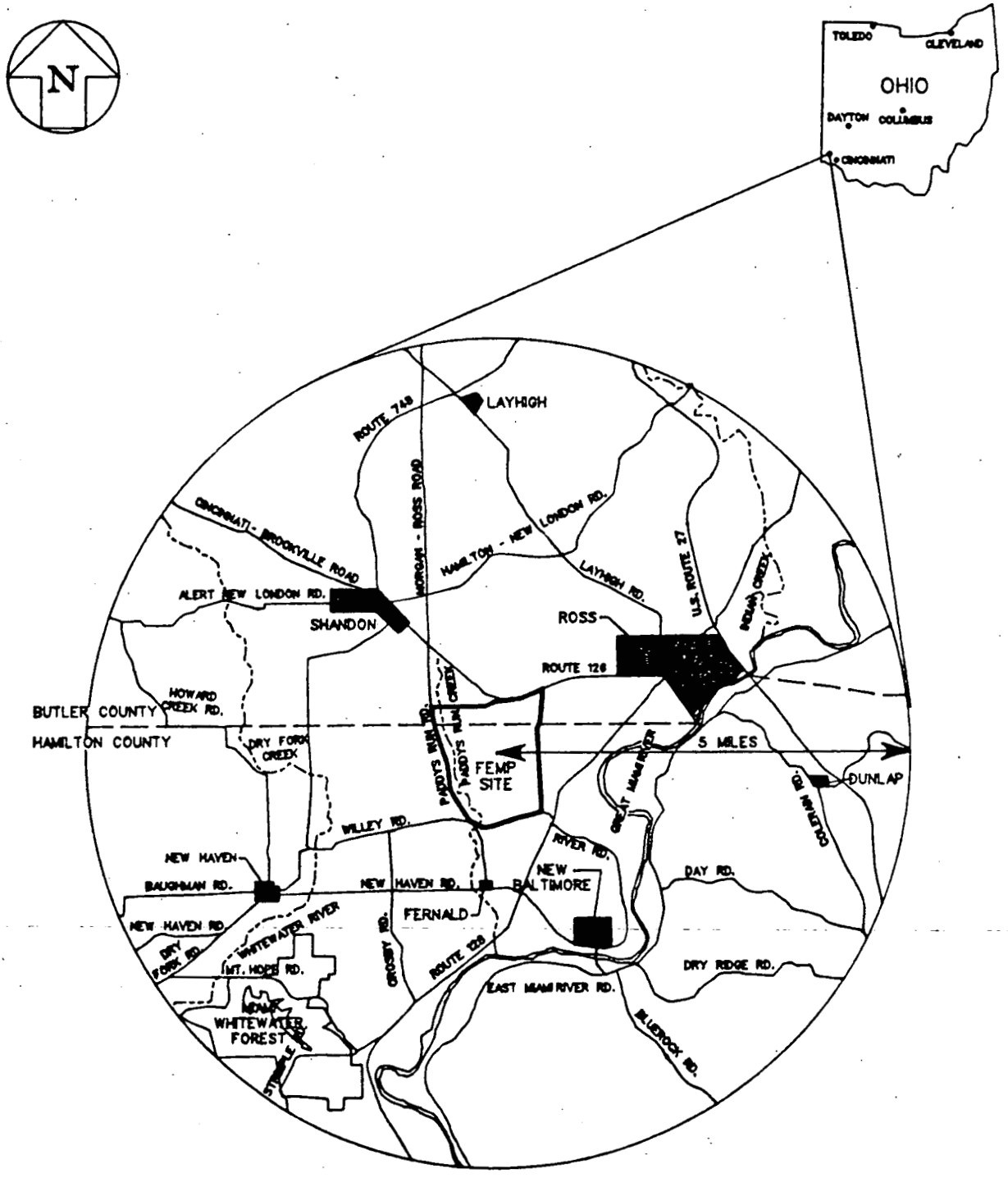

Figure 2-1. Regional Setting of the Fernald Environmental Management Project

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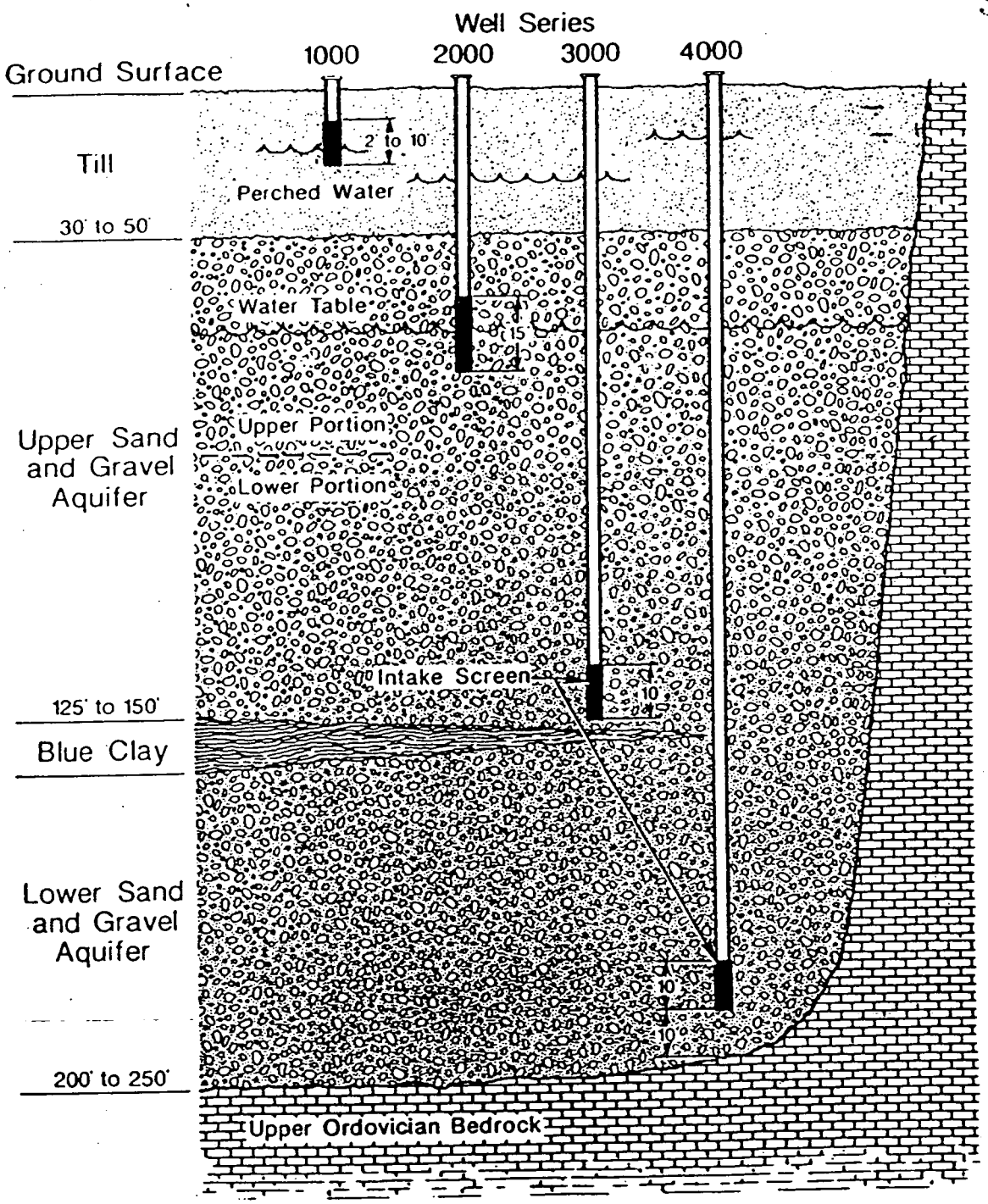

Figure 2-2. Generalized Cross Section of Site Hydrogeology and Monitoring Well Placement

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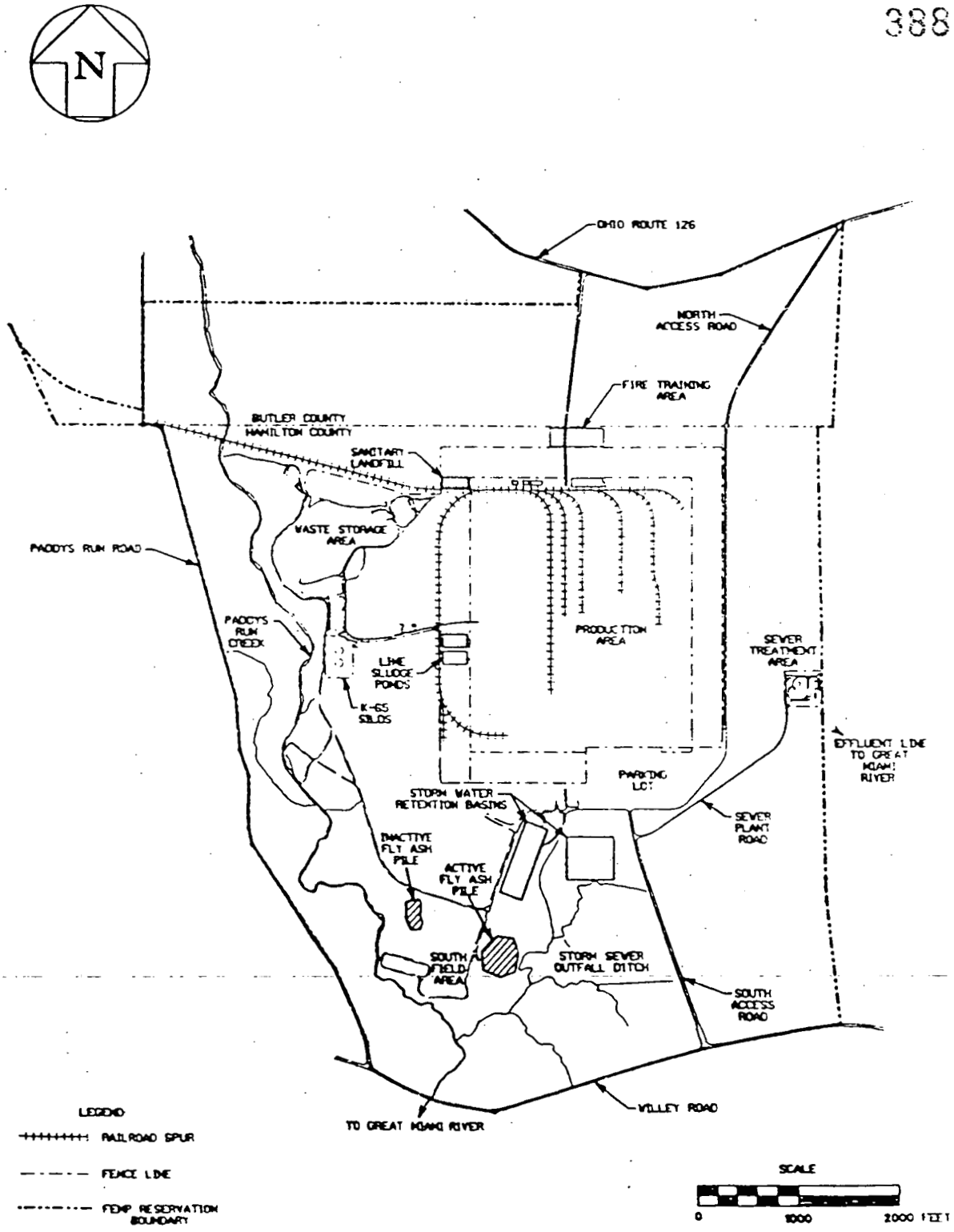

Figure 2-3. Major Features of Fernald Environmental Management Project

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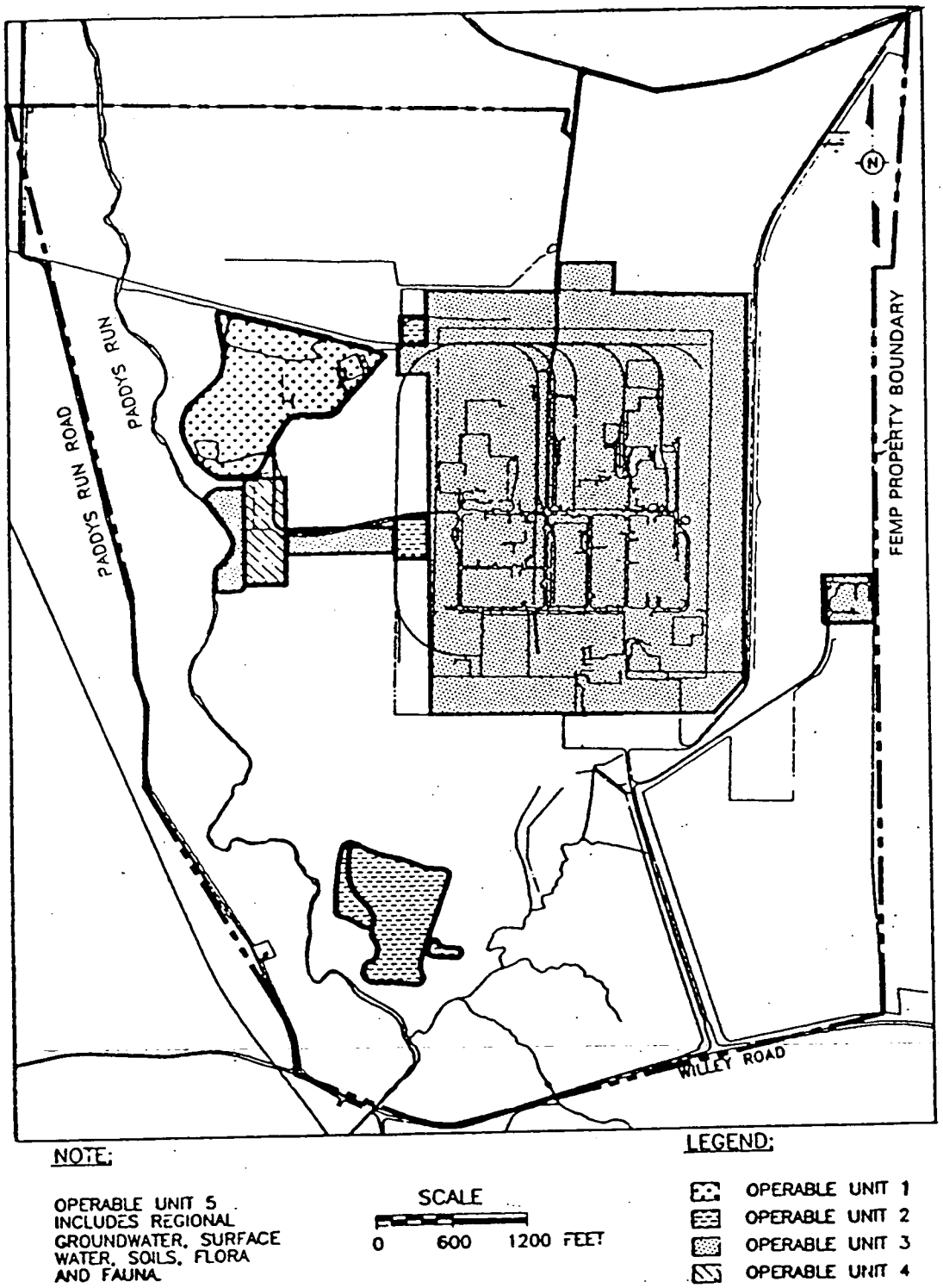

Figure 2-4. Source Operable Units 1 Through 4

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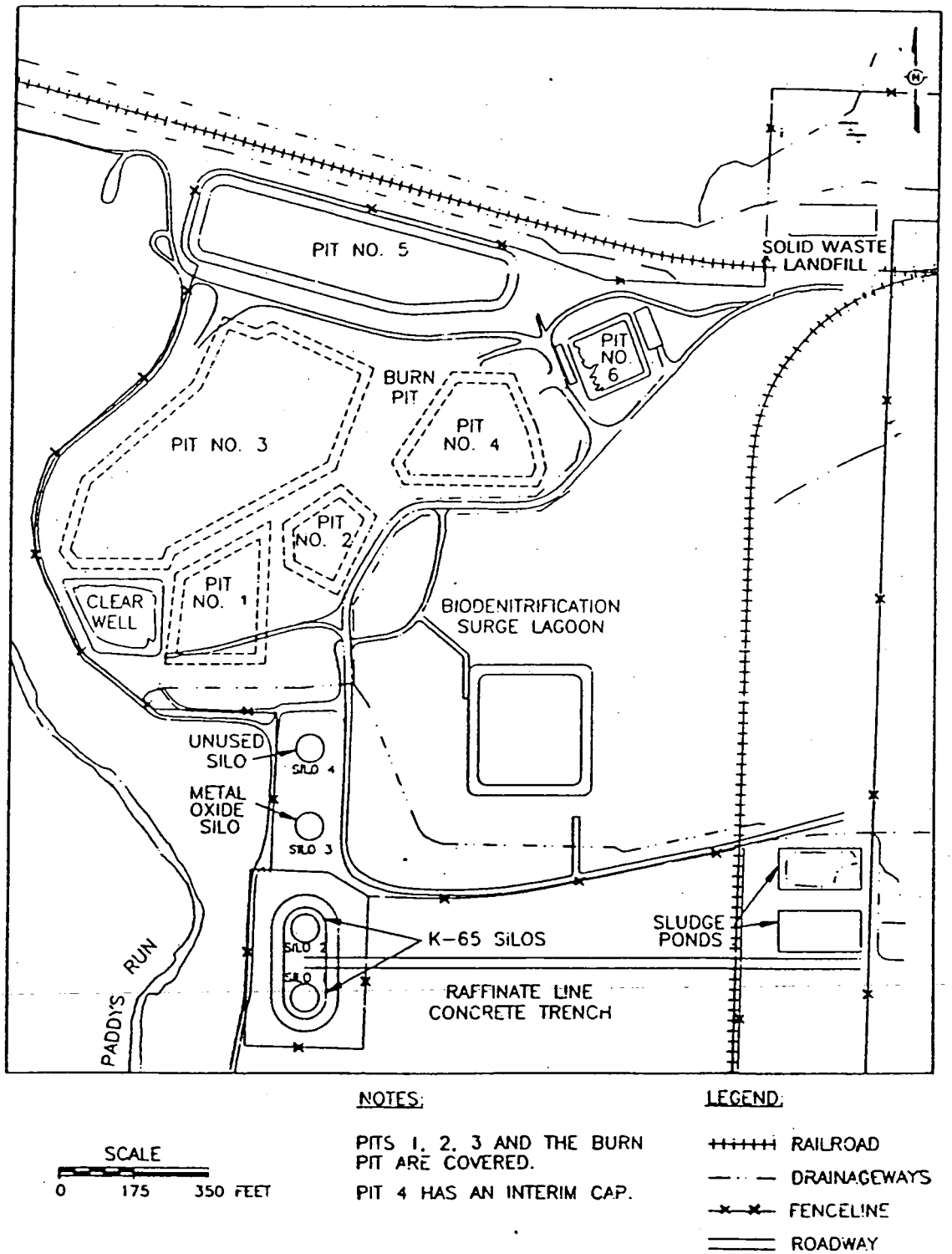

Figure 2-5. Waste Storage Area (Operable Units 1 and 4)

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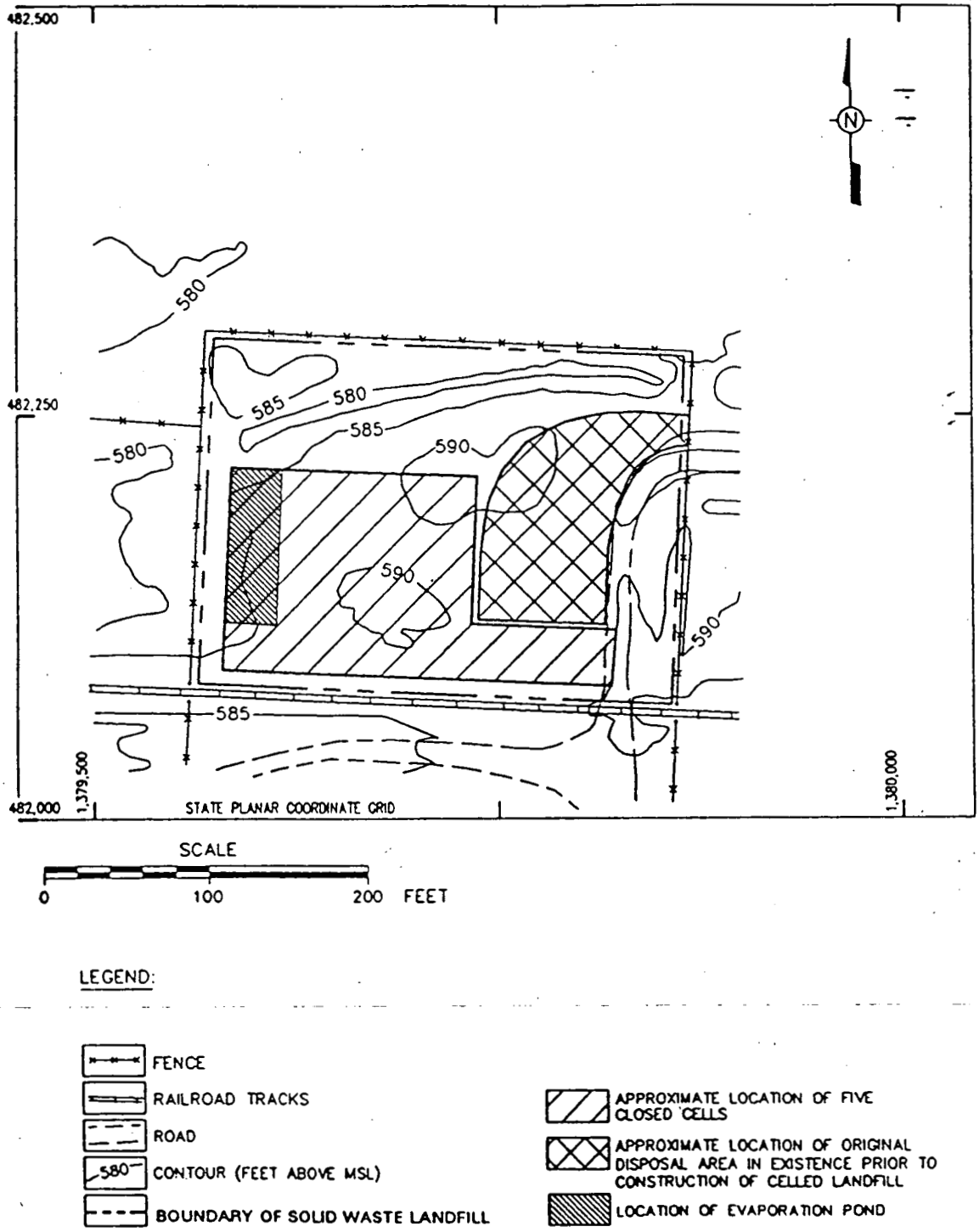

Figure 2-6. Solid Waste Landfill (Operable Unit 2)

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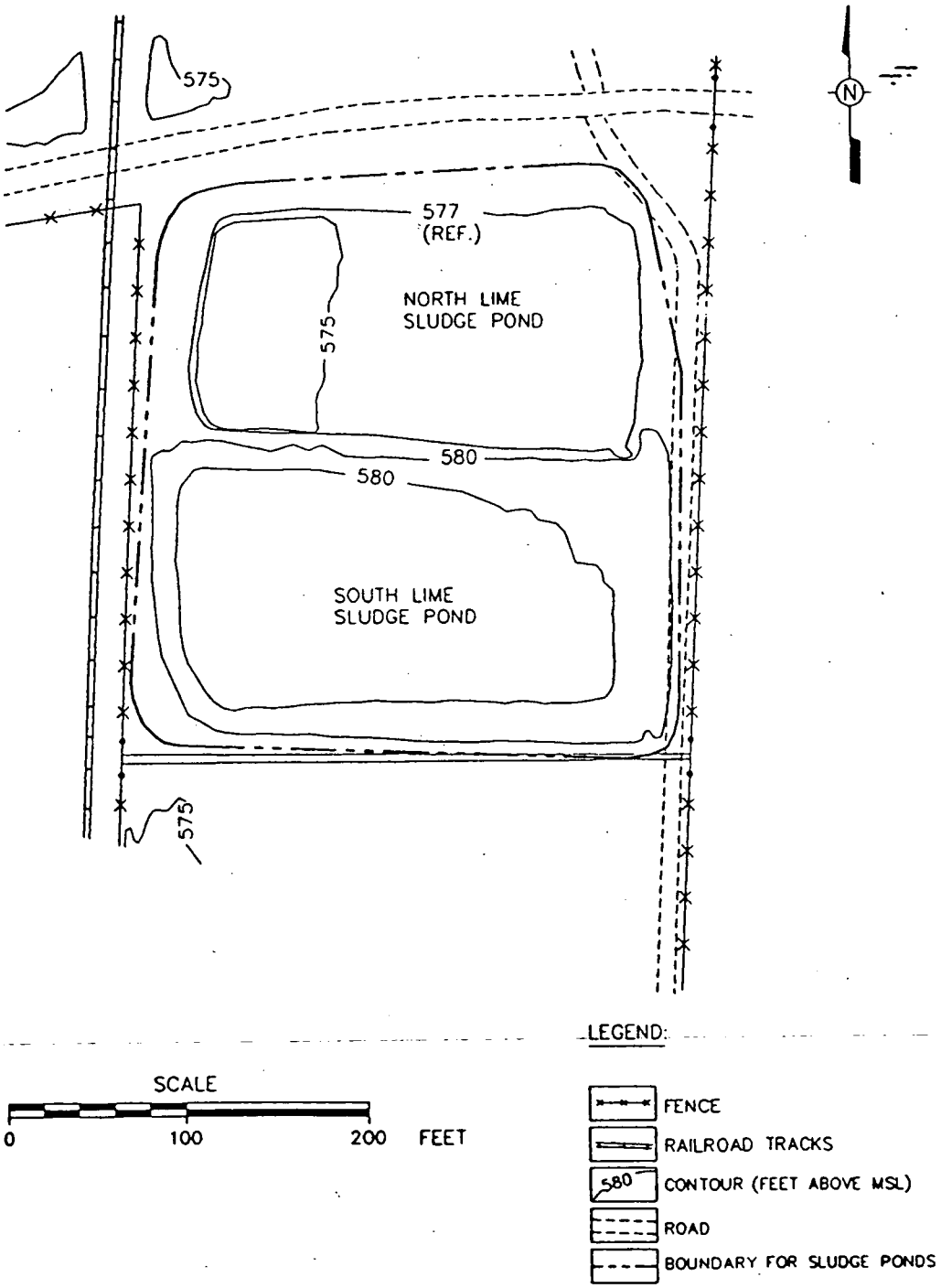

Figure 2-7. North and South Lime Sludge Ponds (Operable Unit 2)

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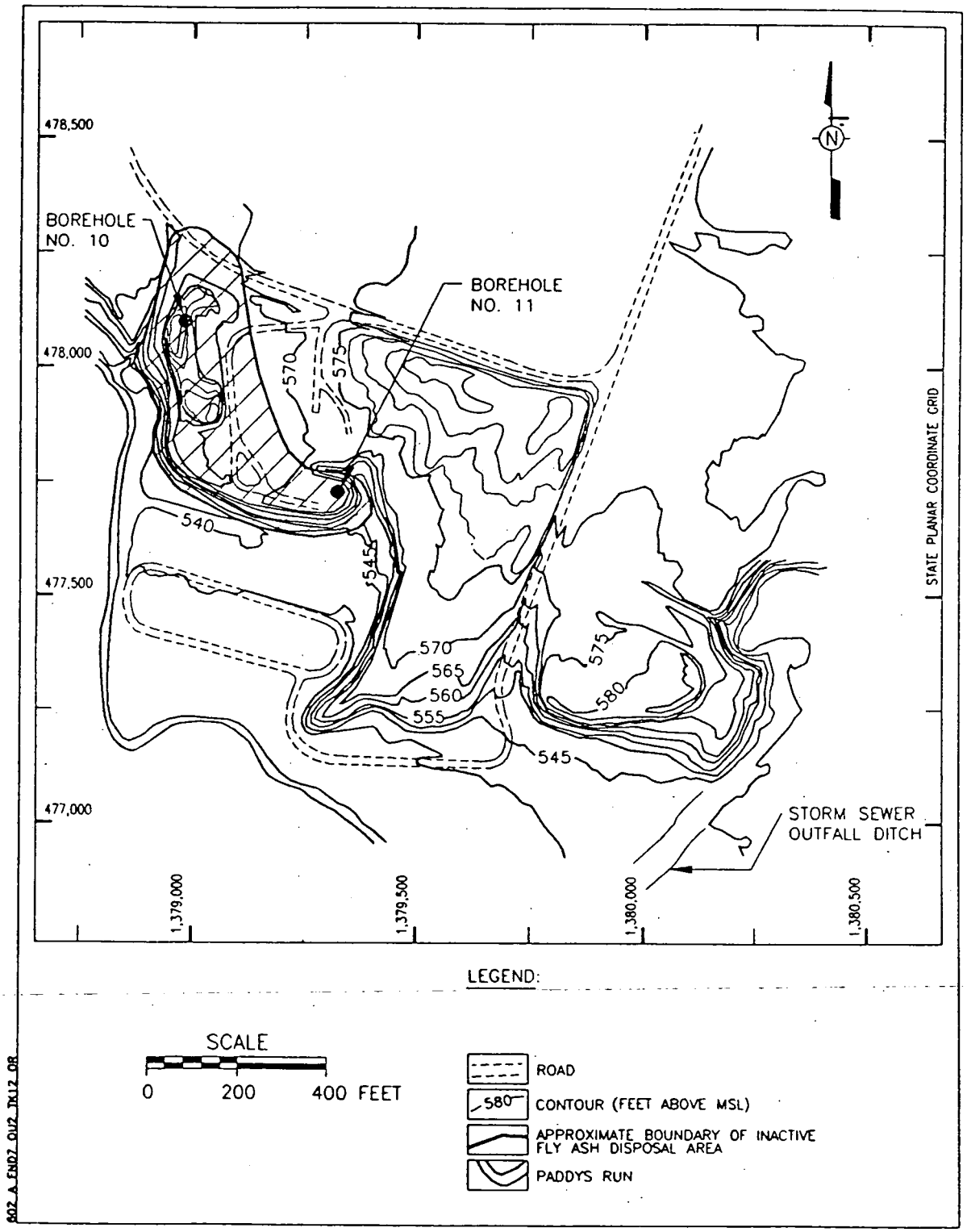

Figure 2-8. Inactive Fly Ash Disposal Area (Operable Unit 2)

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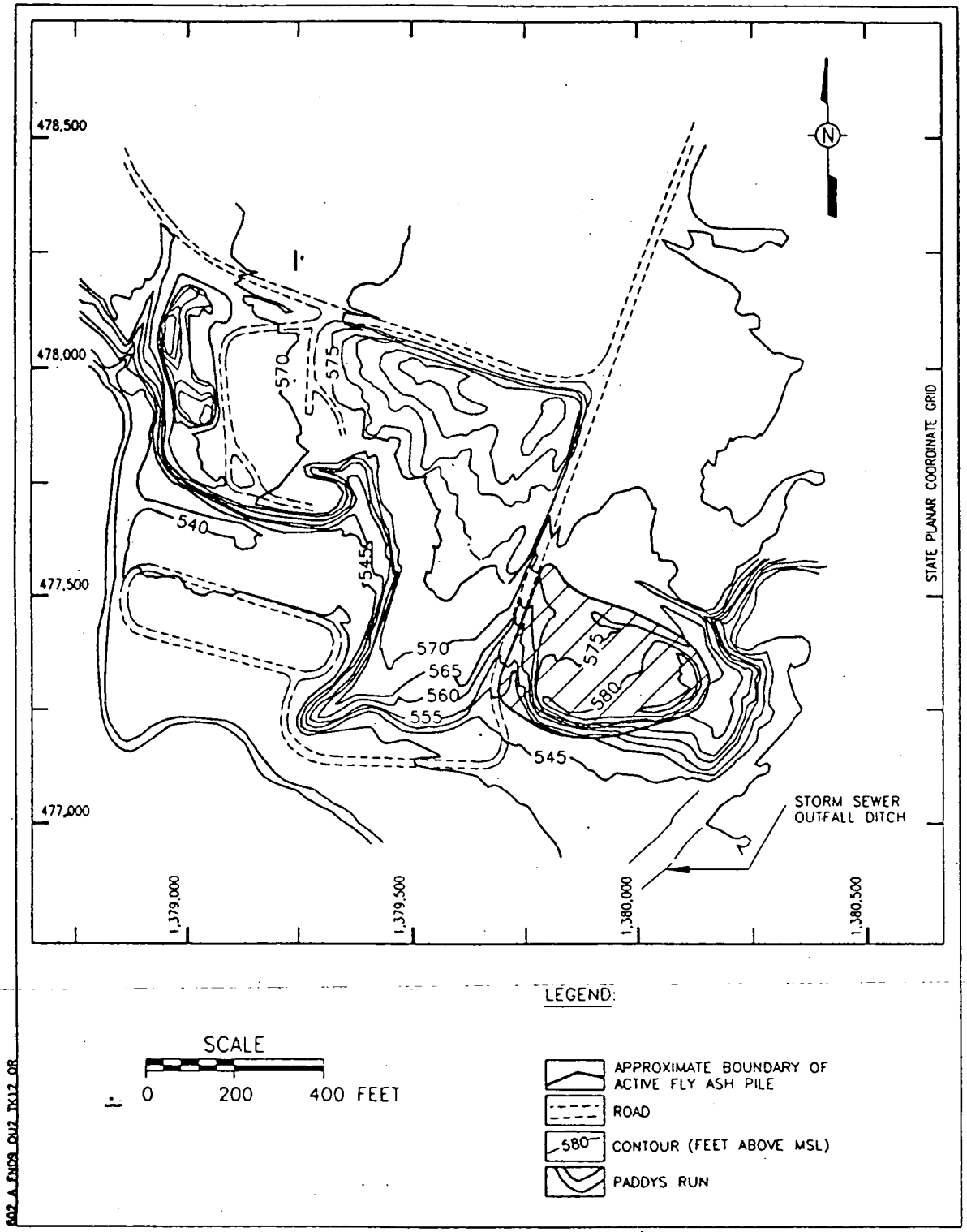

Figure 2-9. Active Fly Ash Pile (Operable Unit 2)

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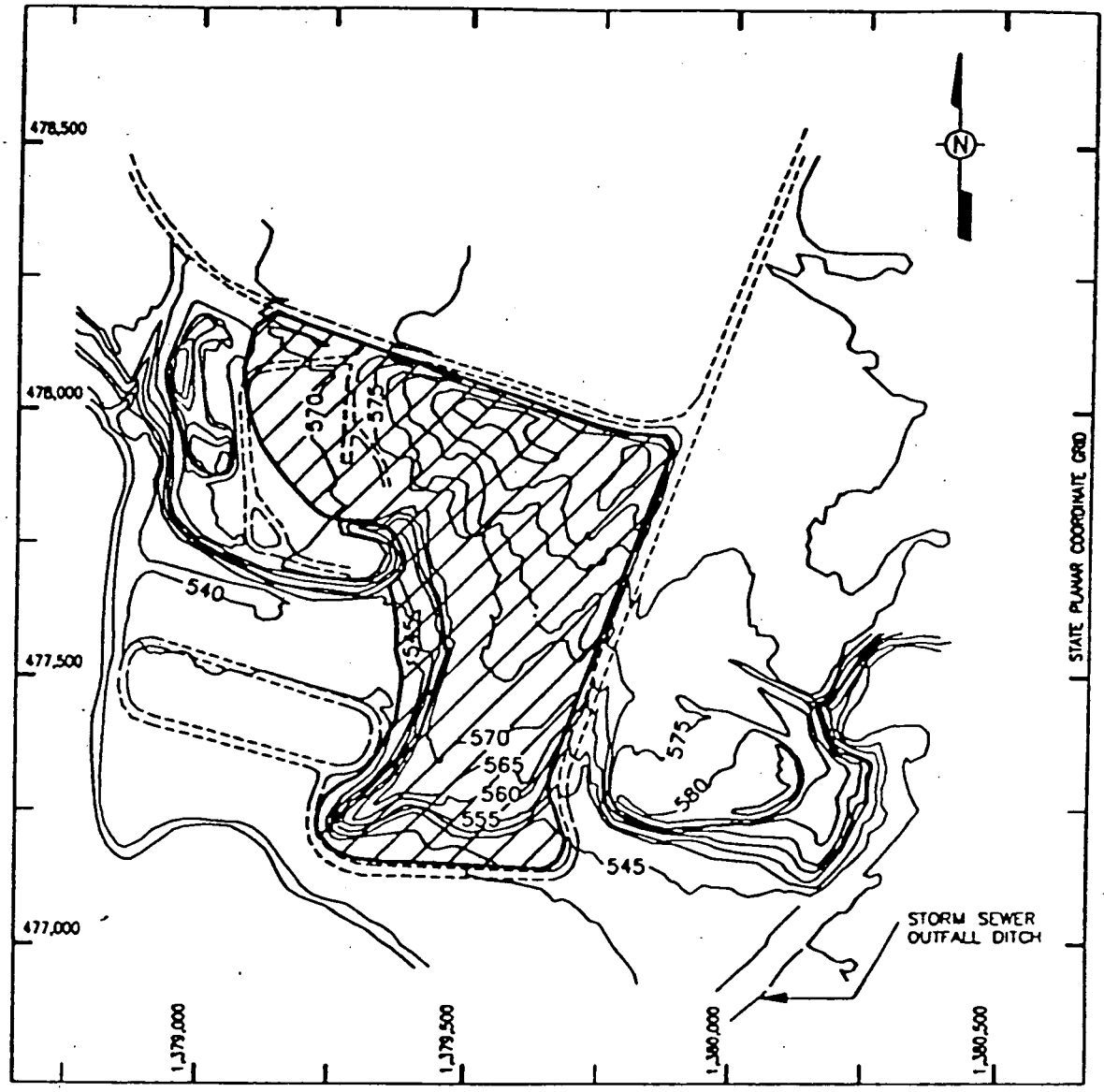

LEGEND:

SCALE
0 200 400 FEET

- APPROXIMATE BOUNDARY OF SOUTHFIELD AREA
- ROAD
- 580 CONTOUR (FEET ABOVE MSL)
- PADDYS RUN

Figure 2-10. Southfield (Operable Unit 2)

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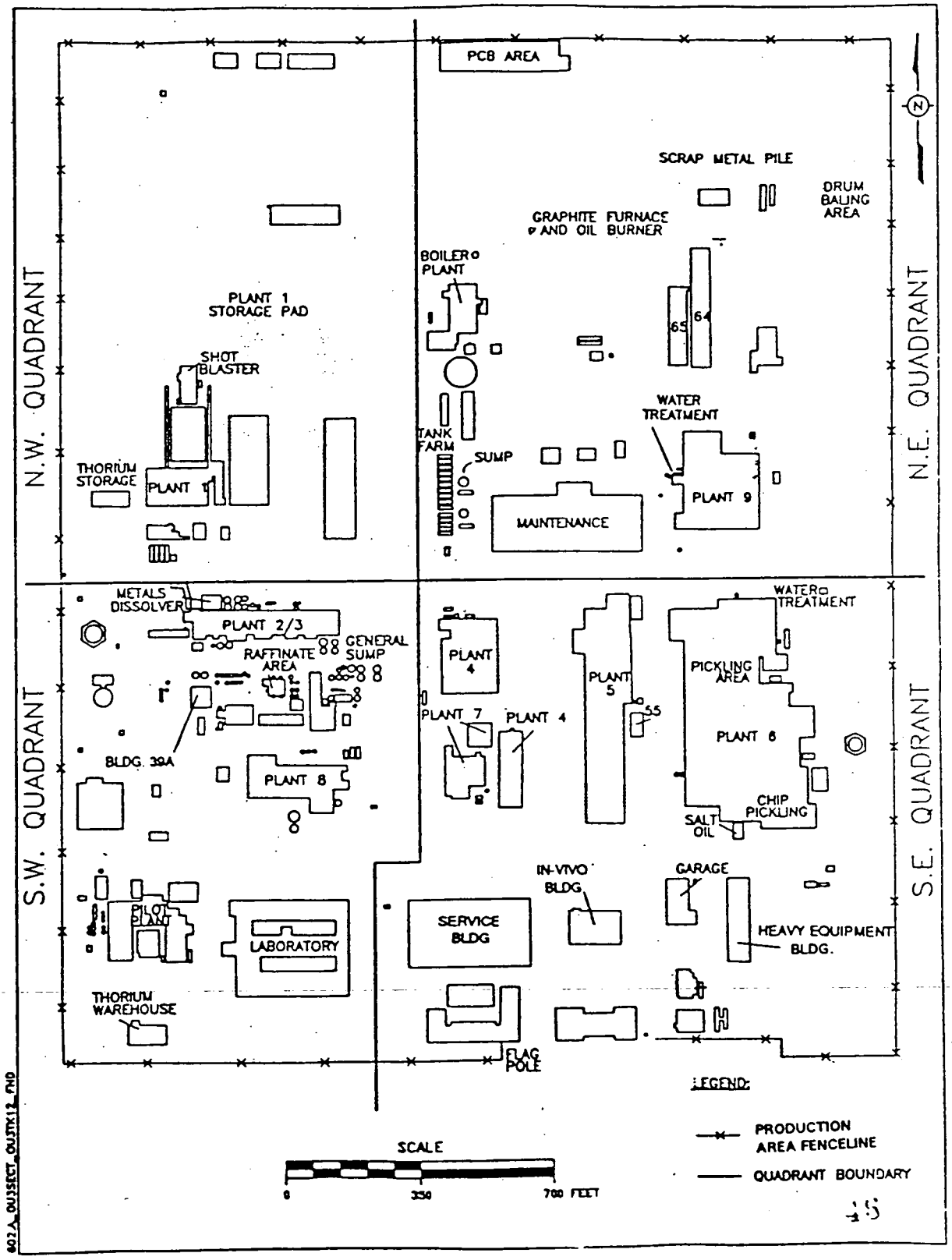

Figure 2-11. Fernald Environmental Management Project Former Production Area (Operable Unit 3)

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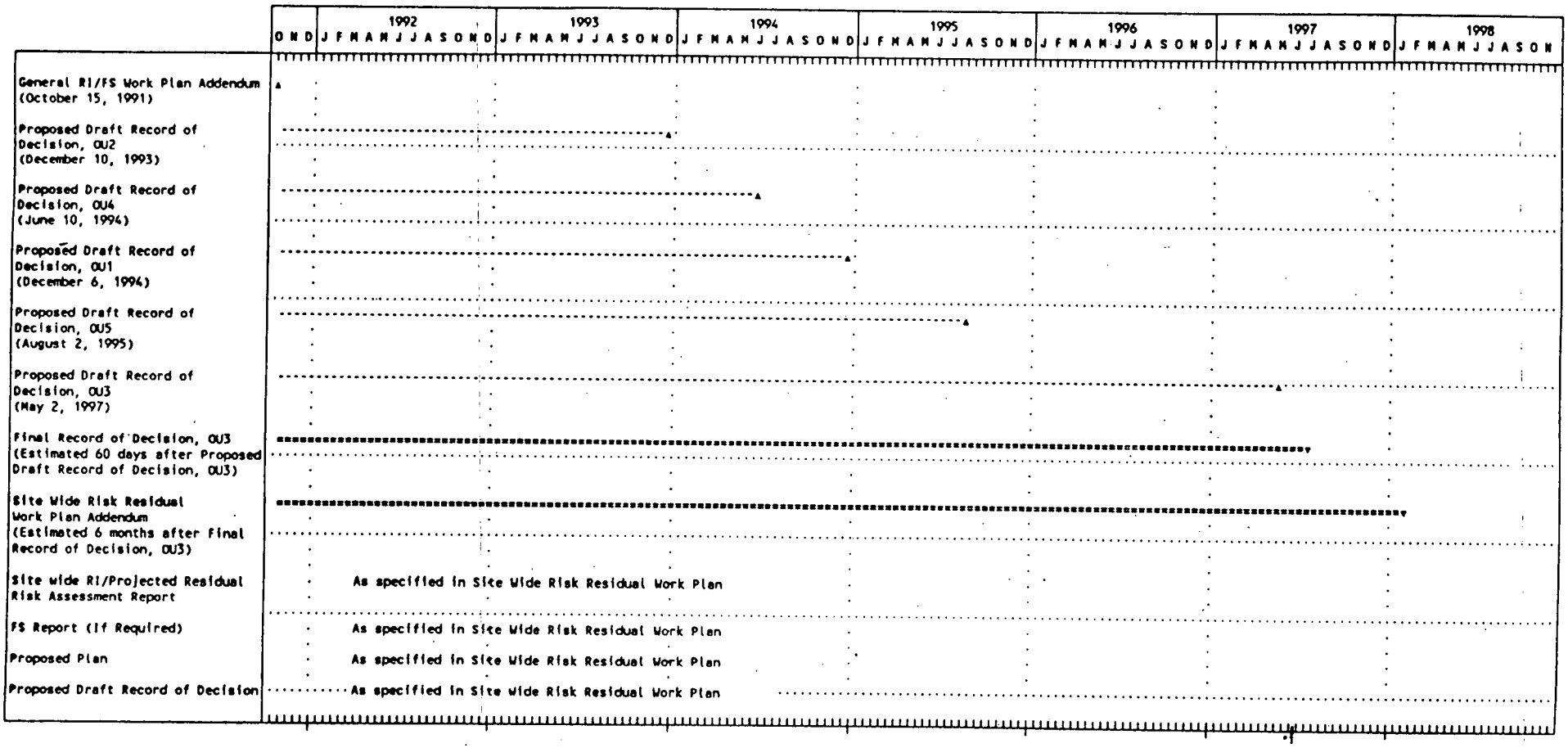

Figure 2-12. 1991 Amended Consent Agreement Schedule for Fernald Environmental Management Project Remedial Investigation/Feasibility Study

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(Milestones indicate deliverables to EPA)

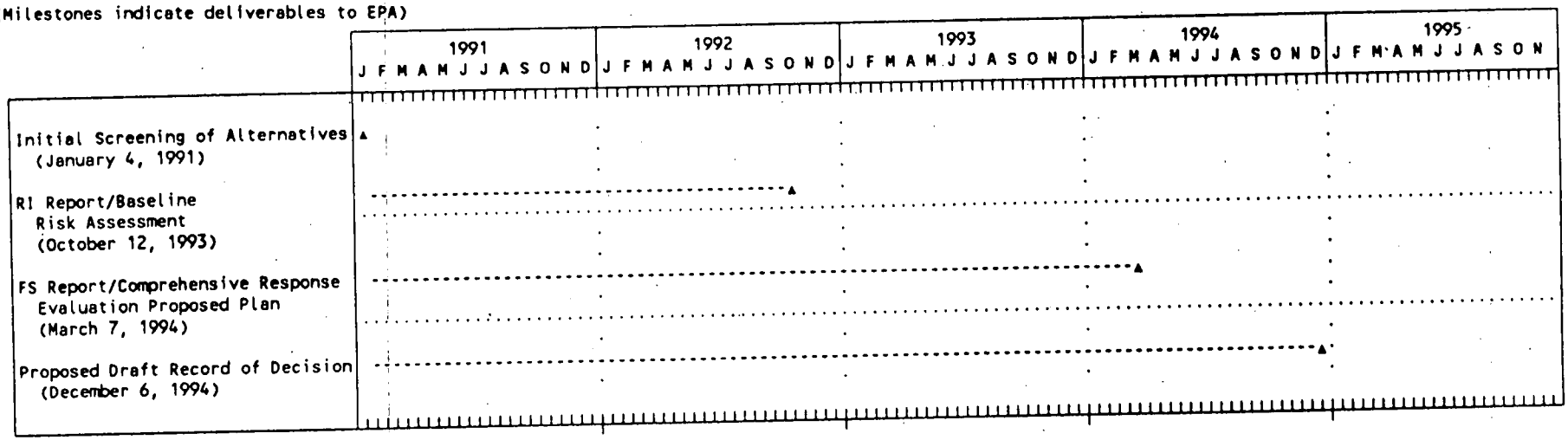

Figure 2-13. 1991 Amended Consent Agreement Schedule for Operable Unit 1

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(Milestones indicate deliverables to EPA)

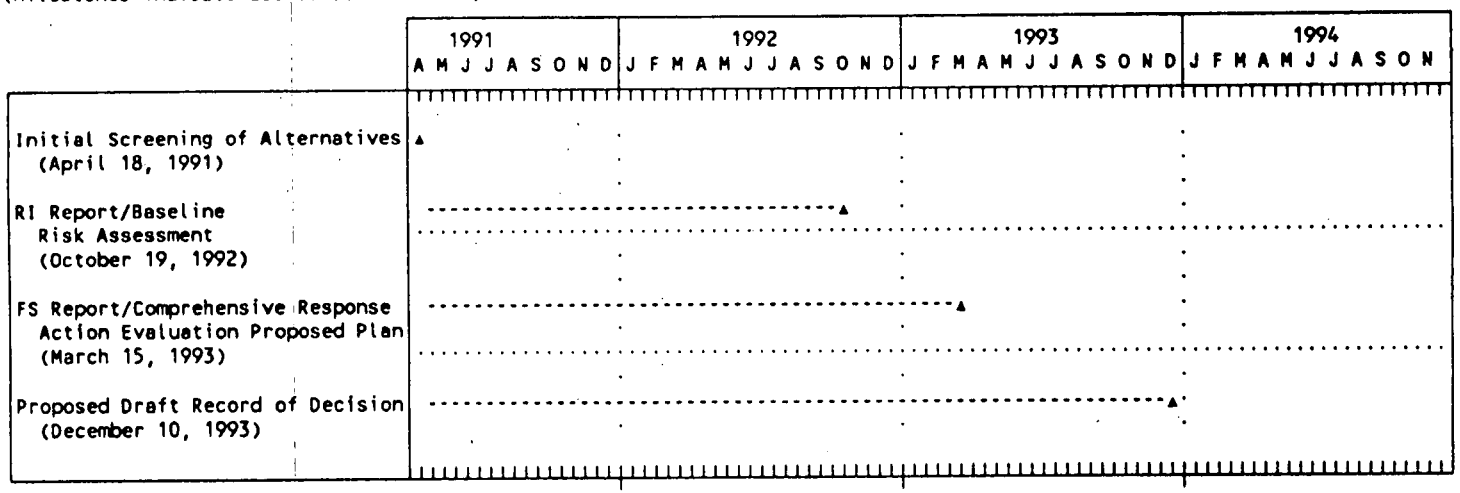

Figure 2-14. 1991 Amended Consent Agreement Schedule for Operable Unit 2

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(Milestones indicate deliverables to EPA)

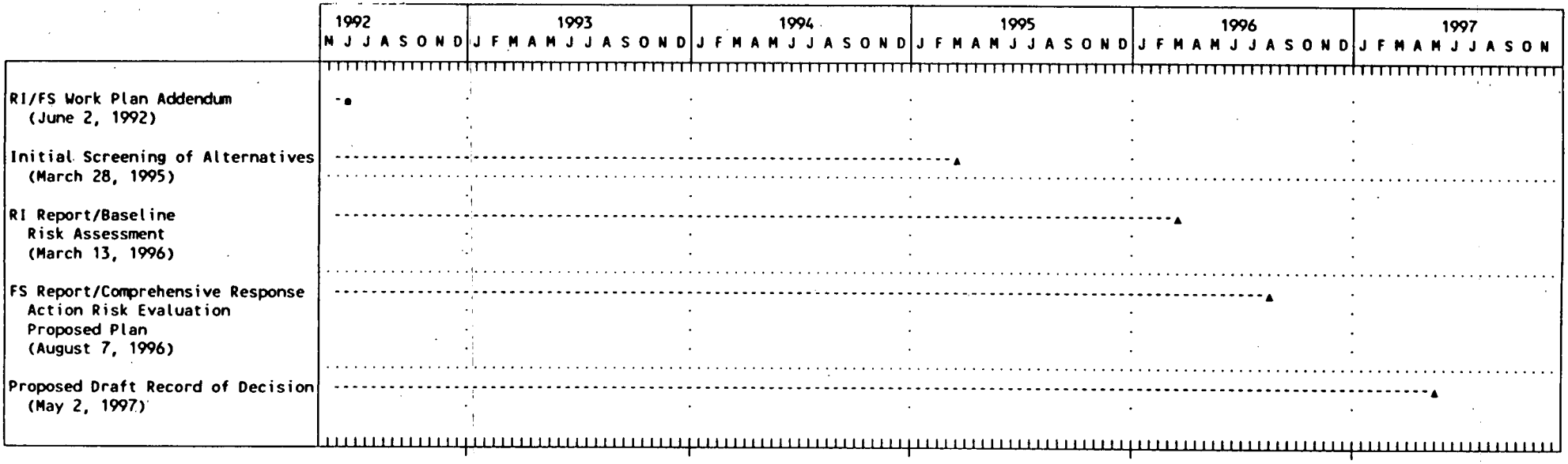

Figure 2-15. 1991 Amended Consent Agreement Schedule for Operable Unit 3

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(Milestones indicate deliverables to EPA)

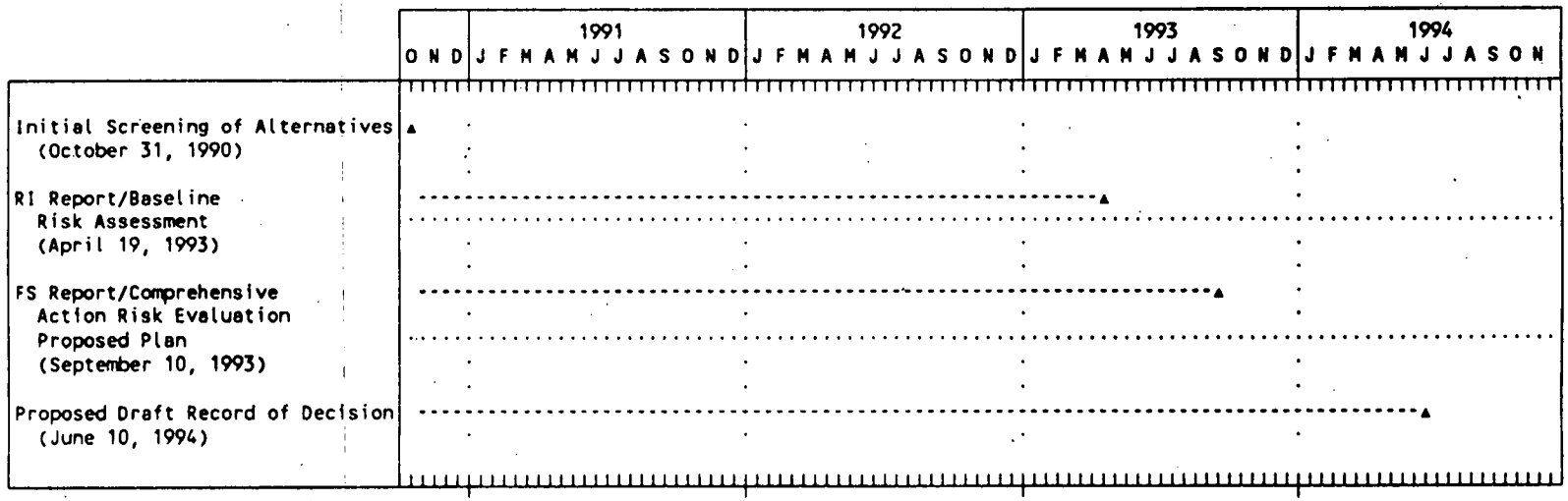

Figure 2-16. 1991 Amended Consent Agreement Schedule for Operable Unit 4

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(Milestones indicate deliverables to EPA)

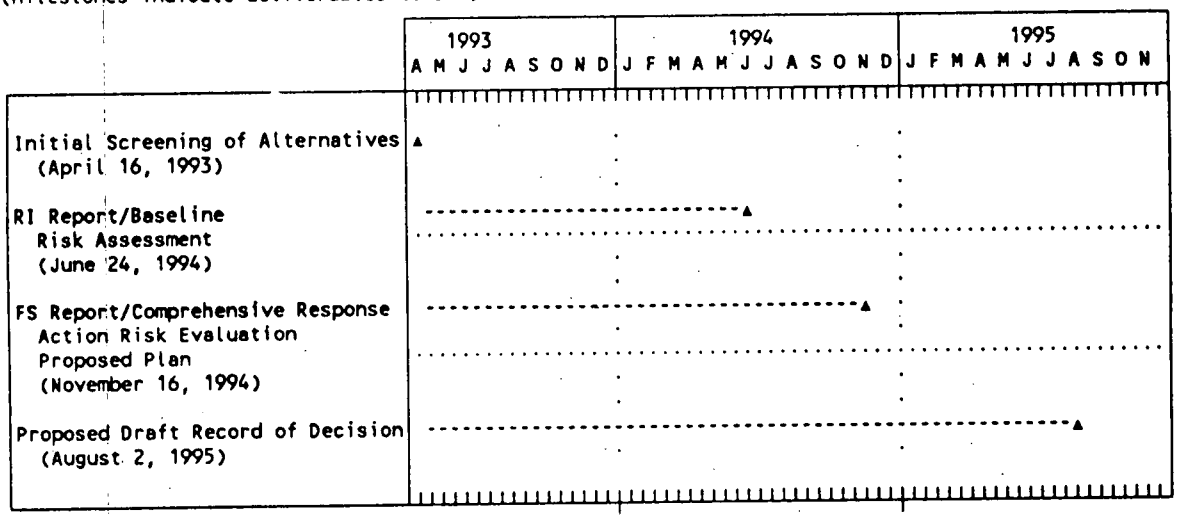

Figure 2-17. 1991 Amended Consent Agreement Schedule for Operable Unit 5

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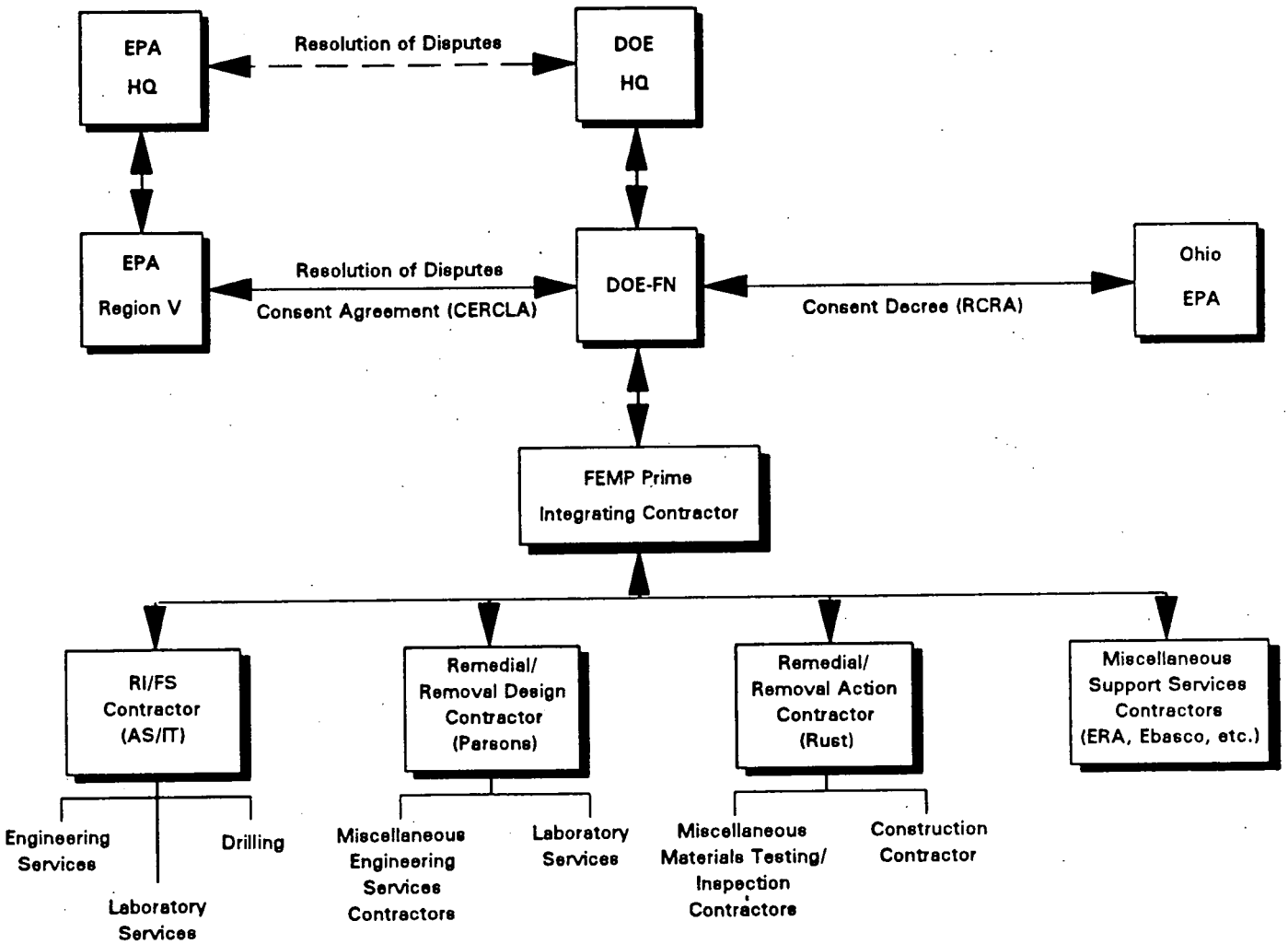

Figure 3-1. Fernald Environmental Management Project Organizations

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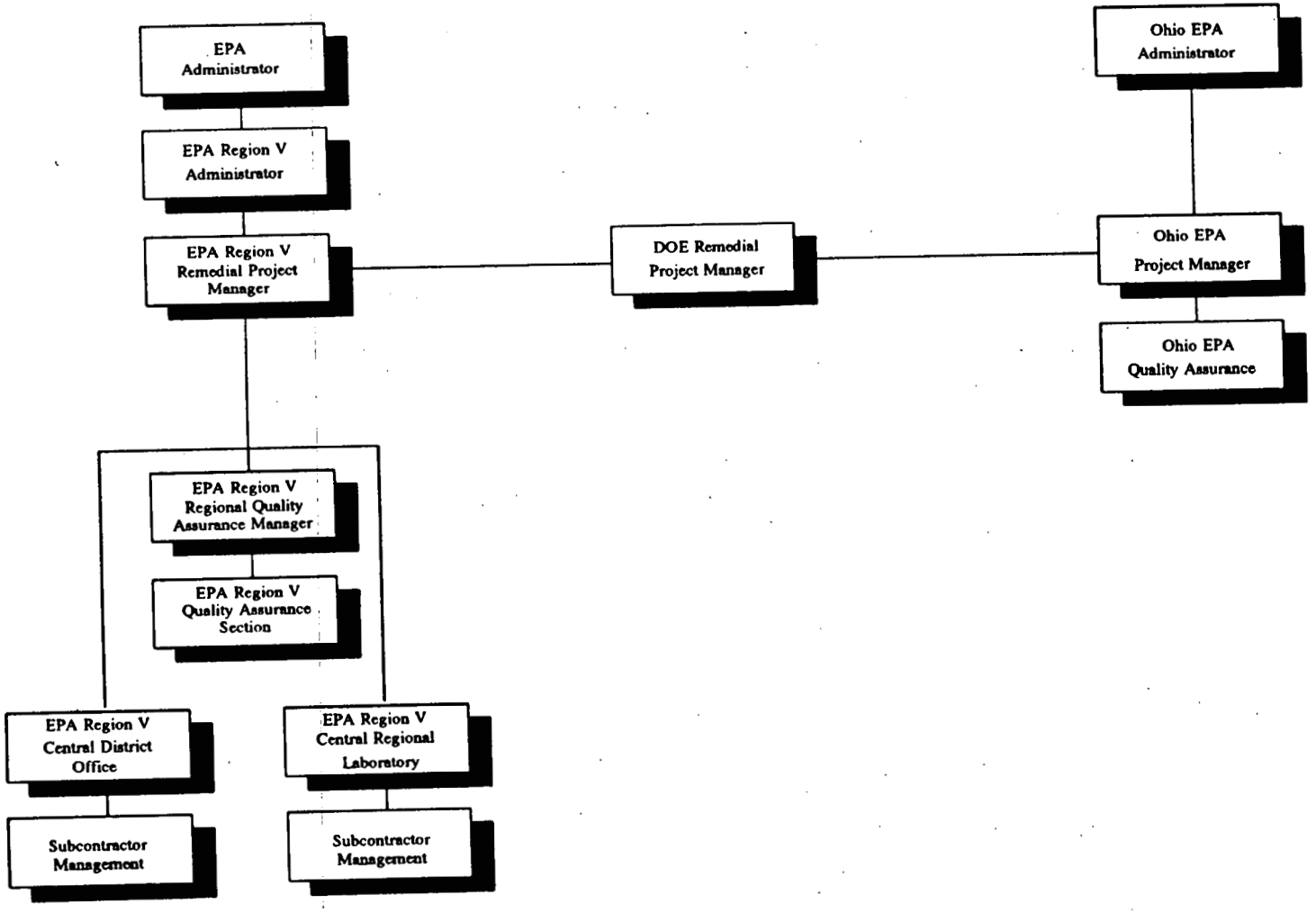


Figure 3-2. Fernald Environmental Management Project Management Structure Interface with Regulatory Agencies
(sheet 1 of 4)

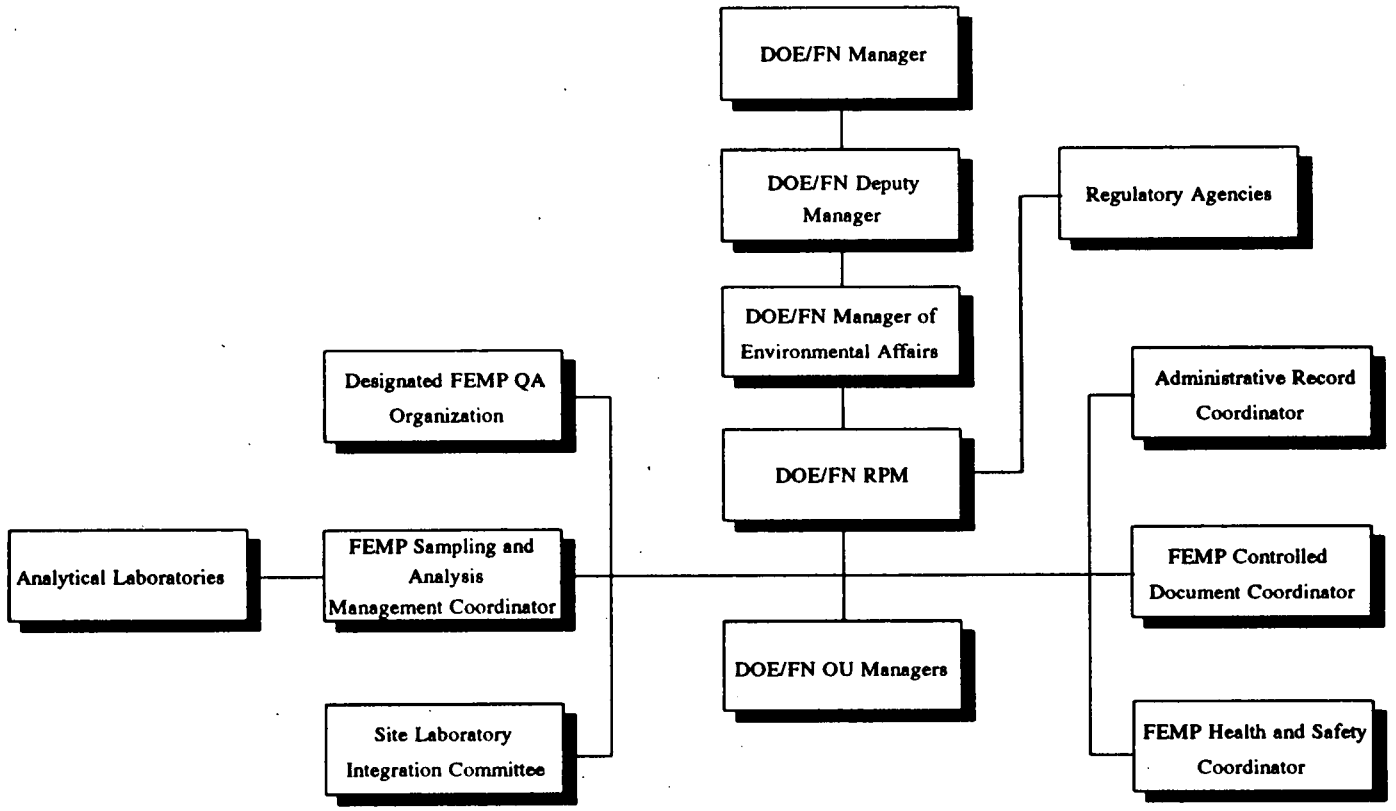
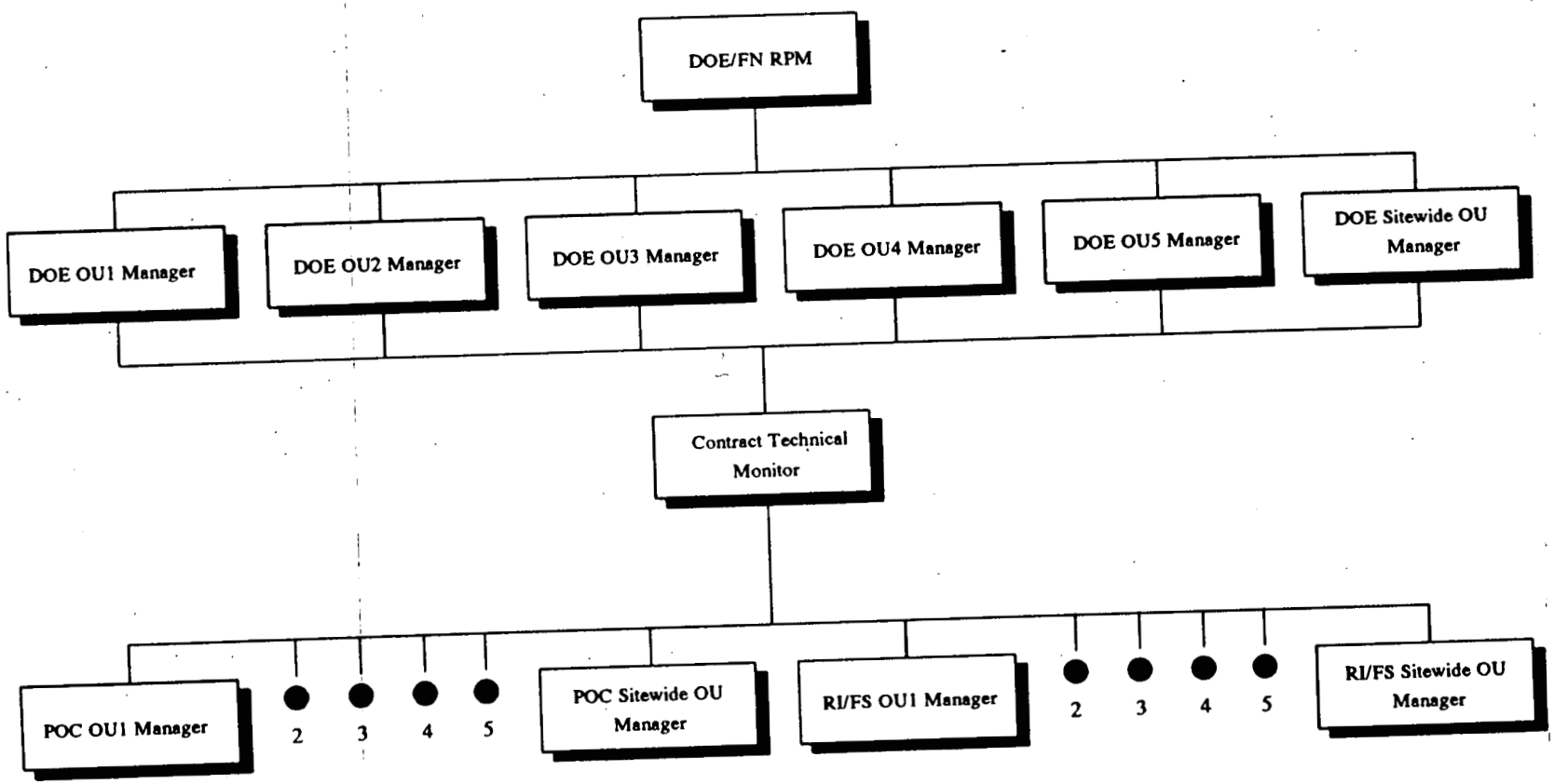


Figure 3-2. Fernald Environmental Management Project Management Structure Interface with Regulatory Agencies
(sheet 2 of 4)



POC = Prime Operating Contractor
OU = Operable Unit

Figure 3-2. Fernald Environmental Management Project Management Structure Interface with Regulatory Agencies (sheet 3 of 4)

For A Single OU

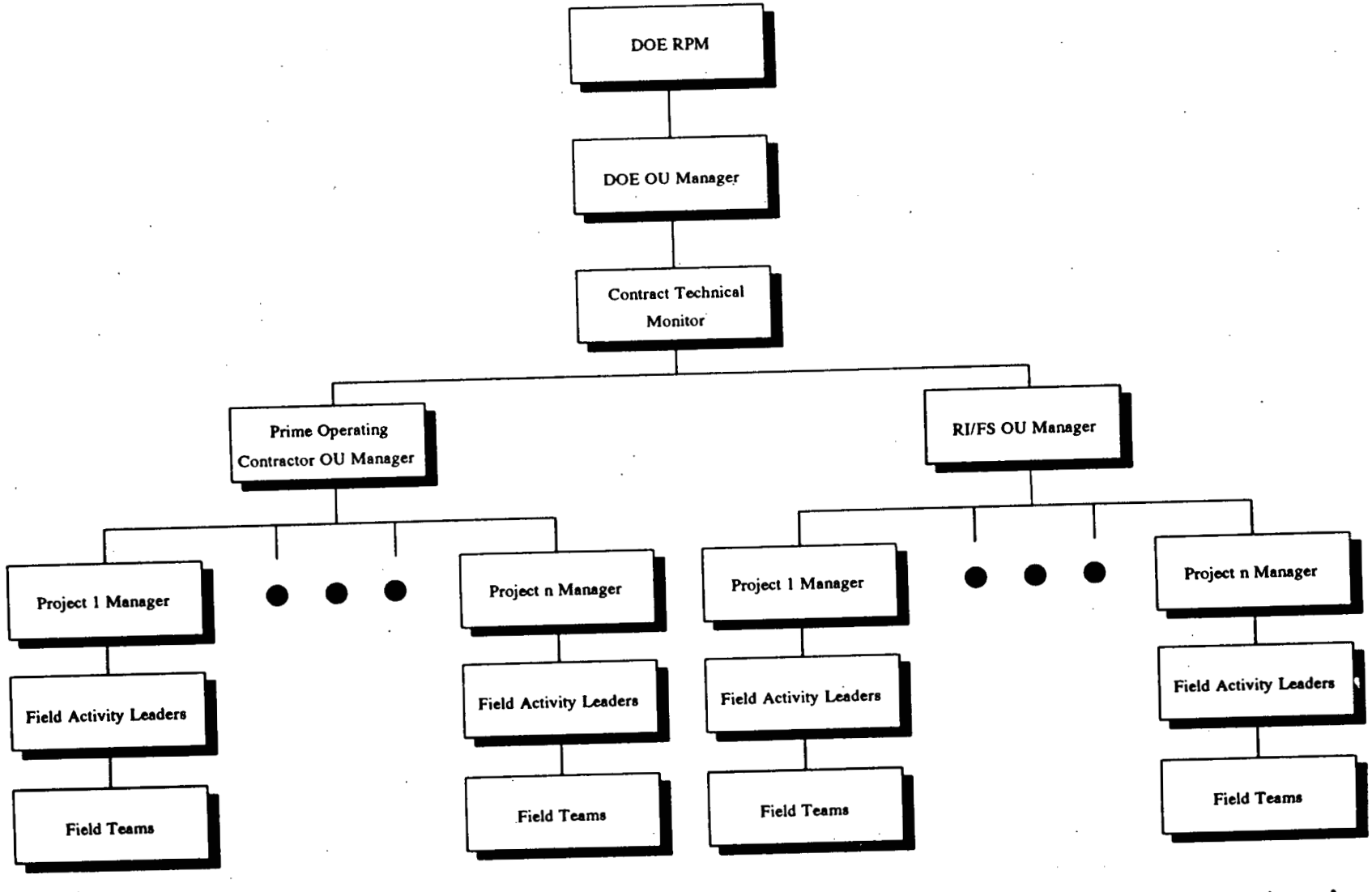


Figure 3-2. Fernald Environmental Management Project Management Structure Interface with Regulatory Agencies
(sheet 4 of 4)

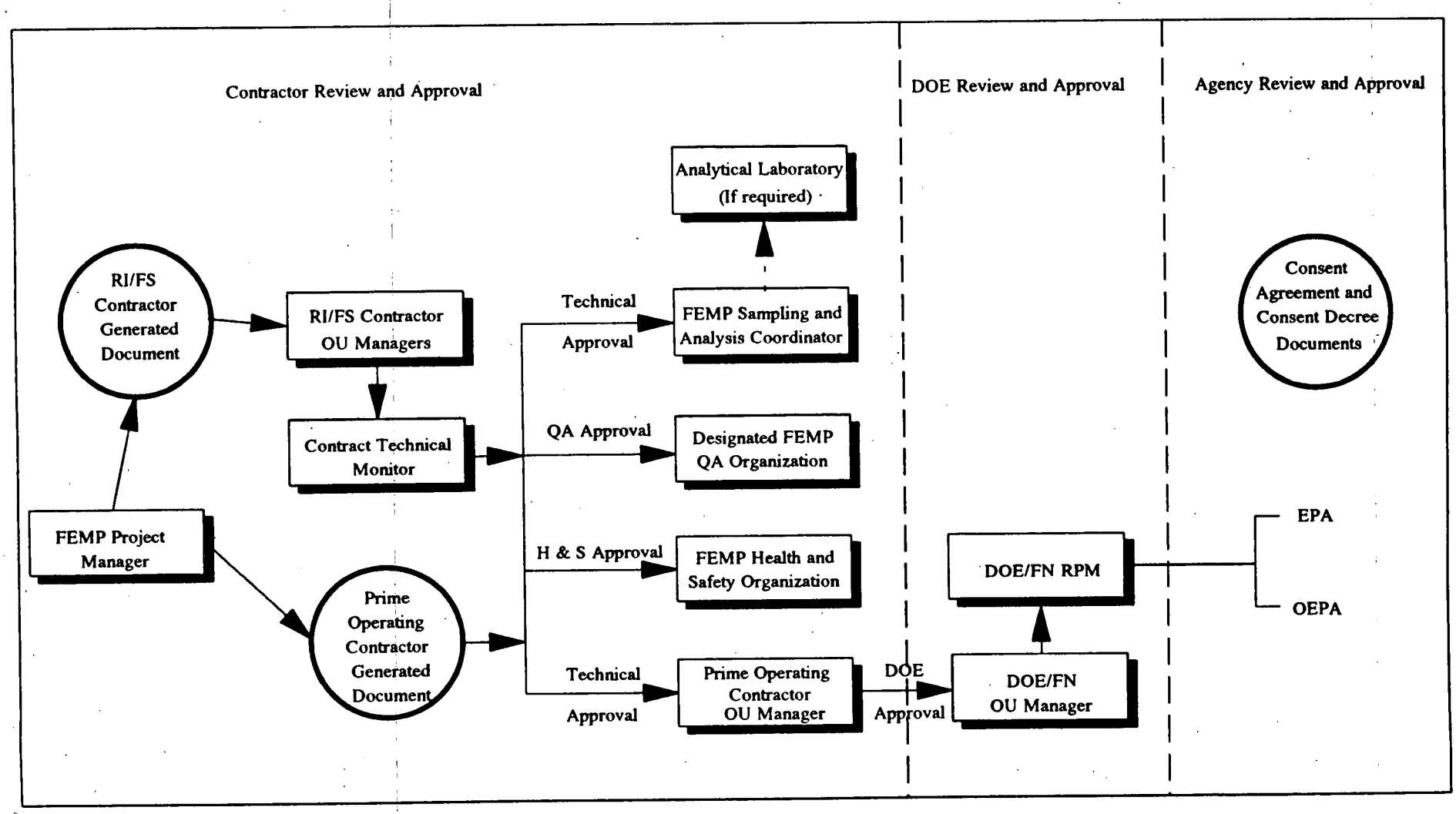


Figure 3-3. Project Specific Plans Generation, Review and Approval

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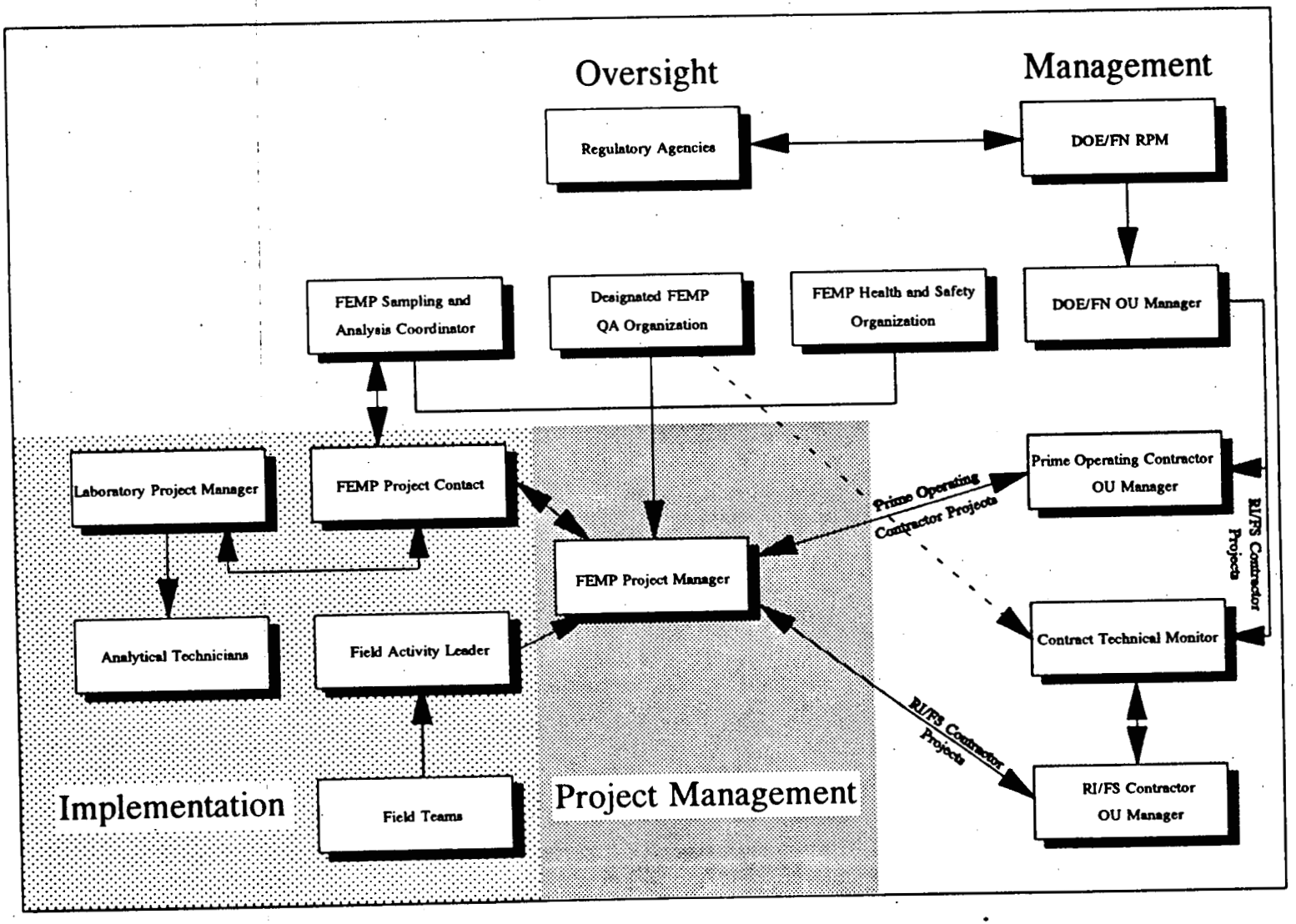

Figure 3-4. Project Specific Plans Implementation Responsibilities

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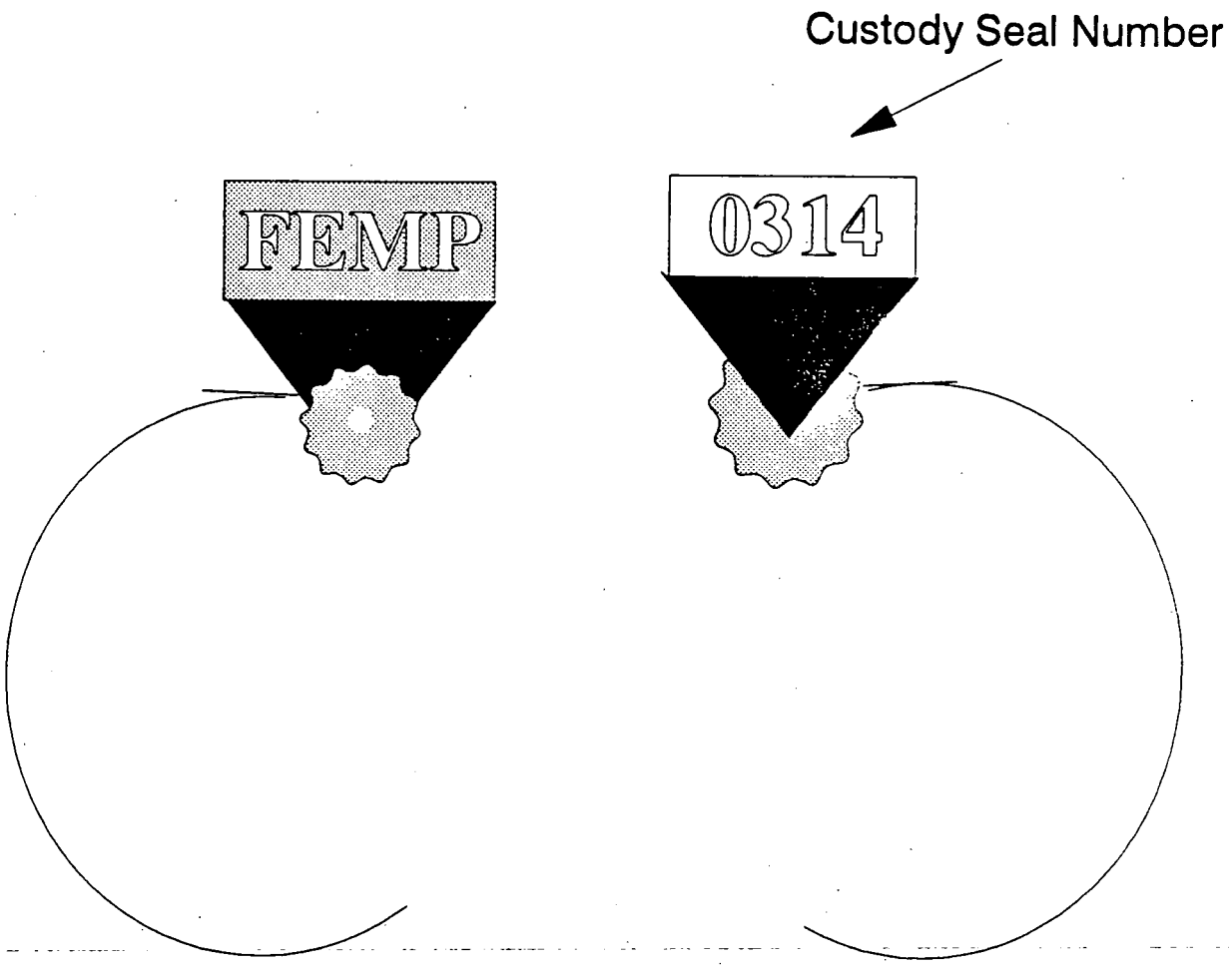

Figure 7-1. Locking Custody Seal Page 1 of 2

Wire Custody Seal Attachment

1. Wind the wire end of the custody seal around and/or through the locking ring and bolt or the latch of the container being sealed.

2. Slide the end of the wire through the seal portion of the custody seal till the wire is bound tightly around the container.

3. Crimp the seal to lock the wire in place.

NOTE

There may be several varations of how the seal is attached. However, the seal must be attached in a way so it will be broken or destroyed when the container is opened.

Figure 7-1. Locking Custody Seal Page 2 of 2

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LAB SAMPLE DATE _____

DO NOT TAMPER INITIALS _____

Figure 7-2. Example Custody Tape

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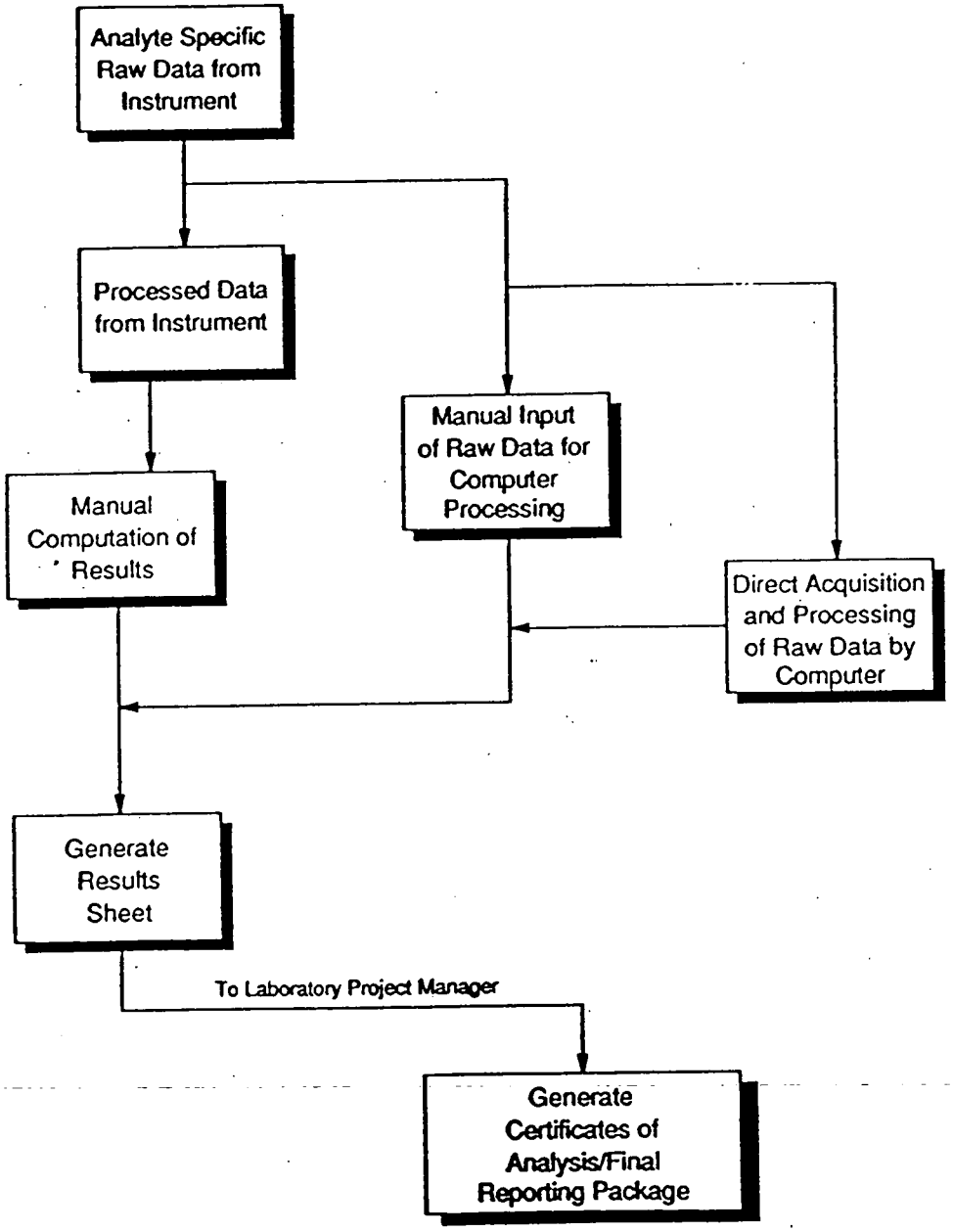

Figure 11-1. Data Reduction Process Summary

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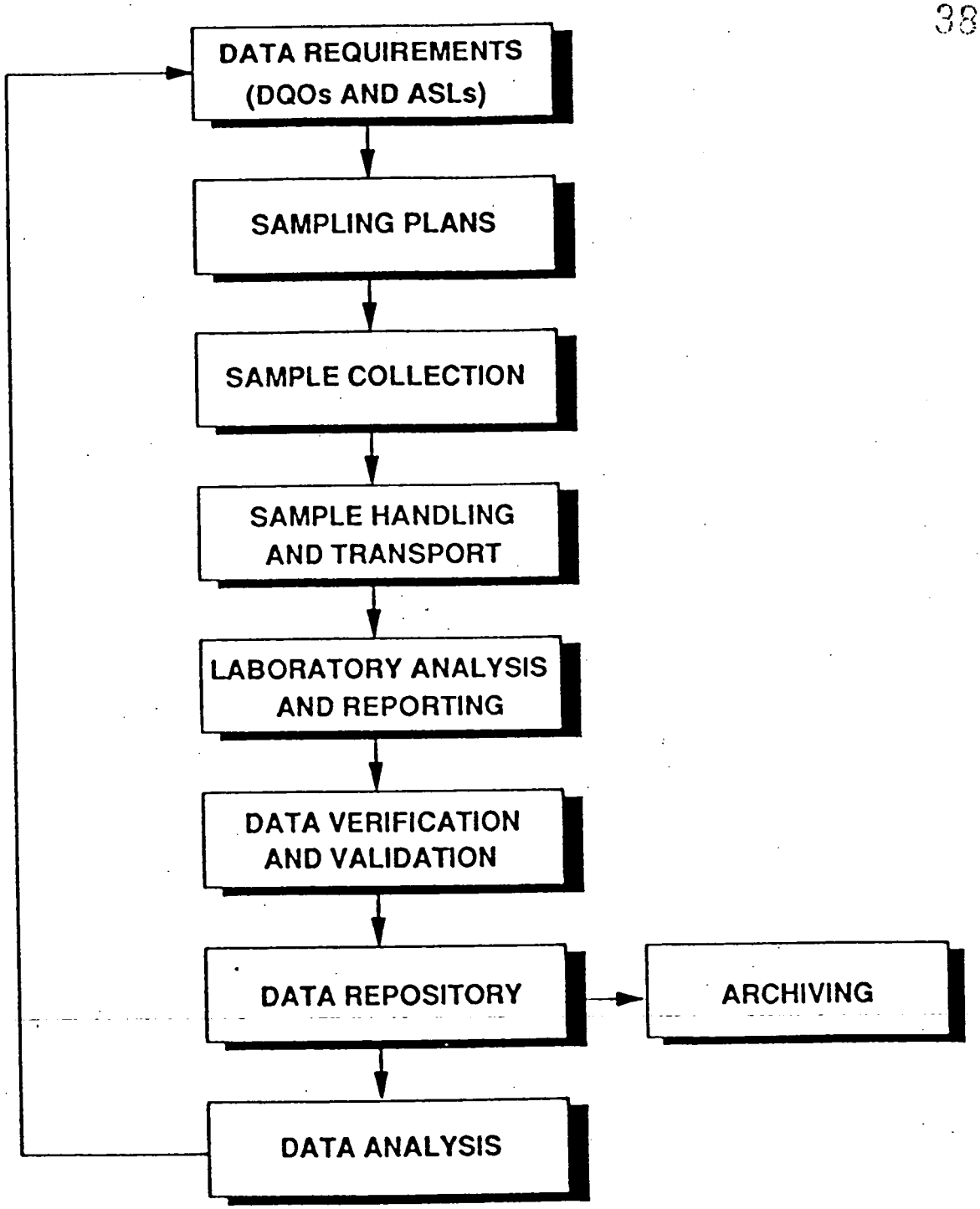

Figure F-1. Fernald Environmental Management Project Environmental Data Life Cycle

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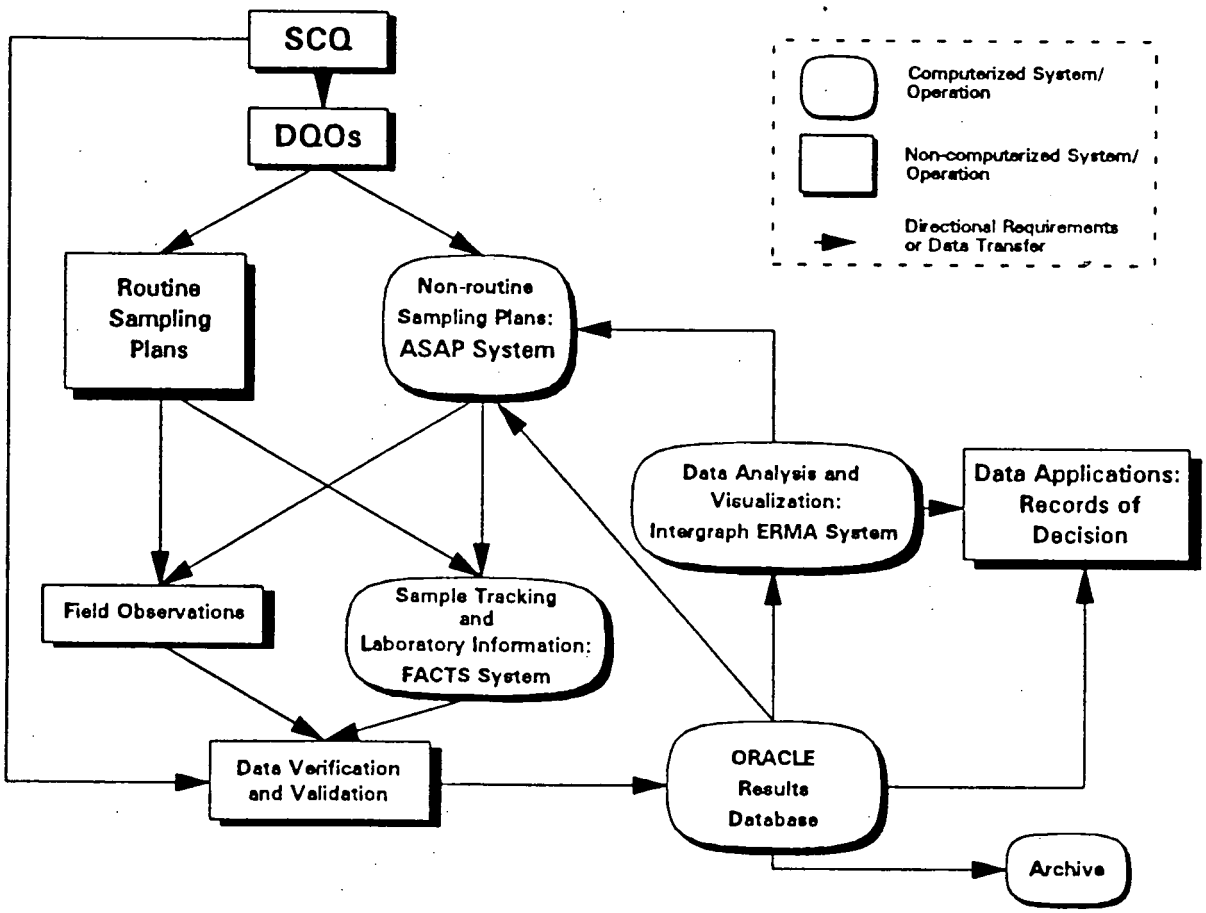

Figure F-2. Interrelationships of Fernald Environmental Management Project Environmental Data Management Systems

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A.2 TABLES

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Table 2-1 Example Project Objectives for Remedial Investigation/Feasibility Study

Table 2-2 Internal Quality Control Requirements

Table 2-3 Summary of Data Uses by ASL

Table 2-4 Required Quantitation Limits

Table 3-1 Organizations Operating at Fernald Environmental Management Project

Table 3-2 List of Laboratories Approved for Fernald Environmental Management Project Analyses

Table 3-3 Quality Assurance Responsibilities

Table 4-1 Site Training Requirements

Table 6-1 Sample Container and Preservation Requirements

Table 9-1 Methods in the Fernald Environmental Management Project Laboratory Analytical Methods Manual

Table 12-1 Example Audit Schedule

Table 13-1 Minimum Preventive Maintenance for Commonly Used Field Equipment

Table C-1 Summary of Data Quality Objective Summary Forms

Table I-1 Summary Table of Operational Calibration Requirements

Table K-1 Reportable Quantities for Classification as a Hazardous Material

Table K-2 Allowable Shipping Quantities for Uranium Decay Series Radionuclides

Table K-3 Low Specific Activity Concentration Limits for Radionuclides of the Uranium Decay Series

Table K-4 Label Selection

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Table 2-1 EXAMPLE PROJECT OBJECTIVES FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY

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General Objectives	Specific Project Objectives	
Determine presence or absence and types of suspected contaminants.	a.	Perform waste inventory to identify potential contaminants in source areas.
	b.	Sample and analyze source areas for suspected contaminants.
	c.	Conduct hazardous waste characteristic tests and TCLP.
Locate contaminated hot spots	a.	Evaluate historic information, visual information, and remote sensing information to determine judgemental sampling sites.
	b.	Systematically sample using grid or random methods to determine distribution of contaminants in the source area with probabilistic inferences.
Determine the modes of contaminant transport and the direction and rate of contamination migration.	a.	Develop a conceptual model for contaminant transport.
	b.	Use screening techniques such as soil gas, geophysics, or radiological screening with field instruments to qualitatively determine extent of contamination in various matrices.
	c.	Test for contaminants in various pathways, sampling and analyzing for contaminants detected in the source area and degradation products.

Table 2-1 EXAMPLE PROJECT OBJECTIVES FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY (cont.)

General Objectives	Specific Project Objectives	
Determine the modes of contaminant transport and the direction and rate of contamination migration. (cont.)	d.	Determine matrix properties that may affect contaminant transport.
	e.	Develop analytical models to predict future contaminant transport.
Determine the extent of contamination and variability over time.	a.	Determine background concentrations.
	b.	Determine boundary cutoff criteria (required reporting limits, accuracy, and precision).
	c.	Determine sampling points based on areas of known contamination, model predictions, medium discontinuities, and statistical prediction methods.
Assess risk to human health and the environment.	a.	Obtain background information on contaminant types, toxicity, potential receptors, pathways, and exposure scenarios.
	b.	Perform preliminary risk assessment of current situation.
	c.	Perform baseline risk assessment when RI data become available.
Identify potential remedial alternatives.	a.	Identify data needs for each category of remedy based on current regulatory policies, guidance, and standards.
	b.	Eliminate alternatives which are obviously technically infeasible.

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Table 2-1 EXAMPLE PROJECT OBJECTIVES FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY (cont.)

General Objectives	Specific Project Objectives	
Begin identification of ARARs.	a.	Determine regulations, policies, guidelines, or health-based criteria for contaminants of concern in various media.
	b.	Continue to revise the list of ARARs throughout the RI/FS, eliminating those that will obviously not meet remediation goals, and identifying new ones as they become available.
Identify remedial alternatives.	a.	Identify at least one potential remedy from each category considering how health and environmental risks would be abated, control/containment standards, and the list of options and technologies available.
Assess remedial alternatives.	a.	Identify further data needs considering performance criteria, point of compliance, and current level of information available about site conditions.
	b.	Develop evaluation criteria for each alternative based on EPA guidance.
	c.	Perform evaluation of each alternative.
Assess risk associated with each alternative.	a.	Evaluate exposure scenarios under each alternative based on predictive modeling, current site conditions, and local demography.

Table 2-1 EXAMPLE PROJECT OBJECTIVES FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY (cont.)

General Objectives	Specific Project Objectives	
Rank alternatives according to criteria.	a.	Eliminate combinations of alternatives that will not meet cleanup criteria or risk goals, or that present implementation or cost effectiveness problems.
	b.	Identify preferred alternatives based on guidance criteria.
Other (fill data gaps, interim measures, validation.)	a.	Develop as required.

Table 2-2 INTERNAL QUALITY CONTROL REQUIREMENTS

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	ANALYTICAL SUPPORT LEVELS		
	B	C	D
INORGANICS			
Field QC Samples			
Field blanks	A/S	1 per 20 or 1 per sampling event, whichever is more frequent	1 per 20 or 1 per sampling event, whichever is more frequent
Equipment rinsate blanks	A/S	1 per 20 or 1 per sampling event, whichever is more frequent	1 per 20 or 1 per sampling event, whichever is more frequent
Field duplicates	A/S	1 per 20 or 1 per sampling event, whichever is more frequent	1 per 20 or 1 per sampling event, whichever is more, frequent
Preservative blanks	A/S	A/S	A/S
Container blanks	A/S	1 per QC lot of containers	1 per QC lot of containers
Analytical QC Samples			
Laboratory control samples	1 per analytical batch if applicable	1 per analytical batch if applicable	1 per analytical batch if applicable
Method blanks	1 per analytical batch of samples	1 per analytical batch of samples	1 per analytical batch of samples

Table 2-2 INTERNAL QUALITY CONTROL REQUIREMENTS (cont.)

	ANALYTICAL SUPPORT LEVELS		
	B	C	D
INORGANICS - (cont.)			
Analytical QC Samples - (cont.)			
Matrix spikes	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method
Laboratory replicate samples	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method
Interference check	A/S	1 per analytical batch per matrix	1 per analytical batch per matrix
Dilution check	A/S	1 per analytical batch per matrix	1 per analytical batch per matrix
Initial calibration	As required by method	A/S	A/S
Continuing Calibration	As required by method	A/S	A/S

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Table 2-2 INTERNAL QUALITY CONTROL REQUIREMENTS (cont.)

	ANALYTICAL SUPPORT LEVELS		
	B	C	D
ORGANICS			
Field QC Samples			
Field blanks	A/S	1 per 20 or 1 per sampling event, whichever is more frequent	1 per 20 or 1 per sampling event, whichever is more frequent
Equipment rinsate blanks	A/S	1 per 20 or 1 per sampling event, whichever is more frequent	1 per 20 or 1 per sampling event, whichever is more frequent
Field duplicates	A/S	1 per 20 or 1 per sampling event, whichever is more frequent	1 per 20 or 1 per sampling event, whichever is more frequent
Trip blanks (VOAs)	A/S	1 per shipping container	1 per shipping container
Preservative blanks	A/S	A/S	A/S
Container blanks	A/S	1 per QC lot of containers	1 per QC lot of containers
Analytical QC Samples			
Method (reagent) blanks	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method

Table 2-2 INTERNAL QUALITY CONTROL REQUIREMENTS (cont.)

	ANALYTICAL SUPPORT LEVELS		
	B	C	D
ORGANICS - (cont.)			
Analytical QC Samples - (cont.)			
Matrix spikes	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method
Matrix spikes duplicates	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method	1 per 20 samples or 1 per analytical batch, whichever is more frequent (per matrix) if applicable to the method
Surrogates	Present in every determination	Present in every determination	Present in every determination
DFTPP and BFB performance results	Daily	Once every 12 hours	Once every 12 hours
Internal standard (GC/MS)	A/S	In every determination	In every determination
Performance evaluation standard (pesticides/PCBs)	A/S	1 per 10 samples	1 per 10 samples
Initial calibration	A/S	A/S	A/S
Continuing calibration	A/S	A/S	A/S

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Table 2-2 INTERNAL QUALITY CONTROL REQUIREMENTS (cont.)

	ANALYTICAL SUPPORT LEVELS		
	B	C	D
ORGANICS - (cont.)			
Analytical QC Samples - (cont.)			
Second column confirmation (GC analyses)	A/S	For all positive hits	For all positive hits
Review of compound identification for target analytes	A/S	For all positive hits by GC/MS methods	For all positive hits by GC/MS methods
Review of tentatively identified compounds	A/S	For GC/MS methods	For GC/MS methods

Note

A/S - As specified in method or project specific plan

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Table 2-3 SUMMARY OF DATA USES BY ASL

ASL	Data Uses
A	Field screening, qualitative presence or absence of contamination, assess areal extent of contamination.
B	Field screening, assess nature and extent of contamination, treatability, engineering studies, risk assessment, environmental monitoring for NPDES, CAA, RCRA, or other permit purposes.
C	Assess nature and extent of contamination, treatability, engineering studies, risk assessment, enviromental monitoring for NPDES, CAA, RCRA or other permit purposes.
D	Assess nature and extent of contamination, treatability, engineering studies, risk assessment, enviromental monitoring for NPDES, CAA, RCRA or other permit purposes.
E	Field screening, assess nature and extent of contamination, treatability, engineering studies, risk assessment, environmental monitoring for NPDES, CAA, RCRA, or other permit purposes.

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Table 2-4 REQUIRED QUANTITATION LIMITS

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
VOCs by GC/MS-FM-ORG-0010		
Chloromethane	10	10
Bromomethane	10	10
Vinyl chloride	10	10
Chloroethane	10	10
Methylene chloride	10	10
Acetone	50	50
Carbon disulfide	50	50
1,1-Dichloroethene	10	10
1,1-Dichloroethane	10	10
1,2-Dichloroethene (total)	10	10
Chloroform	10	10
1,2-Dichloroethane	10	10
2-Butanone	50	50
1,1,1-Trichloroethane	10	10
Carbon tetrachloride	10	10
Bromodichloromethane	10	10
1,2-Dichloropropane	10	10
trans-1,3-Dichloropropene	10	10
Trichloroethene	10	10
Dibromochloromethane	10	10
1,1,2-Trichloroethane	10	10
Benzene	10	10
cis-1,3-Dichloropropene	10	10
Bromoform	10	10
2-Hexanone	50	50
4-Methyl-2-pentanone	50	50
Tetrachloroethane	10	10
Toluene	10	10
Chlorobenzene	10	10
Ethyl benzene	10	10
Styrene	10	10
Total Xylenes	10	10
Acetonitrile	200	200
Acrolein	100	100
Acrylonitrile	100	100

Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
VOCs by GC/MS (cont.)		
2-Chloroethyl vinyl ether	10	10
1,2-Dibromoethane	10	10
Dichlorodifluoromethane	20	20
Dioxane	500	500
Ethyl methacrylate	50	50
Methacrylonitrile	50	50
Methyl methacrylate	50	50
Trichlorofluoromethane	10	10
1,2,3-Trichloropropane	10	10
BTEX by GC/PID-FM-ORG-0020		
Benzene	1.0	1.0
Chlorobenzene	1.0	1.0
1,4-Dichlorobenzene	5.0	5.0
1,3-Dichlorobenzene	5.0	5.0
1,2-Dichlorobenzene	5.0	5.0
Ethylbenzene	1.0	1.0
Toluene	1.0	1.0
Xylenes	5.0	5.0
Pesticides/PCBs by GC-FM-ORG-0030		
Aldrin	0.01	8.0
a-BHC	0.01	8.0
b-BHC	0.02	8.0
d-BHC	0.01	8.0
g-BHC	0.01	8.0
Chlordane	0.1	80
4,4'-DDD	0.02	16
4,4'-DDE	0.02	16
4,4'-DDT	0.02	16
Dieldrin	0.02	16
Endosulfan I	0.02	8.0
Endosulfan II	0.02	16
Endosulfan Sulfate	0.02	16
Endrin	0.02	16
Endrin Aldehyde	0.02	16

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Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
Pesticides/PCBs by GC (cont.)		
Endrin ketone	0.02	16
Heptachlor	0.01	8.0
Heptachlor epoxide	0.01	8.0
Methoxychlor	0.04	80
Toxaphene	0.5	160
PCB 1016	0.8	80
PCB 1221	2	80
PCB 1232	2	80
PCB 1242	0.8	80
PCB 1248	0.4	80
PCB 1254	0.2	160
PCB 1260	0.2	160
Organophosphorus Pesticides by GC-FM-ORG-0040		
Azinphos methyl (Guthion)	1	50
Bolstar (Sulprofos)	1	50
Chlorophyrifos	1	50
Conumaphos (Co-Ral)	1	50
Demeton, O & S	1	50
Diazinon	2	100
Dichlorvos (DDVP)	1	50
Ethoprop	1	50
Fensulfothion (Daasanit)	1	100
Fenthion	2	50
Parathion, methyl	1	50
Phorate (Thimet)	1	50
Ronnel (Trolene)	1	50
Stirophos (Rabon)	1	500
Tokuthn (Prothiofos)	1	
Trichloronate (Agritox)		50
VOCs by GC-FM-ORG-0050		
Chloromethane	1.0	1.0
Bromomethane	1.0	1.0
Dichlorodifluoromethane	1.0	1.0
Vinyl chloride	1.0	1.0
Chloromethane	1.0	1.0

Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
VOCs by GC (cont.)		
Methylene chloride	1.0	1.0
Trichlorofluoromethane	1.0	1.0
1,1-Dichloroethene	1.0	1.0
1,1-Dichloroethane	1.0	1.0
trans-1,2-Dichloroethene	1.0	1.0
Chloroform	1.0	1.0
1,2-Dichloroethane	1.0	1.0
1,1,1-Trichloroethane	1.0	1.0
Carbon tetrachloride	1.0	1.0
Bromodichloromethane	1.0	1.0
1,2-Dichloropropane	1.0	1.0
cis-1,3-Dichloropropene	1.0	1.0
Trichloroethene	1.0	1.0
Dibromochloromethane	1.0	1.0
1,1,2-Tetrachloroethane	1.0	1.0
trans-1,3-Dichloropropene	1.0	1.0
Bromoform	1.0	1.0
1,1,2,2-Tetrachloroethane	1.0	1.0
Tetrachloroethane	1.0	1.0
Chlorobenzene	1.0	1.0
1,3-Dichlorobenzene	1.0	1.0
1,2-Dichlorobenzene	1.0	1.0
1,4-Dichlorobenzene	1.0	1.0
2-Chloroethyl vinyl ether	1.0	1.0
1,2-Dibromo-3-chloropropane (DBCP)	1.0	1.0
1,1,2-Tetrachloropropane	1.0	1.0
Methylene bromide	1.0	1.0
1,2-Dibromoethane (Ethylene dibromide)	1.0	1.0
Benzene	1.0	1.0
Chlorobenzene	1.0	1.0
Toluene	1.0	1.0
Ethylbenzene	1.0	1.0
1,3-Dichlorobenzene	1.0	1.0
1,2-Dichlorobenzene	1.0	1.0
1,4-Dichlorobenzene	1.0	1.0
Xylenes (total)	1.0	1.0
Styrene	1.0	1.0

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Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
SVOCs by GC/MS-FM-ORG-0060		
Dibenz(a,h)anthracene	10	330
Dibenzofuran	10	330
Di-n-butylphthalate	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,2-Dichlorobenzene	10	330
3,3'-Dichlorobenzidine	20	660
2,4-Dichlorophenol	10	330
2,6-Dichlorophenol	10	330
Diethylphthalate	10	330
p-Dimethylaminoazobenzene	50	2400
7,12-Dimethylbenz(a)anthracene	10	330
2,4-Dimethylphenol	10	330
Dimethylphthalate	10	330
Acenaphthene	10	330
Acenaphthylene	10	330
Acetophenone	10	330
Aniline	10	330
Anthracene	10	330
4-Aminobiphenyl	50	2400
Benzidine	50	2400
Benzoic acid	50	2400
Benzo(a)anthracene	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(g,h,i)perylene	10	330
Benzo(a)pyrene	10	330
Benzyl alcohol	20	660
Bis (2-chloroethoxy)methane	10	330
Bis (2-chloroethyl)ether	10	330
Bis (2-chloroisopropyl)ether	10	330
Bis (2-ethylhexyl)phthalate	10	330
4-Bromophenyl phenyl ether	10	330
Butyl benzyl phthalate	10	330
4-Chloroaniline	20	660
1-Chloronaphthalene	10	330
2-Chloronaphthalene	10	330
4-Chloro-3-methylphenol	20	660
2-Chlorophenol	10	330

Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
SVOCs by GC/MS (cont.)		
4-Chlorophenyl phenyl ether	10	330
Chrysene	10	330
4,6- Dinitro-2-methylphenol	50	2400
2,4-Dinitrophenol	50	2400
2,4-Dinitrotoluene	10	330
2,6-Dinitrotoluene	10	330
Diphenylamine	20	660
Di-n-octylphthalate	10	330
Ethyl methanesulfonate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorobutadiene	10	330
Hexachlorocyclopentadiene	10	330
Hexachloroethane	10	330
Indeon(1,2,3-cd)pyrene	10	330
Isophorone	10	330
3-Methylcholanthrene	10	330
Methyl methanesulfonate	10	330
2-Methylnaphthalene	10	330
2-Methylphenol (o-cresol)	10	330
4-Methylphenol (p-cresol)	10	330
Naphthalene	10	330
1-Naphthylamine	50	2400
2-Naphthylamine	50	2400
2-Nitroaniline	50	2400
3-Nitroaniline	50	2400
4-Nitroaniline	50	2400
Nitrobenzene	10	330
2-Nitrophenol	10	330
4-Nitrophenol	50	2400
N-Nitroso-di-n-butylamine	10	330
N-Nitrosodimethylamine	10	330
N-Nitrosodiphenylamine	10	330
N-Nitrosodi-n-propylamine	10	330

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Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
SVOCs by GC/MS (cont.)		
N-Nitrosopiperidine	10	330
Pentachlorobenzene	50	2400
Pentachloronitrobenzene	50	2400
Pentachlorophenol	50	2400
Phenacetin	10	330
Phenanthrene	10	330
Phenol	10	330
2-Picoline	50	2400
Pronamide	10	330
Pyrene	10	330
1,2,4,5-Tetrachlorobenzene	50	2400
2,3,4,6-Tetrachlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
2,4,5-Trichlorophenol	50	2400
2,4,6-Trichlorophenol	10	330
Herbicides by GC-FM-ORG-0070		
2,4-D	10	330
2,4-DB	10	330
2,4,5-T	2	70
2,4,5-TP (Silvex)	2	70
Dalapon	60	2000
Dicamba	3	100
Dichloroprop	10	330
Dinoseb	1	30
MCPA	2500	82000
MCPP	2000	66000
VOCs by GC/MS - drinking water-FM-ORG-0100		
Benzene	5.0	N/A
Bromobenzene	25.0	N/A
Bromochloromethane	25.0	N/A
Bromodichloromethane	5.0	N/A
Bromoform	5.0	N/A
Bromomethane	5.0	N/A
n-Butylbenzene	25.0	N/A
sec-Butylbenzene	25.0	N/A
tert-Butylbenzene	25.0	N/A
Carbon tetrachloride	5.0	N/A

Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
VOCs by GC/MS - drinking water (cont.)		
Chlorobenzene	5.0	N/A
Chloroethane	5.0	N/A
Chloroform	5.0	N/A
Chloromethane	5.0	N/A
2-Chlorotoluene	5.0	N/A
4-Chlorotoluene	5.0	N/A
1,2-Dibromo-3-chloropropane	5.0	N/A
1,2-Dibromoethane	5.0	N/A
Dibromomethane	5.0	N/A
1,2-Dichlorobenzene	5.0	N/A
1,3-Dichlorobenzene	5.0	N/A
1,4-Dichlorobenzene	5.0	N/A
Dichlorofluoromethane	5.0	N/A
1,1-Dichloroethane	5.0	N/A
1,2-dichloroethane	5.0	N/A
1,1-Dichloroethene	5.0	N/A
cis-1,2-dichloroethene	5.0	N/A
trans-1,2-dichloroethene	5.0	N/A
1,2-Dichloropropane	5.0	N/A
1,3-Dichloropropane	5.0	N/A
2,2-Dichloropropane	5.0	N/A
1,1-Dichloropropene	5.0	N/A
Ethylbenzene	5.0	N/A
Hexachlorobutadiene	5.0	N/A
Isopropylbenzene	25.0	N/A
4-Isopropyltoluene	25.0	N/A
Methylene chloride	25.0	N/A
Naphthalene	5.0	N/A
n-Propylbenzene	5.0	N/A
Styrene	5.0	N/A
1,1,1,2-Tetrachloroethane	5.0	N/A
1,1,2,2-Tetrachloroethane	25.0	N/A
Tetrachloroethene	5.0	N/A
Toluene	5.0	N/A
1,2,3-Tetrachlorobenzene	5.0	N/A
1,2,4-Tetrachlorobenzene	5.0	N/A
1,1,1-Trichloroethane	5.0	N/A
1,1,2-Trichloroethane	5.0	N/A
Trichloroethene	5.0	N/A

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Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (µg/Kg)
VOCs by GC/MS - drinking water (cont.)		
Trichlorofluoromethane	5.0	N/A
1,2,3-Trichloropropane	5.0	N/A
1,2,4-Trimethylbenzene	5.0	N/A
1,3,5-Trimethylbenzene	5.0	N/A
Vinyl chloride	5.0	N/A
o-Xylene	5.0	N/A
m-Xylene	5.0	N/A
p-Xylene	5.0	N/A
RCRA Characteristic Methods		
TCLP-FM-MISC-0010		N/A
Corrosivity-FM-MISC-0020		N/A
Flash Point (Ignitibility)-FM-MISC-0030		N/A
Reactivity-FM-MISC-0040		N/A
Inorganic Methods		
Metals by GFAA-FM-INO-0010	**µg/L**	**mg/kg**
Antimony	60	12
Arsenic	10	2
Beryllium	5	1
Cadmium	5	1
Chromium	10	2
Cobalt	10	2
Lead	3	0.6
Selenium	5	1
Silver	10	2
Thallium	10	2
Vanadium	40	8
Metals by Flame AA-FM-INO-0020		
Aluminum	200	40
Antimony	60	12
Barium	200	40
Beryllium	5	1
Cadmium	5	1
Calcium	5000	1000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Iron	100	20

Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (mg/kg)
Metals by Flame AA (cont.)		
Lead	3	0.6
Magnesium	5000	1000
Manganese	15	3
Nickel	40	8
Potassium	5000	1000
Silver	10	2
Sodium	5000	1000
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Metals by ICP-FM-INO-0030		
Aluminum	200	40
Antimony	60	12
Arsenic	50	10
Barium	200	40
Beryllium	5	1
Boron	1000	200
Cadmium	5	1
Calcium	5000	1000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Iron	100	20
Lead	50	10
Lithium	5000	1000
Magnesium	5000	1000
Manganese	15	3
Molybdenum	10	2
Nickel	40	8
Potassium	5000	1000
Selenium	100	20
Silver	10	2
Sodium	5000	1000
Thallium	50	10
Vanadium	50	10
Zinc	20	4

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Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water (µg/L)	Quantitation Limit-Soil (mg/kg)
Mercury by CVAA-FM-INO-0040	0.2	1
Conventional Methods		
Total cyanide (spectrophotometric)-FM-CON-0015	5	
Total cyanide (colorimetric)-FM-CON-0010	20	
Nitrogen, nitrate/nitrite (colormetric)-FM-CON-0030	50	
Nitrogen, nitrate/nitrite (spectrophotometric)-FM-CON-0040	10	
Conductivity-FM-CON-0050	N/A	
Total Kjeldahl Nitrogen-FM-CON-0060	100	
Total Organic Carbon-FM-CON-0080	1000	
Alkalinity, Titrametric-FM-CON-0090	1000	
Alkalinity, automated colormetric-FM-CON-0100	1000	
pH (electrometric)-FM-CON-0110	N/A	
Chloride (color, auto, ferricyanide)-FM-CON-0120	1000	
Sulfide-FM-CON-0130	1000	
Ammonia-FM-CON-0140	1000	
Hexavalent chromium-FM-CON-0150	10	
Temperature-FM-CON-0160	N/A	
Chloride (titrametric, mercuric nitrate)-FM-CON-0170	1000	
Oil & grease (IR)-FM-CON-0175	1000	
Oil & grease (gravimetric)-FM-CON-0180	5000	
Percent solids (moisture)-FM-CON-0190	0.10%	
Total petroleum hydrocarbons (IR)-FM-CON-0200	200	
Total dissolved solids-FM-CON-0210	10000	N/A
Phosphorus-FM-CON-0220	50	
Surfactants (MBAS)-FM-CON-0250	20	
Phenolics, Total Recoverable (Color)-FM-CON-0260	2	
Pheonlics, Total Recoverable (Spectrophotometric)-FM-CON-0270	5	
Sulfate (methylthymol blue)-FM-CON-0290	1000	
Sulfate (turbidimetric)-FM-CON-0280	1000	
Fluoride-FM-CON-0300	100	
Total organic halides-FM-CON-0320	5	
Color-FM-CON-0330	5 units	
Oxidation reduction potential-FM-CON-0340	N/A	

Table 2-4 REQUIRED QUANTITATION LIMITS (cont.)

Method	Quantitation Limit-Water	Quantitation Limit-Soil/Sediment
Radiological Methods*		
Plutonium-isotopic water-FM-RAD-0010	0.02 pCi/L	N/A
Radium 228--water-FM-RAD-0040	1 pCi/L	N/A
Radium 226--water & milk-FM-RAD-0050	0.1 pCi/L	N/A
Radium 226--soil sediment-FM-RAD-0050	N/A	
Lead-210-FM-RAD-0070	7 pCi/L	
		0.04 pCi/L
Uranium by LASER phosphorimetry-FM-RAD-0120	50 mg/L	
Geotechnical Methods**-FM-GTT-0011 thru FM-GTT-0084		

Notes

N/A - not applicable

* Values listed for radiological methods are nominal sensitivities. Where no values are listed, there is not, currently, sufficient performance data to provide a value. These values will have to be determined as the methods are implemented.

** Specific reporting requirements are included in each geotechnical method in Attachment I.

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Table 3-1 ORGANIZATIONS OPERATING AT FERNALD ENVIRONMENTAL MANAGEMENT PROJECT (JULY 1992)

PRIME OPERATING CONTRACTOR	RI/FS CONTRACTOR
Westinghouse Environmental Management Company of Ohio	**Advanced Sciences, Inc.**
REMEDIAL/REMOVAL DESIGN SUBCONTRACTOR	**TECHNICAL SUPPORT**
Parsons	International Technologies, Inc.
REMEDIAL/REMOVAL ACTION SUBCONTRACTOR	**DRILLING SUPPORT**
Rust Engineering	Pennsylvania Drilling
MISCELLANEOUS SUPPORT	
Executive Resource Associates, Inc.	
Ebasco	
Modern Technologies Corporation	
Theta Technologies	

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Table 3-2 LIST OF LABORATORIES APPROVED FOR FERNALD ENVIRONMENTAL MANAGEMENT PROJECT ANALYSES

Laboratory Name	Analytical Support Level	CLP Contract (Y/N)	Type of Service	Period of Performance	Date Last Audited (mo/yr)	Auditing Organization	Audit Results	Audit Frequency	Type of Analyses	Remarks
IT Corp Radiological Sciences Lab* Oak Ridge, Tennessee	B,E	N/A	Radiological	1987 to present	1991 2/91	ASI WEMCO	Pass Pass		Radiological	
IT Corp Mixed Waste Lab* Oak Ridge, Tennessee	B,C,D	Y	Chemical	1987 to present	1991	ASI	Pass		Organics Inorganics	
IT Corp Middlebrook Pike Lab* Knoxville, Tennessee	B,D	Y	Chemical	1987 to present	7/88	WEMCO			Organics Inorganics	
IT Corp Export Lab* Pittsburgh, Pennsylvania	B,D	Y	Chemical	1987 to present	8/88	WEMCO			Organics Inorganics	
IT Corp Technology Development Lab** Knoxville, Tennessee	E	N	Dioxins Geotechnical	1987 to present	7/88	WEMCO			Treatability Studies	
IT Corp San Jose Lab** San Jose California	B,C	N	Chemical Organo-Phosphorus Pesticides	1989 to present	7/88	WEMCO				
IT Corp Cerritos Lab** Cerritos, California	B,C,D	Y	Chemical	1989 to present	9/88	WEMCO				
IT Corp Austin Lab** Austin, Texas	B,C,D	Y	Chemical	1989 to present	10/88	WEMCO				
IT Corp Cincinnati Lab** Cincinnati, Ohio	B,C,D	Y	Chemical	1980 to present	10/88	WEMCO			Organics Inorganics	

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Table 3-2 LIST OF LABORATORIES APPROVED FOR FERNALD ENVIRONMENTAL MANAGEMENT PROJECT ANALYSES (cont.)

Laboratory Name	Analytical Support Level	CLP Contract (Y/N)	Type of Service	Period of Performance	Date Last Audited (mo/yr)	Auditing Organization	Audit Results	Audit Frequency	Type of Analyses	Remarks
IT Corp St. Louis[xxx] 13715 Rider Trail North Earth City, Missouri 63045 (314) 298-8566	B,C	N	Chemical/Radiochemical	4/30/91 to present	4/91	WEMCO	Pass	6 mos	SW-846 TCLP VOAs TCLP Pesticides/Herbicides TCLP Metals TCLP Semi-VOAs (BNAs) Total VOAs Radiological Screening	
IT Corp Edison Lab[xxx] Edison, New Jersey	B,C,D	N	Acute and Chronic	1989 to present	None	Scheduled				
IT Corp Richland	B,C,E	N	Radiological	5/91 to present	5/91	WEMCO	Pass	6 mos		
Hygeia Waltham, Massachussetts	E	N	Asbestos	3/91 to present	3/91	WEMCO	Pass		Asbestos	
TMA-Norcal Glendale, California	E	N	Radiochemical	1984 to 1988	1987	WEMCO				
Reed Environmental Covington, Kentucky	E	N	Asbestos	1987 to 3/91	1989	WEMCO			Asbestos	
FEMP Lab[xxx] Cincinnati, Ohio	B,E	N	Inorganics Radiological	1987 to present	9/91	WEMCO	Pass			

Table 3-2 LIST OF LABORATORIES APPROVED FOR FERNALD EENVIRONMENTAL MANAGEMENT PROJECT ANALYSES (cont.)

Laboratory Name	Analytical Support Level	CLP Contract (Y/N)	Type of Service	Period of Performance	Date Last Audited (mo/yr)	Auditing Organization	Audit Results	Audit Frequency	Type of Analyses	Remarks
Chem-Nuclear Lab*** 25 Woods Lake Road Greenville, South Carolina 29607 (803) 235-0707	B,C	N	Chemical Radiochemical Physical Testing Treatability Analysis	5/24/91 to present	5/91	WEMCO	Pass	6 mos	SW-846 CLP VOAs TCLP Semi-VOAs (BNAs) TCLP Pesticides/Herbicides TCLP Metals Total VOAS Total Uranium Isotopic Uranium Gross Alpha/Beta Radiological	
TCT - St. Louis*** Twin City Testing Corporation 1908 Innerbelt Business Center Drive St. Louis, Missouri 63114-5700 (314) 426-0880	B,C	Y	Chemical	5/2/91 to present	5/91	WEMCO	Pass	6 mos	SW-846 TCLP VOAs TCLP Semi-VOAs (BNAs) TCLP Pesticides/Herbicides TCLP Metals Total VOAs Total PCBs Total BNAs Total Pesticides/Herbicides Total Metals	
NET Lab*** Dayton, Ohio	B,C	N	Chemical	1987 to present	5/91	WEMCO ASI		Annual		
EcoTek Lab Services, Inc*** 3342 International Park Drive, S.E. Atlanta, Georgia 30316 (404) 244-0827	B,C,D	N	Chemical Radiological	12/90 to present	12/90	WEMCO	Pass		VOAs BNAs Pesticides TCLP Metals Gross Alpha/Beta Total Uranium/Thorium	
Datachem*** Salt Lake City, UT	B,C,D	Y	Radiological/Chemical	9/91 to present	1991	ASI	Pass		Organics Inorganics	

Table 3-2 LIST OF LABORATORIES APPROVED FOR FERNALD ENVIRONMENTAL MANAGEMENT PROJECT ANALYSES (cont.)

Laboratory Name	Analytical Support level	CLP Contract (Y/N)	Type of Service	Period of Performance	Date Last Audited (mo/yr)	Auditing Organization	Audit Results	Audit Frequency	Type of Analyses	Remarks
TMA** Thermo Analytical Inc. Albuquerque, NM 87190-3874 (505) 345-9931	B,C	N	Chemical	1991 to present	1991	WEMCO			Metals VOAs Semi-VOAs BNAs CLP Package RCRA TCLP Mixed Waste Explosives PCBs Pesticides	
TMA/Eberline Alburquerque, NM	B,C	N	Radiological		1991	WEMCO	Pass		Radiochemistry	

Notes

* List of laboratories approved for RI/FS
** List of laboratories requested for RI/FS

Column Definitions

Laboratory Name - Complete laboratory name and affiliated organizations. Street address (no P.O. box numbers), telephone number, and name of laboratory contact shall be kept on file by the FEMP prime contractor.

Analytical Support Level - Analytical Support Level (ASL) (A, B, C, D, or E) for which laboratory is qualified. See Section 2 for ASL definitions.

CLP Contract - Y (yes) indicates that laboratory currently performs analyses under the EPA Contract Laboratory Program (CLP).

Type of Services - Type of services laboratory is qualified to perform for FEMP (e.g., chemical, radiochemical, pesticides)

Period of Performance - Interval during which laboratory has been approved to perform type of analysis listed

Table 3-2 LIST OF LABORATORIES APPROVED FOR FERNALD ENVIRONMENTAL MANAGEMENT PROJECT ANALYSES (cont.)

Column Definitions (cont.)

Date Last Audited - Date (month, year) when laboratory was last audited

Auditing Organization - Organization that performed last audit indicated in preceding column. Include a separate line for each auditing organization (e.g., EPA, DOE, or private laboratory auditors)

Audit Frequency - Frequency of audits per year (minimum required - once per year)

Type of Analyses - Specific types of analyses laboratory is qualified to perform (e.g., Volatile Organic Analyses (VOA), Base Neutrals Analyses (BNA), inorganics)

Remarks - Comments relating to activities within the laboratory that may affect its ability to perform to its qualifications (e.g., probation periods because of failed audits, current EPA investigations)

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Table 3-3 QUALITY ASSURANCE RESPONSIBILITIES

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Quality Assurance (QA) Task	Responsible Organization/Personnel
Overall management	DOE Fernald Office site manager DOE remedial project manager EPA Region V remedial project manager
Preparation of SCQ and supporting documents	FEMP prime operating contractor
Review of SCQ and supporting documents	DOE remedial project manager DOE QA officer for RI/FS EPA Region V QA Section EPA Region V Central Regional Laboratory EPA Region V Central District Office Ohio EPA
Approval of SCQ and supporting documents	DOE Remedial Project Manager DOE QA officer for RI/FS EPA Region V remedial project manager EPA Region V regional QA manager
Internal field surveillances/audits	Designated FEMP QA organization FEMP project managers
External field surveillances/performance audits	EPA Region V Central Regional Laboratory EPA Region V Central District Office Ohio EPA
Internal laboratory audits/surveillances	FEMP site laboratory integration committee Designated FEMP QA organization Laboratory managers
External laboratory audits/surveillances	EPA Region V Central Regional Laboratory
Internal approval of project-specific plans	FEMP project manager Prime operating contractor operable unit manager DOE operable unit manager Contract technical monitor (where applicable) Designated FEMP QA organization FEMP health and safety organization
External approval of project-specific plans	EPA Region V remedial project manager Ohio EPA (Consent Decree activities)
Document control of SCQ and supporting documents	FEMP prime operating contractor

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Table 4-1 SITE TRAINING REQUIREMENTS

Course Title	DOE and Regulatory Driver	Length (hours)	Frequency (years)
Portable Fire Extinguisher[1,2,3,4]	29 CFR 1910.157(g)	1.00	1
You and OSHA[1,2,3,4]	Executive Order 12196 DOE Order 5483.1A	.25	1
Radiation Safety Training[1,2,3,4]	DOE Order 5480.11	5.00	2
Radiation Personnel Monitoring[1,2,3,4]	DOE Order 5480.11	1.00	2
Radiation Worker Hands-On Training[2,3,4]	DOE Order 5480.11	2.00	one time
Nuclear Criticality Safety[1,2,3,4]	DOE Order 5480.5 DOE Order 5480.20	3.00	2
Energy Control-Lock and Tag[1,2,3,4]	29 CFR 1910.147	2.00	if required
Energy Control Awareness[1,2,3,4]	29 CFR 1910.147	.30	one time
Respirator Training and Fit Testing[2,3,4] (Note: Only if required)	DOE Order 5400.10	5.00	Respirator training - annually
	29 CFR 1910.134		Fit testing - Annually/(Non-Asbestos Workers)
	ANSI Z88.2-1980		Fit testing - 6 months/ (Asbestos Workers)

Table 4-1 SITE TRAINING REQUIREMENTS (cont.)

Course Title	DOE and Regulatory Driver	Length (hours)	Frequency (years)
Laboratory Chemical Hygiene Program (Module 1)[1,2,3,4]	29 CFR 1910.1450	1.00	one time
Laboratory Chemical Hygiene Program (Module 2)[1,2,3,4]	29 CFR 1910.1450	2.00	one time
Laboratory Chemical Hygiene Program (Module 3)[1,2,3,4]	29 CFR 1910.1450	2.00	one time
Laboratory Chemical Hygiene Program (Module 4)[1,2,3,4]	29 CFR 1910.1450	1.00	one time
Compliance Training Program, Volume I[2,3,4] Consist of the Following:	40 CFR 264.16 29 CFR 1910.120(e) DOE Order 5480.2 DOE Order 5820.2A DOE Order 5400.1 OCA 3745-54-16 Public Law 93-633	4.00	one time
•Handling, Treatment and Disposal of Hazardous Waste at FEMP			
•Emergency Preparedness/Contingency Plans			
•Transportation of Hazardous/RCRA Waste			

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Table 4-1 SITE TRAINING REQUIREMENTS (cont.)

Course Title	DOE and Regulatory Driver	Length (hours)	Frequency (years)
•Toxicology and Recognition of Physical and Chemical Hazards			
•Lot Marking System at FEMP			
•Overview of Personal Protective Equipment			
•Material Evaluation Forms			
•Handling Drums and Other Containers			
•Emergency Action in the Workplace/CFR			
•Emergency First Aid			
Compliance Training Program, Volume II[2,3,4] Consist of the Following:	40 CFR 264.16 29 CFR 1910.120(e) 29 CFR 1910.1200	8.00	one time
•Overview of 29 CFR 1910.120			
•WEMCO Site Overview & Description			

Table 4-1 SITE TRAINING REQUIREMENTS (cont.)

Course Title	DOE and Regulatory Driver	Length (hours)	Frequency (years)
•Site Control and Characterization			
•Decontamination Procedures			
•General Safety Hazards Overview and Site Illumination and Sanitation			
•Site Health & Safety Plan/Medical Surveillance Program			
•Asbestos Awareness			
•Confined Space Entry			
Field Experience[2,3,4]	29 CFR 1910.120(e)(3)	24.00	one time
Eight-Hour Refresher Training[2,3,4]	29 CFR 1910.120(e)(8) 40 CFR 264.16 (c)	8.00	1
Eight-Hour Supervisor Training[2,3,4]	29 CFR 1910.120(e)(4)	8.00	one time (if required)
Sitewide CERCLA Quality Assurance Project Plan[2,3,4]	DOE Order 5700.6 EPA QAMS-005	TBD	one time

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Table 4-1 SITE TRAINING REQUIREMENTS (cont.)

Note
There are four classifications of workers to determine site training required. These classifications are as follows (the numbers identify the reasons required for each classifications):

1. NON-HAZARDOUS SITE WORKER:
   These employees consist mainly of clerical, budgeting, or accounting employees and the employees who work in personnel functions. These employees' responsibilities normally do not require them to go into the process area or waste sites.

2. OCCASIONAL SITE WORKER:
   These workers are onsite occasionally for a specified limited task such as observation, water monitoring, land surveying, or geophysical surveying. They are unlikely to be exposed over permissible limits. Their work may involve hazardous materials, wastes, and/or substances.

3. SITE WORKER:
   These workers are regularly onsite and work in areas which may involve hazardous materials, substances and wastes. But their regular work areas have been monitored and fully characterized indicating that their exposure is under permissible limits.

4. GENERAL SITE WORKER:
   These employees are onsite for the majority of their work time. They are equipment operators, general laborers, and others involved in operations with hazardous substances. These employees could be exposed to levels above permissible limits, daily or they are involved in planned CERCLA clean-up activities.

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

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Analyte	Container	Preservative	Holding Time	Permissible Sample Type
Radiological Samples in Water				
Total uranium	1,000-mL plastic or glass	HNO_3, pH < 2	6 months[7]	G or C
Radium - 228	1,000-mL plastic or glass	HNO_3, pH < 2	6 months[7]	G or C
Lead - 210	1,000-mL plastic or glass	HNO_3, pH < 2	6 months[7]	G or C
Gross Alpha	1,000-mL plastic or glass	HNO_3, pH < 2	6 months[7]	G or C
Gross Beta	1,000-mL plastic or glass	HNO_3, pH < 2	6 months[7]	G or C
Isotopic uranium	1,000-mL plastic or glass	HCl, 0.5N	6 months[7]	G or C
Isotopic thorium	1,000-mL plastic or glass	HCl, 0.5N	6 months[7]	G or C
Radium - 226	1,000-mL plastic or glass	HCl, 0.5N	6 months[7]	G or C
Gamma scan	1,000-mL plastic or glass	HCl, 0.5N	6 months[7]	G or C
Isotopic neptunium	1,000-mL plastic or glass	HCl, 0.5N	6 months[7]	G or C
Isotopic plutonium	1,000-mL plastic or glass	HCl, 0.5N	6 months[7]	G or C
Radiological Samples in Soil/Sediment				
Radium - 226	8-oz. widemouth glass or sealed plastic bag	None	1 year	G or C
Isotopic thorium	8-oz. widemouth glass or sealed plastic bag	None	1 year	G or C
Isotopic uranium	8-oz. widemouth glass or sealed plastic bag	None	1 year	G or C
Gamma scan	8-oz. widemouth glass or sealed plastic bag	None	1 year	G or C
Radiological Samples - Other Materials				
Radium - 228 in air	Sampling jig	None	1 year	G or C
Radium - 226 in air	Sampling jig	None	1 year	G or C
Isotopic uranium in air	Sampling jig	None	1 year	G or C
Uranium in air	Sampling jig	None	1 year	G or C
Gamma scan in air	Sampling jig	None	1 year	G or C
Gross Alpha, Beta in air	Sampling jig	None	1 year	G or C
Radium - 226 in milk	100-mL plastic or glass	5 mL/liter H_3CCHO	3 months	G or C

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

Analyte	Container	Preservative	Holding Times	Permissible Sample Type
Radiological Samples - Other Materials (cont.)				
Isotopic thorium in milk	100-mL plastic or glass	5 mL/liter H_3CCHO	3 months	G or C
Isotopic uranium in milk	100-mL plastic or glass	5 mL/liter H_3CCHO	3 months	G or C
Gamma scan in milk	100-mL plastic or glass	5 mL/liter H_3CCHO	3 months	G or C
Isotopic thorium in vegetation	Sealed plastic bag	Freeze (< 0°C)	1 year	G or C
Isotopic uranium in tissue/ vegetation	Sealed plastic bag	Freeze (< 0°C)	1 year	G or C
Concentrated Waste Samples				
Organic compounds[A]	8-oz. widemouth glass with Teflon liner	None	6 months	G or C
Metals and other[A] inorganic compounds	8-oz. widemouth glass with Teflon liner	None	6 months	G or C
EP toxicity[B]	8-oz. widemouth glass with Teflon liner	None	6 months	G or C
TCLP	500-mL amber glass with Teflon lined lid	Cool[6]	Organics 14 days Inorganics 28 days	G or C
Flash point and/or[B] heat content	8-oz. widemouth glass with Teflon liner	None	28 days	G
Fish Samples				
Semi volatile compounds,[A] organochlorine chlorine pesticides PCBs, herbicides, organo-phosphate pesticides	Wrap in aluminum foil	Freeze	14/40 days[1]	G or C
Metals and other[A] inorganic compounds except Hg	Place in plastic ziplock bag	Freeze	6 months[8]	G or C

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.) 3882

Parameter	Container	Preservative	Holding Time	Permissible Sample Type
Fish Samples (cont)				
Mercury	Place in plastic ziplock bag	Freeze	28 days	G or C
Liquid - Low to Medium Concentration Samples				
Alkalinity[C]	1-liter polyethylene[2] with polyethylene or polyethylene-lined closure	Cool[6]	14 days	G or C
Acidity[C]	500-mL or 1-liter poly-[2] ethylene with polyethy-lene or polyethylene-lined closure	Cool[6]	Immediate (in field)	G or C
Ammonia	1-liter polyethylene[2] with polyethylene or polyethylene-lined closure	Cool[6] H_2SO_4 to pH <2	28 days	G or C
Bacteriological[C]	250-mL glass with glass closure or plastic capable of being autoclaved	Cool[6]	24 hours	G
Static Bioassay[D]	1-gal. amber glass (not solvent rinsed)	Cool[6]	36 hours	G or C
Biochemical oxygen[C] demand (BOD)	1/2-gal. polyethylene[2] with polyethylene closure	Cool[6]	48 hours	G or C
Chloride[C]	500-mL or 1-liter poly-[2] ethylene with polyethy-lene or polyethylene-lined closure	None	28 days	G or C
Chlorine residual[C]	In-situ (beaker or bucket)	None	24 hours	G
Color[C]	500-mL or 1-liter poly-[2] ethylene with polethy-lene or polyethylene-lined closure	Cool[6]	48 hours	G or C

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

Parameter	Container	Preservative	Holding Time	Permissible Sample Type
Liquid - Low to Medium Concentration Samples (cont.)				
Conductivity[C]	500-mL or 1-liter poly-[1] ethylene with polyethylene or polyethylene-lined closure	Cool[6]	28 days	G or C
Chromium, hexavalent[C]	1-liter polythylene with polyethylene closure	Cool[6]	24 hours	G
Cyanide[C]	1-liter or 1/2 gallon polyethylene with polyethylene or polyethylene lined closure	Ascorbic acid[3,5] sodium hydroxide pH >12 Cool[6]	14 days	G
Dissolved oxygen[C] (probe)	In-situ (beaker or bucket)	None	Imediate (in field)	G
Dissolved oxygen[C] (winkler)	300-mL glass (BOD bottle)	Fix on site, store in dark	24 hours	G
EP toxicity[B]	1-gal. glass (amber) with Teflon liner	Cool[6]	6 months	G or C
Fluoride[C]	500-mL or 1-liter poly-[2] ethylene with polyethylene or polyethylene-lined closure	None	28 days	G or C
Hardness[C]	500-mL or 1-liter polyethylene with polyethylene or polyethylene-lined closure	50% nitric[3] acid pH <2	6 months	G or C
MBAS[C]	500-mL or 1-liter poly-[2] ethylene with polyethylene or polyethylene-lined closure	Cool[6]	48 hours	G or C
Metals[C] except Hg	1-liter polyethylene with polyethylene-lined closure	50% nitric[3] acid pH <2	6 months[8]	G or C

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

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Parameter	Container	Preservative	Holding Time	Permissible Sample Type
Liquid - Low to Medium Concentration Samples (cont.)				
Mercury	1-liter polyethylene with polyehtylene-lined closure	50% nitric[3] acid pH<2	28 days	G or C
Metals, dissolved[C] except Hg	1-liter polyethylene with polyethylene lined closure	Filter-on-site[3] 50% nitric acid pH <2	6 months[8]	G
Mercury	1-liter polyethylene with polyethylene-lined	Filter-on-site[3] 50% nitric acid pH <2	28 days	G
Oil and grease[C]	1-liter widemouth glass with Teflon liner	50% sulfuric[3] acid pH <2 Cool[6]	28 days	G
Semi volatile compounds,[C] organochlorine chlorine pesticides PCBs, herbicides, organo-phosphate pesticides in water				
No residual chlorine[C] present	1-gal. amber glass or 2 1/2-gal. amber glass with Teflon liner	Cool[6]	7/40 days[1]	G or C
Residual chlorine[C] present	1-gal. amber glass or 2 1/2-gal. amber glass with Teflon liner	Add 3 mL 10% sodium thio-sulfate per gallon Cool[6]	7/40 days[1]	G or C
Volatile organic compounds			14 days	
No residual chlorine[C] present	2 40-mL vials with Teflon lined septum caps	4 drops conc. hydrochloric acid Cool[6]	14 days	G

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

Parameter	Container	Preservative	Holding Time	Permissible Sample Type
Liquid - Low to Medium Concentration Samples (cont.)				
No residual chlorine[C] present	2 40-mL vials with Teflon lined septum caps	Cool[6]	7 days	G
Residual chlorine[C] present - drinking water	2 40-mL vials with Teflon lined septum caps	See Note 4	7 days	G
Semi volatile compounds,[C] organochlorine chlorine pesticides PCBs, herbicides, organo-phosphate pesticides	1-gal. glass (amber) or 2 1/2-gal. glass (amber) with Teflon lined closure	Cool[6]	7/40 days[1]	G or C
Organic halogens,[E] total (TOX)	250-mL amber glass with Teflon-lined septum closure	Cool[6]	28 days	G
pH[C]	In-situ (beaker or) bucket	None	Immediate (in field)	G
Total Phenols[C]	1-liter amber glass with Teflon-lined closure	50% sulfuric acid pH <4 Cool[6]	28 days	G
Phosphate-ortho[C]	500-mL or 1-liter poly-ethylene with polethy-lene or polyethylene-lined closure	Filter-on-site Cool[6]	48 hours	G
Phosphorus, total[C] dissolved	500-mL or 1-liter poly-ethylene with polyethy-lene or polyethylene-lined closure	Filter-on-site 50% sulfuric acid pH <2 Cool[6]	28 days	G
Solids, settleable[C]	1/2-gal. polyethylene with polyethylene closure	Cool[6]	7 days	G or C
Solids (total and[C] suspended, etc.)	500-mL or 1-liter poly-[2] ethylene with polyethylene or polyethylene lined closure	Cool[6]	7 days	G or C

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

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Parameter	Container	Preservative	Holding Time	Permissible Sample Type
Liquid - Low to Medium Concentration Samples (cont.)				
Sulfates[C]	500-mL or 1-liter poly-[2] ethylene with polyethylene or polyethylene-lined closure	Cool[6]	28 days	G or C
Sulfides[C]	500-mL or 1-liter poly-[3] ethylene with polyethylene or polyethylene-lined closure	2 mL zinc acetate[3] conc. Sodium hydroxide pH >9 Cool[6]	7 days	G
Temperature[C]	In-situ (beaker or bucket)	None	Immediate (in field)	G
Total dissolved solids	1000-mL polyethylene[2] with polyethylene or polyethylene-lined closure	None	7 days	G or C
Soil, Sediment, or Sludge Samples - Low to Medium Concentration				
Cation exchange capacity	1000-mL polyethylene[2] with polyethylene or polyethylene-lined closure	Cool[6]	6 months	G or C
EP toxicity[B]	8-oz. widemouth glass with Teflon-lined closure	Cool[6]	6 months	G or C
Metals[A] except Hg	8-oz. widemouth glass with Teflon-lined closure	Cool[6]	6 months[8]	G or C
Mercury	8-oz. widemouth glass with Teflon-lined closure	Cool[6]	28 days	G or C
Nutrients[A]- nitrogen, phosphorus, chemical oxygen demand	500-mL polyethylene with polyethylene closure or 8-oz. widemouth glass with Teflon-lined closure	Coolz[6]	28 days	G or C
Total petroleum hydrocarbons	1000-mL glass with Teflon-lined closure	Cool[6] HCl to pH < 2	28 days	G or C

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

Parameter	Container	Preservative	Holding Time	Permissible Sample Type
Soil, Sediment, or Sludge Samples - Low to Medium Concentration (cont.)				
Semi volatile compounds,[C] organochlorine chlorine pesticides PCBs, herbicides, organo-phosphate pesticides	8-oz. widemouth glass with Teflon liner	Cool[6]	14/40 days[1]	G or C
Volatile organic compunds[A]	4-oz. (120-mL) widemouth glass with Teflon liner	Cool[6]	14/40 days[1]	G or C
Other inorganic[A] compounds including cyanide	500-mL polyethylene with polyethylene closure or 8-oz. widemouth glass with Teflon-lined closure	Cool[6]	14/40 days[1]	G or C
TCLP	500-mL amber glass widemouth with Teflon lined-closure 4-oz glass with Teflon-lined closure for VOC	Cool[6]	Organics 14 days Inorganics 6 months	G or C
Total petroleum hydrocarbons	500-mL glass with Teflon-lined closure	Cool[6]	28 days	G or C

Notes

1. For holding times listed as xx/yy days, the first number is the allowed holding time for extraction or preparation of the sample for analysis and the second number is the allowed holding time for analysis of the extract.

2. Use indicated container for single parameter requests, 1/2 gallon polyethylene container for multiple parameter requests except those including BOD, or 1-gallon polyethylene container for multiple parameter request that include BOD.

3. Preserved sample in the field at time of collection.

4. Collect the sample in a 4-ounce soil VOA container that has been pre-preserved with four drops of 10-percent sodium thiosulfate solution. Gently mix the sample and transfer to a 40-mL VOA vial that has been pre-preserved with four drops concentrated HC1. Cool to between 2° and 6° C.

5. Use ascorbic acid only if the sample contains residual chlorine. Test a drop of sample with potassium iodide-starch test paper. A blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper, then add an additional 0.6 grams of ascorbic acid for each liter of sample volume.

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Notes (cont)

6. Cool to the range of 2° to 6° C.

7. Radiochemical holding times are 6 months or 5 half-lives, whichever is shorter.

8. Holding time for Mercury analyses is 28 days.

Table 6-1 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS (cont.)

Abbreviations

G	-	Grab
C	-	Composite
VOA	-	Volatile organic analysis
VOC	-	Volatile organic compound

References

A U.S. EPA Region IV, Environmental Services Division, ***Analytical Support Branch, Operations and Quality Control Manual***, June 1, 1985, or latest version.

B EPA Method 1310, "Extraction Procedures", 1982, SW 846, U.S. EPA, Office of Solid Wastes, Washington, D.C.

C 40 CFR Part 136, Federal Register, Vol, 49, No. 209, October 26, 1984.

D U.S. EPA Region IV, Environmental Services Division, ***Ecological Support Branch, Standard Operating Procedures Manual***, latest version.

E EPA Interim Method 450.1, "Total Organic Halide" U.S. EPA, ORD, EMSL, Physical and Chemical Method Branch, Cincinnati, Ohio, November, 1980.

Table 9-1 METHODS IN THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT LABORATORY ANALYTICAL METHODS MANUAL

No.	Method	Method Number
	Volume 1--Organic and Inorganic Methods	
1	General Requirements	FM-GEN-0010
2	VOCs by GC/MS--Medium Level	FM-ORG-0010
3	BTEX by CG/PID	FM-ORG-0020
4	Pesticides/PCBs by GC	FM-ORG-0030
5	Organophosphorus Pesticides	FM-ORG-0040
6	VOCs by GC--Purge and Trap	FM-ORG-0050
7	SVOCs by GC/MS	FM-ORG-0060
8	Herbicides	FM-ORG-0070
9	VOCs by GC/MS	FM-ORG-0100
10	TCLP	FM-MISC-0010
11	Corrosivity	FM-MISC-0020
12	Flash Point (Ignitability)	FM-MISC-0030
13	Reactivity	FM-MISC-0040
14	Metals by GFAA	FM-INO-0010
15	Metals by Flame AA	FM-INO-0020
16	Metals by ICP	FM-INO-0030
17	Mercury by CVAA	FM-INO-0040
	Volume II--Conventional Methods	
18	Total Cyanide (Spectrophotometric)	FM-CON-0010
19	Total Cyanide (Colorimetric)	FM-CON-0015
20	pH of Soil	FM-CON-0020
21	Nitrogen, Nitrate/Nitrite (Colormetric)	FM-CON-0030
22	Nitrogen, Nitrate/Nitrite (Spectrophotometric)	FM-CON-0040

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Table 9-1 METHODS IN THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT LABORATORY ANALYTICAL METHODS MANUAL (cont.)

No.	Method	Method Number
	Volume II--Conventional Methods (cont.)	
23	Conductivity	FM-CON-0050
24	Total Kjeldahl Nitrogen	FM-CON-0060
25	Total Organic Carbon	FM-CON-0080
26	Alkalinity, Titrametric	FM-CON-0090
27	Alkalinity, Automated Colormetric	FM-CON-0100
28	pH (Electrometric)	FM-CON-0110
29	Chloride (Color, Auto, Ferricyanide)	FM-CON-0120
30	Sulfide	FM-CON-0130
31	Ammonia	FM-CON-0140
32	Hexavalent Chromium	FM-CON-0150
33	Temperature	FM-CON-0160
34	Chloride (Titrametric, Mercuric Nitrate)	FM-CON-0170
35	Oil & Grease (IR)	FM-CON-0175
36	Oil & Grease (Gravimetric)	FM-CON-0180
37	Percent Solids (Moisture)	FM-CON-0190
38	Total Petroleum Hydrocarbons (IR)	FM-CON-0200
39	Total Dissolved Solids	FM-CON-0210
40	Phosphorus	FM-CON-0220
41	Surfactants (MBAS)	FM-CON-0250
42	Phenolics, Total Recoverable (Color)	FM-CON-0260
43	Pheonlics, Total Recoverable (Spectrophotometric)	FM-CON-0270
44	Sulfate (Methylthymol Blue)	FM-CON-0280
45	Sulfate (Turbidimetric)	FM-CON-0290

Table 9-1 METHODS IN THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT LABORATORY ANALYTICAL METHODS MANUAL (cont.)

No.	Method	Method Number
	Volume II--Conventional Methods (cont.)	
46	Fluoride	FM-CON-0300
47	Total Organic Halides (Halogens)	FM-CON-0320
48	Color	FM-CON-0330
49	Oxidation-Reduction Potential	FM-CON-0340
	Volume III--Radiometric and Geotechnical Methods	
50	Plutonium-Filtered Water	FM-RAD-0010
51	Radium 228--Water	FM-RAD-0040
52	Radium 226--Water	FM-RAD-0050
53	Radium 226--Sediment & Milk	FM-RAD-0060
54	Lead	FM-RAD-0070
55	Thorium (Total)	FM-RAD-0080
56	Uranium-Miscellaneous	FM-RAD-0100
57	Uranium--Soil	FM-RAD-0110
58	Uranium by Laser Phosphorimetry	FM-RAD-0120
59	Gross Alpha, Beta	FM-RAD-0130
60	Gamma Spectrometry	FM-RAD-0140
61	Soil Classification (Laboratory)	FM-GTT-0011
62	Soil Classification (Visual)	FM-GTT-0012
63	Transporting Samples	FM-GTT-0013

Table 9-1 METHODS IN THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT LABORATORY ANALYTICAL METHODS MANUAL (cont.)

No.	Method	Method Number
	Volume III--Radiometric and Geotechnical Methods	
64	Wet Preparation of Samples	FM-GTT-0014
65	Dry Preparation of Samples	FM-GTT-0015
66	Moisture Content	FM-GTT-0021
67	Moisture Content (Microwave)	FM-GTT-0022
68	Moisture Correction (Oversize)	FM-GTT-0023
69	Specific Gravity	FM-GTT-0024
70	Volume-Weight Relationships	FM-GTT-0025
71	Grain Size Analysis	FM-GTT-0031
72	Atterberg Limits	FM-GTT-0032
73	Shrinkage Limit	FM-GTT-0033
74	Standard Proctor	FM-GTT-0041
75	Modified Proctor	FM-GTT-0042
76	Maximum (Relative) Density	FM-GTT-0043
77	Minimum (Relative) Density	FM-GTT-0044
78	Consolidation	FM-GTT-0051
79	Unconfined Compression	FM-GTT-0061
80	Direct Shear (Controlled Displacement)	FM-GTT-0062
81	Direct Shear (Controlled Stress)	FM-GTT-0063
82	Triaxial Compression (UU)	FM-GTT-0064
83	Triaxial Compression (CU)	FM-GTT-0065
84	California Bearing Ratio	FM-GTT-0066
85	Permeability (Constant Head)	FM-GTT-0071
86	Permeability (Triaxial)	FM-GTT-0072

Table 9-1 METHODS IN THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT LABORATORY ANALYTICAL METHODS MANUAL (cont.)

No.	Method	Method Number
	Volume III--Radiometric and Geotechnical Methods	
87	BTU Content (Solids)	FM-GTT-0082
88	Ash Content	FM-GTT-0083
89	Organic Content	FM-GTT-0084

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Table 12-1 EXAMPLE AUDIT SCHEDULE

QUALITY ASSURANCE AUDIT SCHEDULE
(2nd quarter, FY '92)

Audit No.: I92-02 - Operable Unit #1 Removal Actions*

Department/Section: Environmental Restoration/Operable Unit 1

Audit Team: Weissenberg, J. F. - Lead Auditor

Beyma, K. N. - Auditor

Harris, M. Q. - Technical Rep.

Audit No.: I92-04 - Project Management

Department/Section: Project Management & Acquisition/Project Management

Audit Team: Malone, M. A. - Lead Auditor

Gilbert, D. D. - Auditor

Murrin, K. P. - Auditor

Sattler, J. M. - Auditor

Audit No.: I92-05 - Environmental Monitoring

Department/Section: Environmental Management/Environmental Monitoring

Audit Team: Ford, F. H. - Lead Auditor

Brice, D. A. - Auditor

Laursen, O. D. - Auditor

Thompson, M. B. - Auditor

Table 12-1 EXAMPLE AUDIT SCHEDULE (cont.)

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QUALITY ASSURANCE AUDIT SCHEDULE
(2nd quarter, FY '92)

Audit No.: I92-06 - Radiological Safety

Department/Section: IRS&T/Radiological Safety

Audit Team: Weissenberg, J. F. - Lead Auditor

Connell, D. E. - Auditor

Lindenschmidt, D. J. - Auditor

Russell, M. L. - Auditor

Note

* Rescheduled

Table 13-1 MINIMUM PREVENTIVE MAINTENANCE FOR COMMONLY USED FIELD EQUIPMENT

Equipment Type	Maintenance	Spare Parts	Minimum Frequency
Photo-inonization detector	Clean lamp	Lamp	40 hours of use
	Charge battery		Daily
	Change filter	Filters	80 hours of use
	Factory service		As needed
Flame-ionization detector	Charge battery		Daily
	Change filter	Filters	80 hours of use
	Check H_2 connections		Daily
	Clean ignitor		As needed
	Factory service		As needed
pH meter	Check battery	Batteries	Daily
	Clean electrode	Electrode	40 hours of use
	Check connectors		With each use
Specific conductance meter	Check battery	Batteries	Daily
	Clean probe	Probe	40 hour of use
	Check connectors		Daily
	Inspect Cable		With each use
Hand-held Beta-Gamma frisker	Check battery	Batteries	Daily
	Clean probe exterior		As needed
	Check connectors		With each use
	Factory service		As needed
Hand-held Alpha frisker	Check battery	Batteries	Daily
	Clean probe exterior		As needed
	Check connectors		With each use
	Factory service		As needed
Dissolved oxygen meter	Check battery	Batteries	Daily
	Clean probe		40 hours of use
	Check cable and connectors		With each use
Explosimeter	Check battery	Batteries	Daily
	Clean sensor		As needed
	Factory maintenance		As needed
Thermometers	Clean and check for cracks		With each use
Electronic water level indicator	Check battery	Batteries	Daily
	Clean probe		As needed
Pressure transducers	Check cables		With each use
	Clean probe		As needed

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Table C-1 SUMMARY OF DATA QUALITY OBJECTIVES SUMMARY FORMS

DQO Number	DQO Title
AR-001	Site Perimeter Radon Sampling
AR-002	Occupational Radiological Air Monitoring
AR-003	Radiological Air Sampling of Stacks
AR-004	Real Time Radon Monitoring - On Site
AR-005	Non-Radiological Occupational Air Sampling
AR-006	Routine Radiological Air Monitoring
BL-001	Fish Sampling - Routine Surveillance
BL-002	Grass Sampling - Routine Surveillance
BL-003	Milk Sampling - Routine Surveillance
BL-004	Meat Sampling - Routine Surveillance
BL-005	Produce Sampling - Routine Surveillance
GW-001	RCRA Ground-water Assessment Sampling
GW-002	Ground-water Sampling - RI/FS
GW-003	Long Term Ground-water Monitoring
GW-004	Monitoring of the FEMP Potable Water Supply
GW-005	Coal Pile Run-off Basin Groundwater Monitoring
GW-006	Sampling at Residences Serviced by Private Ground-water Supply Wells - Metals

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Table C-1 SUMMARY OF DATA QUALITY OBJECTIVES SUMMARY FORMS (cont)

DQO Number	DQO Title
GW-007	Sampling at Residences Serviced by Private Ground-water Supply Wells - Radiological
GW-008	Special Request Sampling of Local Property Owner Water Sources
GW-009	CERCLA Removal Site Evaluation - Ground-water
GW-010	CERCLA Ground-water Removal Action - Phase 1
GW-011	CERCLA Ground-water Removal Action - Phase 2
GW-012	CERCLA Ground-water Removal Action - Phase 3
MS-001	Biological Hazards Assessment
MS-002	Radioactive Contamination Surveys for Offsite Release
MS-003	Bulk Sampling of Potential Asbestos Containing Building Materials (ACBMs)
MS-004	Environmental Radiation Dose Measurements
MS-005	Treatability Studies - Generic
SD-001	Routine Sediment Sampling
SD-002	Sediment Sampling - RI/FS
SL-001	Soil Sampling - Firing Range
SL-002	Soil Sampling - RI/FS
SL-003	Soil Sampling - Routine Surveillance

Table C-1 SUMMARY OF DATA QUALITY OBJECTIVES SUMMARY FORMS (cont)

DQO Number	DQO Title
SL-004	Soil Sampling for Disposal
SW-001	Routine Surface Water Sampling of Paddys Run
WS-002	Drummed Waste Characterization
WS-003	Sampling of Construction Materials for Disposal
WS-004	Sampling of Flyash from Active Deposits and Boiler Plant Waste Stream
WW-001	Storm Water Retention/Emergency Spill Containment Basin (SWRB) Sampling
WW-002	NPDES Compliance Sampling

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Table I-1 SUMMARY TABLE OF OPERATIONAL CALIBRATION REQUIREMENTS

Equipment	Calibration Frequency	Acceptance Limits
pH meter	Daily: two buffers that are three pH units apart	± 0.1 pH units
Specific conductance meter	Daily	3% of full scale over temperature range of -2° C to 40° C with instrument response time no greater than 2.0 minutes
Dissolved oxygen meter	Daily or before each use	0.2 mg/L over water temperature range of -2° C to +40° C with response time no greater than 2.0 minutes
Redox potential meter	Daily	200 to 300 mVolts in ZoBell A solution
Water level indicator	Biannually	± 0.001 ft/10 ft
Thermometer	Annually	± 1° C
Photo-ionization detector	Routine calibration: daily Factory calibration: annually	See paragraph I.4.8
Flame-ionization detector	Routine calibration: daily Factory calibration: annually	See paragraph I.4.9
Explosimeter	Daily	Instrument has a tolerance of 40% (e.g., a reading of 20% lower explosive limit could be as high as 28% or as low as 12%)
Pressure transducers	Annually: return to manufacturer for calibration	± 0.5% at full scale
Radiological Survey Instruments	Annually	Instrument specific requirements based on intended use.

(intentionally left blank)

Table K-1 REPORTABLE QUANTITIES FOR CLASSIFICATION AS A HAZARDOUS MATERIAL

Reportable Quantity [pounds (kilograms)]	Concentration by Weight (percent)	Parts per Million (PPM)
5,000 (2270)	10	100,000
1,000 (454)	2	20,000
100 (45.4)	0.2	2,000
10 (4.54)	0.02	200
1 (0.454)	0.002	20

Source: 49 CFR 171.8, October 1, 1989 Edition

Table K-2 ALLOWABLE SHIPPING QUANTITIES FOR URANIUM DECAY SERIES RADIONUCLIDES

A_1 AND A_2 QUANTITIES FOR RADIONUCLIDES OF THE URANIUM DECAY SERIES

Isotope	Atomic Number	Decay	Half-Life	Quantity in Curies A1	A2
U-238	92	Alpha	4.5×10^9 years	Unlimited	
Th-234	90	Beta	24 days	10	
U-234	92	Alpha	2.5×10^5 years	100	0.1
Th-230	90	Alpha	7.5×10^4 years	3	0.003
Ra-226	88	Alpha	1622 years	10	0.05
Rn-222	86	Alpha	3.8 days	10	2.0
Pb-210	82	Beta	22 years	100	0.2
Bi-210	83	Beta	5 days	100	4.0
Po-210	84	Alpha	138 days	200	0.2

Source: 49 CFR 173.435, October 1, 1989 Edition

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Table K-3 LOW SPECIFIC ACTIVITY CONCENTRATION LIMITS FOR RADIONUCLIDES OF THE URANIUM DECAY SERIES

Nuclide	A2 Value (curies)	Estimated Average Concentration (microcuries/gram)	(curies/kilogram)
Th-230	0.003	0.1	0.0001
Ra-226	0.05	0.1	0.0001
Rn-222	2.0	300	0.3
Pb-210	0.2	5.0	0.005
Bi-210	4.0	300	0.3
Po-210	0.2	5.0	0.005

Table K-4 LABEL SELECTION

Transport Index Category	Radiation Level at Package Surface	Fissile Criteria	Label Category[1]
N/A	RL[2] < 0.5 millirem per hour	Fissile class I only, no fissile class II or III	White - 1
T.I.[3] < 1.0	.05 millirem per hour < RL < 50 millirem per hour	Fissile class I, fissile class II with a T.I. < 1.0, no fissile class III	Yellow - 11
1.0 < T.I.	50 millirem per hour	Fissile Class II with a 1.0 < T.I., Fissile Class III	Yellow - 111

Source: 49 CFR 172.403, October 1, 1989 Edition

Notes

1. Any package containing a highway-route-controlled quantity (49 CFR 173.403) shall be labeled "Radioactive Yellow".

2. Radiation Level

3. Transport Index

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APPENDIX B

FORMS

This appendix contains the forms referred to in Sections 1 through 16. The following forms may be found herein.

Form 4-1.	Document Change Request
Form 5-1.	Example Field Activity Form
Form 5-2.	Example Generic Sample Collection Log Form
Form 7-1.	Analysis Request/Custody Record Form
Form 7-2.	Example Sample Label
Form 12-1.	Example Surveillance Plan and Checklist for Field Performance Audit
Form 12-2.	Example Surveillance Plan and Checklist for Sample Shipment
Form 12-3.	Example Surveillance Plan and Checklist for Ground Water Sampling
Form 12-4.	Example Surveillance Plan and Checklist for Sample Shipment (Receipt by Laboratory)
Form 12-5.	Example Surveillance Plan and Checklist for Monitoring Well Installation
Form 12-6.	Example Surveillance Plan and Checklist for Surface Water Sampling
Form 12-7.	Example Surveillance Plan and Checklist for Subsurface Drilling and Soil Sampling
Form 12-8.	Example Surveillance Plan and Checklist for Field Screening of Samples to be Shipped (Smear Counter)
Form 12-9.	Example Surveillance Plan and Checklist for Field Screening of Samples to be Shipped [NaI (Tl) Detector]

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Form 12-10.	Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist
Form 12-11.	Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items
Form 15-1.	Example Deviation Report
Form 15-2.	Example Corrective Action Report for Field Activities
Form 15-3.	Example Laboratory Corrective Action Report
Form C-1.	DQO Summary Form
Form D-1.	General Validation Checklist for Field Daily Log
Form D-2.	General Validation Checklist for Sample Collection Log
Form D-3.	General Validation Checklist for Chain-of-Custody Record
Form D-4.	General Validation Checklist for Request for Analysis
Form D-5.	General Validation Checklist for Training, Procedures, Audits, Deviations, Surveillances, Variances and Document Change Control
Form D-6.	Specific Validation Checklist for Subsurface Soil Sampling Data
Form D-7.	Specific Validation Checklist for Well Construction and Development Data
Form D-8.	Specific Validation Checklist for Aquifer/Permeability Test (Slug Test) Data
Form D-9.	Specific Validation Checklist for Ground-Water Sampling and Field Analysis Data
Form D-10.	Specific Validation Checklist for Surface Soil Sampling Data

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Form D-11.	Specific Validation Checklist for Surface-Water and Sediment Sampling Data
Form D-12.	Specific Validation Checklist for Radiation Measurement (Node Survey)
Form D-13.	Specific Validation Checklist for Radiation Measurement (Walkover Survey)
Form D-14.	Checklist for Organic Data Validation of ASL B
Form D-15.	Checklist for Inorganic Data Validation at ASL B
Form D-16.	Data Validation Report Form for ASL B Analytical Methods
Form D-17.	Data Validation Checklist for ASL B Gross Alpha and Gross Beta in Water by Proportional Counting
Form D-18.	Checklist for Supplemental Completeness Requirements for Analyses Using Gas Proportional Counters
Form D-19.	Checklist for Supplemental Completeness Requirements for Analyses Using Alpha Spectroscopy
Form D-20.	Checklist for Supplemental Completeness Requirements for Analyses Using Gamma Spectroscopy
Form D-21.	Checklist for Supplemental Completeness Requirements for the Analysis of Alpha-Emitting Ra Isotopes Using Scintillation Counting
Form D-22.	Checklist for Supplemental Completeness Requirements for the Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting
Form D-23.	Checklist for Supplemental Completeness Requirements for Analysis of Tritium Using Liquid Scintillation Counting
Form D-24.	Checklist for Supplemental Completeness Requirements for Fluorometric Analysis of Uranium
Form J-1.	Example Lithologic Log
Form J-2.	Example Well Completion Log

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Form K-1. Example Stack Sampler Inspection Report Form

Form K-2. Example Radiation Stack Monitor Inspection Report Form

Form K-3. Example Final Stack Sampler Results Form

Form K-4. Example Dust Collector Stack Sampling Log Form

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FEMP SCQ
DOCUMENT CHANGE REQUEST

This form is used to initiate permanent change to controlled distribution project-specific procedures.

REQUEST #: _____

Issue Date: _____

Page ___ of ___

Do not write in this block

REQUESTOR: _____ PHONE #: _____ REQUESTED DATE: _____

DCR TITLE: _____ SECTION/PAGE #: _____ REV. DATE: _____

CHANGE JUSTIFICATION:

CONTENT OF CHANGE:

IMPLEMENTATION DATE:

☐ EFFECTIVE DATE: _____

☐ OTHER: _____

REQUIRED APPROVALS:

FEMP PROGRAM/PROJECT MGR - ASI	DATE	OTHERS AS REQUIRED	DATE
QA OFFICER - ASI	DATE		
FEMP PROGRAM/PROJECT MGR - PARSONS	DATE	OTHERS AS REQUIRED	DATE
QA OFFICER - PARSONS	DATE		
FEMP PROGRAM/PROJECT MGR - WEMCO	DATE	DOE COTR	DATE
QA OFFICER - WEMCO	DATE		

TO BE COMPLETED BY DOE

A. Prior EPA notification required?	☐ YES	☐ NO
B. Prior EPA approval required?	☐ YES	☐ NO
C. Immediate Implementation?	☐ YES	☐ NO

DOE FO _____ DATE

Form 4-1. Document Change Request

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FIELD ACTIVITY LOG

Date:	Control Number: 000000	Sheet _____ of _____
Field Team Leader:		Field Team Members:
Project Name:		Project Number:

Time	Description of Activity

Visitors Name: Organization: Time Arrived and Left:	Location: Time Arrived and Left:
Weather Conditions:	Related Field Forms Used:
Supervisor:	Date:

Form 5-1. Example Field Activity Log Form

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FIELD ACTIVITY LOG INSTRUCTIONS

1. Enter the following information on the top portion of the log sheet:
   - Date, and
   - Control Number is preprinted on.
   - Page Numbering.
2. Record the following information before beginning any activities:
   - Field Team Leader,
   - Field Team Members,
   - Project Name, and
   - Project Number.
3. Record all activities with the following information:
   - Time (of activity) and
   - Description of Activity.
4. Record any visitor information such as:
   - Name,
   - Organization, and
   - Time Arrived and Left.
5. Record other activity information such as:
   - Location and
   - Time Arrived and Left.
6. Record other information such as:
   - Weather Conditions and
   - Related Field Forms Used.
7. Have the Supervisor sign and date the Field Activity Log when all information for the log is completed.

Form 5-1. Example Field Activity Log Form Page 2 of 2

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SAMPLE COLLECTION LOG

Date:	Control Number: 000000	Sheet _____ of _____

Sample Team Leader:	Sampling Team Members:
Project Name:	Project Number:

Sample Medium:	Sample Location (Site # or Description):
Time Arrived on Site:	
Time Sample Collection Started:	
Time Sample Collection Finished:	
Time Left Site:	

Field Measurements and Unique Equipment Identification:	Calibration Standards Used: Instrument Calibration Result:

Visual Description of Samples:	Sample Container Type and Size:	Preservatives:	Analytical Parameters:
Weather Conditions and Changes:			

Unusual Occurances:

Form 5-2. Example Generic Sample Collection Log Form

SAMPLE COLLECTION LOG INSTRUCTIONS

1. Enter the following information on the top portion of the log sheet:
   - Date, and
   - Control Number is preprinted.
   - Page Numbering.
2. Record the following information before collecting samples:
   - Sample Team Leader,
   - Sample Team Members,
   - Project Name, and
   - Project Number.
3. Record the following information while collecting samples:
   - Sample Medium,
   - Time Arrived on Site,
   - Time Sample Collection Started,
   - Time Sample Collection Finished,
   - Time Left Site, and
   - Sample Location (Site # or Description).
4. Record the following equipment information:
   - Field Measurements and Unique Equipment Identification,
   - Calibration Standards Used, and
   - Instrument Calibration Results.

Form 5-2. Example Generic Sample Collection Log Form Page 2 of 3

5. Record the following sample information:

- Visual Description of Samples,
- Sample Container Type and Size,
- Preservatives, and
- Analytical Parameters.

6. Record the following other information:

- Weather Conditions and Changes, and
- Unusual Occurrences.

FERNALD SITE
SITE SERVICES - ANALYTICAL
SITE-WIDE ANALYSIS REQUEST/CUSTODY RECORD

(35) Form Number: ____ - ____ - ____
Page (9) ____ of ____

PROJECT: (1)	FOR SAMPLE RELATED PROBLEMS, CONTACT: (10)
☐ PLAN NO.: (2) OR ☐ PROJECT NO.:	ORGANIZATION: (11)
PROJECT MANAGER/ENGINEER: (3)	NAME: (12) PHONE: (13)
SAMPLER: (4) PHONE:	SAMPLER REMARKS: (14)
CHARGE NUMBER: (5) LOT MARKING CODE: (8)	
SAMPLER SIGNATURE(S): (6)	
SEND RESULTS TO: (7)	

(15) (16) (17)
CHECK FOR: ☐ S R LAB ☐ BIO LAB ☐ WTP LAB

SAMPLE SOURCE, DESCRIPTION/IDENTIFICATION, ANALYSIS REGIMEN

(18)	(19) SAMPLE NUMBER	(20) CUSTOMER NUMBER	(21) SAMPLE POINT	(22) MATRIX CODE	COLLECTED (23) DATE	COLLECTED (24) TIME	(25) CONTAINER/ VOLUME	(26) COMPOSITE	GRAB	NO. OF CONTAINERS (27)	ANALYTES CODE - (UNITS CODE) (28)	(29) REMARKS
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

ITEM/REASON	RELINQUISHED BY	RECEIVED BY	DATE	TIME	ITEM/REASON	RELINQUISHED BY	RECEIVED BY	DATE	TIME
(30)	(31)	(32)	(33)	(34)					

NO.	DISTRIBUTION OF COPIES
1	LABORATORY
2	REQUESTER
3	SAMPLER

FMPC-83-3381 (7/10/91)

Form 7-1. Analysis Request/Custody Record Form (Sheet 1 of 8)

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INSTRUCTIONS FOR COMPLETING SITE-WIDE ANALYSIS REQUEST/CUSTODY RECORD FORM PART 1 OF 2

SAMPLING PERSONNEL

Prior to sample collection, obtain a Site-Wide Analysis Request/Custody Record (SAR/CR) form from the FEMP poject contact. If a project-specific plan requires samples to be delivered to more than one sampling receiving area, obtain a separate SAR/CR form for each FEMP laboratory.

Use a black indelible ink pen, applying pressure to ensure good resolution on the copies.

1. Space 1 - Enter project name (e.g., NPDES, drum waste, general sump).

2. Space 2 - Enter plan or project number.

3. Space 3 - Print name of FEMP project manager.

4. Space 4 - Print name and phone number of sampling team leader.

5. Space 5 - Enter account number for charging analysis cost.

6. Space 6 - Sign form. If the sample inventory listed on the SAR/CR represents the efforts of more than one sampler, each sampler shall legibly sign the form using full name.

7. Space 7 - Enter name, organization, and address to which analysis results should be sent.

8. Space 8 - Enter sample batch number.

9. Space 9 - Enter page number of form and total number of pages of form.

10. Space 10 - If problems related to samples arise, complete spaces 11, 12, and 13. If there are no problems, enter N/A (not applicable) in each space.

11. Space 11 - Enter name of group responsible for sampling.

Form 7-1. Analysis Request/Custody Record Form (Sheet 2 of 8)

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12. Space 12 - Enter name of FEMP project contact for answering questions about samples.

13. Space 13 - Enter phone number of person named in space 12.

14. Space 14 - Enter special information that may help analyst (e.g., samples suspected of containing high VOA concentrations).

15. Spaces 15, 16, and 17 - Check applicable laboratory to which sample is transferred.

16. Space 20 - Enter sample identification number.

17. Space 21 - Enter specific location from which samples was taken (e.g., drum number, building number, manhole 175).

18. Space 22 - Enter matrix code for sample analysis (from ***Analysis Code Book***).

19. Space 23 - Enter month, day, and year sample was collected.

20. Space 24 - Enter time (24-hour style) sample was collected.

21. Space 25 - Enter type of container (e.g., glass, plastic) and size of container (e.g., 4-ounce, 1 liter).

22. Space 26 - Check composite or grab column as applicable to each sample listed.

23. Space 27 - Enter total number of containers per sample listed in space 20.

24. Space 28 - Enter analyte code, preservative code, and unit code from the ***Analysis Code Book*** .

25. Space 29 - Use to explain or clarify information about the samples.

26. Space 30 - Reference item numbers in column 18 and provide reason for sample transfer (e.g., for analysis, sampling completed).

27. If the SAR/CR is missing information or the information does not match the samples or the sampling plan, correct the SAR/CR before relinquishing samples to the laboratory.

Form 7-1. Analysis Request/Custody Record Form (Sheet 3 of 8)

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28. If an entry needs to be changed, proceed as follows.

    a. Draw a single line through the entry so that the old data is still legible, enter correct information, and initial and date the change. Do not erase or use white out.

    b. If the change is major, provide a brief statement to explain why the data is being changed or discarded along with initials and date. Use extra sheets if necessary.

29. Deliver/ship the completed SAR/CR along with the samples to the Laboratory.

30. Space 31 - Sign to relinquish to receiver. If the sample inventory listed on the SAR/CR represents the efforts of more than one sampler, each sampler shall legibly sign here using full name.

31. Space 33 - Enter month, day, and year of sample transfer.

32. Space 34 - Enter time (24-hour style) of transfer.

ANALYTICAL LABORATORY

1. Upon receipt of samples from sampling personnel, inspect sample containers for damage.

2. If damage is found, document it in space 29.

3. Check the SAR/CR for completeness and accuracy.

4. If the SAR/CR is complete and accurate, sign the form in space 32.

NOTE

Red ink designates the form as the original.

Form 7-1. Analysis Request/Custody Record Form (Sheet 4 of 8)

5. Assign a form number (space 35) to the SAR/CR form and using red ink, record the form number developed in accordance with the following format.

   Laboratory Name / Calendar Year (2 digits) / Consecutive Number (e.g., SRL-91-0001 would be the first SAR/CR form to arrive in the sample receiving laboratory in the year 1991)

6. Record this number in a controlled, bound log with sequentially numbered pages. Include a brief description of the samples.

7. To transfer or dispose of a sample, obtain the original SAR/CR and complete spaces 30 through 34.

   a. If the sample is being returned to the sampling requestor, enter "return to customer" in space 30.

   b. If the sample requires disposal, enter "disposal" in space 30.

8. Return the original SAR/CR to the project contact.

Form 7-1. Analysis Request/Custody Record Form (Sheet 5 of 8)

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WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO
Sample Processing Laboratory
Site Sample Management

REQUEST FOR ANALYSES/OFF-SITE CUSTODY TRANSFER RECORD

Receiving Laboratory:(1) CLEMSON TECHNICAL CENTER, Inc.
CLEMSON RESEARCH PARK
100 TECHNOLOGY DRIVE
ANDERSON, SC 29625

Release #: (2)
Purchase Order #: 4-13910 (3)
Page 1 of 1
(4) (4a)

Sample Type: (5)

ITEM #	CODE	PHASE	WEMCO LAB NO.	ANALYSIS REQUESTED	DATE SAMPLED	NO. OF SAMPLES
(6)	(7)	(8)	(9)	(10)	(11)	(12)

PROCESS KNOWLEDGE: (13)

***** PHASES: O = SOLID L = LIQUID S = SLUDGE (MIXTURE OF BOTH) *****

WEMCO: The container(s) in which the above samples were packaged were sealed by (14) _____ on DATE with seal #xxxx(15b)
(15a)

RECEIVER: I certify that the seal(s) on the container(s) in which the above samples were packaged were intact when received.

Signature (16) _____ Date (17) _____

NOTE: **If the seal(s) were not intact please contact D. J. Smith at (513) 738-9161 as soon as possible and send a nonconformance report to D. J. Smith. Please return this form to Analytical Data Review & Reporting in the envelope provided.**

Westinghouse Environmental Management Company of Ohio,
P. O. Box 398704 Cincinnati, Ohio 45239-8704

Form 7-1. Analysis Request/Custody Record Form, Part 2 of 2 (Sheet 6 of 8)

INSTRUCTIONS FOR COMPLETING SITE-WIDE ANALYSIS REQUEST/CUSTODY RECORD FORM PART 2 OF 2

FEMP LABORATORY PERSONNEL

1. Space 1 - Enter name and address of off-site analytical laboratory that will receive samples.

2. Space 2 - Enter release number.

3. Space 3 - Enter purchase order number.

4. Spaces 4 and 4a - Enter page number and total number of pages in form.

5. Space 5 - Indicate sample type (composite or grab).

6. Space 6 - Enter item number.

7. Space 7 - Enter matrix code from attached list.

8. Spaces 8 - Enter phase code. (see *** on OCTR.).

9. Space 9 - Enter were laboratory sample ID number.

10. Space 10 - Enter list of Analysis Requested for sample.

11. Space 11 - Enter date sample was collected in the filed. (See SAR/CR).

12. Space 12 - Enter number of sample containers being sent for each sample.

13. Space 13 - Enter any process knowledge information that is known about the samples. (Example: High organics, highly radioactive, etc.)

14. Space 14 - Signature of FEMP personnel that is sealing the container for shipment.

15. Space 15a - Enter date container is sealed.

16. Space 15b - Enter custody seal ID number.

Form 7-1. Analysis Request/Custody Record Form, Part 2 of 2 (Sheet 7 of 8)

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OFF-SITE LABORATORY PERSONNEL

1. Space 16 - Enter signature of off-site laboratory person receiving samples.

2. Space 17 - Enter month, day, and year samples were received.

3. Return original form to person named in NOTE.

4. Maintain copy of form with sample until return to FEMP.

Form 7-1. Analysis Request/Custody Record Form, Part 2 of 2 (Sheet 8 of 8)

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SAMPLE LABEL

PROJECT IDENTIFIER: _____

SAMPLE NUMBER: _____

GRAB OR COMPOSITE: _____

DATE AND TIME SAMPLED: _____

MTL. DESCRIPTION: _____

COLLECTED BY (INITIALS): _____

PRESERVATIVES (IF ANY): _____

ANALYTICAL PARAMETERS: _____

COMMENTS: _____

Form 7-2. Example Sample Label

(intentionally left blank)

SURVEILLANCE PLAN AND CHECKLIST FOR FIELD PERFORMANCE AUDIT

Page 1 of 2

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	COMMENTS
PROJECT RESPONSIBILITIES			
Was the PSP prepared?			
Was a briefing held for project participants?			
Were additional instructions given to project participants?			
SAMPLE COLLECTION			
Is there a written list of sampling locations and descriptions?			
Are samples collected as stated in the PSP?			
Are samples collected in the type of containers specified in the PSP?			
Is sample equipment available, calibrated, and in proper working order?			
Are samples preserved as specified in the PSP?			
Are the number, frequency, and type of samples collected as specified in the PSP?			

Form 12-1. Example Surveillance Plan and Checklist for Field Performance Audit (sheet 1 of 2)

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SURVEILLANCE PLAN AND CHECKLIST FOR FIELD PERFORMANCE AUDIT

Page 2 of 2

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	COMMENTS
SAMPLE COLLECTION - cont.			
Are quality assurance checks performed as specified in the PSP?			
DOCUMENT CONTROL			
Have any accountable documents been lost?			
Have any accountable doucuments been voided?			
Have any accountable documents been disposed of?			
Are the samples identified as specified in the PSP?			
Are blank and duplicate samples properly identified?			
Are samples listed on a chain-of-custody record?			
Is chain-of-custody documented and maintained?			

Evaluator Signature: Date:

Form 12-1. Example Surveillance Plan and Checklist for Field Performance Audit (sheet 2 of 2)

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SURVEILLANCE PLAN AND CHECKLIST FOR SAMPLE SHIPMENT

Page 1 of 3

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Sample Receipt and Scanning				
Chain-of-custody signed by sample coordinator?				
General inventory taken:				
* Number of pieces correct?				
* Label complete, legible?				
* pH taken?				
* Leakage?				
* Tightness of lid?				
* Security tape affixed?				
Sulphites preserved with zinc acetate and pH > 12 checked?				
Were the sample bottles placed in clear plastic bags?				
Were samples individually checked with an ESP monitor for number of decays?				
Was the number of decays logged in the log book?				

Form 12-2. Example Surveillance Plan and Checklist for Sample Shipment (sheet 1 of 3)

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SURVEILLANCE PLAN AND CHECKLIST FOR SAMPLE SHIPMENT

Page 2 of 3

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Were samples placed in refrigerator for 12 to 24 hours?				
Sample Packing Procedure				
Were sample bottles placed in a controlled 4±2°C?				
Were coolers pre-cooled for 10 to 15 minutes?				
Were the bottom of coolers line with blue ice?				
Were the bottom of coolers filled with 1 to 2 inches of vermiculite above the blue ice?				
Were samples placed in coolers in such a manner to minimize contact between bottles?				
Was blue ice placed between bottles?				
Was vermiculite filled to sample lids?				
Was vermiculite pressure packed?				
Was blue ice laid on top of pressure packed vermiculite?				
Was vermiculite filled to top of coolers?				

Form 12-2. Example Surveillance Plan and Checklist for Sample Shipment (sheet 2 of 3)

SURVEILLANCE PLAN AND CHECKLIST FOR SAMPLE SHIPMENT

Page 3 of 3

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Was billing number put on C of C and RFA?				
Were C of C and RFA placed inside the coolers?				
Were coolers secured with duct tape?				
Were coolers secured with custody tape, initialed and dated?				
Final Shipment Process				
Were coolers weighed for shipment?				
Were appropriate shipping labels put on coolers?				
Were outside of the coolers scanned with micro-R meter prior to shipment?				
Was bill of the lading acquired by sample coordinator?				

ADDITIONAL COMMENTS:

Date:

Evaluator Signature:

Form 12-2. Example Surveillance Plan and Checklist for Sample Shipment (sheet 3 of 3)

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SURVEILLANCE PLAN AND CHECKLIST FOR GROUND WATER SAMPLING

Page 1 of 6

ORGANIZATION
PROJECT _____
LOCATION _____

Surveillance No.
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
I. Organic Vapor Detection				
Photoionization detector calibrated?				
Did the sampler check the air in the well head for organic vapors using photoionization detector?				
Section I Comments				
II. Measurement of STATIC Water Level Elevation				
Was the M-Scope decontaminated?				
Was the sampler wearing gloves?				
Was the water level in the well measured and recorded?				
Was the total depth of the well measured?				
Was the M-scope graduated to .01 foot?				
Section II Comments				

Form 12-3. Example Surveillance Plan and Checklist for Ground Water Sampling (sheet 1 of 6)

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SURVEILLANCE PLAN AND CHECKLIST FOR GROUND WATER SAMPLING

Page 2 of 6

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
III. Well Evacuation				
Did the sampler calibrate the instruments (pH, temperature, dissolved O_2, specific conductance, and others as per plan)?				
Did the sampler calculate the quantity of water to be evacuated and record the calculation on the sample log?				
Sample lines decontaminated?				
Did the sampler use gloves?				
Did the sampler evacuate three volumes of water from the well, or evacuate dry if a low-volume well?				
Did the sampler have a reliable method of determining the amount of water evacuated (i.e., flowmeter or graduated tank)?				
Did the sampler measure general water quality parameters (pH, temperature, dissolved O_2, and specific conductance) while evacuating the well, and record the readings on the sample log?				
If the well was pumped/bailed dry, were general water quality parameter measurements taken as soon as the well recharged?				

Form 12-3. Example Surveillance Plan and Checklist for Ground Water Sampling (sheet 2 of 6)

SURVEILLANCE PLAN AND CHECKLIST FOR GROUND WATER SAMPLING

Page 3 of 6

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Upon completion of well evacuation, did the sampler measure general water quality parameters and record the readings?				
Did the sampler document the time the well was evacuated?				
Section III Comments				
IV. Sample Withdrawal				
Prior to sampling, did the sampler put on new gloves?				
Did the sampler document the time the sample was collected on the sample log?				
Were the sample devices decontaminated?				
Did the sampler take precautions to ensure that contaminated surfaces did not come into contact with equipment that was inserted into the well (i.e., putting down plastic sheeting)?				
Were the sample devices approved sample equipment?				
Were the sampling devices dedicated to the well?				

Form 12-3. Example Surveillance Plan and Checklist for Ground Water Sampling (sheet 3 of 6)

SURVEILLANCE PLAN AND CHECKLIST FOR GROUND WATER SAMPLING

Page 4 of 6

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
If a positive gas displacement bladder pump was used for the sampling, and volatile constituents were being sampled, was the flow rate reduced to approximately 100 milliliters/minute (after the volatiles are collected, the rate may be increased)?				
Was the pump operated in a continuous manner?				
If a bailer was used for sampling, did the sampler lower it slowly into the well?				
Was the sample transferred to the sample container in a way that minimized agitation and aeration?				
Did the sampler collect the samples in the following order: volatile organics (VOA); total organic halogens (TOX); total organic carbons (TOC); total metals; dissolved metals; phenols; cyanide; sulfate and chloride; nitrate and ammonia, and radionuclides?				
Did the sampler use a bailer to collect the volatile organics (VOA)?				

Form 12-3. Example Surveillance Plan and Checklist for Ground Water Sampling (sheet 4 of 6)

SURVEILLANCE PLAN AND CHECKLIST FOR GROUND WATER SAMPLING

Page 5 of 6

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
When sampling for volatiles, did the sampler fill the sample container so that no headspace existed (i.e., air bubbles), precluding the escape of volatiles from the sample?				
Did the sampler open only one sample container at a time?				
Did the sampler document on the sample log the climatic conditions at the time the sample was collected?				
Section IV comments				
V. Decontamination				
If sampling equipment was not dedicated to well sampled, did the sampler decontaminate the equipment?				
Did the sampler follow the procedure prescribed in the SCQ?				
After decontamination, did the sampler store the equipment in sealed plastic to ensure that equipment is not contaminated prior to reuse?				
Did the sampler submit an equipment blank (decontamination rinseate sample) for analysis?				

Form 12-3. Example Surveillance Plan and Checklist for Ground Water Sampling (sheet 5 of 6)

SURVEILLANCE PLAN AND CHECKLIST FOR GROUND WATER SAMPLING

Page 6 of 6

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Did the sampler transport a trip blank during the sampling event?				
Section V comments				

ADDITIONAL COMMENTS:

Evaluator Signature:	Date:

Form 12-3. Example Surveillance Plan and Checklist for Ground Water Sampling (sheet 6 of 6)

SURVEILLANCE PLAN AND CHECKLIST FOR SAMPLE SHIPMENT RECEIPT BY LABORATORY

Page 1 of 2

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Was custody tape around the cooler intact upon arrival?				
Was temperature of samples checked and at 4±2°C?				Actual Temperature:
Was there damage or leakage to the samples upon arrival?				
Were the chain-of-custody forms and RFAs inside the cooler upon arrival?				
Were the sample numbers correctly matched against the RFA and chain-of-custody forms?				
Have holding times been met during the shipment process?				
Was the chain-of-custody signed upon receiving samples?				
Were samples placed in adequate storage (4±2°C?)				
Was sample information inventoried? (See below)				
* Project identification numbers				
* Sample numbers				
* Type of samples				

Form 12-4. Example Surveillance Plan and Checklist for Sample Shipment Receipt by Laboratory (sheet 1 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR SAMPLE SHIPMENT RECEIPT BY LABORATORY

Page 2 of 2

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Was sample receipt acquired?				

ADDITIONAL COMMENTS:

Evaluator Signature:	Date:

Form 12-4. Example Surveillance Plan and Checklist for Sample Shipment Receipt by Laboratory (sheet 2 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR MONITORING WELL INSTALLATION

Page 1 of 2

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Once the boring is advanced to the desired depth, was the stainless steel screen and casing set in such a manner to minimize the introduction of contaminants into the subsurface soil and groundwater?				
Was the following equipment decontaminated?				
* Well casing				
* Screen				
Was the sandpack placed at the proper height?				
Was a sandpack of five feet above the screen used for 3000- and 4000-series wells?				
Was the annular space filled to the surface with volclay grout?				
Was the temporary casing removed gradually and were the backfill materials placed in such a manner that the bottom of the temporary casing was kept below the top of the backfill material?				
Was a five-foot bentonite pellet plug placed on top of the sandpack on the 1000- and 2000-series wells?				

Form 12-5. Example Surveillance Plan and Checklist for Monitoring Well Installation (sheet 1 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR MONITORING WELL INSTALLATION

Page 2 of 2

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Was a protective casing consisting of 10-inch iron pipe set in concrete to 30 inches and a concrete apron?				
Was the protective casing fitted with a hinged cap, hasp, and lock? Was a drain hole drilled in the oversleeve one foot above the land surface.				
Was a measuring point notch filed on the inner casing and the top of the casing finished with a vented stainless steel cap, or an air-tight cap and a vent hole not more than six inches from the top of the casing?				
Was the well ID number welded into the top of the protective casing?				
Was the well ID number painted on the inside lid and sides of the protective casing?				
Was the grout seal installed between the riser pipe and protective casing to a height of six inches above ground surface?				

ADDITIONAL COMMENTS:

Date:

Evaluator Signature:

Form 12-5. Example Surveillance Plan and Checklist for Monitoring Well Installation (sheet 2 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR SURFACE WATER SAMPLING

Page 1 of 2

Surveillance No. _____
DATE _____

ORGANIZATION _____
PROJECT _____
LOCATION _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Was the sample taken from location with respect to the information desired and in conformity to local conditions?				
Were areas where visible surface debris or artificial turbulence is present avoided during sampling?				
Is sample location situated away from possible contamination source?				
Was a decontaminated "Grab Bottle" used for sample collection?				
Was sampler standing downstream during collection?				
Was the technique specified in the SCQ used?				
Did the sampler calibrate the instruments (pH, temperature, dissolved O_2, and specific conductance)?				
Did the sampler collect the samples in the following order: volatile organics (VOA); total organic halogens (TOX); total organic carbons (TOC); total metals; dissolved metals; phenols; cyanide; sulfate and chloride; nitrate and ammonia, and radionuclides?				

Form 12-6. Example Surveillance Plan and Checklist for Surface Water Sampling (sheet 1 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR SURFACE WATER SAMPLING

Page 2 of 2

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Were the VOAs collected 12 inches below surface of water?				
Were VOAs immediately filled after collection?				
When sampling for volatiles, did the sampler fill the sample container so that no headspace existed (i.e., air bubbles), precluding the escape of volatiles from the sample?				
Did the sampler document on sample log the climatic conditions at the time the sample was collected?				

ADDITIONAL COMMENTS:

Evaluator Signature:

Date:

Form 12-6. Example Surveillance Plan and Checklist for Surface Water Sampling (sheet 2 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR SUBSURFACE DRILLING AND SOIL SAMPLING

Page 1 of 2

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Has all sampling equipment been decontaminated prior to its use?				
Has all sampling equipment been stored properly to prevent contamination?				
Are sample collectors changing gloves between samples?				
Is sampling equipment being decontaminated properly between use?				
Are adequate sample volumes being collected?				
Are VOA sample bottles filled with minimum head space?				
Are split spoon samples scanned with a PID immediately after opening?				
Are soils being described properly?				
Are soil description logs complete?				
Are sample bottles labeled properly and sealed with chain-of-custody tape?				

Form 12-7. Example Surveillance Plan and Checklist for Subsurface Drilling and Soil Sampling (sheet 1 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR SUBSURFACE DRILLING AND SOIL SAMPLING

Page 2 of 2

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Are sample labels covered with clear tape?				
Are samples placed in a pre-chilled cooler and maintained at 4 degrees C (±2°C)?				
Are empty bottles, samples, and coolers kept secure and in sight at all times?				
Have field blanks and trip blanks been collected?				
Have rinseates been collected for every 20 sample sets?				
Has the chain-of-custody form been filled out properly?				
Has the sample collection log been completed?				
Has the field activity log been maintained?				
If no well was installed, was the borehole properly abandoned?				

ADDITIONAL COMMENTS:

Evaluator Signature:

Date:

Form 12-7. Example Surveillance Plan and Checklist for Subsurface Drilling and Soil Sampling (sheet 2 of 2)

SURVEILLANCE PLAN AND CHECKLIST FOR FIELD SCREENING OF SAMPLES TO BE SHIPPED (SMEAR COUNTER)

Page 1 of 1

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Has the smear source and background check been performed on the beta smear counter?				
If the samples were taken from inside the process area, is there a radiological survey report accompanying them?				
Did the technician smear approximately 100 cm^2 of outer surface of each sample container?				
Was each smear counted for a minimum of one minute?				
Was each sample determined to be < 100 dpm above background?				
Was the smear data recorded on the usage log?				

ADDITIONAL COMMENTS:

Evaluator Signature:

Date:

Form 12-8. Example Surveillance Plan and Checklist for Field Screening of Samples to Be Shipped (Smear Counter)

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SURVEILLANCE PLAN AND CHECKLIST FOR FIELD SCREENING OF SAMPLES TO BE SHIPPED [NaI (Tl) DETECTOR]

Page 1 of 1

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	NA	COMMENTS
Has a source and background check been performed on the NaI (Tl) detector?				
Were the samples placed firmly in front of the NaI (Tl) detector?				
Were the samples counted for one minute?				
Was the counting activity recorded on the NaI (Tl) count log?				
Were count rates for U-natural or U-depleted ($R_{,}$) ≤ 3400 cpm or radium and progeny ≤ 9000 cpm?				
If not, were proper adjustments or sample for net count rate made?				

ADDITIONAL COMMENTS:

Evaluator Signature: | Date:

Form 12-9. Example Surveillance Plan and Checklist for Field Screening of Samples to Be Shipped [NaI (Tl) Detector]

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ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 1 of 17

Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
1. ORGANIZATION		
1.1 Organization structured in a manner to consistently document activities affecting quality.		
+ Functional responsibility assignments.		
+ Levels of authority defined and provide sufficient independence from cost and schedule considerations.		
+ Lines of communication open between all levels of Management/Anl Personnel.		
1.2 Responsibility assigned for assuring that an appropriate QA program has been established and maintained through defined verification activities.		
+ Assignments are at appropriate levels of authority.		
AND + Assignee(s) have appropriate access to work areas.		
TO + Identify and help solve quality problems.		
+ Verify implementation of solutions.		
AND + Assure further processing or use is controlled until proper disposition of a nonconformance deficiency or condition adverse to quality.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 1 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC		SAT./ UNSAT.	COMMENTS
1.	ORGANIZATION - Cont.		
1.3	Persons/organizations identified in 1.1 and 1.2 have direct access to responsible management at a level where appropriate actions can be affected.		
1.4	Persons/organizations identified in 1.1 and 1.2 have sufficient independence from cost and schedule considerations.		
1.5	Individuals/organizations responsible for establishing and executing the QA program IAW DOE Order 5400.XY who have delegated any or all of the work to others, have retained responsibility.		
1.6	External interfaces between organizations and internal interfaces within the organizational units are documented; with changes maintained.		
1.7	Interface responsibilities have been defined and documented.		
2.	QUALITY ASSURANCE PROGRAM		
2.1	A documented QA program has been planned, implemented and maintained IAW DOE Order 5400.XY.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 2 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
2. QUALITY ASSURANCE PROGRAM - Cont.		
2.2 The QA program provides a guide for planning, accomplishment and control of activities affecting quality to an extent consistent with their importance by:		
+ Using appropriate equipment (including equipment used to analyze organic samples).		
+ Providing suitable environmental conditions for accomplishing the activity.		
+ Providing assurance that prerequisites for the given activities have been satisfied.		
2.3 The Anl Laboratory QA program provides for verification analyses quality by routine assessments of QA program implementation.		
2.4 The QA program provides for indoctrination and training of personnel performing activities affecting quality to assure that suitable proficiency is achieved and maintained.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 3 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
2. QUALITY ASSURANCE PROGRAM - Cont.		
+ Assignment of responsibility for selection, training and qualification of Anl personnel.		Title(s)
+ Assignment of responsibility for implementing training and qualification of Anl personnel.		Title(s)
+ Anl personnel are indoctrinated and trained to assure proficiency is achieved and maintained to an extent consistent with the job requirements.		Example(s)
2.5 Personnel qualification record files have been established and maintained.		Example(s)
3. DESIGN CONTROL		
3.1 Design of facilities related to MW certification (including Anl work) must reflect standards for treatment appearing in Title 40 CFR 268.		
3.2 Design of facilities for MW Anl work must consider requirements for sampling analysis and data control required by EPA-SW-846.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 4 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
4. PROCUREMENT DOCUMENT CONTROL		
4.1 Procurement documents issued for Anl equipment, parts and supplies are tracked and records maintained pertaining to schedule performance and quality of items delivered.		
When required by purchaser, procurement documents issued at all tiers include provisions for the following:		
4.2 Scope of Work		
+ Statement(s) outlining work to be performed.		
4.3 Technical Requirements		
+ Requirements are specified in procurement documents.		
+ Where necessary, requirements are specified by reference to specific drawings, specifications codes, standards, regulations, procedures, or instructions that describe items/services needed.		
+ Procurement documents provide for identification of certification, test, inspection and acceptance requirements.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 5 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
4. PROCUREMENT DOCUMENT CONTROL - Cont.		
4.4 Quality Assurance Requirements		
+ To the extent necessary, quality assurance requirements are incorporated in subtier procurement documents.		
4.5 Right of Access		
+ Procurement documents provide for access to Supplier's plant facilities, at each tier of procurement, for inspection of records of audit activities as authorized by purchaser.		
4.6 Procurement Document Review		
+ Review of procurement documents and changes are made to assure documents transmitted to suppliers include provisions required to satisfy specific needs.		
+ Reviews are performed by personnel having access to pertinent information and have adequate understanding of the requirements and intent of the procurement documents.		
4.7 Procurement document changes are subject to the same degree of control utilized for original documents.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 6 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 7 of 17

Date _____

Supplier Identification _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
5. INSTRUCTIONS, PROCEDURES, DRAWINGS		Refer to checklist items 8.3, 8.5, 9.3, 9.4, 9.5, 9.6, 9.7, 10.1, 13.2 and 17.9.
5.1 Activities affecting quality are prescribed and performed IAW documented instructions, SOPs, or drawings, as appropriate.		
5.2 Documents shown in Item 5.1 include or reference quantitative and qualitative acceptance criteria.		
6. DOCUMENT CONTROL		
6.1 Preparation, issue and change of documents that specify quality requirements or prescribe activities affecting quality are controlled to assure correct documents are available locally, where used.		
6.2 Document controls include:		
+ Identification of documents to be controlled.		
+ Identification of personnel, positions, or organizations responsible for preparing, reviewing, approving and issuing documents.		
+ Document changes are subject to same degree of review and control utilized for original documents.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 7 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 8 of 17

Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
7. CONTROL OF PURCHASE ITEMS AND SERVICES		
7.1 Procurement activities (items or services) are controlled to assure conformance with specified requirements.		
7.2 Supplier selections are based on evaluation of their capability to provide items or services IAW procurement document requirements.		
7.3 Interfaces are established with suppliers to verify acceptable performance by:		
+ Establishing an understanding between Purchaser and Supplier of the provisions and specifications of the procurement document(s).		
+ Identifying and processing necessary change information.		
+ Establishing the extent of source surveillance and inspection activities.		
+ By establishing an understanding that Purchaser verification activities do not relieve the Supplier from responsibility for self-verification of quality achievement.		
7.4 Activities performed to verify conformance to requirements of procurement documents are recorded.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 8 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
7. CONTROL OF PURCHASE ITEMS AND SERVICES - cont.		
7.5 Whenever Anl services are being procured, Purchaser bases acceptance on any or all of the following:		
+ Technical verification of data produced.		
+ Surveillance and/or audit of supplier activities.		
+ Review of objective evidence for conformance to procurement document requirements such as certification and document validations.		
7.6 Purchaser and Supplier have established and documented methods for disposition of items/services that do not meet procurement document requirements.		
7.7 Purchaser maintains records of Supplier(s) nonconformances.		
8. IDENTIFICATION AND CONTROL OF ITEMS		
8.1 Standards used are labeled and dated with discard date.		
8.2 Samples are labeled and dated throughout lab processes.		
8.3 Chain-of-Custody defined and implemented throughout lab.		
8.4 All standard solutions are traceable back to stock solutions.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 9 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 10 of 17

Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
8. IDENTIFICATION AND CONTROL OF ITEMS - cont.		
8.5 Procedures established and implemented for preparation and labeling of standards.		
9. CONTROL OF PROCESSES		
9.1 Training records maintained for all Anl personnel.		
9.2 Up-to-Date resumes maintained for all Anl personnel.		
9.3 Internal controlled procedures are maintained for all Anl methods used.		
9.4 Internal controlled procedure is maintained for receipt, storage and distribution of samples.		
9.5 Internal controlled procedures maintained include disposal of samples and Anl process waste.		
9.6 Sample accountability procedure(s) are controlled and provide assurance that regulatory limits are not exceeded.		
10. INSPECTION		
10.1 Internal controlled procedures are implemented that include verification of final data reports (cross checking transcription and calculations).		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 10 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Date _____

Supplier Identification _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
10. INSPECTION - cont.		
10.2 Persons checking or validating data must be someone other than the person performing the work.		
11. TEST CONTROL		
11.1 Acceptance criteria defined for instrument calibration and standardization.		
11.2 Instrument calibration schedules defined, implemented and documented.		
11.3 All procedures are qualified, when required.		
11.4 Records maintained are traceable to procedure/method used to perform any given analysis.		
12. CONTROL OF MEASURING AND TEST EQUIPMENT		
12.1 PM schedules for instruments and equipment are established and maintained.		
12.2 PM logs are maitained for each instrument.		
12.3 PMs, as a minimum, are maintained as specified by instrument and equipment manufacturers		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 11 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
12. CONTROL OF MEASURING AND TEST EQUIPMENT - cont.		
12.4 Calibration schedules are specified and maintained for intruments and materials used to control ovens, balances, water supplies and refrigeration equipment.		
12.5 Calibration records/logs are maintained and readily accessible for major instruments and are traceable to samples analyzed.		
12.6 Out-of-calibration devices are tagged or isolated from use.		
12.7 Calibration methods are defined based on type of equipment, stability characteristics, required accuracies, and intended use.		
12.8 When instruments are identified out-of-calibration, evaluations are made/documented to determine validity of previous data.		
13. HANDLING, STORAGE, AND SHIPPING		
13.1 Storage facilities, including refrigeration equipment, are adequate.		
13.2 Sample preservation is performed according to established procedures, when required.		
13.3 Positive handling/tracking systems are used to control samples during the analytical process.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 12 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
14. INSPECTION, TEST, AND OPERATING STATUS		
14.1 Positive methods are used to ensure that sample holding times are not violated.		
14.2 Positive methods are used to ensure that equipment and process status indicators are used for information transfers during operation/analyst changes.		
14.3 Refrigeration equipment monitored daily for compliance.		
14.4 Authority for application and removal of non-conformance tags and markings are specified.		
14.5 Control charts are maintained and used for controlling individual lab procedures and performance tracking.		
15. CONTROL OF NON-CONFORMING ITEMS		
15.1 Items that do not conform to specified requirements are controlled to prevent inadvertant installation or use.		
15.2 Non-conforming items are legibly identified by marking or tagging.		
15.3 Non-conforming items are segragated, when practical, by placing them in clearly identified and designated hold areas until properly dispositioned.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 13 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 14 of 17

Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
15. CONTROL OF NON-CONFORMING ITEMS - cont.		
15.4 Non-conforming characteristics are reviewed and recommended dispositions are proposed and approved IAW documented procedures.		
15.5 Further processing or use of non-conforming items is controlled pending an evaluation and approved disposition by authorized personnel.		
15.6 Technical justifications are provided whenever dispositions are acceptable for use "as is" or repair work is performed.		
16. CORRECTIVE ACTIONS		
16.1 Conditions adverse to quality are identified promptly and corrected on a timely basis.		
16.2 Identification, cause and corrective action for significant conditions adverse to quality are documented and reported to appropriate levels of management.		
16.3 Follow-up actions are taken to verify implementation of corrective actions.		
17. QUALITY ASSURANCE RECORDS		
17.1 Records systems are defined and implemented IAW documented procedures or instructions.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 14 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

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Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
17. QUALITY ASSURANCE RECORDS - cont.		
17.2 Records that furnish documentary evidence of quality are specified.		
17.3 Records are legible, identifiable and retrievable.		
17.4 Requirements and responsibilities for records transmittal, distribution, retention, maintenance and disposition are established and documented.		
17.5 Documents considered to be "validated" (verified that QA and procedural requirements are met) have been marked by authorized personnel or otherwise authenticated.		
17.6 Records/indexing system(s) provide sufficient information to permit identification between the record and items/activities which apply.		
17.7 Corrections to records include date and ID of person authorized to issue/make corrections.		
17.8 Records are stored in predetermined locations that meet the requirements and intent of the contract.		
+ Records maintained by a Supplier at the Supplier's facility or other location are accessable to the Purchaser or the Purchaser's representative.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 15 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 16 of 17

Supplier Identification _____ Date _____

CHARACTERISTIC	SAT./ UNSAT.	COMMENTS
17. QUALITY ASSURANCE RECORDS - cont.		
17.9 Records storage/distribution procedures include:		
+ Methods for verifying that records received are in agreement with transmittal and chain-of-custody documents.		
+ Rules governing access to and control of record files.		
+ Control methods for maintaining accountability for records removed from storage.		
18. AUDITS		
18.1 Planned and scheduled internal and external audits are performed to verify compliance with QA program requirements to determine program effectiveness.		
18.2 Audits are performed IAW written procedures or checklists by personnel who do not have direct responsibility performing the activities being audited.		
18.3 QA audit personnel have experience or training commensurate with the scope, complexity, or special nature of the activities being audited.		

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 16 of 17)

ANALYTICAL SERVICES FOR CHARACTERIZATION OF SAMPLES FOR RCRA HAZARDOUS/MIXED WASTE CONSTITUENTS
PRE-AWARD SURVEY AND/OR AUDIT CHECKLIST

Page 17 of 17

Supplier Identification _____ Date _____

CHARACTERISTIC		SAT./ UNSAT.	COMMENTS
18.	AUDITS - cont.		
18.4	Audit results are documented and reported to and reviewed by responsible management.		
18.5	Follow-up/verification actions are taken where indicated.		

ADDITIONAL COMMENTS:

Evaluator Signature: Date:

Form 12-10. Example Analytical Services for Characterization of Samples for RCRA Hazardous/Mixed Waste Constituents Pre-Award Survey and/or Audit Checklist (sheet 17 of 17)

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SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 1 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE RECEIPT					
Log in procedures on sample logs					
Sampling tracking (internal/external)					
Variance reports/procedures (condition on receipt)					
Work area isolation					
Chain of possession					
Transfer to labs, etc. opening?					
Sample storage/disposal					
Worker protection, safety procedures					
Inspection of receiving area					
SAMPLE PREP					
Isolation of labs, work areas					
- Routines					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 1 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 2 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE PREP - cont.					
- Metals					
- Organics (extractable)					
- VOAs					
- Others					
- Isolation/storage of samples					
Storage of prepared samples/extracts					
- Delivery to analysis					
Variance reports procedures					
Glassware and Cleanup					
- Conditions					
- Use of Class A glassware					
- Wash procedures					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 2 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 3 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE PREP - cont.					
- Glassware blanks					
Prep blanks					
QUALITY CONTROL SECTION					
QA officer - not in lab chain of command					
QC sample prep MS/MSD					
- Separate area?					
- Quality of SRMs used					
- QC records (precision/accuracy)					
- Lab					
- Operator					
- Parameter					
- Non compliance actions/documentation					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 3 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 4 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
QUALITY CONTROL SECTION - cont.					
- Records maintained					
- Inspection of records and work area					
- Blind samples to labs					
- Std checks					
QA manual - review					
SOPs for operations and safety					
MSDS/safety information					
Library of lab reference documents					
- Methods of analysis					
- QAPPs					
- Use of Class A glassware					
- SOPs					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 4 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 5 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE ANALYSIS					
Separation/condition of laboratories					
- Routines - Extractables					
- Inorganic - Volatile					
- RAD - Other					
- Biological					
Separation of equipment					
Condition of equipment					
- Daily calibration logs					
- Maintenance logs, routine					
- Injection logs					
- Repair logs, non-routine					
- Equipment updates					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 5 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 6 of 10

ORGANIZATION _____ Surveillance No. _____
PROJECT _____ DATE _____
LOCATION _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE ANALYSIS - cont.					
- Service agreements					
- Spare parts on hand					
- Original manufacturer spares					
- OEM from secondary suppliers					
- AA lamps					
- GC columns and supplies					
- Other					
- Instrument calibration procedures					
- AA					
- GC					
- ICP					
- GC/MS					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 6 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 7 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE ANALYSIS - cont.					
- Survey of equipment available for lab use					
- Dedicated use?					
- Multi use?					
- Multiple GC, GC/MS, AA, GFAA					
- Condition of laboratories					
- Education, training of personnel					
- Familiarity with procedures/methods					
- Instrument calibration procedures					
QA review					
- Compliance with holding time requirements					
- Return for re-analysis within holding times					
- Statistics evaluated and/or improved					
- Corrective procedures					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 7 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 8 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
SAMPLE ANALYSIS - cont.					
Data evaluation for QC compliance					
CLP package - review contents/assembly					
Data storage					
Review of data entry for errors					
RADIOLOGICAL					
NRC permits to handle radioactive materials					
SAMPLE DISPOSAL					
Procedures used					
Waste disposal contractor (Y/N)					
Handling/storage procedures					
Safety and training					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 8 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 9 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
CLP SPECIFIC QC PARAMETERS					
Instrument detection limits					
- Organics					
- Inorganic					
- Other parameters					
Initial/continuing calibration				Inorganic	
- Inorganic - every 10 samples					
Blank evaluation					
ICP interference check samples (min. 8 hrs.)					
Matrix spike/matrix spike duplicates					
Laboratory control samples (metals)					
Std. addition for AA					
CLP, specific QC parameters					
Serial dilutions for ICP					

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 9 of 10)

SURVEILLANCE PLAN AND CHECKLIST FOR LABORATORY AUDIT - CLP

Page 10 of 10

ORGANIZATION _____
PROJECT _____
LOCATION _____

Surveillance No. _____
DATE _____

SURVEILLANCE REQUIREMENT	YES	NO	CHECK	SOP	COMMENTS
DFTPP/BFB calibration (min. 12 hrs.)				Organics	
Surrogate spike recoveries					
Matrix spike/matrix spike duplicate analyses					
Blank evaluation					
Initial and continuing calibration (RF, %RDS, %D)					
Internal Std evaluation					
- Pesticide/PCB analysis					
- DDT RT > 12 in. and within RT windows					
- DDT/Endrin TTL breakdown < 20%					
- RT Shift for DBC < 2%					

ADDITIONAL COMMENTS:

Evaluator Signature: Date:

Form 12-11. Example Surveillance Plan and Checklist for Laboratory Audit for CLP Items (sheet 10 of 10)

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DR NO.:	DEVIATION REPORT	REVISION:

1

Date of Discovery: _____ Responsible Organization: _____

Responsible Organization Representative: _____

Activity: _____ Location: _____

2

Requirement(s): _____

Deviation: _____

Verbally Notified Management: _____ (DATE) Prepared by: _____ _____ (DATE)

Is Corrective Action Report Required? ☐ Yes ☐ No Provide Disposition by: _____ (DATE)

Evaluator: _____ Date: _____

3

Is the Deviation Reportable under OR? ☐ *Yes (OR No. _____) ☐ No

**If yes, proceed in accordance with PR-FMPC-4006 and close this DR.*

Disposition: ☐ Accept-As-Is ☐ Rework ☐ Repair ☐ Reject ☐ Other

Accept-As-Is/Repair Justification: _____

_____ Scheduled Completion Date: _____

Responsible Organization's Representative: _____ Date: _____

4 Evaluation of Disposition:

Evaluator: _____ Date: _____

5 Verification of Disposition Action Completion:

Evaluator: _____ Date: _____

Form 15-1. Example Deviation Report (sheet 1 of 2)

DEVIATION REPORT (DR) - INSTRUCTIONS

PREPARER - COMPLETE SECTION 1 AND 2 AS FOLLOWS	
ITEM	INSTRUCTIONS
DATE OF DISCOVERY	Enter date that deviation was discovered.
RESPONSIBLE ORGANIZATION	Enter the organization responsible for the item or activity in which a deviation is discovered.
RESPONSIBLE ORGANIZATION'S REPRESENTATIVE	Enter name of the representative responsible for disposition/corrective action.
ACTIVITY	Enter activity performed. (Example Audit 189-1)
LOCATION	Location of the activity (Example Plant 6)
REQUIREMENTS	Identify the procedure, instruction, standard, or code which establishes the acceptance criteria for the activity or item being evaluated.
DEVIATION	Fully describe the deviation as it relates to the requirements.
VERBALLY NOTIFIED MANAGEMENT	List the date that the responsible organization's management was verbally notified of the potential deviation.
PREPARED BY	The preparer signs and dates for Section 2.

EVALUATOR - COMPLETE SECTION 2 AND HEADING AS FOLLOWS	
IS CORRECTIVE ACTION REPORT REQUIRED	Evaluate deviation for issue of a Corrective Action Report. Check "Yes" if required, or "No" if not required.
DR NO.	Obtain and enter on the DR Form a DR Number from the Computer DR Data Base or from the Administrator, Deviation Control and Corrective Action.
REVISION	Enter the current revision number 0, 1, etc.
PROVIDE DISPOSITION BY DATE	Request the organization deemed responsible to provide dispositioning action by a certain date outlining steps taken or planned to correct immediate problem.
EVALUATOR	Sign and date Section 2 of the DR form.

RESPONSIBLE ORGANIZATION REPRESENTATIVE - COMPLETION OF DISPOSITION ACTION SECTION 3	
IS DEVIATION REPORTABLE UNDER OR	Evaluate the deviation in accordance with PR-FMPC-4006 for Occurrence Reporting and check the appropriate block. If an OR is required, sign off Section 3 as complete and foward back to Evaluator.
DISPOSITION	For DRs not reportable as an OR, check the appropriate block for Accept-as-is, Rework, Repair, Reject or Other and indicate the appropriate disposition in the space provided. If disposition is Accept-as-is or Repair, provide a technical justification.

EVALUATOR - COMPLETION OF THE RECEIPT AND EVALUATION OF PROPOSED DISPOSITIONS SECTION 4
Receive and evaluate the proposed corrective action to determine its adequacy for solving the specific problem identified in the deviation report, which includes verification that a decision has been made, by the Manager of the organization responsible, as to whether the deviation is reportable in accordance with PR-FMPC-4006 for Occurrence Report (OR). If the "Yes" box is checked, the responsible organization proceeds with the reportability process in accordance with PR-FMPC-4006 and the DR can be closed based upon the issue of a OR.
Document acceptance of the proposed disposition in Block 4 by signature and date.
Notify the organization responsible for disposition action of the rejection of the proposed disposition action and coordinate with the organization to obtain a revised response.

EVALUATOR - COMPLETION OF THE VERIFICATION AND CLOSURE OF DISPOSITION ACTION SECTION 5
Monitor the disposition and verify that the actions taken to correct the deviation have been completed satisfactorily.
Approve acceptance of verified disposition in Section 5 by signature and date.
Ensure the removal of nonconforming item tag(s) only after verifying satisfactory completion of all dispositioning actions.
Forward the closed out deviation report (DR) to the Administrator, Deviation Control and Corrective Action with a copy to responsible organization management.

Form 15-1. Example Deviation Report (sheet 2 of 2)

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CAR NO.:	CORRECTIVE ACTION REPORT	REVISION:

1

Date of Discovery: _____ Responsible Organization: _____

Responsible Organization Representative: _____

Activity: _____ Location: _____

2

Requirement(s): _____

Deviation: _____

Verbally Notified Management: _____ (DATE) Evaluator: _____ _____ (DATE)

Provide Disposition by: _____ (DATE) Evaluating Manager: _____ _____ (DATE)

3 Response to the Request for Corrective Action:

Is the Deviation Reportable under OR? ☐ *Yes (OR No. _____) ☐ No

**If yes, proceed in accordance with PR-FMPC-4006 and close this CAR.*

A. Reason for the Deviation (Root Cause): _____

B. Action Taken/Proposed to Investigate and Correct Similar Work: _____

C. Action Taken to Prevent Recurrence: _____

D. Date(s) Action(s) will be Complete: _____

Responsible Organization's Representative: _____ Date: _____

4 Evaluation of Corrective Action Response:

Evaluator: _____ Date: _____

Evaluating Manager: _____ Date: _____

5 Verification of Corrective Action Completion:

Evaluator: _____ Date: _____

FS-ECAOA-2909 -1 (8/18/91)

Form 15-2. Example Corrective Action Report for Field Activities (sheet 1 of 2)

CORRECTIVE ACTION REPORT (CAR) - INSTRUCTIONS

EVALUATOR - COMPLETE SECTION 1 AND 2 AS FOLLOWS	
ITEM	**INSTRUCTIONS**
DATE OF DISCOVERY	Enter date that corrective action was discovered to be required.
RESPONSIBLE ORGANIZATION	Enter the organization responsible for the item or activity in which a corrective action is required.
RESPONSIBLE ORGANIZATION'S REPRESENTATIVE	Enter name of the representative responsible for corrective action.
ACTIVITY	Enter activity performed. (Example Audit I89-1)
LOCATION	Location of the activity (Example Plant 6)
REQUIREMENTS	Identify the procedure, instruction, standard, or code which establishes the acceptance criteria for the activity or item being evaluated.
DEVIATION	Fully describe the deviation as it relates to the requirements.
VERBALLY NOTIFIED MANAGEMENT	List the date that the responsible organization's management was verbally notified of the potential deviation.
CAR NO.	Obtain and enter on the CAR Form a CAR Number from the Computer CAR Data Base or from the Administrator, Deviation Control and Corrective Action.
REVISION	Enter the current revision number 0, 1, etc.
PROVIDE DISPOSITION BY DATE	Request the organization deemed responsible to provide dispositioning action by a certain date outlining steps taken or planned to correct immediate problem.
EVALUATOR	Sign and date Section 2 of the CAR form.
EVALUATING MANAGER	Obtain the concurrence of the Evaluator's Manager.

RESPONSIBLE ORGANIZATION REPRESENTATIVE - COMPLETION OF DISPOSITION ACTION SECTION 3	
Evaluate deviations for reportability under the occurrences reporting system. See PR-FMPC-4006, Occurrence Reporting (OR)	
A. REASON FOR THE DEVIATION (ROOT CAUSE)	Determine the underlying (root) cause of the problem and document it in Section 3A of the CAR form.
B. ACTION TAKEN/PROPOSED TO INVESTIGATE AND CORRECT SIMILAR WORK	If necessary, perform an investigation to determine if any similar work is affected by the problem and, if so, identify the action taken/proposed and the schedule to correct it in Section 3B of the CAR form.
C. ACTION TAKEN TO PREVENT RECURRENCE	Describe action taken/proposed to correct the root cause and to prevent recurrence of the problem in Section 3C of the CAR form.
D. DATE(S) ACTION(S) WILL BE COMPLETE	Enter the scheduled completion date for corrective action in Section 3D.

EVALUATOR - COMPLETION OF THE EVALUATION OF CORRECTIVE ACTION RESPONSE SECTION 4
Receive and evaluate the proposed corrective action to determine its adequacy for solving the specific problem identified in the deviation report, which includes verification that a decision has been made, by the Manager of the organization responsible, as to whether the deviation is reportable in accordance with PR-FMPC-4006 for Occurrence Report (OR). If the "Yes" box is checked, the responsible organization proceeds with the reportability process in accordance with PR-FMPC-4006 and the CAR can be closed based upon the issue of an OR.
Document acceptance of the proposed disposition in Block 4 by signature and date.
Notify the organization responsible for disposition action of the rejection of the proposed disposition action and coordinate with the organization to obtain a revised response.

EVALUATOR - COMPLETION OF THE VERIFICATION AND CLOSURE OF DISPOSITION ACTION SECTION 5
Monitor the disposition and verify that the actions taken to correct the deviation have been completed satisfactorily.
Approve acceptance of verified disposition in Section 5 by signature and date.
Ensure the removal of nonconforming item tag(s) only after verifying satisfactory completion of all dispositioning actions.
Forward the closed out corrective action report (CAR) to the Administrator, Deviation Control and Corrective Action with a copy to responsible organization management.

Form 15-2. Example Corrective Action Report for Field Activities (sheet 2 of 2)

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Westinghouse Environmental Management Company of Ohio

Fernald Site
Analytical Laboratories
NONCONFORMANCE MEMO

Log Number: AnL-

Filed By | Date

Samples Affected

Area:
☐ SLR ☐ Organic ☐ AAS/ICP ☐ EPM ☐ Isotopic ☐ Bioassay
☐ Spectroscopy ☐ QC ☐ Contract Lab (Specify _____)

NONCONFORMANCE (Check appropriate item(s))

1. ☐ Not enough sample received for proper analysis
2. ☐ Sample received:
   ☐ Broken ☐ Without proper preservative
   ☐ In improper container ☐ With incomplete paperwork/chain-of-custody
3. ☐ Holding time exceeded.
   ☐ At receipt ☐ In the lab by _____ days
4. ☐ Sample lost during extraction/analysis; no re-prep or re-analysis possible
5. ☐ QC data reported to client outside of:
   ☐ Method ☐ Internal ☐ Regulatory limits
   ☐ Associated samples affected _____
6. ☐ Incorrect preparation/analysis procedure(s) used; no re-prep or re-analysis possible
7. ☐ Samples analyzed and reported under an invalid calibration
8. ☐ Incorrect/Incomplete data reported to client
9. ☐ Blank contamination; no re-prep of associated samples possible
10. ☐ Reported detection limits higher than specified due to:
    ☐ Matrix ☐ Insufficient sample ☐ Instrumentation
    ☐ Other _____
11. ☐ Other (specify) _____

CORRECTIVE ACTION

☐ Client informed verbally on: | By:

☐ Client informed in writing on: | By:

☐ Sample(s) processed "as is." Comments:

☐ Sample(s) on hold until: | If released, notify:

Corrective action initiated/performed by: | Date:

Group manager's concurrence: | Date:

QC Concurrence: ☐ Nonconformance ☐ Deficiency | Date:

PROPOSED CORRECTIVE ACTION APPROVAL

☐ Approved ☐ Cannot approve | Reason:

QC Coordinator: | Date:

Form 15-3. Example Laboratory Corrective Action Report (sheet 1 of 2)

☐ Proposed Corrective Action:	
Performed By:	Due Date:
☐ Underlying Root Cause:	
Performed By:	Due Date:
☐ Actions to Prevent Recurrence:	
Performed By:	Due Date:
Responsible Manager:	Due Date:
QA Concurrence:	Due Date:
Corrective Action Performed By:	Date:
CORRECTIVE ACTION COMPLETED	
Laboratory Director:	Date:
CORRECTIVE ACTION VERIFICATION	
☐ Verified ☐ Cannot Verify Reason:	
NCR Closure: QC Coordinator:	Date:

Form 15-3. Example Laboratory Corrective Action Report (sheet 2 of 2)

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DQO SUMMARY FORM

Revision: **Page 1 of 3**
Effective Date:

1.A. Task/Description: OU #: _____

1.B. Project Phase: (Circle the appropriate selection.)

RI FS RD RA R,A OTHER (specify) _____

1.C. DQO No.: ____ DQO Reference No.: _____

2. Media Characterization: (Circle the appropriate selection.)

Air Biological Groundwater Sediment Soil

Waste Waste water Surface water Other (specify) _____

3. Data Use with Analytical Support Level (A-E): (Circle the appropriate Analytical Support Level selection(s) beside each applicable Data Use.)

Site Characterization A B C D E Risk Assessment A B C D E Evaluation of Alternatives A B C D E Engineering Design A B C D E Monitoring during remediation activities A B C D E
Other A B C D E (Explain) _____

4.A. Drivers:

4.B.Objective:

5. Site Information (Description):

Form C-1. DQO Summary Form (sheet 1 of 8)

DQO SUMMARY FORM

Revision: **Page 2 of 3**
Effective Date:

DQO Number: _____

6.A. Data Types with appropriate Analytical Support Level Equipment Selection and SCQ Reference: (Place an "X" to the right of the appropriate box or boxes selecting the type of analysis or analyses required. Then select the type of equipment to perform the analysis if appropriate. Please include a reference to the SCQ Section.)

1. pH _
   Temperature _
   Specific Conductance _
   Dissolved Oxygen _

2. Uranium _
   Full Radiologic _
   Metals _
   Cyanide _
   Silica _

3. BTX _
   TPH _
   Oil/Grease _

4. Cations _
   Anions _
   TOC _
   TCLP _
   CEC _
   COD _

5. VOA _
   ABN _
   Pesticides _
   PCB _

6. Other (specify)
   _____

6.B. Equipment Selection and SCQ Reference:

Equipment Selection		Refer to SCQ Section
ASL A	_____	SCQ Section: _____
ASL B	_____	SCQ Section: _____
ASL C	_____	SCQ Section: _____
ASL D	_____	SCQ Section: _____
ASL E	_____	SCQ Section: _____

7.A. Sampling Methods: (Circle the appropriate selection.)

Biased Composite Environmental Grab Grid

Intrusive Non-Intrusive Phased Source

Other (specify): _____

Form C-1. DQO Summary Form (sheet 2 of 8)

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DQO SUMMARY FORM

Revision: **Page 3 of 3**
Effective Date:

DQO Number: _____

7.B. Sample Work Plan Reference: (List the samples required. Reference the work plan or sampling plan guiding the sampling activity, as appropriate.)

Background samples: _____ _____

7.C. Sample Collection Reference: (Please provide a specific reference to the SCQ Section and subsection guiding sampling collection procedures.)

Sample Collection Reference: _____

---

8. Quality Assurance/Control Samples: (Place an "X" to the right of the appropriate selection(s).)

8.A. Field Quality Assurance Samples:

Trip Blanks _ Container Blanks _
Field Blanks _ Duplicate Samples _
Equipment Rinsate Samples _ Split Samples _
Preservative Blanks _ Performance Evaluation Samples _
Other (specify) _ _____

8.B. Laboratory Quality Control Samples:

Method Blank _ Matrix Duplicate/Replicate (Matrix Spike _ Duplicates)
Matrix Spike _ Surrogate Spikes _

Other (specify) _
_____

9. Other: Please provide any other germane information that may impact the data quality or gathering of this particular objective, task or data use.

Form C-1. DQO Summary Form (sheet 3 of 8)

DQO SUMMARY FORM

INSTRUCTIONS FOR COMPLETING THE DATA QUALITY OBJECTIVE SUMMARY FORM

These instructions are provided to assist in completing the DQO summary form. Each section and section element is explained as it appears on the form. The DQO summary form shall be completed using the information and logic flow statements explained in Appendix C.

SECTION 1

Section 1A

Task/Description - Provide concise description of the task (e.g., RCRA ground water sampling).

OU# (Operable Unit Number) - Identify the operable unit where the sampling will occur. (See SCQ Section 2 for a description of OUs.)

Section 1B

Project Phase - Identify the work phase for which the data will be used. More than one phase may be circled because data generated by a sampling and analysis activity may support more than one phase of the project. If **OTHER** is used, provide an explanation (e.g., RCRA detection monitoring).

Explanations of acronyms

RI - Remedial Investigation

FS - Feasibility Study

RD - Remedial Design

RA - Remedial Action

R$_v$A - Removal Action

Form C-1. DQO Summary Form (sheet 4 of 8)

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Section 1C

DQO No. - Enter the number assigned to this particular DQO. It will be assigned by the FEMP sampling and analysis management coordinator of the prime operating contractor.

DQO Reference No. - Identify all other DQOs that are related to the DQO being prepared.

SECTION 2

Media Characterization - Specify the medium being investigated. Only one medium will be considered per DQO. If other media are sampled to support a work phase, a separate DQO for each medium and sampling activity shall be prepared. If **OTHER** is used, include an explanation.

SECTION 3

Data Use with Analytical Support Level (A-E) - Identify data use by activity and the Analytical Support Levels (ASL)s specified for generation of data. (ASLs are described in SCQ Section 2.) More than one activity or ASL may be indicated because an activity may be required to generate data from field measurements to laboratory analysis. Each discrete task requires a separate evaluation of its respective ASL. If **other** is used, include an explanation.

Explanations of terminology

- **Site Characterization** - Determination of the level, extent and location of contamination
- **Risk Assessment** - Endangerment assessment or public health evaluation
- **Evaluation of Alternatives** - Evaluation or screening of remedial alternatives
- **Engineering Design** - Detailed engineering design of remedial actions for the site
- **Monitoring** - During remediation activities, monitoring remedy implementation or establishing baseline conditions for long term monitoring after site remediation

Form C-1. DQO Summary Form (sheet 5 of 8)

SECTION 4

Section 4A

Regulatory Drivers - Identify regulatory drivers and Applicable or Relevant and Appropriate Requirements (ARAR) associated with the task.

Section 4B

Objective - Provide a clear, concise statement of the reason for the sampling activity (e.g., 1991 amended Consent Agreement requirement, RCRA monitoring, waste characterization). Include imminent health risks associated with sampling effort.

SECTION 5

Site Information - Identify information required to gain an overview of the site and the relative complexity and extent of data requirements. Briefly describe the physical setting, dimensions, and current use of the site.

SECTION 6

Section 6A

Data Types, Analytical Support Level, Equipment Selection, and SCQ Reference - Specify data requirements for establishing the type, degree, extent, and migration characteristics of the contaminants and the required site characteristics.

Explanation

- **Analytical Parameters 1 - 6** - Describe the necessary analysis to acquire data necessary to satisfy task requirements by data quality level and analysis activity. (Full radiological includes uranium.)

  The list of analytes and **other** category are completed according to data requirements.

Section 6B

Equipment Selection and SCQ Reference (ASLs A through E with SCQ) - Identify equipment required to analyze sample parameters and corresponding reference to that equipment by analytical method in Attachment I, the FEMP Laboratory Analytical Methods Manual.

Form C-1. DQO Summary Form (sheet 6 of 8)

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SECTION 7

Section 7A

Sampling Methods - Identify appropriate sampling methods for acquiring required data in accordance with task objectives, including methods for determining sample collection location, frequency, and type, but not the physical collection of the sample.

Explanations

- **Biased** - Sampling of a specific site area, characteristic, or problem factor based upon site knowledge and/or modeling
- **Composite** - A mixture of a number of grab samples to represent the average properties of the parameters of concern over the extent of the area sampled
- **Environmental** - Media sampling of air, water, soils, and biological environment to determine the extent of contamination
- **Grab** - Discrete samples that are representative of a specific location at a specific point in time
- **Grid** - Unbiased sampling that provides a representative estimate of the contamination problem over the entire site
- **Intrusive** - Physically extracting samples from the media being sampled
- **Non-intrusive** - Obtaining data using methods and equipment that do not require physical extraction of material from the media being sampled
- **Phased** - Performing discrete time-phased sampling events and using the information obtained in the previous event to refine the subsequent sampling event
- **Source** - Sampling of actual contamination source

Section 7B.

Sampling Work Plan Reference - Identify the appropriate project-specific plan.

Form C-1. DQO Summary Form (sheet 7 of 8)

Section 7C

Sample Collection Reference - The procedures to be used in obtaining the required samples are to be defined. The requirement of obtaining background samples is to be provided. This section references the appropriate sample collection procedures and methods to insure the integrity and defensibility of the samples required to satisfy the objective of the task.

SECTION 8

Quality Assurance/Control (QA/QC) Samples - Identify minimum standards for field QA and laboratory quality control samples. Definitions and use of QA samples are defined in SCQ Section 4. Required frequencies of QA/QC samples are specified for each ASL in Table 2-2 (Appendix A). If the number of samples to be collected is not specified, define the frequency in the project-specific plan.

Section 8A

Field QC Samples - Identify QA/QC samples required for sample integrity and data defensibility to be taken in the field.

Section 8B

Laboratory QC Samples - Identify QA/QC samples required for sample integrity and data defensibility to be analyzed at the analytical laboratory.

SECTION 9

Other - Provide other information relevant to the DQO process.

Form C-1. DQO Summary Form (sheet 8 of 8)

GENERAL VALIDATION CHECKLIST	TITLE: DAILY FIELD LOG	
PROJECT:		
SAMPLE/I.D.:	DATE:	Page __ of __

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Project Name and Number				
Field Activity Subject and Date				
Work Activity				
Unusual Events				
Changes to Plans and Specifications				
Visitor(s) on Site				
Weather Conditions				
Subcontractor Progress				
Communication With Agencies				
Personnel on Site				
Important Phone Calls				
Supervisor Signature and Date				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

Form D-1. General Validation Checklist for Field Daily Log

(intentionally left blank)

GENERAL VALIDATION CHECKLIST	TITLE: SAMPLE COLLECTION LOG	
PROJECT:	DATE:	Page __ of __
SAMPLE/I.D.:		

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Unique Sample Number				
Sample Location				
Collector Signature				
Date and Time Sample Collected				
Sample Coordinates				
Sample Identification				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

Form D-2. General Validation Checklist for Sample Collection Log

(intentionally left blank)

GENERAL VALIDATION CHECKLIST	TITLE: CHAIN OF CUSTODY	
PROJECT:	DATE:	Page __ of __
SAMPLE/I.D.:		

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Project Name/Number				
Laboratory Destination				
Sample Team Members				
Carrier/Waybill Number				
Sample Number				
Sample Location and Description				
Date and Time Collected				
Sample Type				
Container Type				
Disposal Record Number				
Condition on Receipt				
RA Control Number				
C/C Control Number				
Signature(s)				
Original Returned from Laboratory				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

Form D-3. General Validation Checklist for Chain-of-Custody Record

(intentionally left blank)

GENERAL VALIDATION CHECKLIST	TITLE: REQUEST FOR ANALYSIS	
PROJECT:	DATE:	Page __ of __
SAMPLE/I.D.:		

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
R/A Control Number				
C/C Control Number				
Project Name and Number				
Date Samples were Shipped				
Laboratory Destination and Lab Contract				
Unique Sample Number				
Sample Type				
Sample Volume				
Preservative				
Requested Testing Program				
Applicable Special Instruction				
Turnaround Time Indicated				
Possible Hazard ID Indicated				
Original R/A Returned to Laboratory				
Correspondence to Laboratory Report				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

Form D-4. General Validation Checklist for Request for Analysis

(intentionally left blank)

GENERAL VALIDATION CHECKLIST				TITLE: TRAINING,PROCEDURES,AUDITS,NONCONFORMANCES, SURVEILLANCES, VARIANCES, DOCUMENT CHANGE CONTROL
PROJECT:				
SAMPLE/I.D.:				DATE: Page __ of __
CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Procedures approved at the time of data collection, document change requests				
Personnel trained to procedures and document change requests				
Instruments calibrated at the time of collection				
The following items require QA Verification:				
Impact on data by site audits, nonconformances, variances, or surveillances				
Deficient Characteristics flagged for Database				
Any variances that may impact data:				
REVIEWED BY: DATE:				CONCURRENCE BY: DATE:

Form D-5. General Validation Checklist for Training, Procedures, Audits, Deviations, Surveillances, Variances, and Document Change Control

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST	TITLE: SUBSURFACE SOIL SAMPLING	
PROJECT:		
SAMPLE/I.D.:	DATE:	Page __ of __

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Boring Log Complete and Accurate?				
Sample Numbers on Sample Collection Log correspond to Boring Log?				
Calibration Records Log?				
Is the Sample Collection Log Complete and Correct?				
Is the Chain-of-Custody Complete and Correct?				
Is the Request For Analysis Complete and Correct?				
Is the Daily Log Complete and Correct?				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

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Form D-6. Specific Validation Checklist for Subsurface Soil Sampling Data

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST	TITLE: WELL CONSTRUCTION AND DEVELOPMENT	
PROJECT:	DATE:	Page __ of __
SAMPLE/I.D.:		

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Monitoring Well Installation Details Schematic Complete and Correct?				
Piezometer Installation Sheet Complete and Correct?				
Monitoring Well Development Completion Checklist Complete and Correct?				
Monitoring Well Development Form Complete and Correct?				
Piezometer Sensitivity Test Form Complete and Correct?				
Calibration Records Complete?				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

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Form D-7. Specific Validation Checklist for Well Construction and Development Data

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST	AQUIFER/PERMEABILITY TESTING (SLUG TEST)	
PROJECT:		
SAMPLE/I.D.:	DATE:	Page __ of __

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
PERMEABILITY TESTING CONDUCTED AND DOCUMENTED AS DESCRIBED IN SECTION APPENDIX J OF SCQ				
PERMEABILITY TEST DATA FORM COMPLETE AND CORRECT				
DIAGRAM OF EQUIPMENT USED TO CONDUCT TEST				
CALIBRATION DOCUMENTATION SUPPLIED BY VENDOR FOR EQUIPMENT (GAUGES, FLOW METERS, ETC.) COMPLETE				
ARE WATER METER CALIBRATION RECORDS ON FILE AND COMPLETE				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

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Form D-8. Specific Validation Checklist for Aquifer/Permeability Test (Slug Test) Data

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST				TITLE: GROUND WATER SAMPLING AND FIELD ANALYTICAL DATA	
PROJECT:					
SAMPLE/I.D.:				DATE:	Page __ of __
CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS	
WATER QUALITY COLLECTION REPORT COMPLETE (INCLUDING CALIBRATIONS)					
IS THE CHAIN-OF-CUSTODY COMPLETE AND CORRECT?					
IS THE REQUEST FOR ANALYSIS COMPLETE AND CORRECT?					
IS THE DAILY LOG COMPLETE AND CORRECT?					
TEMPERATURE					
pH					
SPECIFIC CONDUCTANCE					
DISSOLVED OXYGEN					
ALKALINITY					
ALL READINGS RECORDED ON FIELD MEASUREMENT FORM (WATER, QUALITY FIELD COLLECTION REPORT)					
REVIEWED BY: DATE:				CONCURRENCE BY: DATE:	

Form D-9. Specific Validation Checklist for Ground-Water Sampling and Field Analysis Data

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST	TITLE: SURFACE SOIL SAMPLING	
PROJECT:	DATE:	Page __ of __
SAMPLE/I.D.:		

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Correct Form Used				
Unique Soils Sample Number				
Sample Location				
Collector's Initials				
Collection Date and Time				
Northerly/Easterly Coordinates				
Was the Sample Rinsate Collected				
Sample Depth/Units				
Sample Type				
Definition of Composite				
Sample Media				
Temperature to Cool/Put to 4 °C				
Is the Sample Sequence Correct				
Is the Sample a Sequence or a Blank				
Chain of Custody Complete and Correct				
Daily Log Complete and Correct				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

Form D-10. Specific Validation Checklist for Surface Soil Sampling Data

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST				TITLE: SURFACE WATER AND SEDIMENT SAMPLING
PROJECT:				DATE: / Page __ of __
SAMPLE/I.D.:				
CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Sample Collected in Accordance with Section 6 of SCQ?				
Sample Collection Log Complete and Correct?				
Chain-of-Custody Complete and Correct?				
Request For Analysis Complete and Correct?				
Daily Log Complete and Correct?				
REVIEWED BY: DATE:				CONCURRENCE BY: DATE:

Form D-11. Specific Validation Checklist for Surface-Water and Sediment Sampling Data

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST	TITLE: RADIATION MEASUREMENT (NODE SURVEY)	
PROJECT:		
SAMPLE/I.D.:	DATE:	Page __ of __

CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
Correct Form Used				
Sample ID Number(s)				
Location Coordinates				
Date and Time of Sample Collection				
Location Description				
Sampling Team Member Listing				
Description of Weather Conditions				
Instrument and Probe Serial Numbers				
Background Results				
Sample Results				
Instrument Calibration Due Date				
Is there a QA Review of Form?				
Is the Sample Sequence Correct?				

REVIEWED BY: DATE:	CONCURRENCE BY: DATE:

Form D-12. Specific Validation Checklist for Radiation Measurement (Node Survey)

(intentionally left blank)

SPECIFIC VALIDATION CHECKLIST				TITLE: RADIATION MEASUREMENT (WALK OVER SURVEY)
PROJECT:				DATE: Page __ of __
SAMPLE/I.D.:				
CHECKLIST ITEMS	YES	NO	N.A.	REMARKS/COMMENTS
CORRECT FORM USED				
SAMPLE ID NUMBER(S)				
GRID AREA LOCATION				
DATE/TIME OF SAMPLE COLLECTION				
LOCATION DESCRIPTION				
LIST OF SAMPLE TEAM MEMBERS				
COUNT TIME/UNIT OF COUNT				
INSTRUMENT AND PROBE/MODEL NO.				
BACKGROUND RESULTS				
SAMPLE RESULTS				
INSTRUMENT CALIBRATION DUE DATE				
IS THERE A QA REVIEW OF FORM?				
IS THE SAMPLE SEQUENCE CORRECT?				
REVIEWED BY: DATE:				CONCURRENCE BY: DATE:

Form D-13. Specific Validation Checklist for Radiation Measurement (Walkover Survey)

(intentionally left blank)

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ORGANIC VALIDATION CHECKLIST FOR ASL B DATA
(sheet 1 of 2)

____Case Narrative

____Quality Control Summary Package
____Surrogate Recovery Summary
____MS/MSD Summary
____Reagent Blank Summary
____GC/MS Tuning and Mass Calibration

____Sample Data Package
____Holding Times
____Organic Analysis Data Sheets
____Reconstructed Ion Chromatograms
____GC/EC Chromatograms
____Quantitation Reports
____Mass Spectral Data
____NIST Mass Spectral Lab Research for TIC

____Standards Data Package
____Current List of Laboratory/Instrument Limits
____Initial Calibration Data for each Instrument
____Continuing Calibration Data for each Instrument
____Pesticide Evaluation Standard Summary
____Pesticide/PCB Standard Summary
____Pesticide/PCB Identification for Positive Results only
____VOA and BNA Standards RICs
____VOA and BNA Standards Quantitation Reports
____Pesticide/PCB Standard Chromatograms and Data System Printouts

____Raw QC Package
____ DFTPP and BFB mass spectra and mass listings
____ Reagent Blank Data
____Organic Analysis Data Sheets
____RIC
____Quantitation Reports
____NIST Library Search TICs
____GC/EC Chromatograms and Data System Printouts
____Mass Spectral Data
____ Matrix Spike/Matrix Spike Duplicate Data
____Organic Analysis Data Sheets
____RIC
____Quantitation Reports
____NIST Library Search TICs
____GC/EC Chromatograms and Data System Printouts
____Mass Spectral Data

Form D-14. Checklist for Organic Data Validation at ASL B (sheet 1 of 2)

ORGANIC VALIDATION CHECKLIST FOR ASL B DATA
(sheet 2 of 2)

____ Sample Tracking Package
- ____ Chain-of-Custody Records
- ____ Sample Log-in/Receipt Records
- ____ Preparation/Extraction/Bench Sheets
- ____ Instrument Run Logs

____ Method References

Comments:

Evaluator Signature: _____ Date: _____.

Form D-14. Checklist for Organic Data Validation at ASL B (sheet 2 of 2)

INORGANIC VALIDATION CHECKLIST FOR ASL B DATA

_____ Inorganic Cover Page
_____ Inorganic Analysis Data Sheet
_____ Initial Calibration and Calibration Verification Results
_____ Continuing Calibration Verification Results
_____ Linear Range Analysis and RDL Standard for AA
_____ Blank Analysis Results
_____ ICP Interference Check Sample Results
_____ Spiked Sample Results
_____ Post-digest Spiked Sample Analysis
_____ Duplicate Sample Results
_____ Instrument Detection Limits
_____ Laboratory Control Sample Results
_____ Standard Addition Results
_____ ICP Serial Dilution Results
_____ Holding Times Summary Sheet
_____ ICP Interelement Correction Factors
_____ ICP Linear Ranges
_____ Raw Data
  _____ Samples
  _____ Calibration Standards
  _____ Blanks
  _____ Spikes
  _____ Duplicates
  _____ ICP QC (ICS and Serial Dilution)
  _____ ICS
  _____ Furnace AA
  _____ Mercury Analysis
  _____ Cyanide Analysis
_____ Percent Solids Calculations- Solids only
_____ Sample Prep/Digestion Logs
_____ Chain-of-Custody
_____ Sample Description
_____ Case Narrative
_____ Method References

Comments:

Evaluator Signature: _____ Date: _____

Form D-15. Checklist for Inorganic Data Validation at ASL B

(intentionally left blank)

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ASL B DATA VALIDATION REPORT FORM

PROJECT:	DATE:	ANALYTICAL METHOD: SAMPLE I.D.:

Action Items: _____

_____

_____

_____

_____

Comments: _____

_____

_____

_____

Note: Data Validation Checklist is attached.

_____ _____
Reviewer Signature Date

Form D-16. Data Validation Report Form for ASL B Analytical Methods

(intentionally left blank)

DATA VALIDATION CHECKLIST FOR ASL B GROSS ALPHA AND GROSS BETA IN WATER BY PROPORTIONAL COUNTING

(sheet 1 of 2)

Analysis Results Report

_____ Abnormalities described

_____ Alpha and Beta Results

_____ Calculation Sheets

_____ Sample Identifications

_____ Detector Identification

_____ Analysis (Count) Date and Initials of Analyst

_____ Volumes of Samples Prepared

_____ pH of Samples

_____ Net Weights of Solids Counted

_____ Sample Count Times for Alpha and Beta

_____ Background Count Times for Alpha and Beta

_____ Counts or Count Rates Alpha and Beta Samples and Backgrounds

_____ Alpha and Beta Integrated Efficiency Factors Used for Each Detector

_____ Alpha Amplification Factors Used for Each Detector

Form D-17. Data Validation Checklist for ASL B Gross Alpha and Gross Beta in Water by Proportional Counting
(sheet 1 of 2)

Validation Report

_____ Results Marked (on photocopied pages)

_____ Corrected Pages Signed and Dated

_____ Other Observations (e.g., biases or trends observed over the course of the validated samples)

_____ Checklists and Forms

_____ Report Reviewed

_____ Defficiency Report Initiated

Evaluator Signature: _____ Date: _____

Form D-17. Data Validation Checklist for ASL B Gross Alpha and Gross Beta in Water by Proportional Counting
(sheet 2 of 2)

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Checklist for Supplemental Completeness Requirements for Analyses Using Gas Proportional Counters

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Counting Logs, Printouts, Notebook Pages)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification
_____ Analysis Date and Initials of Analyst
_____ Amounts of Samples Prepared or Counted
_____ Weights of Solids Counted

Initial and Continuing Calibration

_____ Detector Identification
_____ Calibration Date(s) and Initials of Analyst
_____ Identification of Calibration and Check Standards including Radionuclide, Certification, Expiration Date, and Activity
_____ Amount of (Check) Standard Used
_____ Raw Data including Counts and Count Duration for Standards
_____ Weights of Preparations
_____ Efficiencies
_____ Weights of Carriers Added, If Applicable
_____ Results of Statistical Tests Used to Evaluate Instrument Reliability and Efficiency Checks
_____ Raw Data of Background Counts and Count Duration
_____ Results of Statistical Test Used to Evaluate Instrument Background
_____ Control Limits for Check Source and Background Counts

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used in Blank

Form D-18. Checklist for Supplemental Completeness Requirements for Analyses Using Gas Proportional Counters (sheet 1 of 2)

Radiometric and Gravimetric Yields

_____ Amounts (Volumes, Concentrations, Activity) of Spikes, Tracers, or Carriers Used
_____ Weights of Precipitates or Solids Counted
_____ Calculated Recoveries

Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Aliquots of Samples
_____ Weights of Solids Counted
_____ Count Durations
_____ Sample Identifications
_____ Calculated Precision

Laboratory Control Samples

_____ Detector Identification
_____ Date of Analysis
_____ Calculation of Recoveries
_____ Results of Analyses

Form D-18. Checklist for Supplemental Completeness Requirements for Analyses Using Gas Proportional Counters (sheet 2 of 2)

Checklist for Supplemental Completeness Requirements for Analyses Using Alpha Spectroscopy

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Spectra, Printouts, Notebook Pages)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification
_____ Analysis Date and Initials of Analyst
_____ Amounts of Samples Counted (Precipitated or Deposited)

Initial and Continuing Calibration

_____ Detector Identification
_____ Calibration Date(s) and Initials of Analyst
_____ Identification of Calibration and Check Standards including Radionuclide, Certification, Expiration Date, and Activity
_____ Amount of (Check) Standard Used
_____ Raw Data including Spectra or Counts per Channel
_____ Kev/channel
_____ Count Duration for Standards
_____ Efficiencies
_____ Raw Data of Background Counts, Dates Counted, and Duration of Counts

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used in Blank

Form D-19. Checklist for Supplemental Completeness Requirements for Analyses Using Alpha Spectroscopy (sheet 1 of 2)

Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Amounts of Samples Counted
_____ Count Durations
_____ Sample Identifications
_____ Calculated Precision

Radiometric and Gravimetric Yields

_____ Amounts (Volumes, Concentrations, Activity) of Spikes, Tracers, or Carriers Used
_____ Weights of Precipitates or Solids Counted
_____ Calculated Recoveries

Laboratory Control Samples

_____ Detector Identification
_____ Date of Analysis
_____ Calculation of Recoveries
_____ Results of Analyses

Form D-19. Checklist for Supplemental Completeness Requirements for Analyses Using Alpha Spectroscopy (sheet 2 of 2)

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Checklist for Supplemental Completeness Requirements for Analyses Using Gamma Spectroscopy

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Spectra, Printouts of Counts per Channel, Notebook Pages)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification and Counting Position
_____ Analysis Date and Initials of Analyst
_____ Amounts of Samples Counted

Initial and Continuing Calibration

_____ Detector Identification
_____ Calibration Date(s) and Initials of Analyst
_____ Identification of Calibration and Check Standards including Radionuclides, Certification, Expiration Date, and Activity
_____ Amount of (Check) Standard Used
_____ Raw Data including Counts and Count Duration for Standards
_____ Efficiencies and/or Geometry and Matrix Factors
_____ Raw Data of Background Counts, Count Dates, and Duration of Counts
_____ Kev/Channel
_____ FWHM

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used in Blank
_____ Raw Data

Form D-20. Checklist for Supplemental Completeness Requirements for Analyses Using Gamma Spectroscopy (sheet 1 of 2)

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Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Count Durations
_____ Sample Identifications
_____ Results of Analyses and Calculated Precision
_____ Raw Data

Radiometric and Gravimetric Yields

_____ Amounts (Volumes, Concentrations, Activity) of Spikes, Tracers, or Carriers Used
_____ Weights of Precipitates or Solids Counted
_____ Calculated Recoveries

Laboratory Control Samples

_____ Detector Identification
_____ Date of Analysis
_____ Calculation of Recoveries
_____ Results of Analyses

Form D-20. Checklist for Supplemental Completeness Requirements for Analyses Using Gamma Spectroscopy (sheet 2 of 2)

Checklist for Supplemental Completeness Requirements for the Analysis of Alpha-Emitting Ra Isotopes Using Scintillation Counting

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Notebook Pages, etc.)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification and Counting Position
_____ Analysis Date and Analyst Initials
_____ Amounts of Samples Counted
_____ Background Counts Associated with Each Sample Result

Initial and Continuing Instrument Calibration

_____ Detector Identification
_____ Calibration Dates and Analyst Initials
_____ Identification of Calibration Standards including Radionuclides, Certification, Expiration Date and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Routine Control Charts

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data

Form D-21. Checklist for Supplemental Completeness Requirements for the Analysis of Alpha-Emitting Ra Isotopes Using Scintillation Counting (sheet 1 of 2)

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Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric and Gravitimetric Yields

_____ Amount of Spike Used for Spiked Samples
_____ Amount of Ra Standard Used for Radiometric Yield Determination

Radiometric and Gravitimetric Yields (cont.)

_____ NIST Certification for Ra Standards
_____ Calculated Radiometric Yield
_____ Weight of Carrier Added for Gravitimetric Determination
_____ Weight of Carrier Recovered for Gravitimetric Determination
_____ Calculated Gravitimetric Yields

Laboratory Control Samples

_____ Detector Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

Form D-21. Checklist for Supplemental Completeness Requirements for the Analysis of Alpha-Emitting Ra Isotopes Using Scintillation Counting (sheet 2 of 2)

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Checklist for Supplemental Completeness Requirements for the Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Notebook Pages, etc.)
_____ Calculation Sheets
_____ Sample Identifications
_____ Scintillation (Lucas) Cell Identification
_____ Analysis Date and Analyst Initials
_____ Amounts of Samples Counted
_____ Background Counts Associated with Each Sample Result

Initial and Continuing Instrument Calibration

_____ Scintillation (Lucas) Cell Identification
_____ Calibration Dates and Analyst Initials
_____ Identification of Calibration Standards including Radionuclides, Certification, Expiration Date and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Routine Control Charts

Blanks

_____ Scintillation (Lucas) Cell Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data

Form D-22. Checklist for Supplemental Completeness Requirements for the Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting (sheet 1 of 2)

Duplicates

_____ Scintillation (Lucas) Cell Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric and Gravitimetric Yields

_____ Amount of Spike Used for Spiked Samples
_____ Weight of Carrier Added for Gravitimetric Determination
_____ Weight of Carrier Recovered for Gravitimetric Determination
_____ Calculated Gravitimetric Yields

Laboratory Control Samples

_____ Scintillation (Lucas) Cell Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

Form D-22. Checklist for Supplemental Completeness Requirements for the Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting (sheet 2 of 2)

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Checklist for Supplemental Completeness Requirements for Analysis of Tritium Using Liquid Scintillation Counting

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Notebook Pages, etc.)
_____ Calculation Sheets
_____ Sample Identifications
_____ Instrument Identification
_____ Analysis Date and Analyst Initials
_____ Amounts of Samples Counted
_____ Background Counts Associated with Each Sample Result

Initial and Continuing Instrument Calibration

_____ Instrument Identification
_____ Identification of Calibration Standards including Radionuclides, Certification, Expiration Date and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Counting Efficiency Determination Method and Results
_____ Quench Correction Method

Blanks

_____ Instrument Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data
_____ Tritium Levels in Background Water

Form D-23. Checklist for Supplemental Completeness Requirements for Analysis of Tritium Using Liquid Scintillation Counting (sheet 1 of 2)

Duplicates

_____ Instrument Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric and Gravitimetric Yields

_____ Amount of Tritium Standard Used for Radiometric Yield Determination
_____ Radiometric Yield Calculations and Results

Laboratory Control Samples

_____ Instrument Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

Form D-23. Checklist for Supplemental Completeness Requirements for Analysis of Tritium Using Liquid Scintillation Counting (sheet 2 of 2)

Checklist for Supplemental Completeness Requirements for Fluorometric Analysis of Uranium

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Notebook Pages, etc.)
_____ Calculation Sheets
_____ Sample Identifications
_____ Instrument Identification
_____ Analysis Date and Analyst Initials
_____ Amounts of Samples Counted
_____ Background Counts Associated with Each Sample Result

Initial and Continuing Instrument Calibration

_____ Instrument Identification
_____ Calibration Dates and Analyst Initials
_____ Identification of Calibration Standards including Radionuclides, Certification, Expiration Date and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)

Blanks

_____ Instrument Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data

Form D-24. Checklist for Supplemental Completeness Requirements for Fluorometric Analysis of Uranium (sheet 1 of 2)

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Duplicates

_____ Instrument Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric and Gravitimetric Yields

_____ Amount of Spike Used for Spiked Samples
_____ Weight of Carrier Added for Gravitimetric Determination
_____ Weight of Carrier Recovered for Gravitimetric Determination
_____ Calculated Gravitimetric Yields

Laboratory Control Samples

_____ Instrument Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

Form D-24. Checklist for Supplemental Completeness Requirements for Fluorometric Analysis of Uranium (sheet 2 of 2)

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Lithologic Log

PROJECT NUMBER:	PROJECT NAME:	
BORING NUMBER:	COORDINATES:	DATE:
ELEVATION:	GROUND WATER LEVEL: Depth Date/Time	DATE STARTED:
GEOLOGIST:	Date/Time	DATE COMPLETED:
DRILLING METHODS:		PAGE OF

DEPTH (ft) ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS

NOTES: (Drilling fluid volume used; size and type of temporary or surface casing, etc.)

Form J-1. Example Lithologic Log

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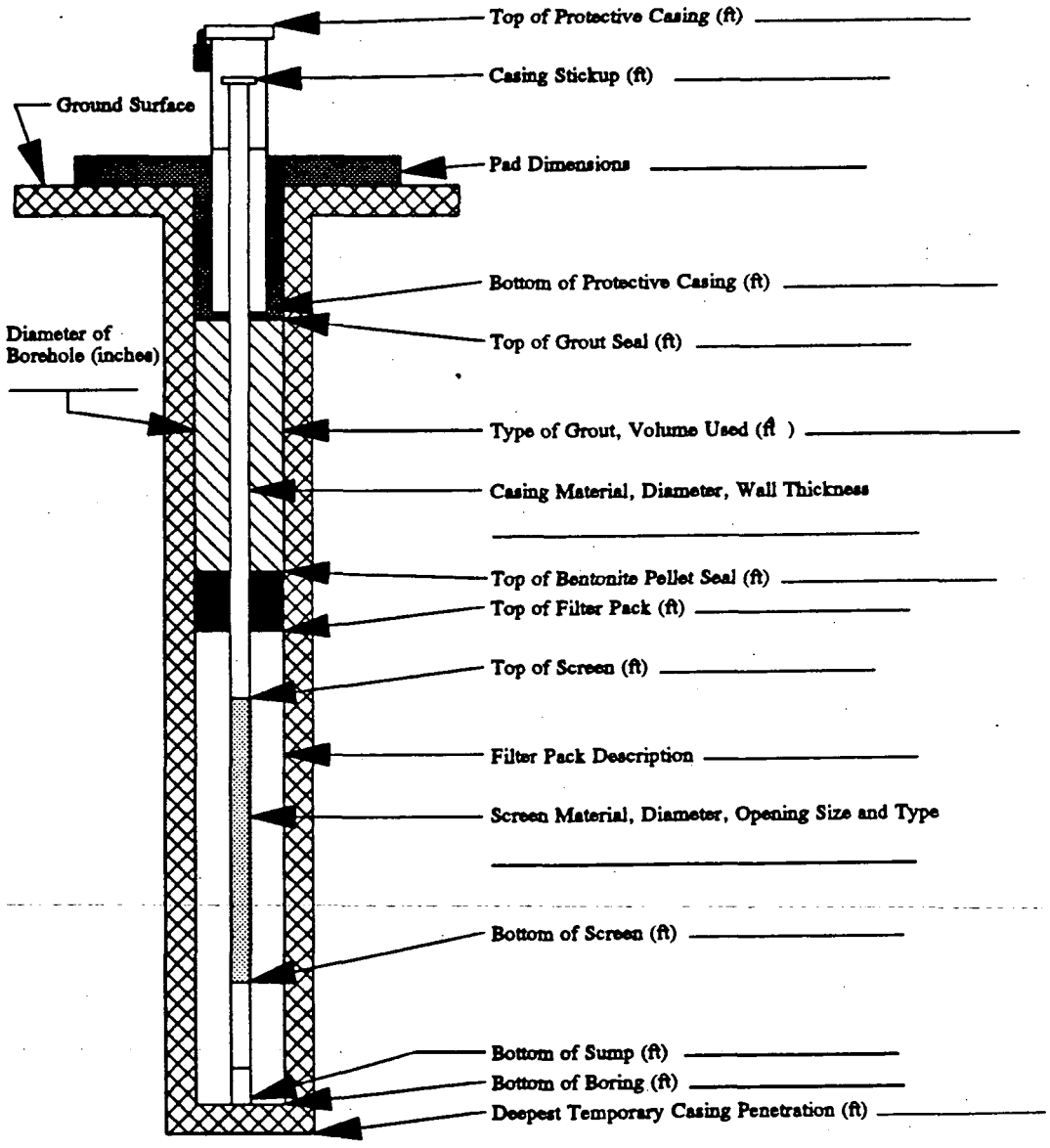
(intentionally left blank)

PROJECT NAME _____ GEOLOGIST _____ DATE _____
PROJECT NO. _____ CHECK BY _____ DATE _____
BORING NO. _____ DRILLING METHOD _____
WELL NO. _____ DATE OF INSTALLATION _____
COORDINATES _____



Note: Length measurements are from ground surface

Form J-2. Example Well Completion Log

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FMPC
ENVIRONMENT SAFETY & HEALTH - INDUSTRIAL HYGIENE

STACK SAMPLER INSPECTION REPORT (REFINERY)

Date _____

Inspected By _____

NOTE: Contaminated Type "S" pleated filter should be replaced by a new prenumbered filter.

COLLECTOR NUMBER		IDENTIFICATION NUMBER		RATE (L/m)		COND. CODE (A-B-C)	D. P. READING		LUDLUM (CPM)		ALARM SET POINT	TIME	LOCATION
		NEW FILTER	OLD FILTER	PRE-SCRIBED	ACTUAL		MINIMUM	MAXIMUM	BEFORE INSP.	AFTER CHANGE			
REFINERY	G1-94												Top level, N/E corner of digestion area
	G1-456												Top level, N/W corner of digestion area
	G1-252												Top level, West center of digestion area
	Plant 3 North												Top level, N/E corner of denitration area
	Plant 3 South												Top level, S/E corner of denitration area

NOTES:

NO.	DISTRIBUTION OF COPIES
1	Industrial Hygiene (RECORD COPY)
2	General Superintendent
3	Chemical Plants Superintendent
4	General Supervisor
5	Area Supervisor
6	Industrial Hygiene Technician

Code: A - Filter Sample appeared to be clean.
B - Filter sample showed evidence of small accumulation of material.
C - Filter Sample laden with material.

Form K-1. Example Stack Sampler Inspection Report Form

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FMPC
QUALITY & SAFETY
LUDLUM RADIATION STACK MONITOR INSPECTION REPORT (Pg. 1 of 2)

Inspected By _____ Time: _____ Date: _____

Stack Monitor ID	Honeywell Number	Ludlum Reading (CPM)	Scale Setting	Stack Alarm Set Point	Stack Alarm Audio Check	Source Check	Ludlum Detector		Honeywell		Printer		Lights Test			System Power On
							Power on	Battery Check	Alarm Check	Trouble Check	Power on	Response Check	Low Flow	High Flow	Alarm	
GS-247 Stack	13701															
GS-248 Stack	13702															
GS-251 Duct																
GS-253 Duct																
GS-251/253 Stack																
GS-254 Stack	13302															
GS-259 Duct																
GS-259 Stack																
GS-260 Stack																
GS-261 Stack																
GS-262 Stack																
GS-267 Stack	1340															
W. Cool. Well, PIL 5 Stack																
E. Cool. Well, PIL 5 Stack																
W. Burnout Stack																
E. Graphite Breakup Exhaust																
E. Burnout Stack																

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1	Radiological Safety (RECORD COPY)
2	Metals Plants Superintendent
3	Chemical Plants Superintendent
4	Health & Safety Instrumentation

Note:
- Cool. Well - W. PIL 5 - Near GS-267 on Platform
- E. Burnout Stack - N. end of E. Burnout
- E. Graphite Breakup - behind E. Remelt Furnaces, 569'
- Cool. Well - E. PH 5 - Near breakout
- W. Burnout Stack - N. end of W. Burnout

FMPC-QAS-1600 (Rev. 7/28/92)

Form K-2. Example Radiation Stack Monitor Inspection Report Form
(sheet 1 of 2)

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FMPC
ENVIRONMENT, SAFETY & HEALTH - INDUSTRIAL HYGIENE

LUDLUM RADIATION STACK MONITOR INSPECTION REPORT (METALS PLANTS)

Inspected By: _____ Time: _____ Date: _____

STACK NUMBER	HONEY-WELL NUMBER	LUDLUM READING (CPM)	SCALE SETTING	STACK ALARM SET POINT	STACK ALARM AUDIO CHECK	LUDLUM DETECTOR		HONEYWELL		PRINTER		LIGHTS TEST			SYSTEM POWER ON
						POWER ON	BATTERY CHECK	ALARM CHECK	TROUBLE CHECK	POWER ON	RESPONSE CHECK	LOW FLOW	HIGH FLOW	ALARM	
G5-247	13201														
G5-248	13202														
G5-249	13203														
G5-250	13204														
G5-251	13301														
G5-254	13302														
G2-67	13401														
G5-258	13303														
G5-259	13304														
G5-260															
G5-261															
G5A-100	13402														
G5SE-100	13403														
G8N1-1030															

COMMENTS:

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2	Metals Plants Superintendent
3	General Supervisor
4	Health & Safety Instrumentation

Form K-2. Example Radiation Stack Monitor Inspection Report Form
(sheet 2 of 2)

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FMPC
OPERATIONS SAFETY & HEALTH DEPARTMENT - RADIOLOGICAL SAFETY
FINAL STACK SAMPLER RESULTS

Date: _____

PLANT NUMBER	COLLECTOR NUMBER	FILTER NUMBER	FILTER DATES		* CHANGE CODE	SAMPLE COLLECTED BY	TOTAL URANIUM (mg)	FINAL LOSS (kg U)	RESULTS CALCULATED BY	REVIEWED BY
			ON	OFF						

* CHANGE CODE:
1. Filter changed as a result of a routine inspection.
2. Filter changed at the request of plant supervision.

NOTIFICATION OF STACK RESULTS			
PLANT NUMBER	SUPERVISOR NOTIFIED	TIME	NOTIFIED BY

NO.	DISTRIBUTION
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5	Chemical Area Superintendent/Metals Area Superintendent
6	Production Supervisor
7	Environmental & Radiological Monitoring

Form K-3. Example Final Stack Sampler Results Form

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FMPC

ENVIRONMENT, SAFETY & HEALTH - ENVIRONMENT & RADIOLOGICAL MONITORING

DUST COLLECTOR STACK SAMPLING LOG

Plant: _____ Collector No.: _____ Conversion Factor: _____

FILTER NUMBER	SAMPLING DATA				ANALYTICAL RESULTS				NOTES
	ON		OFF						
	Date	Rate	Date	Rate	Total mg U in Sample	U Lab Qual	Total mg Particulate On Sample	Particulate Lab Qual	

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FMPC-ESH-1326 (3/20/87)

Form K-4. Example Dust Collector Stack Sampling Log Form

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APPENDIX C

DATA QUALITY OBJECTIVES

C.1 INTRODUCTION

DOE orders, environmental regulations, the FEMP Federal Facilities Compliance Agreement, Ohio Environmental Protection Agency Director's Findings and Orders, and the EPA/DOE 1991 amended Consent Agreement require sampling and analysis by specific methods and procedures for analytes of FEMP environmental media. All sampling and analysis programs at FEMP ultimately contribute towards fulfillment of the site mission: restoration of the environment. Samples collected shall provide data for one of the following purposes.

- Identification of potential contamination (e.g., routine monitoring programs, air and water permit verification, investigation of suspect source areas, sampling of decommissioned equipment and materials)
- Confirmation of contamination (e.g., biased sampling of spill areas, collection of samples from areas targeted during screening investigations, sampling of suspected asbestos containing materials)
- Characterization of contamination (e.g., delineation of source areas or plumes by random, biased, or combination methods; sampling of containerized waste)
- Determination of environmental and human health risks (e.g., risk assessments and environmental assessments)
- Evaluation of remedial alternatives (e.g., treatability studies)
- Design of remedial alternatives (e.g., remedial design)
- Monitoring of response actions (e.g., monitoring during removal actions, confirmation sampling to determine effectiveness of a response action)
- Monitoring to comply with regulations (1991 amended Consent Agreement, CERCLA, NPDES, RCRA.)
- Determine background concentration of constituents

Data Quality Objectives (DQO) are scoping and planning tools applicable to every

environmental sample collection effort and are a necessary step in the generation of a project-specific plan. DQOs are quantitative and qualitative descriptions of the the data required to fulfill one of the stated purposes. As target values for data quality, they are not necessarily criteria for acceptance or rejection of data. The DQO process generates a logical set of decisions that determines whether collection of samples is necessary; types of samples to collect, including quality control samples; design of the sample collection effort including location and number of samples; analytical requirements including precision, accuracy, comparability, completeness, and sensitivity of the method; and overall confidence level that the data will fulfill requirements.

Decisions should fill existing data gaps and be based on intended data use. All steps of the process should be completed in sequence, and be appropriately documented.

Analytical support levels (ASLs) must be specified for each analysis. See SCQ Section 2 for a description of FEMP ASLs and example uses. All DQOs will be approved and documented in a separate document controlled by the FEMP sampling and analysis management coordinator. A list of existing DQOs for FEMP projects are presented in Table C-1.

C.2 DATA QUALITY OBJECTIVE LOGIC FLOW PROCESS

The logic flow process presents the rationale for deciding what data are necessary, what quality and type of data are required, how the data will be technically defensible, and how risk is comprehended and minimized to ensure total quality throughout the remediation process.

The logic flow will help to identify areas of concern, the selection of equipment, quality assurance requirements, and analytical support levels. The logic statement is considered part of the DQO as a supporting document and is kept on file. This logic flow process consists of the following seven steps.

1. Statement of the problem

2. Identification of a decision that addresses the problem

3. Identification of inputs that affect the decision

4. Specification of the domain of the decision

5. Development of logic statement

6. Establishment of constraints on uncertainty

7. Optimization of design for obtaining data

These steps as defined by Neptune (1991) are presented in paragraphs C.2.1 through C.2.7.

C.2.1 Statement of the Problem (Step 1)

This paragraph describes problem definition and any resource, time, or other practical limits on data collection. The purpose of step 1 is to evaluate existing knowledge about the problem and identify available resources. By carefully defining the problem early in the planning process, the planning team can ultimately save time and money. In addition, refinements to the way in which the problem is stated are often made when the planning team better understands the implications of the original problem definition. Items to be addressed include, but are not limited to the following.

- Identification of the planning team, including senior program staff, technical experts, senior managers (decision makers) whose planning input will be needed during the process in order to ensure implementation of the study findings and a statistician (or someone with statistical expertise).

- Specification of resource or time limits for this study, including the anticipated budget and available personnel (Identify obvious practical considerations, such as time of year when data collection is not possible. These practical considerations will be expanded upon later in the process.)

- Statement of the problem including the following elements.

  - Description of the problem as it is currently understood

  - Consideration of the importance of social and political concerns to the problem

  - Organization and review of existing information including preliminary studies and indication of the source and reliability of information

  - Literature searches and exploration of on-going studies to ensure that the problem has not been previously resolved

  If it is a complex problem, organize understanding of it by identifying components of the problem, each of which could potentially be addressed by a separate study. Try to prioritize these components for further planning.

- Determination of whether new data are critical to resolving this problem

C.2.2 Identification of a Decision That Addresses the Problem (Step 2)

Step 2 is identification of a primary decision that will address the concern, a list of alternative actions that address the problem, and the actions that will result. If the planning team believes actions may be taken based on the study data, but doesn't know what specific actions, then it will save time and resources to try to elicit possible actions from the decision maker so that the team understands the intended use of the data. The decision should be stated as narrowly and specifically as possible. General statements of goals or objectives are not adequate.

Items to be addressed include, but are not limited to, the following as appropriate.

1. State the decision so that the role of data is clear in deciding action to be taken.

    a. Describe initial ideas on approaches to resolving the problem.

    b. State the range of actions that may be taken based on the outcome of the study. Consider agency policies that may influence these actions (e.g., agency emphasis on pollution prevention rather than source containment or treatment).

    c. Specify criteria for taking these actions as "if..., then..." scenarios when possible. If the criteria are not known, specify how they will be established.

    d. State the decision as a choice among alternative courses of action that will resolve one or more components of the problem.

2. If several separate decisions must be made to address a component of the problem, begin by mapping out a decision or logic tree. This exercise should reveal the relationship among decisions. Try to determine the relative importance of each decision to the overall problem. Determine which decisions require new environmental data and the importance of those data to the decision. Use the DQO process for each of the decisions that require new data starting with the most important decision. In certain cases, go back and reflect further on the problem.

The decision maker (data user) should be involved in step 2 and is encouraged to provide general guidance for taking action.

C.2.3 Identification of Inputs That Affect the Decision (Step 3)

This paragraph discusses identification of environmental variables or characteristics to be measured; criteria for taking action; and other information needed to make the decision. During step 3 the planning team should identify all variables or environmental characteristics that may be relevant to the decision and then focus on those that must be measured to have

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information needed for the decision. Items to address shall include, but are not limited to, the following as appropriate.

- Development of a list of variables (or environmental characteristics) that may affect the decision and separation of those that must be measured to make the decision (which action to take). (Identify those variables that together will provide sufficient information to make the decision.)

- Specification of criteria for taking action. (Identify information from other studies and regulations needed to establish the criteria for taking action.)

- Confirmation that each variable (environmental characteristic) can be measured. If it can not, determine if it is reasonable to make assumptions about the variable in order to draw conclusions without data. If the necessary assumptions cannot be defended, conduct a pilot study or select an alternative approach that involves different variables that are measurable. If no practical approach can be developed, consider shifting the effort to develop the research tools needed to address the problem. Consider not conducting the study at this time.

C.2.4 Specification of the Domain of the Decision (Step 4)

This paragraph concerns development of a statement addressing the domain of the decision. The process includes a detailed description of the boundaries of the decision including area and time period. The purpose of step 4 is to define the population for which the decision will be made (people, objects, portions of media) so that it is clear what belongs in this population and what the boundaries on this population are (area or volume and time period).

When the population consists of people and objects, it is important to define space and time boundaries and other characteristics that determine what belongs in and out of the population. Alternatively, the population may consist of a continuous medium (air, water, soil). In this case, the portion of the medium that belongs in the population can usually be defined just by spatial and temporal boundaries, although other characteristics may help to define it further.

Sampling from this population may be necessary to make inferences about the population as a whole. Sometimes it is not possible to sample from the entire population. In this case, either inferences are made only to that portion of the population that can be measured, or assumptions are made that allow inference to the entire population. Statistical analysis will be implemented based upon available data on the population.

Items to address include, but are not limited to, the following as appropriate.

1. Specify the population for which the decision will be made so that it is clear what belongs in this population.

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2. Define the spatial and temporal boundaries of this population.

3. Define additional characteristics needed to determine what belongs in the population.

4. If applicable, specify the smallest sub-population for which the decision will be made. The cost of the study usually increases for each sub-population group because more samples are required to adequately estimate the variables within each group.

5. Make sure that practical considerations (step 1) are consistent with these boundaries.

C.2.5 Development of Logic Statement (Step 5)

This paragraph describes steps in developing a statement to define how environmental data will be summarized and used to make the decision. After the data for a study have been collected, they are summarized to form a result for the study, which is compared to the criteria for taking action to make the decision. The purpose of step 5 is to integrate output from previous steps into a single statement specifying how environmental data will be summarized and used to make the decision, including quantitative criteria for determining what action to take.

It is important that staff with statistical expertise be involved in this step to insure statement of the decision rule in a manner that leads to an efficient sample collection design.

Items to be addressed include, but are not limited to, the following as appropriate.

1. Describe the intended study result (the way in which the data will be summarized) and how the result will be calculated (e.g., mean, range, maximum).

2. Develop a decision rule as an "if...,then..." statement that incorporates the study result, criteria for taking action, and actions that will be taken under various possible scenarios.

   Example: If in the monthly sample, X analyte exceeds Y ppm for two sampling periods, increase sample frequency to weekly and additionally analyze for Z.

   In this example, the study result is the X analyte over two sampling periods, the criterion for taking action is maximum allowable of X analyte of Y ppm, and the actions are to increase sample frequency to weekly and to add Z analyte.

3. Confirm that all data collected is necessary. If it is not, define a more narrowly-focused set of input variables.

4. Consider uses of the data by other programs within FEMP. For example, if the

primary reason for collecting the data is to determine nature and extent of potential ground water contamination would the same data be used in a risk assessment. If so, the DQOs should include the additional use of data.

C.2.6 Establish Constraints on Uncertainty (Step 6)

This paragraph discusses development of constraints on uncertainty. The decision maker's expressed desire to control decision errors should be stated as limits on the acceptable probability of making an incorrect decision based on the study findings. These limits on uncertainty may be expressed as acceptable false positive and false negative error rates.

There is always some error in environmental data and as a result, some degree of uncertainty will exist in any decision based on these data. The limits on uncertainty should be based on careful consideration of the consequences of incorrect conclusions. The planning team will need to estimate the economic, health, and ecological consequences of decision errors and the decision maker will also need to consider the political and social consequences when setting limits on uncertainty.

The decision maker (data user) needs to be actively involved in the specification of limits on uncertainty. In addition, the planning team should work with a statistician during step 6 to ensure that the limits are reasonable and complete.

There are two types of decision errors for all studies that will support a decision on whether or not to take action: false positives and false negatives. The definition of what constitutes false positive and false negative errors depends on how the decision is defined. (Consult a statistician if there are questions.)

Example: consider a decision on whether to take corrective action where you presume that action will not be required and the purpose of the study is to support or refute this presumption. In this case,

- A false positive error is deciding to take corrective action when the environmental data incorrectly indicate that a problem exists; and

- A false negative error is deciding not to take corrective action when environmental data incorrectly indicate that a problem does not exist.

Limits on uncertainty for these studies can be expressed as limits on the acceptable rates of false positive and false negative errors.

The uncertainty associated with data and the inherent natural variability make it unreasonable (very expensive) to determine small differences in an environmental variable. As a result, when true conditions are very close to the criterion for taking action, it is difficult (if not

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impossible) to determine if conditions are above or below the criterion. To respond to this problem, consider defining a region of indifference where either decision is acceptable. This region may be placed around, at or below the criteria for taking action, depending on the decision being made. The width of this interval can vary, but generally, the cost of the study increases with a narrower region of indifference.

Items to address shall include, but are not limited to, the following as appropriate.

1. Define false positive (f(+)) and false negative (f(-)) errors for the decision (decision errors) and describe scenarios in which each type of error might take place.

2. Order the importance of expected economic, ecological, health, political and social consequences according to the level of concern the decision maker has with each one.

3. Determine if false positive or false negative errors are of greater concern.

4. Determine if the level of concern for either type of decision error depends on the magnitude of the error (e.g., a case where there is a threshold below which a decision error leads to economic consequences and above which it also leads to adverse health effects). The decision maker would be more concerned about the larger decision error that has both health and economic consequences.

5. Consider the estimated magnitude of the expected consequences and decide what magnitude of false positive and false negative errors would be almost always, often, sometimes, or almost never acceptable. (It may not be necessary to assign values to all four categories.)

6. Establish, with statistical advice, an acceptable probability for the occurrence of each of these errors. Also, specify a region of indifference (the area in which you choose not to control the probability of an incorrect outcome because, under the stated conditions, either decision is acceptable). This region may be narrow or broad and must be acceptable to the decision maker.

7. Combine the probability statements into a formal statement of the levels of uncertainty that can be tolerated in the results. This formal statement may take the form of a table or graph.

C.2.7 Optimize Design for Obtaining Data (Step 7)

This paragraph addresses how to optimize data collecting by identifying the most efficient way calculated to achieve the desired constraints on uncertainty. Items to address shall include, but are not limited to, as appropriate.

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1. What are the estimated variabilities and distributions of site-related contaminants of potential concern?

2. Based on existing estimates of variabilities and distributions of contaminants of potential concern and relative costs of proposed sampling and analysis options, what is the lowest cost sampling and analysis plan that will achieve the desired data and constraints on uncertainty (i.e., how many samples will be collected; how will sampling points be identified or chosen; what is the sampling method; how frequently will samples be collected; what level of Quality Control (QC) is required; what are the requirements for precision, accuracy, sensitivity, and completeness; and what analytical methods are appropriate)?

C.2.8 Summary

Using the information of the logic flow, state the analytical support levels required and briefly explain the rationale. Analytical support levels are specified based on intended use of the data. In addition, identify the analytes, quality control and quality assurance samples required to support the analytical support levels identified. List the summary information on the bottom of the logic flow document.

C.3 THE DATA QUALITY OBJECTIVE SUMMARY FORM

A FEMP DQO Summary Form (Form C-1, Appendix B) was designed using EPA guidance. (1987). This form shall be completed as documentation for DQO development. Analytical and sampling requirements of those regulations, orders, and agreements are summarized within the nine sections of the DQO Summary Form.

C.4 REFERENCES

U. S. Environmental Protection Agency. 1987. ***Data Quality Objectives for Remedial Response Activities***. Prepared for the U.S. Environmental Protection Agency by CDM Federal Programs Corporation, EPA Contract No. 68-01-6939

Neptune, Dean. 1991. ***The Data Quality Objective Process for Environmental Decisions***. U. S. Environmental Protection Agency.

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APPENDIX D

DATA VALIDATION PLAN

D.1 INTRODUCTION

Data generated for FEMP activities is validated to ensure that it complies with Data Quality Objectives (DQO) defined in Appendix C of the FEMP Sitewide CERCLA Quality Assurance Project Plan (SCQ) and in Project-Specific Plans (PSP) described in Section 6. Implementation of procedures in this Data Validation Plan (DVP) is one step in providing quality data on which to base definitive decisions at a known level of confidence.

Data validation procedures generally fall into two categories depending upon whether the data in question are field- or laboratory-generated. Field data validation consists of verifying PSP compliance and appropriate documentation of field activities. The laboratory data validation process includes assessment of data package completeness and DQO compliance to ensure that data generated is at the specified Analytical Support Level (ASL) (Section 2).

D.1.1 Purpose

Prescribed data validation procedures, implemented in a timely, independent, systematic process, will ensure that FEMP data are in compliance with specified criteria and adequate for the intended use.

D.1.2 Scope

This DVP establishes the following requirements for validating FEMP data.

- Technical Approach (subsection D.2)
    - Data Validation Procedures (paragraph D.2.1)
    - Checklists (paragraph D.2.2)
    - Analytical Support Levels (paragraph D.2.3)
    - Data Qualifier Codes (paragraph D.2.4)
    - Sequence of Data Validation Activities (paragraph D.2.5)
    - Discrepancy/Deficiency Resolution (paragraph D.2.6)

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- Data Validation Documentation (paragraph D.2.7)
- Surveillance and Audit (paragraph D.2.8)

- Organizational Responsibilities and Functions (subsection D.3)
  - FEMP Project Manager (paragraph D.3.1)
  - Designated FEMP Quality Assurance Organization Representative (paragraph D.3.2)
  - Field Data Validation Personnel (paragraph D.3.3)
  - Laboratory Data Validation Personnel (paragraph D.3.4)
- Data Validation and Reports (subsection D.4)
  - Overview of Data Validation (paragraph D.4.1)
  - Data Validation Report Requirements (paragraph D.4.2)
  - Review of Data Validation Reports (paragraph D.4.3)
- Field Data Validation Procedures (subsection D.5)
  - General Instructions (paragraph D.5.1)
  - Procedures for Data Validation (paragraph D.5.2)
  - General Instructions (paragraph D.5.3)
- Volatile and Semi-Volatile Data Validation Procedures for ASLs C and D (subsection D.6)
  - Holding Times (paragraph D.6.1)
  - Gas Chromatography/Mass Spectroscopy (GC/MS) Tuning (paragraph D.6.2)
  - Calibration (paragraph D.6.3)
  - Blanks (paragraph D.6.4)
  - Percent Surrogate Recovery (paragraph D.6.5)

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- Matrix Spike/Matrix Spike Duplicates (paragraph D.6.6)
- Field Duplicates (paragraph D.6.7)
- Internal Standards Performance (paragraph D.6.8)
- Target Compound Identification (paragraph D.6.9)
- Compound Quantitation and Reported Detection Limits (paragraph D.6.10)
- Tentatively Identified Compounds (paragraph D.6.11)
- System Performance (paragraph D.6.12)
- Overall Assessment of Data for a Case (paragraph D.6.13)

- Pesticides Data Validation Procedures for ASLs C and D (subsection D.7)
  - Holding Times (paragraph D.7.1)
  - Instrument Performance (paragraph D.7.2)
  - Calibration (paragraph D.7.3)
  - Blanks (paragraph D.7.4)
  - Percent Surrogate Recovery (paragraph D.7.5)
  - Matrix Spike/Matrix Spike Duplicates (paragraph D.7.6)
  - Field Duplicates (paragraph D.7.7)
  - Compound Identification (paragraph D.7.8)
  - Compound Quantitation and Reported Detection Limits (paragraph D.7.9)
  - Overall Assessment of Data for a Case (paragraph D.7.10)
- Inorganic Data Validation Procedures for ASLs C and D (subsection D.8)
  - Holding times (paragraph D.8.1)
  - Calibration (initial and continuing) (paragraph D.8.2)

- Blanks (paragraph D.8.3)
- Inductively Coupled Plasma (ICP) interference check sample (paragraph D.8.4)
- Laboratory control sample (paragraph D.8.5)
- Duplicate sample analyses (paragraph D.8.6)
- Matrix spike sample analyses (paragraph D.8.7)
- Furnace Atomic Absorption Quality Control (paragraph D.8.8)
- ICP serial dilution (paragraph D.8.9)
- Sample result verification (paragraph D.8.10)
- Field duplicates (paragraph D.8.11)
- Overall assessment of data for a case (ASL D data only) (paragraph D.8.12)

- Data Validation Procedures for Gas Chromatography of Organic Compounds for ASLs B, C, and D (subsection D.9)
  - Validation Guidelines for Gas Chromatography Data (paragraph D.9.1)
  - Holding Times (paragraph D.9.2)
  - Calibration (paragraph D.9.3)
  - Blanks (paragraph D.9.4)
  - Surrogates (paragraph D.9.5)
  - Matrix Spike/Matrix Spike Duplicate (paragraph D.9.6)
  - Compound Identification (paragraph D.9.7)
  - Laboratory Control Samples (paragraph D.9.8)
  - Compound Quantitation and Reported Detection Limits (paragraph D.9.9)
  - Overall Assessment of Data for a Case (paragraph D.9.10)

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- Drinking Water Data Validation Procedures for ASL B (subsection D.10)
  - Internal Standard (paragraph D.10.1)
  - Surrogate Analyte (paragraph D.10.2)
  - Laboratory Duplicates (paragraph D.10.3)
  - Field Duplicates (paragraph D.10.4)
  - Laboratory Reagent Blanks (paragraph D.10.5)
  - Field Reagent Blanks (paragraph D.10.6)
  - Laboratory Performance Check Solution (paragraph D.10.7)
  - Matrix Spike/Matrix Spike Duplicates (paragraph D.10.8)
  - Calibration Standards (paragraph D.10.9)
  - Compound Quantitation and Reported Detection Limits (paragraph D.10.10)
  - Overall Assessment of Data for a Case (paragraph D.10.11)
- Data Validation Procedure for Radiological Analyses (subsection D.11)
  - Completeness Checks (paragraph D.11.1)
  - Calibration (paragraph D.11.2)
  - Blanks (paragraph D.11.3)
  - Detection Limits and Sample Results (paragraph D.11.4)
  - Radiometric and Gravimetric Yields (paragraph D.11.5)
  - Duplicate Samples and Analyses (paragraph D.11.6)
  - Laboratory Control Samples (paragraph D.11.7)
  - Holding Times (paragraph D.11.8)
  - Alpha-Emitting Ra Isotopes Using Scintillation Counting (paragraph D.11.9)

- Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting (paragraph D.11.10)
- Supplemental Requirements for Fluorometric Analysis of Uranium (paragraph D.11.11)
- Other Quality Control (paragraph D.11.12)

- Conventional Parameters Data Validation Procedures (subsection D.12)
  - Holding Times (paragraph D.12.1)
  - Calibration (paragraph D.12.2)
  - Blanks (paragraph D.12.3)
  - Laboratory Control Samples (paragraph D.12.4)
  - Duplicate Sample Analyses (paragraph D.12.5)
  - Matrix Spike Sample Analysis (paragraph D.12.6)
  - Sample Result Verification (paragraph D.12.7)
  - Field Duplicates (paragraph D.12.8)
  - Overall Assessment of Data for a Case (paragraph D.12.9)

D.2 TECHNICAL APPROACH

The following technical approach shall be applied to ensure that data validation activities are cost-effective and technically sound.

D.2.1 Data Validation Procedures

Procedures herein meet technical, regulatory, and Quality Assurance (QA) requirements and guidance of the documents listed in D.12.

D.2.2 Checklists

Checklists are provided for reviewing data. Checklists may either be on hardcopy or automated. When possible, data validation shall be conducted electronically.

Data validation checklists were developed based on the following documents.

- FEMP DQOs (Appendix C)
- ***Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analysis***, U.S. Environmental Protection Agency, 1988a and 1988b
- Radiochemical and other QA acceptance criteria for other methods

Data review checklists contain questions and specific guidance on information to be provided for each major measurement parameter. Completion of the checklist will reveal missing data, anomalous data or lack of criteria compliance that may threaten data integrity.

D.2.2.1 <u>**Field Checklist Development**</u>**.** Validity of the sample collection process is as important as sample analysis. The field data package shall be available for validation and shall include, but not be limited to, the following as applicable.

- Soil boring logs or drillers logs
- Water sampling logs
- Soil/sediment sampling logs
- Custody records
- Field instrument calibration records
- Shipping records
- Field logs or daily log forms
- Health and safety logs
- Data sheets for temperature correction adjustments (e.g., pH and conduction with measurements)

These items are portions of the daily log specified in Sections 5 and 6 (field activities and sampling procedures).

D.2.2.2 **Laboratory Checklist Development.** Checklists for validating chemical analyses shall be directly traceable to appropriate requirements and industry standards [e.g., American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), American Society of Mechanical Engineers (ASME), EPA]. Laboratory data validation criteria are determined by analytical methods and ASLs specified for the data (Table 2-2, Appendix A). Checklists shall include, but not be limited to, the following criteria.

- **Organic Materials**
  - Holding times
  - Gas chromatograph/spectrometer tuning
  - Calibration
  - Blanks
  - Percent Surrogate recovery
  - Matrix Spike/Matrix Spike Duplicates (MS/MSD)
  - Field duplicates
  - Internal standards
  - Mass spectra/chromatograms
- **Inorganic Materials**
  - Holding times
  - Calibration
  - Blanks
  - Field duplicates
  - MS/MSD
  - AA
  - Serial dilution analysis

- Contract-Required Detection Limit (CRDL) standards for AA and ICP spectroscopy
- ICP interference check sample
- Verification of instrument parameters (e.g., detection limits, linear ranges)

- **Radiochemical**
  - Holding times
  - Calibration verifications
  - Blanks
  - Replicates
  - Relative standard deviation
  - Spikes
  - Percent bias exceeding control limits

D.2.3 Analytical Support Levels

A graded approach shall be applied to determine extent of the validation effort required and useability of data generated based on the following. Reporting and deliverable requirements are determined by the ASL specified for the analysis.

- Intended use of data (level of confidence)
- ASL of the sample
- Useability of qualified data

D.2.4 Data Qualifier Codes

Codes shall be assigned to data during the validation process to identify the confidence level of identification and quantitation. Qualifiers are taken from the following fundamental guides for organic and inorganic analysis validation.

- *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis*, U.S. Environmental Protection Agency, February 1, 1988a

- *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis*, U.S. Environmental Protection Agency, July 1, 1988b

For FEMP data, the following qualifier code letters and definitions shall be used.

J Analyte was analyzed for and positively identified, but the associated numerical value may not be consistent with amount present in the environmental sample. Data should be seriously considered for making decisions and are useable for many purposes.

N Analysis indicates that an analyte is present, and there are strong indications that the identity is correct.

NJ This is a combination of the "N" and "J" qualifiers. The analysis indicates that the analyte is tentatively identified, and the associated numerical value may not be consistent with the amount present in the environmental sample.

R Data are unuseable for any purpose. Analyte was analyzed for, but the presence or absence of the analyte was not verified. Resampling and re-analysis are necessary to confirm or deny presence of the analyte.

U Analyte was analyzed for and was not present above the level of the associated value. Associated numerical value indicates the approximate concentration necessary to detect the analyte in the sample.

UJ This is a combination of the "U" and "J" qualifiers. Analyte was analyzed for and was not present above the level of the associated value. The associated value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample. If a decision requires quantitation of the analyte close to the associated numerical level, re-analysis or alternative analytical methods should be considered.

When reporting result of metals analysis, the following flags shall also be used by the laboratory.

B Reported value was obtained from a reading that was less than the Required Detection Limit (RDL) but greater than or equal to the Instrument Detection Limit (IDL).

E The reported value is estimated because of the presence of interference.

M Duplicate injection precision was not met.

N Spiked sample recovery was not within control limits.

S Reported value was determined by the Method of Standard Additions (MSA)

W Post-digestion spike for furnace AA analysis is out of control limits (85 to 115 percent), while sample absorbance is less than 50 percent of spike absorbance.

* Duplicate analysis was not within control limits.

+ Correlation coefficient for the MSA was less than 0.995.

No combination of "S", "W", or "+" shall appear in the same field for an analyte. Use of these qualifiers is mutually exclusive.

D.2.5 Sequence of Data Validation Activities

Validation activities for field sample collection and laboratory analysis data shall be accomplished in the following sequence. Subsection D.5 provides complete field data validation procedures. Subsections D.6 through D.12 provide complete laboratory analysis data validation procedures.

D.2.5.1 Field Data Validation. Validation of field activities, including results of field analytical methods for ASL A, shall be performed in the following sequence.

1. Prior to beginning data validation, ensure that the custody record and daily log (defined in Sections 5 and 7) are available as specified in paragraph D.5.2. Sample numbers on the custody record should be compared to the two part sample label to make sure the numbers are identical.

2. Review completed sampling data in the field log and associated documentation to ensure that forms specified in PSP and the SCQ have been completed and that required instrument calibration documentation exists.

3. If checklist requirements are not met, initiate the discrepancy/deficiency resolution process specified in paragraph D.2.6.

4. Report data validation results to the FEMP project manager by hardcopy or electronic data transfer. Provide a hardcopy summary that lists sample numbers, flag discrepant/deficient data samples, and include copies of data validation Data Deficiency Reports (DDR) without review checklists.

5. Retain copies of completed review checklists in Data Validation Team (DVT) files. Place original field data forms and records in FEMP files.

D.2.5.2 Laboratory Analysis Validation. Laboratory analysis data validation activities shall be performed in the following sequence.

1. Obtain original, completed laboratory certificate-of-analysis data packages from the FEMP project manager.

2. Review data sets using laboratory analysis review instructions, procedures, and checklists.

3. Check that sample numbers on custody record matches those reported on the laboratory data package.

4. If laboratory analyses or results do not meet review requirements, see applicable ASL procedure.

5. Report laboratory data review results to the FEMP project manager. List sample numbers, flag discrepant, deficient, or questionable samples and include copies of data validation DDRs without review checklists.

6. Retain copies of completed review checklists in DVT files. Replace original laboratory documentation in FEMP files.

D.2.6 Discrepancy/Deficiency Resolution

The data validation process may raise questions as to useability of some data because of failure to comply with one or more of the following data quality requirements.

- PSP
- Sample collection/tracking procedures
- Holding times
- Field and analytical instrument calibration requirements
- Quality control procedures
- Compliance with method procedures or requirements (Attachment I)
- Laboratory contamination evaluation

If so, the following formal evaluation process shall be conducted to resolve status of questionable data.

D.2.6.1 Initiation of Deficiency Report. The DVT shall initiate a DDR as follows.

1. Document discrepancies/deficiencies by completing the FEMP data validation DDR and attaching applicable checklist.

2. Sign and date DDR, ensuring that it is sequentially numbered and logged.

3. Deliver DDR to the designated FEMP Quality Assurance (QA) organization.

D.2.6.2 Resolution of Deficiency. A designated FEMP QA organization representative shall determine corrective action as follows.

1. If the discrepancy/deficiency is associated with field observations and measurements, proceed as follows.

   a. Assign it to the FEMP project manager or designee to find missing information, repeat the procedure, or explain impact of discrepancy/deficiency on data validity and useability.

   b. The FEMP project manager or designee shall enter the resolution on the DDR, sign and date it in ink, and return it to the designated FEMP QA organization representative.

2. If discrepancy/deficiency is associated with laboratory analysis, proceed as follows.

   a. Direct it to the laboratory manager to find missing information, correct mistakes or omissions, resolve inconsistencies, request re-analysis, or explain impact of deficiency on data validity.

   b. The laboratory manager or designee shall incorporate the resolution on the DDR, sign and date it in ink, and return it to the designated FEMP QA organization representative.

3. The designated FEMP QA organization representative shall initiate appropriate Quality Assurance/Quality Control (QA/QC) system actions, sign and date the DDR, and return it to the DVT.

4. The DVT leader shall re-evaluate the application of data qualifiers and verify changes the database and return it to the designated FEMP QA organization.

5. The designated FEMP QA organization representative shall transmit completed DDR to the FEMP project manager.

D.2.6.3 Completion of DDR. The FEMP project manager shall initiate the appropriate QA/QC system and complete the DDR as follows.

1. The FEMP project manager or designee shall indicate concurrence with the designated FEMP QA organization representative's recommendation and approval to use deficient/discrepant data for a specific purpose by signing the data validation DDR.

2. The data qualifier assigned to each data sample number shall be entered in the FEMP sitewide relational database.

3. After data qualifiers have been entered in the project database, the approved, signed DDR shall be placed in project files.

D.2.6.4 Deficiencies in ASL C Data. If deficiencies are noted in the validation of data analyzed at ASL C the following steps shall be performed in addition to the requirements of sections D.2.6.1 through D.2.6.3 above.

1. The DVT leader shall assess the deficiency and decide whether or not the information available in an ASL D data package would assist in resolving the deficiency.

2. The DVT leader and designated FEMP QA organization representative shall discuss the deficiencies with the FEMP project manager, and determine whether an ASL D data package should be requested from the laboratory for the affected sample(s). Decision to request an ASL D data package shall be based on the team evaluation of the nature and severity of the deficiency and the significance of the data in accomplishing the objectives of the PSP for this event.

3. Upon receipt of the ASL D data package it will be reviewed and validated according to the requirements of the analytical method for ASL D as listed in this Appendix.

D.2.7 Data Validation Documentation

Documentation of the data validation process shall become part of FEMP files and shall include the following.

- Original project documentation, validation documentation, and reports summarizing or evaluating validation effort

- DVT reports to the FEMP project manager that document progress of validation

- Surveillance reports

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D.2.8 Surveillance and Audit

The data validation process shall be subject to periodic surveillance and audit by QA staff as specified in Section 12 to monitor and document DVT compliance with the DVP and to assess DVT effectiveness.

D.3 ORGANIZATIONAL RESPONSIBILITIES AND FUNCTIONS

The DVT consists of the FEMP project manager or designee, a designated FEMP QA organization representative, and data validation personnel. DVT members have authority to document and transmit review results. The following sections outline specific functions associated with each organizational responsibility.

D.3.1 FEMP Project Manager

The FEMP project manager is responsible for ensuring that the following are accomplished.

- Plan, assign, direct, coordinate, control, and report DVT activities and results
- Review and sign data validation discrepancy reports
- Train DVT validation personnel

D.3.2 Designated FEMP Quality Assurance Organization Representative

The designated FEMP QA organization representative is responsible for the following.

- Review data validation procedures for technical adequacy
- Develop checklists and procedures
- Review completed checklists
- Recommend appropriate qualifiers for data
- Review and sign data validation discrepancy reports
- Advise FEMP project manager on personnel qualifications and training

D.3.3 Field Data Validation Personnel

The following activities shall be done in accordance with supervisory guidance and the DVP.

- Review and verify field measurements and observations as specified
- Complete review checklists
- Prepare data validation discrepancy reports
- Prepare reports of data validation results
- Submit checklists and report to designated FEMP QA organization representative

D.3.4 Laboratory Data Validation Personnel

Personnel shall be responsible for performing the following activities in accordance with supervisory guidance and the DVP.

- Review, verify, and certify laboratory analyses as specified
- Complete review checklists
- Prepare data validation discrepancy reports
- Prepare reports of data validation results
- Submit checklists and report to designated FEMP QA organization representative

D.4 DATA VALIDATION AND REPORTS

Data validation begins with a review of data by a data validator who is independent of the data acquisition process or the analytical laboratory. The review confirms that data processing was performed as specified. Data review continues with verification that reported analytical results correspond to data acquired and processed.

D.4.1 Overview of Data Validation

The following describes the basic approach to be used for validating data. Specific procedural steps are prescribed in paragraphs D.4.2 and D.4.3.

- The data package shall include, as applicable, raw data; data sheets; strip charts; dates of sample receipt, preparation, and analysis; lab bench sheets; computer input/ output; calculations; and sources for input parameters such as Response Factor (RF).

- Data package items shall be identified so that the sample number can be correctly associated with all parts of the reported data package.

- The independent validator shall review the data package for the following.

  - Appropriateness of equations

  - Correctness of numerical output, including correct united and consistent rounding of numerical values

  - Numerical correctness of calculations (by repeating computations)

  - Correct interpretation of strip charts

  - Appropriate detection limits

- The validator shall submit checklists and reports to the designated FEMP QA organization representative.

Entries and calculations reviewed by validator shall be marked in ink with a check mark. If validator disagrees with any part of the computations, a single line shall be drawn through the number, a revised number placed above or beside it, and the change initialed and dated.

If data have been processed by computer, validator shall check input only. Agreement shall be indicated by a check mark on each line. If validator disagrees with input, the number shall be lined through, the correction entered above or beside it, and the change initialed and dated. At least one percent of raw data that were automatically acquired and processed shall be manually checked. These data do not require validation beyond that previously discussed. The validator shall sign and date in ink the corrected original pages of the data package.

D.4.2 Data Validation Report Requirements

Data validation reports shall be prepared to comply with the following requirements.

- Data shall be presented in a tabular format whenever possible.

- Each table shall be identified with project number and name and date of report issue.
- Tables shall include the following.

  - Sample IDentification (ID) number used by laboratory and sample identification provided to laboratory if different than laboratory ID

  - Analyte parameters, reported values, and units of measurement reported with consistent significant figures for samples

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- Detection limit of analytical procedure if reported value is less than quantitation limit
- Analytical method used (Attachment I, FEMP Laboratory Analytical Methods Manual)
- Results of QC sample analyses including calibration standards
- Achieved accuracy, precision, and completeness of data when appropriate
- Footnotes to specific data if required to explain reported values
- Data qualifiers

D.4.3 Review of Data Validation Reports

Review of data validation reports is required to verify that validated results correspond to processed analytical results reported by laboratory. This review is performed on data as it is presented for issuance in the report.

After the draft data report is prepared, results shall be checked against validated data to ensure against transcription errors. The checking procedure is performed by a DVT team member as follows.

1. Using draft report, check data entries to ensure that items cited in paragraph D.4.2 are complete and correct.
2. Place a check mark in ink beside correct entries on draft report.
3. Draw a single line through entries needing correction and write correct entry beside it in ink. Initial and date each correction. Do not erase or use white-out.
4. Indicate that corrections were made in final report by placing a check mark by correction after comparing change with revised copy.
5. Sign and date in ink every page of draft data report used to verify corrections.
6. Maintain draft data reports used to verify corrections on file as a record to prove that review occurred.

NOTE

Step 7 is not intended to verify reported data; rather, it is intended to determine that the report meets project requirements.

7. After checking data report, transmit it to the sampling and analysis management coordinator or designee for final review.

8. After final review, transmit final data report to the FEMP project manager for approval to issue.

D.5 FIELD DATA VALIDATION PROCEDURES

Field data validation procedures for ASL A are based on the Remedial Investigation/ Feasibility Study (RI/FS) DVP (an addendum to the RI/FS Quality Assurance Project Plan, U.S. Department of Energy, 1988a). The purpose of field data validation is to ensure that sample collection and documentation was in accordance with PSPs and the SCQ.

Field measurements and observations generated at FEMP consist primarily of radiological screening data; field temperature, pH, and specific conductance data; and data associated with soil boring advancement, monitoring well installation and development, geophysical logging, and soil classification. These data shall be validated by a review of project documentation to ensure that forms specified in PSPs are complete and comply with SCQ requirements and that documentation exists for required instrument calibration.
Compliance with the following procedure is sufficient for the DVT to certify that proper procedures were followed during field investigation as specified in Section 10 and that data reports and forms have been validated.

D.5.1 General Instructions

The following general guidelines shall be applied throughout the data validation process.

- As each document is reviewed, indicate this on the checklist.
- Maintain traceability to each document reviewed.
- Signify review completion by reviewer's signature and date on the document.
- Use checklists (Forms D-1 through D-17 in Appendix B) as a guide to ensure that SCQ requirements were implemented when the reviewed document was prepared.
- If no deviations are found on a particular document, complete the checklist by indicating same with a check.
- If a discrepancy is found, mark the applicable box on the checklist and enter pertinent comments in the comments section. Documentation of discrepancies will aid in determination of future corrective action.

- Follow applicable instructions, guidelines and procedures referenced in this appendix to other appendices and sections of the SCQ and the PSP. These references will aid the reviewer in determining the requirements that apply to a particular document and concluding whether a discrepancy actually exists.

- Check recorded field measurements and observations for completeness and accuracy. Ensure that entries have the information required (e.g., the temperature space shall contain a temperature reading, not just a check mark).

- Ensure that spaces are completed as specified in Section 5. There are to be no blank data entry spaces. If the information required is not applicable, enter "NA" (for not applicable) in the space. If the information is unknown, enter "NK" (for not known) in the space. If some steps or procedures were not performed as specified, the reason must be stated as completely as possible on the appropriate form or submitted as an attachment thereto.

D.5.1.1 **General Validation Checklists.** The following general validation checklists shall be used for validation of indicated field measurement and observation data documents.

- Daily field log (Form 5-1, Appendix B)

- Sample collection log (Form 5-2, Appendix B)

- Site-wide analysis request/custody record (Form 7-1, Appendix B)

- Training documentation, procedures, audits, deviation or nonconformance reports, surveillance reports, variances, and document change control records (Form D-5, Appendix B)

D.5.1.2 **Specific Validation Checklists.** The following specific validation checklists shall be used for validation of data forms indicated.

- Subsurface soil sampling (Form D-6, Appendix B)

- Well construction and development (Form D-7, Appendix B)

- Aquifer/permeability tests (Form D-8, Appendix B)

- Ground-water sampling and field analysis data (Form D-9, Appendix B)

- Surface soil sampling (Form D-10, Appendix B)

- Surface-water and sediment sampling (Form D-11, Appendix B)
- Radiation measurement (node survey) (Form D-12, Appendix B)
- Radiation measurement (walkover survey) (Form D-13, Appendix B)

D.5.1.3 ASL B Data Validation. For user-defined ASL B analyses, the QA/QC sample type and frequency, method performance criteria, and data package deliverables shall be specified in applicable PSPs. The PSP shall also specify data validation requirements and evaluation criteria. Validation may range from minimal checks of method performance to a level similar to ASL C or D validation. Intended use of the data shall determine the nature and level of data validation. Checklists (Forms D-14 through D-17, Appendix B) indicate the types of information that may be required for validation of user-defined ASL B data.

Laboratory QC sample type and frequency for specified ASL B analysis shall be provided in Attachment I. Data package deliverable items for specified ASL B analyses are discussed in Section 11. Analytical results and QC sample performance that is within QC acceptance criteria specified in the Attachment I method shall be reported as received with no flags or qualifiers added. Reported QC sample results that are outside the method-specified acceptance criteria shall be reviewed and qualified unuseable (R), (J), (UJ), or other, as applicable. Qualification shall be based on intended use of the analytical data and the reviewer's judgement.

D.5.2 Procedures for Data Validation

The following procedures have been established to implement the DVP.

D.5.2.1 Preliminary Procedures. The following steps shall be performed to initiate the validation review process.

1. Obtain the field daily log and associated documentation, master sample list, SCQ, and applicable validation checklist. Only one checklist is required for the data package.
2. Complete header information at top of checklist.
3. Consult PSP to determine required ASL.
4. Using custody records, list collected samples in column 1 of master sample list form.
5. Review water or soil sampling log for each sample and verify that each log is completed in ink and signed and dated.

D.5.2.2 Checklist Review. Use checklist to determine if data meet the following criteria.

1. Verify that checklist information is included in each sampling log and check off each checklist item if it is correctly entered in the log.

2. If an error is detected, line through incorrect entry, write correct information beside it in ink, and initial and date correction. Do not erase or use white-out.
3. If information is omitted or a log is missing, obtain information from sampling team, verify its accuracy by signature of the team leader, and incorporate it as follows.

   a. Correct omissions by filling in required information. Initial and date correction.

   b. Replace missing logs by filling out a form indicating that the record was created "after the fact."

4. If errors are identified on sampling logs that cannot be corrected, record this fact in comments section of checklist.

5. If data were developed from samples collected without acceptable documentation or from samples that were not collected in accordance with the SCQ, classify the data as either "unuseable" or "qualitative" as applicable.

6. If no documentation is available to assess sample collection, classify data as unuseable. Data may be classified as "qualitative" if limited documentation exists and it is possible to demonstrate that samples were collected in a manner consistent with SCQ requirements.

D.5.2.3 Organizing and Binding Field Records. Field records shall be organized and bound as follows.

1. Attach sampling logs to back of their respective custody records and arrange in order according to sample collection dates.

2. Assign a number (1, 2, 3, etc.) to each record starting with the one with the earliest sample collection date.

3. Include a table of contents for each volume (may be a copy of the master sample list).

4. In column 2 of master sample list (step 4, paragraph 5.2.1), indicate, next to applicable sample ID, the assigned number (step 2) of each sample.

5. Enter sample collection date in column 4 of the master sample list next to each applicable sample in column 4.

6. Make a photocopy of master sample list for each analytical method requested plus extra copies for binding with custody records (step 1).

7. Hold these copies to use as work sheets in the next phase of validation, which is the evaluation of data package completeness and compliance with specified holding times.

8. Place field records in plastic binders.

D.5.2.4 Sample Count per Matrix and Parameter.

1. Using the master sample list, count the number of samples submitted for each matrix and parameter. Field QC samples are not included in this count.

2. Count field QC samples separately as follows.

   a. Determine separately the number of field replicates, field blanks, rinsate blanks, and trip blanks submitted.

   b. Determine percent frequency of each field QC sample per matrix and parameter.

   c. Compare this number to frequency specified in the SCQ.

   d. Place a check mark on checklist for each field QC sample collected and submitted for analysis.

NOTE

Failure to meet frequencies specified in the SCQ for analysis of field QC samples does not of itself invalidate data; but, in strictly regulated investigations, it may affect useability of data.

   e. If sample was not submitted for analysis, place a reference number in space provided and enter deficiency in comments section of checklist.

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D.5.2.5 Field Instrument Calibration Logs.

1. Check that field measuring instruments [pH meters, conductivity meters, Flame-Ionization Detectors (FID), and Photo-Ionization Detectors (PID)] were calibrated in accordance with manufacturer specifications and SCQ and PSP requirements.

2. Review calibration logs to verify that instruments were properly calibrated prior to use, and indicate this on checklist.

D.6 VOLATILE AND SEMI-VOLATILE ORGANIC DATA VALIDATION PROCEDURES FOR ASLs C AND D

Volatile and semi-volatile organic data validation procedures are based on ***EPA Functional Guidelines for Evaluating Organics Analyses*** (June 1988). This subsection describes procedures for validation of data that must be in compliance with ASLs C and D.

D.6.1 Holding Times

Ascertain that sample holding time from sample collection to analysis or sample preparation, as applicable, was not exceeded.

D.6.1.1 Criteria. The following technical requirements for sample holding times have been established for water and soil matrices.

- **Purgeables** (Volatiles) - Samples shall be analyzed within the holding times specified in Table 6-1 (Appendix A).

- **Extractables** - Samples shall be extracted and analyzed within the holding times specified in Table 6-1 (Appendix A).

D.6.1.2 Procedure.

1. Establish actual holding times by comparing sample collection dates on the Site-wide Analysis Request/Custody Record (SAR/CR (Form 7-1, Appendix B) with dates of analysis and/or extraction.

2. If holding times were exceeded, flag positive results as estimated (J) and sample quantitation limits as estimated (UJ). Document that holding times were exceeded. Reviewer may determine that non-detect data are unuseable (R).

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3. If holding times are exceeded, either on the first analysis or upon re-analysis, use professional judgement to determine reliability of data and effects of additional storage on sample results.

D.6.2 Gas Chromatography/Mass Spectroscopy Tuning

Tuning and performance criteria for Gas Chromatography/Mass Spectroscopy (GC/MS) are established to ensure mass resolution, identification, and, to some degree, sensitivity. The criteria are from the EPA Contract Laboratory Program (CLP) Statement of Work (U.S. Environmental Protection Agency, July 1988) and are subject to review and change. The most recent set of criteria shall be used by the laboratories if the listed criteria are superceded. Attachment I method modifications shall be submitted to DOE if this occurs.

D.6.2.1 Criteria. Criteria are not sample-specific; conformance is determined using standard materials; therefore, criteria shall be met in all circumstances.

- **DecaFluoroTriPhenylPhosphine (DFTPP) for Semivolatile Organic Compounds**

m/z	Ion Abundance Criteria
51	30.0 - 60.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.0% of m/z 198
441	present, but less than m/z 443
442	> 40.0 of m/z 198
443	17.0 - 23.0% of m/z 442

- **BromoFluoroBenzene (BFB) for Volatile Organic Compounds**

m/z	Ion Abundance Criteria
50	15.0 - 40.0% of m/z 95
75	30.0 - 60.0% of m/z 95
95	base peak, 100% relative abundance
96	5.0 - 9.0% of m/z 95
173	less than 2.0% of m/z 174
174	> 50.0 of m/z 95
175	5.0 - 9.0% of m/z 174
176	95.0 - 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

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D.6.2.2 **Procedure for ASL D**. The following procedure applies to ASL D data.

1. Verify from raw data that mass calibration is correct.

2. Compare data presented for each tuning to each mass listing submitted.

3. Ensure the following.

   a. Forms are available for each 12-hour period that samples are analyzed as specified in the Laboratory Services Contract (LSC)

   b. Laboratory made no transcription errors

   c. Appropriate number of significant figures has been reported (number of significant figures given for each ion in ion abundance criteria column).

   d. Laboratory made no calculation errors (e.g., percent mass of m/z 443 relative to mass of m/z 442 was calculated using the following equation)

$$\text{percent abundance} = \frac{\text{relative abundance of m/z 443}}{\text{relative abundance of m/z 442}} \times 100\%$$

4. If possible, verify that spectra were generated using appropriate background subtraction techniques. DFTPP and BFB spectra are obtained from chromatographic peaks that should be free from co-elution problems, so background subtraction should be straightforward and designed only to eliminate column bleed or instrument background ions. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting contract specifications are contrary to QA objectives and are unacceptable.

5. If mass calibration is in error, classify associated data as unuseable (R).

D.6.2.3 **Procedure for ASLs C and D.** The following procedure applies to ASLs C and D data and shall be performed if tuning acceptance criteria in paragraph D.6.2.2 are not met.

1. If ion abundance criteria are not met and the data in question are needed on a priority basis, use the following guidelines and apply professional judgement to determine extent of data that may be used.

   a. **DFTPP** - The most critical factors in DFTPP criteria are non-instrument-specific requirements that are not unduly affected by location of the spectrum on the chromatographic profile. The m/z 198/199 and 442/443 ratios are based on natural abundance of carbon 12 and carbon 13 and are critical. They shall always be met.

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Similarly, m/z 68, 70, 197, and 441 relative abundance ratios indicate condition of the instrument and suitability of resolution adjustment and are very important. These ratios relate to adjacent ions and are relatively insensitive to differences in instrument design and position of the spectrum on the chromatographic profile.

For ions at m/z 51, 127, and 275, actual relative abundance is not as critical. For instance, if m/z 275 has 40 percent relative abundance (criteria 10 to 30 percent) and other criteria are met, the deficiency is minor.
The relative abundance of m/z 365 is an indicator of suitable instrument zero adjustment. If m/z 365 relative abundance is zero, minimum detection limits may be affected. However, if m/z 365 is present but is less than the 1.0 percent minimum abundance criteria, the deficiency is not as serious.

b. **BFB** - The most important factors to consider are the empirical results that are relatively insensitive to location on the chromatographic profile and the type of instrumentation. Therefore, the critical ion abundance criteria for BFB are the m/z 95/96, 174/175, 176/177, and 174/176 ratios. Relative abundance of m/z 50 and 75 are of lesser importance.

2. In line with guideline 2, an expansion of minus ten percent of the low limit and plus ten percent of the high limit for selected ions may be appropriate. For example, in DFTPP, the m/z 51 ion abundance criteria might be expanded from 30 to 80 percent of m/z 198 to 27 to 88 percent of m/z 198. Complete expanded criteria for DFTPP and BFB follows.

- **DFTPP Expanded Criteria**

m/z	Ion Abundance Criteria
51	22.0 - 75.0 % of m/z 198
68	less than 2.0 % of m/z 69
70	less than 2.0 % of m/z 69
127	30.0 - 75.0 % of m/z 198
197	less than 1.0 % of m/z 198
198	base peak, 100 % relative abundance
199	5.0 - 9.0 % of m/z 198
275	> 7.0 - 37.0 % of m/z 198
365	greater than 0.75 % of m/z 198
441	present, but less than m/z 443
442	> 30.0 of m/z 198
443	17.0 - 23.0 % of m/z 442

- **BFB Expanded Criteria**

m/z	Ion Abundance Criteria
50	11.0 - 50.0 % of m/z 95
75	22.0 - 75.0 % of m/z 95
95	base peak, 100 % relative abundance
96	5.0 - 9.0 % of m/z 95
173	less than 2% of m/z 174
174	> 50.0% of m/z 95
175	5.0 - 9.0 % of m/z 174
176	95.0 - 101.0 % of m/z 174
177	5.0 - 9.0 % of m/z 176

If results fall within these expanded criteria, data may be acceptable. If results fall outside these expanded criteria, data are unuseable (R).

If the reviewer has reason to believe that tuning criteria were achieved using techniques that distorted the spectra, full documentation on tuning quality control shall be obtained. If techniques employed are found to be at variance with accepted practices, the laboratory QA program may merit evaluation.

It is at the reviewer's discretion based on professional judgement to flag data associated with times meeting expanded criteria, but not basic criteria. If only one element falls within the expanded criteria, qualification may not be needed. On the other hand, if several data elements are in the expanded windows, associated data may merit an estimated flag (J). The data reviewer is not required to use expanded criteria. The reviewer may still choose to flag data associated with a tune as unuseable (R) if it is appropriate to do so. A decision to use expanded criteria shall be based on intended use of the data.

D.6.3 Calibration

Compliance requirements for instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning, and continuing calibration checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

D.6.3.1 **Criteria.** Initial calibration criteria for volatile and semi-volatile fractions follow.

- Average Relative Response Factors (AVGRRF) for Target Compound List (TCL) and Hazardous Substance List (HSL) compounds shall be greater than or equal to 0.05 and greater than 0.01 for all other compounds.

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- Percent Relative Standard Deviations (%RSD) shall be less than or equal to 30 percent.

Continuing calibration criteria for volatile and semi-volatile fractions follow.

- Relative Response Factors (RRF) for TCL and HSL compounds shall be greater than or equal to 0.05 and greater than 0.01 for other compounds.

- Percent Difference (%D) shall be less than or equal to 25 percent.

D.6.3.2 **Procedure.** Initial calibration procedures are as follows.

1. Evaluate RRF for compounds and verify the following.

   a. Check and recalculate the RRF and AVGRRF for one or more volatile and semi-volatile compounds and verify that recalculated values agree with laboratory reported values.

   b. Verify that the compounds have an AVGRRF of at least 0.05 for those compounds that are on the TCL and HSL and have AVGRRFs of at least 0.01 for all other compounds. The other compounds not on the HSL or TCL are often times "poor performers" such as amines or ketones. If these analytes are held to the same AVGRRF requirement of 0.05, they would often fail to meet it. This would result in qualification of much of the data as estimated or unuseable. Since it is known that these analytes may present a problem a more realistic acceptance criterion has been set for use in data validation.

2. Evaluate %RSD for compounds and verify the following.

$$\sigma = \mathrm{SQRT}\left(\sum_{i=1}^{n} \frac{(x_i - x)^2}{(n-1)} \right)$$

Where:

$\%RSD = \sigma * 100 / x$

σ = Standard deviation of 5 response factors

x = Mean of 5 response factors

x_i = individually measured response factor

a. Check and recalculate %RSD for one or more compounds and verify that recalculated value agrees with laboratory reported value.

b. Verify that compounds (volatile and semi-volatile) have a %RSD of less than or equal to 30 percent.

3. If errors are detected in calculations of either RRF or %RSD, perform a more comprehensive recalculation.

4. If a compound has an AVGRRF of less than 0.05 for TCL or HSL compounds or less than 0.01 for all other compounds, proceed as follows.

   a. Flag positive results for that compound as estimated (J).

   b. Flag non-detects for that compound as unuseable (R).

5. If any compound has a %RSD greater than 30 percent, proceed as follows.

   a. Flag positive results for that compound as estimated (J).

   b. Qualify non-detects using professional judgement.

Continuing calibration procedures follow.

1. If a compound has an RRF of less than 0.05 for TCL or HSL compounds or less than 0.01 for all other compounds, proceed as follows.

   a. Flag positive results for that compound as estimated (J).

   b. Flag non-detects for that compound as unuseable (R).

2. If any compound has a %D between initial and continuing calibration greater than 25 percent, proceed as follows.

   a. Flag positive results for that compound as estimated (J).

   b. Qualify non-detects using professional judgement.

D.6.4 Blanks

Blank analysis results shall be assessed to determine existence and magnitude of contamination problems.

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D.6.4.1 Criteria. Criteria for evaluation apply to blanks associated with samples. If there is a problem with a blank, associated sample data shall be evaluated to determine if there is an inherent variability in data for the case or if the problem is an isolated occurrence not affecting other data.

Contaminants should not be present in blanks.

D.6.4.2 Procedure.

1. Review results of associated blanks, FEMP forms, and raw data (e.g., chromatogram, reconstructed ion chromatogram, quantitation reports or data system printouts).

2. Verify that method blank analysis has been reported per matrix, per concentration level for each GC/MS system used to analyze Volatile Organic Analysis (VOA) samples and for each extraction batch for semi-volatiles. When unsuitable blank results are obtained, action depends on circumstances and origin of the blank. The method blank summary may be used to assist in identifying samples associated with each method blank.

3. Do not report positive sample results unless concentration of compound in sample exceeds ten times amount in any blank for common contaminants listed in step 7 or five times amount for other compounds.

4. When more than one blank is associated with a given sample, base qualification upon comparison with the associated blank having the highest concentration of contaminant.

NOTE

Results shall not be corrected by subtracting a blank value.

5. Take no action if compound is found in a blank but not found in the sample.

6. Qualify compounds other than those listed in step 7 that are detected in the sample and also detected in an associated blank when sample concentration is less than five times the blank concentration.

7. Report a positive result, if concentration of compound in the sample exceeds ten times amount in a blank for the following common laboratory contaminants.

   - Methylene chloride
   - Acetone
   - Toluene

- 2-butanone (Methyl-ethyl Ketone)
- Common phthalate esters

NOTE

The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. These factors shall be taken into consideration when applying the 5-times and 10-times criteria so that a comparison of the total amount of contamination is actually made.

Additionally, there may be instances where little or no contamination is present in the associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this can be detected when contaminants are found in the diluted sample result but are absent in the undiluted sample result. However, if the reviewer determines that the contamination is from a source other than the sample, data shall be qualified. In this case, the 5-times or 10-times rules do not apply and sample value shall be reported as a non-detect.

Following are examples of applying blank qualification guidelines; however, certain circumstances may warrant deviation from these guidelines.

Case 1 Sample result is greater than contract Required Quantitation Limit (RQL) but less than (5- or 10-times) required amount of the blank result.

	Rule	
	10 Times	5 Times
Blank Results	7	7
RQL	5	5
Sample Results	60	30
Qualified Sample Result	60U	30U

In the example for the 10-times rule, sample results less than 70 (or 10 x 7) are qualified as non-detects.

For the 5-times rule, sample results less than 35 (or 5 x 7) are qualified as non-detects.

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Case 2 Sample result is less than RQL and also less than (5- or 10-times) required amount of the blank result.

	Rule	
	10 Times	5 Times
Blank Result	6	6
RQL	5	5
Sample Result	4J	4J
Qualified Sample Result	5U	5U

Data are not reported as 4U because this indicates a detection limit below the RQL.

Case 3 Sample result is greater than (5- or 10-times) required amount of the blank result.

	Rule	
	10 Times	5 Times
Blank Result	10	10
RQL	5	5
Sample Result	120	60
Qualified Sample Result	120	60

For both 10-times and 5-times release, sample results exceeded adjusted blank results of 100 (or 10 x 10) and 50 (or 5 x 10).

8. If gross contamination exists (e.g., saturated peaks by GC/MS), flag affected compounds as unuseable (R) in samples affected by interference.

9. If inordinate amounts of other compounds are found at low levels in blanks, record it in data review comments because it may be indicative of a laboratory problem.

10. If Tentatively Identified Compounds (TIC) are found in both the sample and associated blanks, record this in data review comments because it may be indicative of a laboratory problem.

D.6.5 Percent Surrogate Recovery

Laboratory performance on individual samples is checked by spiking samples with surrogate compounds prior to sample preparation and evaluating the percent recovery. Evaluation of results of surrogate spikes is not necessarily straightforward. The sample itself may produce effects caused by such factors as interferences and high concentrations of analytes. Because effects of the sample matrix are frequently outside laboratory control and may present relatively unique problems, review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement. Accordingly, the following procedures consist primarily of guidelines and, in some cases, optional approaches are suggested.

D.6.5.1 **ASL C and D Criteria.** Sample and blank surrogate recoveries for volatile and semi-volatile compounds shall be within limits specified in the applicable method and the LSC. When unacceptable surrogate recoveries are followed by successful re-analyses, only the successful run must be reported.

D.6.5.2 **Procedure.**

1. Check raw data (e.g., chromatogram, quantitation list) to verify recoveries on surrogate recovery form.

2. From surrogate recovery forms, determine if any two surrogates within a base/neutral or acid fraction (or one surrogate for the VOA fraction) are out of specification or if any one base/neutral, acid, or VOA surrogate has a recovery of less than ten percent.
3. From surrogate recovery forms, determine if recoveries are out of specification with no evidence of repurging, re-injection, or re-extraction. If so, the laboratory has failed to perform satisfactorily.

4. Verify that no blanks have surrogates outside criteria parameters.

5. If there are two or more analyses for a particular fraction, determine which are the best data to report based on the following considerations.

   - Surrogate recovery (marginal versus gross deviation)

   - Holding times

   - Comparison of compound values reported in each fraction

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6. For surrogate spike recoveries out of specification, proceed as follows.

   a. If at least two surrogates in a base/neutral or acid fraction or one surrogate in the volatile fraction are out of specification but have recoveries greater than ten percent, proceed as follows.

      (1) Flag positive results for that fraction as estimated (J).

      (2) Flag negative results for that fraction with the sample quantitation limit as estimated (UJ).

   b. If a surrogate in a fraction shows less than ten percent recovery, proceed as follows.

      (1) Flag positive results for that fraction as estimated (J).

      (2) Flag negative results for that fraction as unuseable (R).

   c. Do not qualify data with respect to surrogate recovery unless at least two surrogates are out of specification in the base/neutral or acid fraction, one is out of specification in the volatile fraction, or unless recovery of a surrogate is less than ten percent. If reanalysis was performed results of the original anaylsis and reanalysis should be compared to assess whether the results are due to matrix effects or to a problem with the analytical process.

   d. For a blank analysis with surrogates out of specification, give special consideration to validity of associated sample data and determine whether problems are isolated to the blank alone or if there is a fundamental problem with the analytical process.

NOTE

For example, if one or more samples in the batch show acceptable surrogate recoveries, the blank problem may be considered an isolated occurrence. However, even if this judgement allows some use of the affected data, analytical problems remain, which shall be reported to and corrected by the laboratory.

D.6.6 Matrix Spike/Matrix Spike Duplicates

MS/MSD data are generated to determine long-term precision and accuracy of the analytical method on various matrices. These data alone cannot be used to evaluate precision and accuracy of individual samples.

D.6.6.1 Criteria. Spike recoveries and Relative Percent Differences (RPD) between MS/MSD recoveries shall be within advisory limits in the applicable method (Attachment I).

D.6.6.2 Procedure for ASLs C and D Data. The following procedure is applicable to both ASLs C and D data.

1. Inspect data results for MS/MSD recovery.

2. Verify transcriptions from raw data for ASL D and verify calculations.

3. Do not use MS/MSD data alone to qualify an entire case. Use informed professional judgement and MS/MSD results in conjunction with other QC criteria to determine the need for some qualification of the data.

4. Try to determine effect of MS/MSD results on associated data with regard to the MS/MSD sample and specific analytes for samples associated with the MS/MSD.

5. If it can be determined that results of the MS/MSD affect only the spiked sample, limit qualification to this sample alone.

6. If it is determined through MS/MSD results that a laboratory is having a systematic problem in analysis of one or more analytes, apply qualification to associated samples.

D.6.7 Field Duplicates

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision; therefore, results may have more variability than laboratory duplicates, which measure only laboratory performance. It is also expected that solid matrix duplicate results will have a greater variance than water matrices because of difficulty in collecting identical samples.

D.6.7.1 Criteria. There are no specific review criteria for field duplicate analyses comparability.

D.6.7.2 Procedure.

1. Identify samples that are field duplicates using FEMP forms specified in LSC or PSP.

2. Compare results reported for each sample and calculate the RPD.

3. Provide evaluation of field duplicates with reviewer comments.

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D.6.8 Internal Standards Performance

D.6.8.1 Criteria. The following Internal Standards (IS) performance criteria ensure that GC/MS sensitivity response is stable during every analytical run.

- IS area counts shall not vary by more than a factor of two (- 50 percent to + 100 percent) from associated calibration standard.
- Retention time of the IS shall not vary more than ± 30 seconds from the associated calibration standard.

D.6.8.2 Procedure.

1. Check raw data (e.g., chromatograms, quantitation lists) and verify recoveries reported on FEMP forms specified in the LSC.
2. Verify that retention times and IS areas are acceptable.
3. If there are two analyses for a particular fraction, determine which data are best to report considering the following.
   - Magnitude and direction of the IS area shift
   - Magnitude and direction of the IS retention time shift
   - Holding times
   - Comparison of TCL, HSL, and Resource Conservation and Recovery Act (RCRA) Appendix IX compounds values reported in each fraction
4. If an IS area count is outside the range of - 50 percent or + 100 percent of associated standard, results shall be flagged as follows.
   a. Flag positive results for compounds quantified using that IS as estimated (J) for that sample fraction.
   b. Flag non-detects for compounds quantified using that IS with sample quantitation limit classified as estimated (UJ) for that sample fraction.
5. If an IS retention time varies by more than 30 seconds, examine chromatographic profile for that sample to determine if false positives or negatives exist.
6. For shifts of a large magnitude, consider partial or total rejection of data for that sample fraction.

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D.6.9 Target Compound Identification

The objective of criteria for GC/MS qualitative analysis is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not present) or a false negative (not reporting a compound that is present).

Identification criteria can be applied much more easily to detect false positives than false negatives. More information is available because of the requirement for submittal of data supporting positive identifications. Negatives (non-detected compounds), however, represent an absence of data and are, therefore, much more difficult to assess.

D.6.9.1 Criteria.

- Compound shall be within ± 0.06 Relative Retention Time (RRT) units of the standard RRT.

- Mass spectra of the sample compound and a current laboratory-generated standard shall match according to the following criteria.

  - Ions present in the standard mass spectrum at a relative intensity greater than ten percent shall be present in the sample spectrum.

  - Relative intensities of ions shall agree within ± 20 percent between the standard and sample spectra (e.g., for an ion with 50 percent abundance in the standard spectrum, the corresponding sample ion abundance shall be between 30 and 70 percent).

  - Ions greater than ten percent in the sample spectrum but not present in the standard spectrum shall be considered and accounted for.

D.6.9.2 Procedure. The following procedure is applicable to both ASLs C and D data.

1. Ensure that RRT of reported compounds is within 0.06 units of reference standard.

2. Check laboratory standard spectra versus sample compound spectra for ASL D validation as specified in paragraph D.6.9.1.

3. Be alert for situations where sample carry-over is a possibility (e.g., high concentration samples preceding low concentration samples) and use professional judgement to determine if instrument cross-contamination has affected positive compound identification.

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4. Use professional judgement to apply qualitative criteria for GC/MS analyses; if it is determined that incorrect identifications were made, flag such data as not detected (U) or unuseable (R).

5. Use professional judgement to qualify data if it is determined that cross-contamination occurred.

D.6.10 Compound Quantitation and Reported Detection Limits

The data validation objective is to ensure that reported quantitation results and the RQL are accurate.

D.6.10.1 Criteria.

- Compound quantitation as well as adjustment of the RQL shall be calculated according to the applicable method.
- Compound RRF shall be calculated based on the IS specified in the method for that compound.
- Quantitation shall be based on the ion (m/z) specified in the method.
- Compound quantitation shall be based on the RRF from the appropriate daily standard.

D.6.10.2 Procedure.

1. For fractions, examine raw data to verify correct calculation of sample results reported by the laboratory.

2. Compare quantitation lists, chromatogram, and sample preparation log sheets to reported positive sample results and quantitation limits.

3. Verify that correct internal standard, quantitation ion, and RRF were used.

4. Verify that RQLs have been adjusted to reflect sample dilutions, concentrations, splits, clean-up activities, and dry-weight factors are not accounted for by the method.

5. If discrepancies are found, obtain additional information from the laboratory that may resolve differences. If discrepancy remains unresolved, decide which value is best. Reviewer may determine qualification of data is warranted.

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D.6.11 Tentatively Identified Compounds

This procedure for TICs is applicable to ASL D data. Chromatographic peaks in volatile and semi-volatile fraction analyses that are not on the TCL, HSL, or RCRA Appendix IX list; analytes; surrogates; or internal standards are potential TICs that the reviewer shall qualitatively identify by GC/MS library search and assess.

D.6.11.1 Criteria.

- For each sample, the laboratory shall conduct a mass spectral search of the National Institute of Standards and Technology (NIST) library and report possible identities for the ten largest VOA fraction peaks and the 20 largest Base Neutrals Analysis (BNA) fraction peaks that are not surrogate, IS, or compounds, but have area/height greater than ten percent of the size of the nearest IS. TIC results shall be reported for each sample.

- Guidelines for tentative identification are as follows.

  - Major ions (greater than ten percent relative intensity) in the reference spectrum shall be present in the sample spectrum.

  - Relative intensities of major ions shall agree within $\pm$ 20 percent between the sample and reference spectra.

  - Molecular ions present in the reference spectrum shall be present in the sample spectrum.

  - Ions present in the sample spectrum but not in the reference spectrum shall be reviewed for possible background contamination, interference, or co-elution of additional compounds.

  - Even if these criteria are not met, the data reviewer may report identification if a mass spectral interpretation specialist reviewer judges it to be correct.

  - If, in the data reviewer's judgement, identification is uncertain or there are extenuating factors affecting compound identifications, the TIC result may be reported as "unknown".

D.6.11.2 Procedure.

1. Check raw data to verify that laboratory has generated a library search for required peaks in the chromatogram (samples and blanks).

2. Examine blank chromatogram to verify that TIC peaks present in samples are not in blanks. If a low-level compound that is a common artifact or laboratory contaminant is detected in a sample, check the blank chromatogram for peaks of less than ten percent of IS height that are present in the blank chromatogram at a similar RRT.

3. Examine mass spectra in each sample and blank.

4. Because TIC library searches often yield several candidate compounds with a close matching score, consider all reasonable choices.

5. Be alert for the following common laboratory artifacts/contaminants and their sources that may be present in blanks and not reported as sample TICs.

   - Common laboratory contaminants: CO_2 (m/z 44), siloxanes (m/z 73), diethyl ether, hexane, certain freons (1,1,2-trichloro-1,2,2-trifluoroethane or fluorotrichloromethane), and phthalates at levels less than 100 μg/l or 4000 μg/kg

   - Solvent preservatives: cyclohexene, a methylene chloride preservative, and related by-products including cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, and chlorocyclohexanol

   - Aldol reaction products of acetone including 4-hydroxy-4-methyl-2-pentanone; 4-methyl-2-penten-2-one; and 5,5-dimethyl-2(5H)-furanone

NOTE

A compound may be identified in the proper analytical fraction by non-target library search procedures even though it was not found on the quantitation list.

6. If total-area-quantitation method was used, request laboratory recalculation of the result using proper quantitation ion. Also, evaluate other sample chromatograms and check library reference retention times on quantitation lists to determine if the false negative result is an isolated occurrence or if data from the entire case is affected.

7. Compounds may be identified in more than one fraction, so verify that quantitation is made from the proper fraction.

8. Flag TIC results as tentatively identified with estimated concentrations (JN).

9. If it is determined that tentative identification of a compound is not acceptable, change the tentative identification to "unknown" or an appropriate identification.

10. If contractually required peaks were not library searched, request the data from the laboratory.

11. Do not report TICs that are not sufficiently above the level in the blank. Consider dilutions and sample size when comparing amounts present in blanks and samples.

12. When a compound is not found in blanks but is a suspected artifact or a common laboratory contaminant, flag result as unuseable (R).

13. To decide if a library search identification of a TIC is realistic, exercise professional judgement. If there is more than one reasonable match, report result as either compound "X" or "Y". If there is a lack of isomer specificity, change TIC result to a non-specific isomer result (1,3,5-trimethyl benzene to trimethyl benzene isomer) or to compound class (2-methyl-3-ethyl benzene to substituted aromatic compound). The reviewer may elect to summarize and report similar isomers as a total (e.g., alkanes may be reported as total hydrocarbons).

NOTE

Other case factors may influence TIC judgements. If a sample TIC match is poor but other samples have a TIC with a good library match, similar relative retention time, and the same ions; identification information may be inferred from the other TIC results. Physical constants, such as boiling point, may be factored into professional judgement of TIC results.

D.6.12 Procedure for ASL C

Because the ASL C data package does not include the raw data, it is not possible to review the spectra and tentative spectral identifications of TICs. However, the reviewer shall examine the reported list of TICs and the apparent reported concentrations and tentative identifications. The review shall consider other reported site data and information in assessing the overall significance of reported TICs.

D.6.13 System Performance

After instrument performance QC checks (e.g., blanks, tuning, calibration), changes may occur that degrade data quality. While this degradation is not directly shown until the next series of analytical QC checks, a thorough review of ongoing data acquisition can indicate degradation of instrument performance. Following are some examples of these indicators.

- Abrupt, discrete shifts in Reconstructed Ion Chromatograph (RIC) baseline may indicate gain or threshold changes.

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- Poor chromatographic performance affects both qualitative and quantitative results. Indications of substandard performance include the following.
  - High Reconstructed Ion Chromatograph (RIC) background levels or shifts in absolute retention times of ISs
  - Excessive baseline rise at elevated temperature
  - Extraneous peaks
  - Loss of resolution suggested by factors such as non-resolution of 2,4- and 2,5-dinitrotoluene
  - Peak tailing or peak splitting may result in accurate quantitation

Continued analytical activity with degraded performance suggests lack of attention or professional experience. Using instrument performance indicators, data reviewer shall decide if the system has degraded to the point of affecting data quality or validity. If data quality may have been affected, data shall be qualified using reviewer's best professional judgement.

D.6.14 Overall Assessment of Data for a Case

It is appropriate for data reviewer to make professional judgements and express concerns and comments on validity of the overall data package for a case. This is particularly true when there are several QC criteria out of specification.

The additive nature of QC factors out of specification is difficult to assess in an objective manner, but reviewer has a responsibility to inform users concerning data quality and data limitations in order to avoid inappropriate use of data while not precluding consideration of the data. The reviewer is greatly assisted if DQOs are provided.

D.7 PESTICIDES DATA VALIDATION PROCEDURES FOR ASLs C AND D

Data validation procedures for pesticides are based on the *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis*, 1 February 1988 (U.S. Environmental Protection Agency, 1988a).

This subsection describes general procedures for data validation from Gas Chromatography (GC) analysis of pesticides (e.g., herbicides, purgeable halocarbon, organo-phosphate pesticides) for ASLs C and D. Specific performance criteria, surrogates, spike compounds, instrument performance requirements, calibration, and standards are provided in Attachment I (FEMP Laboratory Analytical Methods Manual) and shall be used as validation criteria. The following procedures shall be performed for GC data validation in the order indicated.

D.7.1 Holding Times

The objective of validating holding time data is to establish validity of analysis results by ensuring that sample holding times from receipt to analysis or preparation were in compliance with the specified method in Attachment I. This procedure applies to both ASLs C and D data.

D.7.1.1 Criteria.

- Extraction of water samples by the separatory funnel methods shall be completed within seven days of sample collection date.
- Extraction of water samples by continuous liquid/liquid extraction shall be started within seven days of sample collection time.
- Extraction of soil or sediment samples by sonication shall be completed within fourteen days of sample collection time.
- Analysis of samples shall be completed within forty days following start of extraction.

D.7.1.2 Procedure.

1. Verify holding time by comparing sample collection date with dates of extraction and analysis on LSC-specified FEMP form.
2. Examine sample records to determine if samples were preserved as specified in the Project-Specific Plan (PSP).
3. If holding times were exceeded, proceed as follows.
   a. Flag positive results as estimated (J).
   b. Flag sample quantitation limits as estimated (UJ).
   c. Document that holding times were exceeded.
4. If holding times are grossly exceeded either on first analysis or re-analysis, proceed as follows.
   a. Use professional judgement to establish reliability of data and effect of additional storage on sample results.
   b. If non-detect data are unuseable, flag data as (R).

D.7.2 Instrument Performance

D.7.2.1 Criteria. Criteria are established to ensure that adequate chromatographic resolution and instrument sensitivity are achieved by the chromatographic system. These criteria are not sample specific. Conformance is determined using standard materials; therefore, criteria shall be met in all circumstances.

D.7.2.2 Procedure for ASL D.

1. Check raw data to verify that the following conditions exist.

   a. Retention-time windows are reported and pesticide standards are within established windows.

   b. Percent breakdown for DDT or endrin does not exceed 20 percent in evaluation standard analyses.

$$\text{\% Breakdown (DDT)} = \frac{\text{Total (DDE + DDD)}}{\text{Total (DDE+DDD+DDT)}} \times 100$$

$$\text{\% Breakdown (Endrin)} = \frac{\text{Total(Endrin ketone + Endrin Aldehyde)}}{\text{Total (Endrin ketone + Endrin Aldehyde + Endrin)}} \times 100$$

   c. Percent breakdown for combined endrin and DDT does not exceed 30 percent in evaluation standard analyses.

   d. If the retention time shift for DiButylChlorendate (DBC) is greater than 0.3 percent for narrow-bore capillary columns or greater than 1.5 percent for wide-bore capillary columns, the analyses may be flagged unuseable (R) for that sample, but the reviewer shall use professional judgement to qualify data.

2. Check affected sample chromatograms for peaks within an expanded window surrounding expected retention-time window of analyte of interest and proceed as follows to ensure that standards fall within retention-time windows. Retention-time windows are used for qualitative identification. If standards do not fall within the windows, associated sample results shall be evaluated. Samples injected after the last in-control standard may be affected.

   a. If no peaks are present within or close to the window of the deviant target compound, there is usually no effect on data. (Non-detected values can be considered valid.)

b. If affected sample chromatograms contain peaks that may be of concern (i.e., above PQL and either close to or within expected retention-time window of analyte), two options (steps c and d) are available to determine affect on data.

c. If no additional effort is warranted, flag positive results and quantitation limits as unuseable (R). In the comments, emphasize the possibility of either false negatives or false positives as appropriate.

d. If additional effort is warranted (e.g., if data are needed on a priority basis and if peaks may represent a level of concern for that particular analyte), proceed as follows to determine a useable window for affected samples.

(1) Examine data package for presence of three or more standards containing analyte of interest that were run within a 24-hour period during which sample was analyzed.

(2) If three or more such standards are present, re-evaluate mean and standard deviation of retention-time window.

(3) If all standards and matrix spikes fall within revised window, determine valid positive or negative sample results using this window.

(4) Record additional efforts taken and resultant impact on data useability.

(5) Include calculations and comparisons generated in support documentation.

D.7.3 Calibration

Calibration requirements ensure that measuring instruments are capable of producing acceptable quantitative data. Initial calibration ensures that instruments are capable of specified performance in the beginning. Continuing calibration ensures that instruments are adjusted at specific time periods and that required calibration documentation is maintained.

D.7.3.1 Initial Calibration Criteria for ASLs C and D Data.

- Retention-time windows are specified for compounds in the applicable method (Attachment I).
- All compounds except surrogates shall have a %RSD less than or equal to 20.0 percent.
- Surrogates shall have a %RSD less than or equal to 30.0 percent.

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- Up to two target compounds (except surrogates) may have a %RSD greater than 20.0 percent but less than or equal to 30.0 percent.

D.7.3.2 Continuing Calibration Criterion for ASLs C and D Data.

- RPD shall be less than or equal to 25.0 percent.

D.7.3.3 Procedure for Initial Calibration Data for ASL C.

1. Verify that %RSD for calibration factor of each analyte is less than or equal to 20 percent for each 12-hour period.

2. If linearity criteria are not met, flag associated quantitative results as estimated (J).

D.7.3.4 Procedure for Initial Calibration Data for ASL D.

1. Verify that %RSD for calibration factor of each analyte is less than or equal to 20 percent for each 12-hour period.

2. If linearity criteria are not met, flag associated quantitative results as estimated (J).

3. Inspect standards results and verify agreement with raw GC data (chromatograms and data system printouts).

4. Check raw data and recalculate one percent of the calibration factors and %RSD for calibration concentrations.

5. If errors are detected, perform more comprehensive recalculations.

6. Inspect multi-component analysis results and verify agreement with the raw data.

D.7.3.5 Procedure for Continuing Calibration Data for ASLs C and D.

1. To verify quantitative results, check %D between calibration factors by recalculating approximately ten percent of values reported in raw data using the following formula.

$$\%D = \frac{R_1 - R_2}{R_1} \times 100$$

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Where:

R_1 = Calibration factor from first analysis

R_2 = Calibration factor from subsequent analysis

2. If percent difference between calibration factors is greater than 25 percent of quantitated compounds, flag associated positive quantitative results as estimated (J).

D.7.4 Blanks

Assessment of blank analyses results determines existence and magnitude of contamination problems. If problems exist, data associated with the case shall be evaluated to determine whether there is an inherent variability in data for the case or if the problem is an isolated occurrence not affecting other data.

D.7.4.1 **Criteria.** The following criterion applies to both ASLs C and D data.

- No contaminants should be present in blanks.

D.7.4.2 **Procedure for ASLs C and D.** The following procedure applies to both ASLs C and D data.

1. Verify that method blank analyses contain less than RQL of target analytes or interfering peaks.

2. Verify that method blank analysis has been reported per matrix, per concentration level, per GC system used to analyze samples for each extraction batch.

NOTE

When unsuitable blank results occur, action depends on circumstances and origin of the blank. Positive sample results shall not be reported unless compound concentration in sample exceeds five times amount in blank. When more than one blank is associated with a given sample, qualification shall be based upon a comparison with the associated blank having the highest concentration of a contaminant. Results shall not be corrected by subtracting the blank value.

3. If a contaminant is found in the blank but not in the samples, take no action.

4. Qualify target analytes detected in sample and also detected in an associated blank when sample concentration is less than five times blank concentration.

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NOTE

Blank analyses may not involve the same weights, volumes, or dilution factors as associated samples. These factors shall be taken into consideration when applying the five-times criteria so that a comparison of the total amount of contamination may be made.

Additionally, there may be instances where little or no contamination was present in associated blanks, but qualification of sample was deemed necessary (e.g., contamination introduced through dilution water).

Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in a diluted sample result, but are absent in the undiluted sample result. Because both results are not routinely reported, it may be impossible to verify this source of contamination. However, if reviewer determines that contamination is from a source other than the sample, data shall be qualified. In this case, the 5-times criterion does not apply; the sample value shall be reported as a non-detect.

Examples of applying blank qualification guidelines follow. Certain circumstances may warrant deviations from these guidelines.

Case 1 Sample result is greater than RQL but is less than required amount (5 times) of blank result.

	5-Times
Blank result	1.0
RQL	0.5
Sample result	4.0
Qualified sample result	4.0U

In this case, sample results less than 5.0 (5 x 1.0) are qualified as non-detects.

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Case 2 Sample result is greater than required amount (5-times) of blank result.

	5-Times
Blank result	1.0
RQL	0.5
Sample result	6.0
Qualified sample result	6.0

D.7.4.3 **Procedure for ASL D.** The following procedure applies only to ASL D data and shall be performed in addition to procedure in paragraphs D.7.4.3.

1. Review results of associated blanks and raw data (chromatograms, quantitation reports or data system printouts).

D.7.5 Percent Surrogate Recovery

Quality of laboratory analysis of individual samples is established by spiking samples with a surrogate compound prior to sample preparation and evaluating the percent recovery. However, evaluation of results of surrogate spikes is not necessarily straightforward. The sample itself may produce effects caused by factors such as interferences and high concentrations of analytes.

The review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement because effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems. Accordingly, this procedure consists primarily of guidelines and, in some cases, several optional approaches are suggested.

D.7.5.1 **Criteria.** The following criterion applies to both ASLs C and D data.

- Sample and blank recoveries of surrogates shall be within advisory limits of the specified method (Attachment I).

D.7.5.2 **Procedure for ASL C.** The following procedure applies to ASL C data only and shall be performed prior to and in addition to procedure in paragraph D.7.5.4.

1. Verify that surrogate recoveries are within advisory limits (paragraph D.7.5.1).

D.7.5.3 **Procedure for ASL D.** The following procedure applies to ASL D data only and shall be performed prior to and in addition to procedure in paragraph D.7.5.4.

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1. Check raw data (e.g., chromatograms, quantitation list) to verify recoveries.

2. If recoveries are not within advisory limits, check raw data for possible interferences that may have affected surrogate recoveries.

D.7.5.4 Procedure for ASLs C and D. The following procedure applies to surrogate recovery data for both ASLs C and D and shall be performed after procedures in paragraphs D.7.5.2 and D.7.5.3.

1. Use the following guidelines if surrogate recoveries are outside advisory windows.

   a. If low recoveries are obtained, flag associated positive results and quantitation limits as estimated (J).

   NOTE

   A high bias may be caused by co-eluting interferences.

   b. If high recoveries are obtained, use professional judgement to determine appropriate action.

   c. If zero surrogate recovery is reported, examine sample chromatogram to determine if surrogate may be present, but slightly outside its retention-time window.

   d. If surrogate is present, in addition to assessing surrogate recovery for quantitative bias, investigate qualitative validity of analysis.

   e. If surrogate is not present, flag negative results as unuseable (R).

D.7.6 Matrix Spike/Matrix Spike Duplicates

MS/MSD data are generated to determine long-term precision and accuracy of the analytical method (Attachment I) on various matrices. These data alone cannot be used to evaluate precision and accuracy of individual samples.

This procedure applies to both ASLs C and D data.

D.7.6.1 Criteria.

- Advisory limits are established for spike recovery limits in the applicable method in Attachment I and on LSC-specified FEMP forms.

- Advisory limits are established for RPD between matrix spike and matrix spike duplicate recoveries in the applicable method in Attachment I and on LSC-specified FEMP forms.

D.7.6.2 Procedure.

1. Inspect results for MS/MSD recoveries.

2. Verify transcriptions from raw data for ASL D evaluation.

3. Verify calculations.

4. Do not use MS/MSD data alone to qualify an entire case, but, using informed professional judgement and MS/MSD results in conjunction with other QC criteria, determine need for qualification of data.

5. First try to determine extent of effects of MS/MSD results on associated data. Make this determination in regard to the sample as well as specific analytes for samples associated with MS/MSD.

6. If it can be determined that results of MS/MSD affect only the spiked sample, limit qualification to sample alone.

7. If it is determined through MS/MSD results that a laboratory is having a systematic problem in analysis of one or more analytes that affect associated samples, laboratory shall be notified and affected samples qualified.

D.7.7 Field Duplicates

Field duplicate samples may be collected and analyzed to evaluate overall precision. These analyses measure both field and laboratory precision; therefore, results may have more variability than laboratory duplicates, which measure only laboratory performance. It is also expected that solid matrix duplicate results will have a greater variance than duplicates of water matrices because of difficulty collecting identical samples. This procedure applies to both ASLs C and D data.

D.7.7.1 Criteria.

- There are no specific review criteria for field duplicate analyses comparability.

D.7.7.2 Procedure.

1. Identify field duplicate samples.

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2. Compare results reported for each sample and calculate RPD.

3. Document field duplicate evaluation.

D.7.8 Compound Identification

Qualitative criteria for compound identification were established to minimize erroneous identifications, which can be either a false positive (reporting a compound when it is not present) or a false negative (not reporting a compound that is present).

D.7.8.1 Criteria. The following criteria apply to both ASLs C and D data.

- Retention times of reported compounds shall fall within calculated windows for the two chromatographic columns.

- GC/MS confirmation is required if the concentration of a compound exceeds 10 ng/μL in the final sample extract.

D.7.8.2 Procedure for ASL D Data. The following procedure shall be performed prior to and in addition to procedure in paragraph D.7.8.3.

1. Review compound identification results and associated raw data (chromatograms, data system printouts).

2. Confirm reported positive detects using appropriate retention times and retention-time windows, and verify that compounds listed as "not detected" are correct.

D.7.8.3 Procedure for ASLs C and D Data.

1. Verify that positive identifications have dissimilar column analysis.

2. If qualitative criteria for the two-column confirmation were not met, consider reported positive detects as non-detects; use professional judgement and assign an appropriate quantitation limit based on the following guidelines.

   a. If mis-identified peak was sufficiently outside target pesticide retention-time window, report RQL.

   b. If identified peak interferes with potential detection of target peak, consider reported value and flag it as estimated quantitation limit (UJ).

D.7.9 Compound Quantitation and Reported Detection Limits

The validation objective is to ensure that reported quantitation results and RQLs are accurate.

D.7.9.1 Criteria. The following criterion applies to both ASLs C and D data.

- Compound quantitation, as well as adjustment of the RQL, shall be calculated in accordance with the specified method in Attachment I.

D.7.9.2 Procedure for ASLs C and D. The following procedure applies to both ASLs C and D data.

1. Verify that RQLs were adjusted to reflect sample dilutions, splits, concentrations, clean-up activities, and dry weight factors that were not accounted for in the method.

2. Flag quantitation limits affected by large, off-scale peaks as unuseable (R).

3. If interference is on-scale, provide an estimated quantitation limit (UJ) for each affected compound.

4. Use professional judgement to decide whether a much larger concentration obtained in one column versus the other column indicates presence of an interfering compound.

5. If an interfering compound is indicated, report lower of the two values and qualify it as presumptively present at an estimated quantity (NJ), which will necessitate a determination of an estimated concentration in confirmation column.

6. Document that presence of interferences has obscured attempt at second-column confirmation.

D.7.9.3 Procedure for ASL D. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.7.9.3.

1. Examine raw data to verify correct calculation of sample results reported by the laboratory.

2. Compare quantitation reports, chromatograms, and sample preparation logs to reported positive sample results and quantitation limits.

D.7.10 Overall Assessment of Data for a Case

The data reviewer shall make professional judgements, express concerns, and comment on validity of the overall data package. This is particularly appropriate when there are several QC criteria out of specification.

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The additive nature of QC factors out of specification is difficult to assess in an objective manner, but reviewer has a responsibility to inform users concerning data quality and limitations. Availability of DQOs is helpful in this review. The information will help the user avoid inappropriate use of data and yet not preclude all consideration of the data.

D.8 INORGANIC DATA VALIDATION PROCEDURES FOR ASLs C AND D

This subsection describes validation procedures for inorganic data for ASLs C and D. Validation procedures for inorganic data for ASL E are provided in subsection D.10. The following procedures are based on the *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis*, 1 July 1988 (U.S. Environmental Protection Agency, 1988b).

D.8.1 Holding Times

The objective of validating holding times data is to establish the validity of analysis results by ensuring that sample holding times from receipt to analysis or extraction were in compliance with the specified method (Attachment I).

This procedure applies to both ASLs C and D data.

D.8.1.1 Criteria. Samples shall be analyzed within the holding times specified in Table 6-1.

D.8.1.2 Procedure. The following procedures apply to both ASLs C and D data.

1. Establish holding times by comparing sample collection date with dates of analysis in raw laboratory data (e.g., digestion logs and instrument run logs). Analyte holding time (days) equals analysis date minus sample collection date.

2. Examine digestion and distillation logs to determine if samples were preserved at pH specified in paragraph D.8.1.1.

3. If holding times and preservation requirements are not met, qualify results that are greater than IDL as estimated (J) and results smaller than IDL as estimated (UJ).

4. If holding times are exceeded, use professional judgement to determine reliability of data and effects of additional storage on sample results. The expected bias will be low, so reviewer may determine that results smaller than IDL are unuseable (R).

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D.8.2 Calibration

Requirements for instrument calibration are established to ensure that instruments are capable of producing acceptable quantitative data. Initial calibration demonstrates that an instrument is capable of required performance at the beginning of an analysis run. Verification of continuing calibration ensures that the initial calibration remains valid.

D.8.2.1 <u>Initial Calibration Criteria for ASLs C and D</u>. The following criteria applies to data for both ASLs C and D.

- **ICP Analysis**
  - A blank and at least one standard shall be used to establish the analytical curve.
  - Analysis results shall fall within control limits of 90 to 110 Percent Recovery (%R) of true value.
- **AA Analysis**
  - A blank and at least three standards, one of which is at specified IDL, shall be used to establish the analytical curve.

NOTE

The correlation coefficient of 0.995 is a technical criterion and not contractual.

  - The correlation coefficient shall be greater than approximately 0.995.
  - Analysis results shall fall within control limits of 90 to 110 %R of true value.
- **Mercury Analysis**
  - A blank and at least four standards shall be used to establish the analytical curve.
  - The correlation coefficient shall be greater than approximately 0.995.
  - Analysis results shall fall within control limits of 80 to 120 %R.

- **Cyanide Analysis**
  - A blank and at least three standards shall be used to establish the analytical curve.
  - A correlation coefficient greater than approximately 0.995 is required for photometric determination.
  - Analysis results shall fall within control limits of 85 to 115 %R.

D.8.2.2 Initial Calibration Criteria for ASL D. The following criterion applies to data for ASL D only and is in addition to criteria in paragraph D.8.2.1.

- **Cyanide Analysis** - A mid-range standard shall be distilled.

D.8.2.3 Continuing Calibration Criteria. The following criteria apply to both ASLs C and D data. The instrument shall be calibrated daily and each time it is set up.

- Analysis results shall fall within control limits of 90 to 110 %R of true value for all analytes except mercury and cyanide.
- Analysis results for mercury shall fall within control limits of 80 to 120 %R.
- Analysis results for cyanide shall fall within control limits of 85 to 115 %R.

D.8.2.4 Procedure for ASLs C and D. The following procedure applies to calibration data for both ASLs C and D.

1. Verify that instrument was calibrated daily and each time it was set up using correct number of standards and blanks.
2. Verify that correlation coefficient was greater than approximately 0.995.
3. If minimum number of standards were not used for initial calibration, or, if instrument was not calibrated daily and each time it was set up, qualify data as unuseable (R).
4. If correlation coefficient is smaller than 0.995, qualify results greater than IDL as estimated (J) and results smaller than IDL as estimated (UJ).

D.8.2.5 Procedure for ASL D. The following procedure applies to calibration data for ASL D only and shall be performed in addition to procedure in paragraph D.8.2.4.

1. Check distillation log and verify that mid-range cyanide standard was distilled.

2. Recalculate one or more of Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV) %R per type of analysis [e.g., ICP, Gas Furnace Atomic Absorption (GFAA)] using the following equation. Verify that recalculated value agrees with laboratory-reported values on LSC-specified FEMP forms. Because of possible rounding discrepancies, allow results to fall within one percent of contract windows (e.g., 89 to 111 percent).

$$\%R = \frac{\text{Found}}{\text{True}} \times 100$$

Where:

Found = Concentration (in μg/L) of each analyte measured in analysis of ICV or CCV solution

True = Concentration (in μg/L) of each analyte in ICV or CCV source

3. If mid-range cyanide standard was not distilled, qualify associated results as estimated (J).

4. If ICV or CCV %R falls outside acceptance windows, use professional judgement to qualify associated data. If possible, indicate review bias as follows.

   a. For all analytes except cyanide and mercury, use the following guidelines.

      (1) If ICVS or CCVS %R falls outside acceptance windows but within ranges of 75 to 89 percent or 111 to 125 percent, qualify results greater than IDL as estimated (J).

      (2) If ICVS or CCVS %R is within range of 111 to 125 percent, results smaller than IDL are acceptable.

      (3) If ICVS or CCVS %R is 75 to 89 percent, qualify results smaller than IDL as estimated (UJ).

      (4) If ICVS or CCVS %R is smaller than 75 percent, qualify positive results as unuseable (R).

   b. For all analytes except cyanide, use the following guidelines.

      (1) If ICVS or CCVS %R is greater than 125 percent, qualify results greater than IDL as unuseable (R).

(2) If ICVS or CCVS %R is greater than 125 percent, results smaller than IDL are acceptable.

c. For cyanide, use the following guidelines.

(1) If ICVS or CCVS %R falls outside acceptance windows but within ranges of 70 to 84 percent or 116 to 130 percent, qualify results greater than IDL as estimated (J).

(2) If ICVS or CCVS %R is within range of 116 to 130 percent, results smaller than IDL are acceptable.

(3) If ICVS or CCVS %R is 70 to 84 percent, qualify results smaller than IDL as estimated (UJ).

(4) If ICVS or CCVS %R is smaller than 70 percent, qualify positive results as unuseable (R).

(5) If ICVS or CCVS %R is greater than 130 percent, qualify results greater than IDL as unuseable (R). Results smaller than IDL are acceptable.

d. For mercury, use the following guidelines in addition to those in step b.

(1) If ICVS or CCVS %R falls outside acceptance windows but within ranges of 65 to 79 percent or 121 to 135 percent, qualify results greater than IDL as estimated (J).

(2) If ICVS or CCVS %R is within range of 121 to 135 percent, results smaller than IDL are acceptable.

(3) If ICVS or CCVS %R is 65 to 79 percent, qualify results smaller than IDL as estimated (UJ).

(4) If ICVS or CCVS %R is smaller than 65 percent mercury, qualify positive results as unuseable (R).

(5) If ICVS or CCVS %R is greater than 135 percent, qualify results greater than IDL as unuseable (R). Results smaller than IDL are acceptable.

D.8.3 Blanks

Blank analysis results are assessed to determine existence and magnitude of sample contamination problems. Criteria for blanks evaluation apply to all blanks associated with a sample. If problems with blanks data for ASL C or D exist, associated data shall be evaluated to determine whether there is an inherent variability in the data or if the problem is an isolated occurrence not affecting other data.

D.8.3.1 Criteria. There shall be no contaminants in blanks.

D.8.3.2 Procedure.

1. Review analytical results as well as raw data (ICP printouts, strip charts, printer tapes, bench sheets) for blanks and verify that results are reported accurately.

NOTE

> If absolute value of the blank contaminant concentration is less than or equal to the RQL, correction of sample results is not necessary. If a blank analyte concentration is above RQL, the lowest concentration of that analyte in associated samples shall be ten times the blank concentration.

2. If samples associated with the blank have an analyte concentration less than ten times the blank concentration and above RQL, qualify data for these samples as unuseable (R) except for an identified aqueous soil field blank.

3. Do not correct sample concentration for the blank value.

4. If concentration of the blank is below negative RQL, qualify samples associated with the blank that are reported below ten times RQL as unuseable (R).

D.8.4 ICP Interference Check Sample

The ICP Interference Check Sample (ICS) verifies inter-element and background correction factors.

D.8.4.1 Criteria.

- An ICS shall be run at the beginning and end of each sample analysis run or a minimum of twice per eight-hour shift, whichever is more frequent.

- Results for ICS solution AB analysis shall fall within control limits of $\pm$ 20 percent of true value.

D.8.4.2 Procedure for ASLs C and D Data.

1. Check ICS raw data for ASL D results with an absolute value greater than IDL for those analytes that are not present in the ICS solution.

2. For samples with concentrations of aluminum, calcium, iron, and magnesium that are comparable to or greater than their respective levels in the ICS, proceed as follows.

   a. If possible, indicate bias for estimated results in the review.

   b. If ICS recovery for an element is greater than 120 percent and sample results are smaller than IDL, identify data as acceptable for use.

   c. If ICS recovery for an element is greater than 120 percent and sample results are greater than IDL, qualify affected data as estimated (J).

   d. If ICS recovery for an element falls between 50 and 79 percent and sample results are greater than IDL, qualify affected data as estimated (J).

   e. If sample results are smaller than IDL and the ICS recovery for that analyte falls within the range of 50 to 79 percent, the possibility of false negatives may exist, so qualify data for these samples as estimated (UJ).

   f. If ICS recovery results for an element are less than 50 percent, qualify data as unuseable (R).

D.8.4.3 Procedure for ASL D. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.8.4.2.

1. From ICP printout, recalculate one or more recoveries using the following equation for %R and verify that recalculated value agrees with laboratory-reported value.

$$\text{ICS } \%R = \frac{\text{Found Solution AB}}{\text{True Solution AB}} \times 100$$

Where:

Found Solution AB = concentration (in μg/L) of each analyte measured in analysis of solution AB

True Solution AB = concentration (in μg/L) of each analyte in solution AB

2. If results greater than IDL are observed for elements that are not present in EPA-provided ICS solution, which indicates a possible false positive, evaluate associated sample data for affected elements.

3. For samples with comparable or higher levels of interferents and with analyte concentrations that approximate those levels found in the ICS (false positive), qualify sample results greater than IDL as estimated (J).

4. If absolute value of negative results is greater than IDL, negative results are observed for elements not present in EPA ICS solutions, and their absolute value is greater than IDL, which indicates a possible false negative; evaluate associated sample data.

5. For samples with comparable or higher levels of interferents, qualify results for affected analytes less than IDL as estimated (UJ).

NOTE

In general, sample data can be accepted if concentrations of aluminum, calcium, iron and magnesium in the sample are found to be less than or equal to their respective concentrations in the ICS.

6. If these elements are present at concentrations greater than level in ICS or other elements are present in the sample at more than 10 mg/L, investigate possibility of other interference effects.

D.8.5 Laboratory Control Sample

The Laboratory Control Sample (LCS) serves as a monitor of overall laboratory analysis performance including sample preparation.

D.8.5.1 Criteria. The following criteria apply to both ASLs C and D.

- Aqueous LCS results shall fall within control limits of 80 to 120 %R except for antimony and silver, which have no control limits.

- Solid LCS results shall fall within control limits.

D.8.5.2 Procedure for ASLs C and D. The following procedure applies to both ASLs C and D data.

1. Review data and verify that results fall within control limits.

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2. For liquid LCSs, proceed as follows.

   a. If LCS recovery for an analyte falls within the range of 50 to 79 percent or is greater than 120 percent, qualify results greater than IDL as estimated (J).

   b. If results are less than IDL and LCS recovery is greater than 120 percent, identify data as acceptable.

   c. If results are less than IDL and LCS recovery falls within the range of 50 to 79 percent, qualify data for affected analytes as estimated (UJ).

   d. If LCS recovery results are less than 50 percent, qualify data for these samples as unuseable (R).

3. For solid LCSs, proceed as follows.

   a. If LCS recovery for an analyte falls outside control limits, qualify sample results greater than IDL as estimated (J).

   b. If LCS results exceed control limits and sample results are less than IDL, identify data as acceptable.

   c. If LCS results are below control limits, qualify sample results less than IDL as estimated (UJ).

D.8.5.3 <u>**Procedure for ASL D**</u>**.** The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.8.5.3.

1. Check raw data (ICP printout, strip charts, bench sheets) to verify reported recoveries.

2. Recalculate one or more of recoveries (%R) using the following equation.

$$\text{LCS } \%R = \frac{\text{LCS Found}}{\text{LCS True}} \times 100$$

Where:

LCS Found = concentration (in μg/L for liquid, mg/kg for solid) of each analyte measured in analysis of LCS solution

LCS True = concentration (in μg/L for liquid, mg/kg for solid) of each analyte in LCS source

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D.8.6 Duplicate Sample Analyses

Duplicate analysis results are indicators of laboratory precision for each sample matrix.

D.8.6.1 Criteria. The following criteria apply to both ASLs C and D data.

- Samples identified as field blanks cannot be used for duplicate sample analyses.
- A control limit of ± 20 percent RPD for water samples and ± 35 percent RPD for soil samples shall be used for sample values greater than five times RDL.
- A control limit of ± RDL shall be used for sample values smaller than five times RDL.

D.8.6.2 Procedure for ASLs C and D. The following procedure applies to both ASLs C and D data.

1. Review and verify that results fall within control limits.
2. If duplicate analyses results for an analyte fall outside appropriate control windows, qualify results for the analyte in associated samples of the same matrix as estimated (J).
3. If a field blank was used for duplicate analyses, check other QC data and exercise professional judgement to evaluate data.

D.8.6.3 Procedure for ASL D. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.8.6.3.

1. Check raw data and recalculate one or more RPD using the following equation to verify that results have been correctly reported.

$$PD = \frac{|S-D|}{(S+D)/2} \times 100$$

Where:

S = first sample value (original)

D = second sample value (duplicate)

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D.8.7 Matrix Spike Sample Analysis

The matrix spike sample analysis provides information about effect of each sample matrix on digestion and measurement methodology.

D.8.7.1 Criteria. The following criteria apply to both ASLs C and D data.

- Samples identified as field blanks shall not be used for spiked sample analysis.
- Spike recovery (%R) shall be within 75 to 125 percent; however, spike recovery limits do not apply when sample concentration exceeds spike concentration by a factor of four or more.

D.8.7.2 Procedure for ASLs C and D. The following procedure applies to both ASLs C and D data.

1. Verify that the field blank was not used for spike analysis.
2. Review and verify that results fall within specified limits.
3. If spike recovery is greater than 125 percent and reported sample result is less than IDL, identify data as acceptable.
4. If spike recovery is greater than 125 percent or less than 75 percent and sample result is greater than IDL, qualify data as estimated (J).
5. If spike recovery is within the range of 30 to 74 percent and sample results are less than IDL, qualify data as estimated (UJ).
6. If spike recovery is less than 30 percent and sample results are less than IDL, qualify data as unuseable (R).
7. If the field blank was used for matrix spike analysis, check other QC data and exercise professional judgement to evaluate data. If matrix spike recovery does not meet criteria (except for silver), a post-digestion spike is required for all methods except furnace, but these data are not used to qualify sample results.

D.8.7.3 Procedure for ASL D. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.8.7.3.

1. Check raw data and recalculate one or more %R using the following equation to verify that results were correctly reported.

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$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

Where:

SSR = Spiked sample result

SR = Sample result

SA = Spike added

D.8.8 Furnace Atomic Absorption

Duplicate injections and furnace post-digestion spikes establish precision and accuracy of individual analytical determinations.

D.8.8.1 **Criteria for ASLs C and D.** The following criteria apply to both ASLs C and D data.

- For sample concentrations greater than RQL, duplicate injections shall agree within ± 20 percent Relative Standard Deviation (RSD). Otherwise, sample shall be rerun once (at least two additional injections).

$$\text{Standard Deviation (SD)} = \left[\frac{\Sigma (x^i - x)^2}{n - i} \right]^{1/2}$$

Where:

$$\text{Relative Standard Deviation (RSD)} = \frac{SD}{x} \times 100$$

- Spike recovery shall be greater than 75 percent and less than 125 percent.
- The furnace AA method shall be used as specified in Attachment I.

D.8.8.2 **Procedure.** The following procedure applies to both ASLs C and D data.

1. Check raw data for ASL D validation to verify that duplicate injections agree within ± 20 percent of RSD or Coefficient of Variation (CV) for sample concentrations higher than RDL.

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2. Review furnace AA raw data for ASL D validation to verify that the method has been followed.

3. If duplicate injections are outside ± 20 percent of RSD or Coefficient of Variation (CV) limits and sample has not been rerun once, qualify data as estimated (J).

4. If rerun sample results do not agree within ± 20 percent of RSD limits, qualify data as estimated (J).

5. If post-digestion spike recovery is less than 40 percent, qualify results higher than IDL as estimated (J).

6. If post-digestion spike recovery is \greater than or equal to 10 percent but less than 40 percent, qualify results less than IDL as estimated (UJ).

7. If post-digestion spike recovery is less than 10 percent, qualify results less than IDL as unuseable (R).

8. If sample absorbance is less than 50 percent of post-digestion spike absorbance, proceed as follows.

   a. If furnace post-digestion spike recovery is not within 75 to 125 percent, qualify sample results higher than IDL as estimated (J).

   b. If furnace post-digestion spike recovery is not within 75 to 125 percent, qualify sample results less than IDL as estimated (UJ).

9. If MSA is required but has not been done, qualify data as estimated (J).

10. If samples run by MSA have not been spiked at appropriate levels, qualify data as estimated (J).

11. If MSA correlation coefficient is less than 0.995, qualify data as estimated (J).

D.8.9 ICP Serial Dilution

The serial dilution determines whether significant physical or chemical interferences exist because of the sample matrix.

D.8.9.1 <u>Criteria</u>. The following criterion applies to both ASLs C and D data.

- If analyte concentration is sufficiently high (concentration in original sample is minimally a factor of 50 above IDL), an analysis of a five-fold dilution shall agree within 10 %D of original results.

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D.8.9.2 Procedure for ASLs C and D. The following procedure applies to both ASLs C and D data.

1. Check raw data for ASL D validation evidence of negative interference (i.e., diluted sample results are significantly higher than original sample).

2. When criteria are not met, qualify associated data as estimated (J).

3. If evidence of negative interference is found, use professional judgement to qualify data.

D.8.9.3 Procedure for ASL D. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.8.9.3.

1. Check raw data and recalculate %D using the following equation to verify that dilution analysis results agree with reported results.

$$\%D = \frac{|I-S|}{I} \times 100$$

Where:

I = Initial sample result

S = Serial dilution result (instrument reading times five)

D.8.10 Sample Result Verification

The objective is to ensure that reported quantitation results are accurate.

D.8.10.1 Criteria. The following criterion applies to both ASLs C and D data.

- Analyte quantitation shall be calculated as specified in the applicable Attachment I method.

D.8.10.2 Procedure for ASLs C and D Data.

1. Examine raw data for ASL D validation and verify correct calculation of sample results reported by the laboratory.

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2. Compare digestion and distillation logs, instrument printouts, and strip charts to reported sample results for ASL D validation.

3. Verify that there are no transcription or reduction errors (e.g., dilutions, percent solids, sample weights) on one or more samples.

4. Verify that results fall within linear range of ICP and within calibrated range for non-ICP parameters.

NOTE

When the laboratory provides both ICP and furnace results for an analyte in a sample and concentration is greater than ICP IDL, results may be used to assist in quantitation problem identification.

5. If ICP analysis results are used for arsenic, thallium, selenium, or lead, proceed as follows.

   a. Verify that sample results are greater than five times ICP IDL.

   b. If discrepancies are found, contact laboratory to obtain additional information to resolve differences. If a discrepancy remains unresolved, qualification of data may be warranted.

D.8.10.3 <u>Procedure for ASL D</u>. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.8.10.3.

1. Examine raw data for ASL D validation for anomalies (e.g., baseline shifts, negative absorbance, omissions, legibility).

D.8.11 Field Duplicates

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision. Therefore, the result may have more variability than laboratory duplicates, which measure only laboratory performance. It is expected that soil duplicate results will have a greater variance than duplicates of water matrices because of difficulties associated with collecting identical soil samples.

D.8.11.1 **Criteria.** There are no review criteria for field duplicate analyses comparability.

D.8.11.2 **Procedure for ASLs C and D.**

1. Identify field duplicate samples on field sample sheets.

2. Compare reported results for each sample and calculate RPDs if appropriate.

3. Provide reviewer comments with evaluation report of field duplicates.

D.8.12 Overall Assessment of Data for a Case

This procedure is applicable to ASL D data only. The data reviewer shall make professional judgements, express concerns, and comment on validity of the overall data package for a case. This is particularly appropriate when there are several QC criteria out of specification.
The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform users concerning data quality and limitations. Availability of DQOs is helpful in this review. The information will help the user avoid inappropriate use of data and yet not preclude all consideration of the data.

D.9 DATA VALIDATION PROCEDURES FOR GAS CHROMATOGRAPHY OF ORGANIC COMPOUNDS FOR ASLs B, C, AND D

Gas chromatography procedures for organic compounds are adapted from ***Test Methods for Evaluating Solid Waste***, EPA SW-846, Third Edition, November 1986. The following procedures apply to data for ASLs B, C, and D.

D.9.1 Validation Guidelines for Gas Chromatography Data

D.9.1.1 **Guidelines for ASL B Data.** There are two sub-levels of ASL B data, and they require different validation procedures.

If the samples taken are user-defined as ASL B, they shall be validated in accordance with requirements in the PSP for that sampling event. When the data user specifies the QC requirements, the validation requirements shall also be specified in the PSP.

If ASL B analysis is specified, QC information shall be reviewed and compared to the QC acceptance criteria of the individual methods. The portions of ASLs C and D procedures that are applicable (e.g., matrix spike/matrix spike duplicate, blanks, laboratory control samples) shall be used as the outline for review. The specific acceptance criteria from the Attachment I method shall be used.

D.9.1.2 Guidelines for ASL C Data. As GC methods are identified or developed for ASL C analysis, corresponding data validation procedures shall be developed and implemented.

D.9.1.3 Guidelines for ASL D Data. The following procedures for ASL D data validation contain basic instructions for several methods. As new methods are identified or developed, corresponding supplemental requirements shall be written.

D.9.2 Holding Times

Holding time is measured from sample collection to time of sample analysis.

D.9.2.1 Criteria.

- Samples shall be analyzed within the holding times specified in Table 6-1 for the appropriate analytes.

D.9.2.2 Procedure.

1. If holding time is exceeded, proceed as follows.

   a. Flag positive results as estimated (J).

   b. Flag associated sample quantitation limits as estimated (UJ).

   c. Document that holding times were exceeded.

2. If holding time is grossly exceeded, use professional judgement to establish data reliability.

NOTE

Associated non-detect data may be flagged as unuseable (R).

D.9.3 Calibration

D.9.3.1 Criteria. An external calibration procedure shall be used for quantitation by the laboratory. If the calibration factor is used for sample quantitation, the following criteria shall apply.

- For initial calibration, percent RSD shall be less than or equal to 20 percent.

- For continuing calibration, percent D shall be less than 15 percent.

If the linear regression method is used for sample quantitation, the following criteria apply.

- Verification of the calibration curve is required.
- Correlation coefficient shall be greater than or equal to 0.995.

D.9.3.2 Procedure. In the primary analysis, standards shall be analyzed at the beginning of the twelve-hour period followed by the proper sample/standard sequence. Confirmation analysis requires a mid-level standard at the beginning of the twelve-hour period. The mid-level standard shall be run at the end of the sample/standard sequence but within the twelve-hour period. If calibration criteria are not met, proceed as follows.

1. If criteria for initial calibration are not met, flag associated quantitative results as estimated (J).
2. If criteria for continuing calibration are not met in the primary analysis, flag associated quantitative results as estimated (J).
3. If criteria for continuing calibration are not met in the confirmation analysis, use professional judgement to determine data reliability.
4. If proper standards have not been analyzed, use professional judgement to determine data reliability.

D.9.4 Blanks

D.9.4.1 Criteria. Blank criteria apply to method, trip, and field blanks.

Criteria for evaluation of blanks apply to blanks associated with samples. If there is a problem with a blank, data associated with the case shall be evaluated to determine if there is an inherent variability in data for the case or if the problem is an isolated occurrence not affecting other data. Contaminants should not be present in blanks.

D.9.4.2 Procedure.

1. Review results of associated blanks and FEMP forms as specified in the LSC and raw data (e.g., chromatogram, reconstructed ion chromatogram, quantitation reports or data system printouts).
2. Verify that method blank analysis has been reported per matrix, per concentration level for each GC system used to analyze VOA samples, and for each extraction batch for other analyses. The method blank summary may be to assist in identifying samples associated with each method blank.

NOTE

When unsuitable blank results are obtained, action depends on circumstances and origin of the blank.

3. Do not report positive sample results unless concentration of compound in sample exceeds ten times amount in any blank for common contaminants listed in step 7 or five times amount for other compounds.

4. When more than one blank is associated with a given sample, base qualification upon comparison with the associated blank having the highest concentration of contaminant.

NOTE

Results shall not be corrected by subtracting a blank value.

5. Take no action if compound is found in a blank but not found in the sample.

6. Qualify compounds other than those listed in step 7 that are detected in the sample and also detected in an associated blank when sample concentration is less than five times the blank concentration.

7. Report a positive result, if concentration of compound in the sample exceeds ten times amount in a blank for the following common laboratory contaminants.

   - Methylene chloride
   - Acetone
   - 2-butanone (Methyl-ethyl Ketone)
   - Common phthalate esters
   - Toluene

NOTE

The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. These factors shall be considered when applying the 5-times and 10-times criteria so that a comparison of the total amount of contamination is actually made. There may be instances where little or no contamination is present in associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution water is one example. Instances of this can be detected when contaminants are found in the diluted sample result but are absent in the undiluted sample result.

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However, if the reviewer determines that the contamination is from a source other than the sample, data shall be qualified. In this case, the 5-times or 10-times rules do not apply and sample value shall be reported as a non-detect.

Following are examples of applying blank qualification guidelines; however, certain circumstances may warrant deviation from these guidelines.

Case 1 Sample result is greater than RQL but less than (5 or 10 times) required amount of the blank result.

	Rule	
	10 Times	5 Times
Blank Results	7	7
RQL	5	5
Sample Results	60	30
Qualified Sample Result	60U	30U

In the example for the 10-times rule, sample results less than 70 (or 10 x 7) are qualified as non-detects.

For the 5-times rule, sample results less than 35 (or 5 x 7) are qualified as non-detects.

Case 2 Sample result is less than RQL and also less than (5- or 10-times) required amount of the blank result.

	Rule	
	10 Times	5 Times
Blank Result	6	6
RQL	5	5
Sample Result	4J	4J
Qualified Sample Result	5U	5U

Data are not reported as 4U because this indicates a detection limit below the RQL.

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Case 3 Sample result is greater than (5- or 10-times) required amount of the blank result.

	Rule	
	10 Times	5 Times
Blank Result	10	10
RQL	5	5
Sample Result	120	60
Qualified Sample Result	120	60

For both 10-times and 5-times release, sample results exceeded adjusted blank results of 100 (or 10 x 10) and 50 (or 5 x 10).

8. If gross contamination exists, flag affected compounds as unuseable (R) in samples affected by interference.

9. If inordinate amounts of other compounds are found at low levels in blanks, record it in data review comments. It may be indicative of a laboratory problem.

D.9.5 Surrogates

Laboratory performance with individual samples is checked by spiking samples with surrogate compounds prior to sample preparation. Evaluation of results of surrogate spikes is not necessarily straightforward. The sample itself may produce effects caused by such factors as interferences and high concentrations of analytes. Effects of the sample matrix are frequently outside laboratory control and may present relatively unique problems, so review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement. Accordingly, the following procedures consist primarily of guidelines and, in some cases, optional approaches are suggested.

D.9.5.1 **ASLs C and D Criteria.** Sample and blank surrogate recoveries for volatile and semi-volatile compounds shall be within limits specified in the applicable method and LSC.

D.9.5.2 **Procedure.**

1. Check raw data (e.g., chromatogram, quantitation list) for ASL D validation to verify recoveries on surrogate recovery form.

2. When there are unacceptable surrogate recoveries followed by successful re-analyses, report only the successful run.

3. From surrogate recovery forms, determine if any one surrogate is out of specification or if any surrogate has a recovery of less than ten percent. If so, re-analyze surrogates that are outside criteria.

4. From surrogate recovery forms, determine if recoveries are out of specification with no evidence of repurging, re-injection, or re-extraction. If so, the laboratory has failed to perform satisfactorily.

5. Verify that no blanks have surrogates outside criteria parameters.

6. If there are two or more analyses for a particular fraction, determine which are the best data to report based on the following considerations.

   - Surrogate recovery (marginal versus gross deviation)
   - Holding times
   - Comparison of the values of compounds reported in each fraction

6. For surrogate spike recoveries out of specification, proceed as follows.

   a. If a surrogate is out of specification but has recoveries greater than ten percent, proceed as follows.

      (1) Flag positive results for that fraction as estimated (J).

      (2) Flag negative results for that fraction with the sample quantitation limit as estimated (UJ).

   b. If a surrogate in a fraction shows less than ten percent recovery, proceed as follows.

      (1) Flag positive results for that fraction as estimated (J).

      (2) Flag negative results for that fraction as unuseable (R).

   c. Do not qualify data with respect to surrogate recovery unless one is out of specification, or unless recovery of a surrogate is less than ten percent.

   d. For a blank analysis with surrogates out of specification, give special consideration to validity of associated sample data and determine if problems are isolated to the blank or if there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable

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surrogate recoveries, the blank problem may be an isolated occurrence. Even if this judgement allows some use of the affected data, analytical problems remain, which shall be reported to and corrected by the laboratory.

D.9.6 Matrix Spike/Matrix Spike Duplicate.

MS/MSD data are generated to determine long-term precision and accuracy of the analytical method on various matrices. These data alone cannot be used to evaluate precision and accuracy of individual samples.

D.9.6.1 Criteria. Spike recoveries and RPDs between MS/MSD recoveries shall be within advisory limits in the applicable method (Attachment I).

D.9.6.2 Procedure for ASLs C and D Data.

1. Inspect data results for MS/MSD recovery.

2. Verify transcriptions from raw data and verify calculations for ASL D validation.

3. Do not use MS/MSD data alone to qualify an entire case. Use informed professional judgement and MS/MSD results in conjunction with other QC criteria to determine the need for some qualification of the data.

4. Assess effect of results of MS/MSD on associated data with regard to the MS/MSD sample itself plus specific analytes for samples associated with the MS/MSD.

5. If it can be determined that results of the MS/MSD affect only the spiked sample, limit qualification to this sample alone.

6. If it is determined through MS/MSD results that a laboratory is having a systematic problem in analysis of one or more analytes, apply qualification to associated samples.

D.9.7 Compound Identification

D.9.7.1 Criteria.

- Retention times of reported compounds shall fall within the calculated window for two chromatographic columns.

- Second-column confirmation is mandatory at ASLs C and D. If qualitative criteria for two-column confirmation are not met, reported positive detects shall be considered non-detects.

D.9.7.2 Procedure.

1. Use professional judgement to assign an appropriate quantitation limit based on the following guidelines.

   a. If misidentified peak was sufficiently outside target compound retention-time window, RQL may be reported.

   b. If misidentified peak poses an interference with potential detection of a target peak, reported value shall be considered and flagged as estimated quantitation limit (UJ).

D.9.8 Laboratory Control Samples

D.9.8.1 Criteria. Internal QC limits set by the applicable method (Attachment I) for a given sample matrix shall be applied.

D.9.8.2 Procedure.

1. If LCS exceeds method limits for a given sample matrix, inspect data from the associated sample batch.

2. If no analytical problems are found, compare data analyzed with the out-of-control point in the QC section of the case narrative provided with the data package by the laboratory performing the analyses.

3. If problems are found in analytical data, re-analyze samples associated with the batch and report data from the re-analysis.

4. If holding times are exceeded during re-analysis, include both sets of data in the data package.

5. If LCS and matrix spike results are outside method limits, either re-analyze sample within holding times or flag data as unuseable (R).

D.9.9 Compound Quantitation and Reported Detection Limits

The objective is to ensure that reported quantitation results and RQLs are accurate.

D.9.9.1 Criteria. The following criterion applies to both ASLs C and D data.

- Compound quantitation, as well as adjustment of the RQL, shall be calculated in accordance with the specified method in Attachment I.

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D.9.9.2 Procedure for ASLs C and D. The following procedure applies to both ASLs C and D data.

1. Verify that RQLs were adjusted to reflect sample dilutions, splits, concentrations, clean-up activities, and dry weight factors there were not accounted for in the FLAMM method.

2. Flag quantitation limits affected by large, off-scale peaks as unuseable (R).

3. If interference is on-scale, provide an estimated quantitation limit (UJ) for each affected compound.

4. Use professional judgement to decide whether a much larger concentration obtained in one column versus the other column indicates presence of an interfering compound.

5. If an interfering compound is indicated, report lower of the two values and qualify it as presumptively present at an estimated quantity (NJ), which will necessitate a determination of an estimated concentration in confirmation column.

6. Document that presence of interferences has obscured attempt at second-column confirmation.

D.9.9.3 Procedure for ASL D. The following procedure applies to ASL D data only and shall be performed in addition to procedure in paragraph D.7.9.3.

1. Examine raw data to verify correct calculation of sample results reported by the laboratory.

2. Compare quantitation reports, chromatograms, and sample preparation logs to reported positive sample results and quantitation limits.

D.9.10 Overall Assessment of Data for a Case

The data reviewer shall make professional judgements, express concerns, and comment on validity of the overall data package. This is particularly appropriate when there are several QC criteria out of specification.

The additive nature of QC factors out of specification is difficult to assess in an objective manner, but reviewer has a responsibility to inform users concerning data quality and limitations. Availability of DQOs is helpful in this review. The information will help the user avoid inappropriate use of data and yet not preclude all consideration of the data.

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D.10 DRINKING WATER DATA VALIDATION PROCEDURES FOR ASL B

Drinking water data validation procedures are based on the EPA method dated December 1988 for GC/MS analysis of volatile organic compounds.

D.10.1 Internal Standards

D.10.1.1 Criteria. The following IS performance criteria will ensure that GC/MS sensitivity response is stable during every run.

- IS area counts shall not vary by more than a factor of two (- 50 percent to + 100 percent) from associated calibration standard.
- IS retention time shall not vary more than ± 30 seconds from associated calibration standard.

D.10.1.2 Procedure.

1. Check raw data to verify recoveries of ISs.
2. Verify retention times.
3. If ISs are outside windows, consider a partial or total rejection of data for that sample fraction.

D.10.2 Surrogate Analytes

D.10.2.1 Criteria. Sample and blank surrogate recoveries shall be within specified limits.

D.10.2.2 Procedure.

1. Check raw data to verify surrogate recovery.
2. If surrogates are outside limits, flag positive results for that fraction as estimated (J).

D.10.3 Laboratory Duplicates

Analysis of laboratory duplicates gives a measure of the precision associated with laboratory procedures.

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D.10.3.1 Criteria.

- Specific criteria for laboratory duplicate analyses comparability are specified in the applicable method (Attachment I).

D.10.3.2 Procedure.

1. Compare results for each sample and calculate RPD.

2. If laboratory duplicate samples are outside control limits, re-analyze them.

D.10.4 Field Duplicates

Analysis of field duplicates gives a measure of precision to sample collection, preservation, and storage as well as to laboratory procedures. Field duplicate samples are collected every sampling round or sample delivery group.

D.10.4.1 Criteria. There are no specific criteria for field duplicate analyses comparability.

D.10.4.2 Procedure.

1. Compare results for each sample and calculate RPD.

D.10.5 Laboratory Reagent Blanks

Assessment of blank analysis results identifies existence and magnitude of contamination problems.

D.10.5.1 Criteria. Contaminants should not be present in blanks.

D.10.5.2 Procedure.

1. If gross contamination exists in the blank, flag affected compounds as unuseable (R).

2. If inordinate amounts of target compounds are found at low levels, take corrective action as this is indicative of a laboratory problem.

D.10.6 Field Reagent Blanks

Reagent water is placed in a sample container in a laboratory and treated as a sample in all respects, including exposure to sampling site conditions, storage, preservation, and analytical procedures.

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D.10.6.1 Criteria. There are no criteria for field reagent blanks.

D.10.6.2 Procedure.

1. If contamination exists, record this fact in data review comments and forward to FEMP project manager.

D.10.7 Laboratory Performance Check Solutions

A laboratory check solution is made up of one or more compounds and used to evaluate performance of the instrument system.

D.10.7.1 Criteria. Criteria are established in the applicable method (Attachment I).

D.10.7.2 Procedure.

1. If check solution is outside control limits, take corrective action (e.g., trouble-shoot instrument and standards preparation).

D.10.8 Matrix Spike/Matrix Spike Duplicates

MS/MSD data are generated to determine long-term precision and accuracy of analytical method on various matrices.

D.10.8.1 Criteria. Spike recoveries shall be within advisory limits established in the applicable method (Attachment I).

D.10.8.2 Procedure.

1. If results are outside advisory limits, use results in conjunction with other QC criteria and establish need for qualification of data.

D.10.9 Calibration Standards

D.10.9.1 Criteria.

- VOA analytes and surrogates are expressed as a percentage of true value and shall be 80 to 120 percent of true value.
- RSD shall be less than 20 percent of true value.
- For continuing calibration, the response factor for each analyte and surrogate shall be within 30 percent of mean value measured in initial calibration.

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D.10.10 Compound Quantitation and Reported Detection Limits

The objective is to ensure that reported quantitation results and RQLs are accurate.

D.10.10.1 Criteria. The following criterion applies.

- Compound quantitation, as well as adjustment of the RQL, shall be calculated in accordance with the specified method (Attachment I).

D.10.10.2 Procedure.

1. Examine raw data to verify correct calculation of sample results reported by the laboratory.

2. Compare quantitation reports, chromatograms, and sample preparation logs to reported positive sample results and quantitation limits.

3. Verify that RQLs were adjusted to reflect sample dilutions, splits, concentrations, clean-up activities that were not accounted for in the Attachment I method.

4. Flag quantitation limits affected by large, off-scale peaks as unuseable (R).

5. If interference is on-scale, provide an estimated quantitation limit (UJ) for each affected compound.

6. Use professional judgement to decide whether a much larger concentration obtained in one column versus the other column indicates presence of an interfering compound.

D.10.11 Overall Assessment of Data for a Case

The data reviewer shall make professional judgements, express concerns, and comment on validity of the overall data package. This is particularly appropriate when there are several QC criteria out of specification. The additive nature of QC factors out of specification is difficult to assess in an objective manner, but reviewer has a responsibility to inform users concerning data quality and limitations. Availability of DQOs is helpful in this review. The information will help the user avoid inappropriate use of data and yet not preclude all consideration of the data.

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D.11 DATA VALIDATION PROCEDURE FOR RADIOLOGICAL ANALYSES

Generally, validation of the data will include examination of the digestion, separation, or other preparation logs, all instrument printouts, including spectra and counting logs for all samples, standards, and QC samples. Chain-of-custody records, calibration data, including certifications of standards, calculations of the detection levels and results, background results, and if available, computer algorithms must also be examined.

Calculations made from the raw data are verified to ensure that no transcription errors were made and that all results are correctly reported in the data package. Verification includes checking the mathematical operations including conversion of units and dilution factors. Other radiological parameters such as the half-lives, decay corrections, branching ratios, dead times for counters, and correlation coefficients for efficiency curves may need verification as well. Requirements to be reviewed during validation are listed below.

1. Completeness Checks
2. Calibration
3. Blanks
4. Detection Limits and Sample Results
5. Radiometric and Gravimetric Yields
6. Duplicate Samples and Analyses
7. Laboratory Control Samples
8. Holding Times
9. Analysis of Alpha-Emitting Radium Isotopes Using Scintillation Counting
10. Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting
11. Supplemental Requirements for Fluorometric Analysis of Uranium
12. Other Quality Control

D.11.1 Completeness Checks

Examine the data package for completeness. Use the checklists included in the Appendices, but also refer to the Statement of Work (SOW) for the analytical laboratory. Items specified in the SOW may supplement or take precedence over the list of items in the checklists.

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D.11.1.1 Evaluation Criteria. Verify that the items listed in the SOW, if available, and the Method Specific Appendices are included in the data package. These items may be recorded in various ways, and the data package may be organized differently than this procedure, so some searching may be required. Information that pertains to a requirement that is associated with an **R** qualifier, e.g., initial calibration, is classed as major, and its lack would be a major deficiency. A minor deficiency would result from a lack of information associated with a **J** qualifier, e.g., duplicates. The validator may have to use professional judgement to classify some deficiencies.

D.11.1.2 Procedure. If minor deficiencies are encountered and can not be rectified by the laboratory, then generally all affected (associated) data must be qualified as estimated (**J**). Major deficiencies that can not be rectified will require that all affected data be qualified as unuseable (**R**). The validator may use other qualifiers, but their definition must be included in the data validation report. If the validator concludes that no qualification is necessary, the reason must be included in the data validation report.

D.11.1.3 Supplemental Initial Calibration Requirements for Analyses Using Gas Proportional Counters Procedure. Use checklist (Form D-20, Appendix B) to assure completeness of the analysis.

D.11.2 Calibration

Instruments must be calibrated in accordance with laboratory standard operating procedures and/or manufacturer's instructions initially and when a detector or other major system component is changed. Frequently thereafter, less extensive continuing calibration checks, which consist of background and check source counts, must be done.

D.11.2.1 Initial Calibration Evaluation Criteria. Review the data package to verify that the instrument was calibrated within the time period specified in the laboratory standard operating procedure or manufacturer's instructions, but not less than annually.

D.11.2.2 Procedure.

1. If the instrument was not calibrated within the specified time period qualify the associated data as unuseable (**R**). Associated data means, in this case, results for all the analyses for each run or day during the period for which no calibration is valid.

2. Each detector in multiple counting systems must be calibrated. Compare the identifications of detectors calibrated against those used for all analyses to verify that each detector used was calibrated.

3. If the detector was not calibrated qualify all associated data as unuseable (**R**).

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4. Use National Institute of Standards and Technology (NIST), NIST-traceable, or equivalent certified standards for calibration.

5. Review the certifications, including identification numbers, of the standards. Compare the identification numbers on the certificates with identification numbers on the instrument printouts.

6. If the standards used for calibration are not certified or traceable, or cannot be positively identified, qualify all associated data as unuseable (**R**).

NOTE

The standards must not have decayed away by the time they are used for calibration.

7. Review the expiration or issue (assay) dates, and activities of the standards.

8. If the standards were used past their expiration dates, or past five half-lives of the radionuclide of interest if no expiration date is provided, qualify all associated data as unuseable (**R**).

D.11.2.3 **Continuing Calibration.** The check source should be identified by activity and radionuclide(s).

D.11.2.4 **Procedure.**

1. If the activity and identity of the radionuclide(s) used in the check source(s) are not provided qualify all associated data as estimated (**J**).
2. Check source(s) shall be counted daily or as specified in the Appendices.

3. If the daily check source is not performed, qualify associated results as unuseable (**R**).

4. The check source counts shall be within the control limits provided by the laboratory but no greater than plus or minus 3 standard deviations of the mean. Review the results, including raw data, of all daily check source counts.

5. If the check source counts are outside of the control limits, qualify all associated data as unuseable (**R**). Associated data means here all the results for all the counts within the time period covered by the out of control counts. Use the raw data, or compare the raw data with the count log, to determine the affected time periods. Note any bias or trend in the data validation report.

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6. Background counts shall be performed at least weekly and before and after all the field and QC samples associated with the Sample Delivery Group (SDG). Review the instrument printouts and counting logs to verify that the background counts were taken on the correct frequency.

7. If the background counts were not performed qualify all associated results as unuseable (**R**).

8. The background counts shall be within the control limits provided by the laboratory but no greater than plus or minus 3 standard deviations of the mean. Review the results, including raw data, of all background counts.

9. If the background counts are outside of the control limits, qualify all associated data as unuseable (**R**). Associated data means all the results for all the field and QC samples counted within the time period covered by the out of control background counts. Use the raw data, or compare the raw data with the count log, to determine the affected time periods. Note any bias or trend in the data validation report.

D.11.2.5 **Supplemental Initial Calibration Requirements for Analyses Using Gas Proportional Counters Evaluation Criteria.** Depending upon the type of counter/system used review the results, as applicable, of the plateau determination, amount of alpha-beta crossover, random coincidence counts, and/or energy calibration. Review the efficiency determinations and self-absorption curves. Compare the range of the self-absorption curve to the amounts of field and QC samples counted. Self-absorption curves shall be generated for each radionuclide of interest.

D.11.2.6 **Supplemental Initial Calibration Requirements for Analyses Using Gas Proportional Counters Procedure.**

1. If the field and QC sample preparations are outside the range of the self-absorption curves, qualify all associated data as estimated (**J**).

2. If the efficiency calculation shows less than 20 percent efficiency, qualify all data as unuseable (**R**).

D.11.2.7 **Supplemental Continuing Calibration Requirements for Analyses Using Gas Proportional Counters Evaluation Criteria.** Verify that chi-square or other appropriate statistical tests were done for the counters on a routine frequency at least weekly.

D.11.2.8 **Supplemental Continuing Calibration Requirements for Analyses Using Gas Proportional Counters Procedure.**

1. If a chi-square test was not performed, or results of the test show non-random behavior, then qualify all data as estimated (**J**).

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2. Stability verifications, e.g., plateau(s) or response(s) to the check sources shall be made after each gas change. Specific verifications may not be needed if check sources are used daily.

3. If stability verifications were not performed qualify all data as estimated (**J**).

D.11.2.9 **Supplemental Initial Calibration Requirements for Analyses Using Alpha Spectroscopy Criteria.** The calibration of the detector system must cover the energy range of interest, that is, the radionuclides (peaks) used for calibration must be identical to and/or bound the energy range of the radionuclides of interest.

D.11.2.10 **Supplemental Initial Calibration Requirements for Analyses Using Alpha Spectroscopy Procedure.**

1. If the energy of the alpha particle(s) of the radionuclide(s) of interest falls outside the calibrated range of the detector, qualify all results as unuseable (**R**).

2. Review the calibration spectrum or printout to verify that the resolution of the detector system provides accurate identification of each peak centroid, i.e., the peaks have sufficient counts and are distinct and separate from each other.

3. If the centroids of the peaks used for calibration can not be determined from the spectrum or printout, qualify all results as unuseable (**R**).

4. A nominal value of 20 keV (or number of channels if detector gain is available) FWHM is used to gauge resolution for each peak used to calibrate the detector system.

5. If the resolution of the system is greater than 20 keV (or corresponding number of number of channels) FWHM for any of the peaks used for calibration, qualify all results as estimated (**J**).

D.11.2.11 **Supplemental Continuing Calibration Requirements for Analyses Using Alpha Spectroscopy Criteria.**

1. Compare the efficiency obtained from the calibration to the efficiency obtained from the check source count(s) for the SDG. The efficiencies should be within 5 percent.

OR

2. Compare the efficiency from the check source count for the SDG with the control charts. The efficiency should be within the control limits or 3 sigma.

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D.11.2.12 Procedure for Supplemental Continuing Calibration Requirements for Analyses Using Alpha Spectroscopy.

1. If the check source efficiency is not within the limits, qualify all associated results as unuseable (R).

D.11.2.13 Criteria for Supplemental Calibration Requirements for Analyses Using Gamma Spectroscopy. Efficiency calibration does not approximate a smooth semi-log curve.

D.11.2.14 Procedure for Supplemental Calibration Requirements for Analyses Using Gamma Spectroscopy.

1. Review the efficiency calibration curve and/or raw data, and, if the efficiency calibration does not approximate a smooth semi-log curve, qualify results as unuseable (R).

2. Verify that geometry and matrix factors were accounted for in the analyses of all field and QC samples.

3. If geometry and matrix factors are not used, qualify all results as unuseable (R).

4. The calibration of the detector system must cover the energy range of interest, but at least 0 to 2 MeV. Review the energy calibration and verify that the radionuclides (peaks) used for calibration are within and/or bound the energy range of the radionuclides of interest.

5. If the energy of the radionuclides falls outside the calibrated range of the detector, qualify all results as unuseable (R).

6. Review the calibration data to verify that the resolution of the detector system is sufficient for the radionuclides of interest, i.e., that accurate identification of peak centroid can be made, and the peaks are distinct and separate from each other. A nominal value of five channels (full width, half maximum) is used to gauge resolution.

7. If the resolution of the system is greater than five channels (full width, half maximum) for any peaks used for calibration, qualify all results as estimated (J).

D.11.2.15 Criteria for Supplemental Calibration Requirements for Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting. A counting system consists of a scintillation cell and associated photomultiplier tube, electronics and scaler. Each counting system should be calibrated as a unit. Calibration consists of determining a calibration constant using a NIST traceable Ra-226 standard. The calibration constant includes the de-emanation

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efficiency of that system and the counting efficiency of the scintillation cell. The calibration constant should be established for a system at the beginning of each day that samples will be analyzed and each time the scintillation cell is replaced. The scintillation cell should be uniquely identified to allow its association with a specific counting system to be identified.

D.11.2.16 Procedure for Supplemental Calibration Requirements for Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting.

1. If calibration data cannot be definitely associated with the specific counting system, qualify associated sample results unuseable, (**R**).

2. If the counting system is not calibrated each day that samples are analyzed, qualify associated results as estimated, (**J**).

3. If the counting system is not calibrated upon replacing the scintillation cell, qualify associated results as estimated, (**J**), if the cell has a previously determined calibration constant or is unuseable, qualify as unuseable (**R**), if no constant is available for the replacement cell.

D.11.2.17 Supplemental Calibration Requirements for the Analysis of Tritium Using Liquid Scintillation Counting. Liquid scintillation counting systems are calibrated using NIST traceable external or internal standards. The chemical and physical matrix of the standards should resemble the samples as closely as possible in order to match light emission (scintillation) and quenching properties.

- If the matrix of the sample is not representative of that for the samples, qualify all associated results as estimated, (**J**).

Most automated liquid scintillation systems are capable of processing many more samples than is normally contained in an SDG. As a minimum, one calibration standard should be included with every analytical run of samples. An analytical run can be comprised of more than one SDG.

- Qualify results associated with runs lacking calibration standards as unuseable, (**R**).

The efficiency for detecting the tritium beta particle must be established for each counting system. The counting system is comprised as the liquid scintillation counter, scintillation solution, and sample matrix. The laboratory should provide detailed explanation of the method and results for determining the counting system efficiency. For automated systems employing computerized algorithms, copies of applicable pages from the instrument manuals should submitted with the analytical results.

- If the method and results for counting efficiency determination are not provided, qualify all associated results as unuseable, (**R**).

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D.11.2.18 **Supplemental Calibration Requirements for Fluorometric Analysis of Uranium.** In addition to the internal standard added to each sample, a calibration should be performed prior to sample analysis to confirm the linear relationship between the fluorometer readings and uranium concentrations.

- If a calibration is not performed prior to sample analysis to verify linear instrument response, qualify associated results as estimated, (J).

D.11.3 Blanks

D.11.3.1 **General Criteria.** A reagent (or method) blank of the same aliquot size as the samples must be processed like a sample and analyzed with each SDG on the same detectors or detector system, or a field blank must be analyzed with each SDG on the same detectors or detector system, or both. As a minimum one blank must be analyzed with the SDG.

D.11.3.2 **General Procedure.**

1. If no blanks were analyzed with the SDG, or if the blanks were not analyzed on the same detectors or detector system, qualify all the results greater than Lower Limit of Detection (LLD) as estimated (J).

2. The net blank value, i.e., the results from the analysis of the blank corrected for background, should be less than the Minimum Detectable Activity (MDA), which is the quantity of radioactive material that can be detected in the sample at the 95 percent confidence level. Review the data and verify that no contaminants were detected.

3. If contaminants are detected in any blank, associated sample results that are reported as statistically greater than background but less than the MDA, are qualified as nondetects (U). Any other sample result is qualified as an estimated detect (J) unless the sample result is 10 times the contaminant in the blank. Generally, no action is taken for radionuclides detected in a blank but not in a sample, although the validator must be vigilant for situations when a radionuclide in a blank but not in a sample may cause interference with other radionuclides of interest in the sample.

4. Verify calculation or method of calculating the net blank value.

5. Any blank with a negative result whose absolute value is greater than LLD must be carefully evaluated to determine its effect on sample data. Review all the QC data specific to the method to evaluate the possibility of false negatives.

D.11.3.3 **Supplemental Blanks Requirements for Analysis of Alpha-Emitting Radium Isotopes Using Scintillation Counting.** Most chemical reagents contain some levels of radium. Generally, it is prudent to analyze additional blank samples in the event that the batch or lot number of a reagent should change in the course of preparing a group of samples for analysis.

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- If additional blank samples are not analyzed to check potential contamination of reagents with a different lot number from those used for previous blanks, qualify associated results as estimated (J).

D.11.3.4 **Supplemental Blanks Requirements for Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting.** Most chemical reagents contain some levels of radium. Generally, it is prudent to analyze additional blank samples in the event that the batch or lot number of a reagent should change in the course of preparing a group of samples for analysis.

- If additional blank samples are not analyzed to check potential contamination of reagents with a different lot number from those used for previous blanks, qualify associated results as estimated (J).

D.11.3.5 **Supplemental Blanks Requirements for the Analysis of Tritium Using Liquid Scintillation Counting.** Tritium in chemical reagents or water used for background determinations will interfere with sample results and reduce the method sensitivity. Tritium levels in reagents and background water should be less than the desired MDA for the method.

- If the tritium levels in reagents or background water exceed the desired MDA, qualify associated results less than 10X the background tritium level as estimated (J).

- If additional blank samples are not analyzed to check potential contamination of reagents with a different lot number from those used for previous blanks, qualify associated results estimated (J).

D.11.4 Detection Limits and Sample Results

D.11.4.1 **Criteria.** Methods must be equivalent to the following.

$$\text{LLD} = (4.66)\ (\text{Background Counts})^{1/2}$$

$$\text{MDA} = \frac{(4.66)\ (\text{Background Counts})^{1/2}}{(\text{Efficiency})\ (\text{Volume})\ (\text{Yield})\ (\text{Conversion Factors})}$$

D.11.4.2 **Procedure.**

1. Verify calculation or method of calculating the LLD and the MDA.

2. Verify that positive results (detects or results not qualified U) reported meet detection limits stated in the SOW and are above the MDA for the analysis or method.

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3. If the LLD and MDA cannot be verified, qualify all associated results as estimated detects (J) or estimated nondetects (UJ).

4. Verify the calculation of sample results by examining the raw data, i.e., spectra or printouts, for counts, counting time, efficiencies, and yields or recoveries, and data transcriptions, e.g., sample volumes.

5. Correct errors on the photocopied pages of the data package and include in the data validation report.

D.11.5 Radiometric and Gravimetric Yields

D.11.5.1 Criteria. At least one spike, tracer, or chemical yield must be analyzed in each SDG. The tracer, spike, or carrier must have chemical and radioactive characteristics appropriate for the sample matrix and analytical method.

D.11.5.2 Procedure.

1. If no or an inappropriate spike, tracer, or carrier was used qualify all associated results as unuseable (R).

2. Samples identified as field blanks may not be used for spike, tracer, or chemical yield analysis. Verify that the field blank was not used for such analyses. Look at chain-of-custody documents to find identifier.

3. If the field blank was used for spike, tracer, or chemical yield analysis, all other QC data must be carefully checked and professional judgement used when evaluating the data. Document if the field blank was used but don't qualify data on this alone.

4. Spike or tracer per cent recovery, or chemical yield must be within the control limits of 30-105 percent for all radionuclides or as specified in the Appendices. If sample activity is greater than 4x the spike activity, recovery limits do not apply. Review the raw data for counts, activity, and aliquot of the tracer, spike, or carrier used. Verify that the per cent recoveries or yields were correctly calculated and reported and that the results fall within the specified limits.

5. Qualify associated sample results outside of the acceptable limits as estimated detects (J), estimated nondetects (UJ), or unuseable (R) according to the following guidelines. Note any bias or trend in estimated results in the data validation report.

Yield (%R):	<30%	30-105%	>105%	>115%
Results < LLD:	R	acceptable		UJR
Results > LLD:	R	acceptable		JR

D.11.5.3 Criteria for Supplemental Requirements for Radiometric Yields for Analyses Using Alpha Spectroscopy. A tracer should be used to spike each sample prior to analysis. The percent recovery of the tracer should be between 30 percent and 105 percent.

D.11.5.4 Procedure for Supplemental Requirements for Radiometric Yields for Analyses Using Alpha Spectroscopy.

1. If a sample did not have a tracer added, qualify the result as unuseable (**R**).

2. Verify that recovery is calculated from the applicable instrument efficiency. Check the calculation of recovery using the following formula.

$$\text{percent recovery} = (\text{net CPM tracer/DPM tracer added}) \times (\text{efficiency in DPM/CPM})\ (100)$$

3. Qualify results outside of the acceptable limits as estimated (**J** or **UJ**), or unuseable (**R**) according to the following guidelines.

Yield (%R):	<30%	30-105%	>105%	>115%
Results < LLD:	R	acceptable		UJR
Results > LLD:	R	acceptable		JR

4. Record any bias or trend in estimated results in the data validation report.

D.11.5.5 Gravitimetric Yield Requirements for Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting. The laboratory shall provide information on typical chemical recoveries achieved with the method and evidence that sample results were corrected.

- If information is not provided on the determination of the chemical yield for each sample, qualify the results as estimated (**J**).

D.11.6 Duplicate Samples and Analyses

D.11.6.1 Criteria. At least one duplicate processing and analysis must be performed for every twenty samples in the SDG.

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D.11.6.2 Procedure.

1. If the number of duplicate analyses is not satisfactory, qualify all associated results as estimated (J).

2. Samples identified as field blanks (look at chain-of-custody documents) may not be used for duplicate sample analysis. Confirm that the field blank was not used for the duplicate analysis.

3. If the field blank was used for duplicate analysis, all other QC data must be carefully checked and professional judgement exercised when evaluating the data. Document if the field blank was used, but don't qualify data on this alone.

4. RPD between the sample and duplicate analysis of samples must be within the control limits of ± 35 percent for results greater than 5x the LLD). A control limit of ± 2x the LLD is applied if one or both of the sample values are less than 5x the LLD. If both values are less than LLD, no control limit is applicable. Review the data package and verify that results have been correctly calculated and reported and fall within the established control limits.

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

S = first sample value (original)

D = second sample value (duplicate)

5. If duplicate analysis results for a particular radionuclide are outside specified control limits, qualify results less than LLD as estimated nondetects (UJ), and results greater than LLD as estimated detects (J) for that radionuclide in all samples of the SDG.

D.11.7 Laboratory Control Samples

LCS may be prepared by the same laboratory performing the analyses or by a reference laboratory or agency. Laboratory control samples are equivalent to internal or external control samples. Laboratory Control Samples, or their equivalents, may be identified as QC samples, as samples from a particular agency, or as LCS.

D.11.7.1 General Criteria. All LCS results must be within the control limits. If control limits are not provided by the laboratory then use the control limits of 80-120 %R. Review the data package and verify that all LCS results have been correctly calculated and reported and fall within the specified control limits.

$$LCS\ \%R = \frac{LCS\ found}{LCS\ true} \times 100$$

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Where:

LCS found = concentration or activity for each radionuclide measured in the LCS

LCS true = concentration or activity of each radionuclide in the LCS

D.11.7.2 General Procedure.

1. Qualify affected sample results as estimated detects (J), estimated nondetects (UJ), or unuseable (R) for radionuclides that are outside control limits according to the following guidelines. Affected sample results may be all results for the SDG or just the results following an out-of-control LCS.

Radionuclide %R	<50%	50-79%>	120%
Results < LLD:	R	UJ	R
Results > LLD:	R	J	R

2. Note any bias or trend in estimated results.

3. At least one LCS must be analyzed with the SDG.

4. If the required LCS are not analyzed, qualify all results as estimated (J).

D.11.7.3 Supplemental Requirements for Laboratory Control Samples for Analysis of Alpha-Emitting Ra Isotopes Using Scintillation Counting. This method will not be able to achieve the criteria for accuracy specified in Section 6.8. Accuracy is determined by comparing the analytical results from laboratory control samples with the known concentration of Ra isotopes. The two values are used to compute a recovery factor (LCS %R presented in Section 6.8).

- Qualify associated sample results according to the following criteria.

Method Accuracy Criteria

	LCS %R			
	<50%	50-69%	70-130%	>130%
Results <LLD	R	UJ	Acceptable	R
Results >LLD	R	J	Acceptable	R

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D.11.8 Holding Times

D.11.8.1 General Criteria. Samples shall be analyzed within the period of 5 half-lives of the radionuclide of interest or within the holding time specified in Table 6-1, whichever comes first. Samples shall be properly contained and preserved (e.g., acidified) in accordance with laboratory standard procedures, to ensure that sample integrity is maintained. Holding times for each radionuclide are established by comparing the sampling date on the chain-of-custody record with the dates of analysis found in the data package.

Analysis date - sample date = radionuclide holding time

D.11.8.2 General Procedure.

1. Review the chain-of-custody documents to determine if the samples were preserved in accordance with the laboratory procedure.

2. If holding time or preservation requirements are not met, qualify all results greater than LLD as estimated detects (J) and results less than LLD as estimated nondetects (UJ). Professional judgement must be used in the case of grossly exceeded holding times. The expected bias would be toward lower results and the reviewer may determine that results less than LLD are unuseable (R).

D.11.8.3 Supplemental Holding Times Requirements for Analysis of Alpha-Emitting Ra Isotopes Using Scintillation Counting. Samples are to be preserved by adjusting the pH to less than 2 with Nitric Acid. Depending on to the time of preservation, the following holding time requirements are specified.

1. If the sample is preserved at the time of collection, subsection 6.9 requirements apply.

2. If the sample is not preserved at the time of collection, the following additional requirements apply.

   - Time from sampling to receipt at laboratory cannot exceed 5 days.

   - Laboratory must preserve the sample upon receipt and hold for at least 16 days prior to analysis.

3. Qualify associated sample results estimated (J) if holding time requirements are not met.

D.11.8.4 **Supplemental Holding Times Requirements for Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting.** Samples are to be preserved by adjusting the pH less than 2 with Nitric Acid. According to the time of preservation the following holding time requirements are specified:

1. If the sample is preserved at the time of collection, Section 6.9 requirements apply.

2. If the sample is not preserved at the time of collection, these additional requirements apply.

   - Time from sampling to receipt at laboratory shall not exceed 5 days.

   - The laboratory shall preserve the sample upon receipt and hold for at least 16 days prior to analysis.

3. Qualify associated sample results as estimated (J) if holding time requirements are not met.

D.11.9 Analysis of Ra-226 Using Scintillation (Lucas) Cell Counting

D.11.9.1 **Scope.** This Appendix provides supplemental information for validating analytical results from the determination of Ra-226 in water. The Ra-226 is separated from interfering species and concentrated by co-precipitation. After allowing for the ingrowth of Rn-222, the radon is purged and counted in a scintillation (Lucas) cell.

D.11.9.2 **Applicability.** The validation criteria in this appendix are intended to be applied in addition to those found in the body of the procedure. In cases where discrepancies exist between the procedure and the appendix, the criteria in the appendix shall apply.

D.11.10 Supplemental Requirements for Fluorometric Analysis of Uranium

D.11.10.1 **Scope.** This Appendix provides supplemental information for validating analytical data from the determination of uranium by fluorometry. The uranium is separated from interferences and concentrated by co-precipitation and purified by solvent extraction. The sample is fused with flux and analyzed on a fluorometer.

D.11.10.2 **Applicability.** The validation criteria in this appendix are intended to be applied in addition to those found in the body of the procedure. In cases where discrepancies exist between the procedure and the appendix, the criteria in the appendix shall apply.

D.11.10.3 **Interferences.** The fluorescence of uranium in the fluoride matrix can be either quenched or enhanced by the presence of cations or anions. When uranium is present in low concentrations, the interferences can be removed by various methods.

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- The analytical laboratory should provide evidence that interference from cations or anions is negligible, or that steps have been taken to minimize their effects. If evidence is not provided, qualify associated results as estimated (J).

D.11.10.4 Method Standardization. The fusion operation is the most critical step in the fluorometric procedure. Small variations in the duration of the fusion temperature of the fusion, and in the method of cooling the fused disk can cause large variations in the fluorescence yield. Each step of the fusion process should be standardized to obtain reproducible results.

- The analytical laboratory should provide a description of the method for fusion standardization. If the fusion process is not standardized, or information is not provided to allow the independent assessment of the standardization process, qualify associated results estimated (J).

D.11.11 Other Quality Control

Other QC checks give the data reviewer an opportunity to provide additional documentation that may be applicable to a particular SDG or useful to data users. The reviewer can also express comments on the overall data quality for an SDG. Other areas that may be addressed under other QC include, but are not limited to, documentation of the following.

- Trends observed in the performance of an instrument, method, or the laboratory over the course of the SDG or past history
- Anomalies associated with the Chain-of-Custody documentation
- Anomalies associated with the shipment or receipt of samples.

It is left to the discretion of the reviewer to evaluate the nature of any problems observed and to attach any qualification which may be necessary to describe the quality of the data. All anomalies and any action taken shall be clearly documented.

D.12 CONVENTIONAL PARAMETERS DATA VALIDATION PROCEDURES

This subsection describes validation procedures for conventional data parameters.

D.12.1 Holding Times

The objective of validating holding times data is to establish the validity of analysis results by ensuring that sample holding times from receipt to analysis or extraction were in compliance with the specified method (Attachment I).

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D.12.1.1 Criteria. The maximum holding times for completion of laboratory sample analysis and preservation requirements are specified in Table 6-1 (Appendix A) of the SCQ.

D.12.1.2 Procedure.

1. Establish holding times by comparing sample collection date with dates of analysis in raw laboratory data (e.g., digestion logs and instrument run logs).

2. Examine digestion and distillation logs to determine if samples were preserved as specified in Table 6-1 (Appendix A).

3. If holding times and preservation requirements are not met, qualify results that are greater than RQL as estimated (J) and results smaller than IDL as estimated (UJ). Analyte holding time (days) equals analysis date minus sample collection date.

4. If holding times are exceeded, use professional judgement to determine reliability of data and effects of additional storage on sample results.

D.12.2 Calibration

Requirements for instrument calibration are established to ensure that instruments are capable of producing acceptable quantitative data. Initial calibration demonstrates that an instrument is capable of required performance at the beginning of an analysis run. Verification of continuing calibration ensures that initial calibration remains valid.

Requirements for initial and continuing calibration are specified in each conventional parameter method. Results of initial and continuing calibration shall be compared to method requirements. If method requirements are not met the reviewer may qualify the associated data as estimated (J) if the variance is small or unuseable (R) if it is major. Professional judgement shall be used to assess the nature of the variances and whether they are major or minor in effect.

D.12.3 Blanks

Blank analysis results assessment helps determine existence and magnitude of sample contamination problems. Criteria for evaluation of blanks apply to all blanks associated with sample. If problems with blanks data for exist, data associated with the case shall be evaluated to determine whether there is an inherent variability in data for the case or if the problem is an isolated occurrence not affecting other data.

D.12.3.1 Criteria. There shall be no contaminants in blanks.

D.12.3.2 Procedure.

1. Review analytical results as well as raw data (printouts, strip charts, printer tapes, bench sheets) for blanks and verify that results are reported accurately.

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NOTE

If absolute value of the blank contaminant concentration is less than or equal to the RQL, correction of sample results is not necessary. If a blank analyte concentration is above RQL, the lowest concentration of that analyte in associated samples shall be ten times the blank concentration.

2. If samples associated with the blank have an analyte concentration less than ten times blank concentration and above RQL, qualify data for these samples as unuseable (R).

3. Do not correct sample concentration for the blank value.

D.12.4 Laboratory Control Sample

The LCS serves as a monitor of overall laboratory analysis performance including sample preparation.

D.12.4.1 Criteria. The following criteria apply.

- Aqueous LCS results shall fall within control limits of 80 to 120 %R.
- Solid LCS results shall fall within control limits.

D.12.4.2 Procedure.

1. Check raw data (printout, strip charts, bench sheets) to verify reported recoveries. Review data and verify that results fall within control limits.

2. Recalculate one or more of recoveries (%R) using the following equation.

$$\text{LCS } \%R = \frac{\text{LCS Found}}{\text{LCS True}} \times 100$$

Where:

LCS Found = concentration (in μg/L for liquid, mg/kg for solid) of each analyte measured in analysis of LCS solution

LCS True = concentration (in μg/L for liquid, mg/kg for solid) of each analyte in LCS source

3. For liquid LCSs, proceed as follows.

a. If LCS recovery for an analyte falls within the range of 50 to 79 percent or is greater than 120 percent, qualify results greater than RQL as estimated (J).

b. If results are less than RQL and LCS recovery is greater than 120 percent, identify data as acceptable.

c. If results are less than RQL and LCS recovery falls within the range of 50 to 79 percent, qualify data for affected analytes as estimated (UJ).

d. If LCS recovery results are less than 50 percent, qualify data for these samples as unuseable (R).

4. For solid LCSs, proceed as follows.

a. If LCS recovery for an analyte falls outside EPA control limits, qualify sample results greater than RQL as estimated (J).

b. If LCS results exceed control limits and sample results are less than RQL, identify data as acceptable.

c. If LCS results are below control limits, qualify sample results less than RQL as estimated (UJ).

D.12.5 Duplicate Sample Analyses

Duplicate analyses are indicators of laboratory precision based on each sample matrix.

D.12.5.1 Criteria. The following criteria apply.

- Samples identified as field blanks cannot be used for duplicate sample analyses.
- A control limit of ± 20 percent RPD for water samples and ± 35 percent RPD for soil samples shall be used for sample values greater than five times RQL.
- A control limit of ± RDL shall be used for sample values smaller than five times RQL.

D.12.5.2 Procedure. The following procedure applies.

1. Review and verify that results fall within control limits.

2. Check raw data and recalculate one or more RPD using the following equation to verify that results have been correctly reported.

$$PD = \frac{|S-D|}{(S+D)/2} \times 100$$

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Where:

S = first sample value (original)

D = second sample value (duplicate)

3. If duplicate analyses results for an analyte fall outside appropriate control windows, qualify results for the analyte in associated samples of the same matrix as estimated (J).

4. If a field blank was used for duplicate analyses, check other QC data and exercise professional judgement to evaluate data.

D.12.6 Matrix Spike Sample Analysis

The matrix spike sample analysis provides information about affect of each sample matrix on digestion and measurement methodology.

D.12.6.1 Criteria. The following criteria apply to methods where matrix spike samples are analyzed.

- Samples identified as field blanks shall not be used for spiked sample analysis.
- Spike recovery (%R) shall be within 75 to 125 percent; however, spike recovery limits do not apply when sample concentration exceeds spike concentration by a factor of four or more.

D.12.6.2 Procedure.

1. Verify that the field blank was not used for spike analysis.

2. Check raw data and recalculate one or more %R using the following equation to verify that results were correctly reported.

$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

Where:

SSR = Spiked sample result

SR = Sample result

SA = Spike added

3. Review and verify that results fall within specified limits.

4. If spike recovery is greater than 125 percent and reported sample result is less than RQL, identify data as acceptable.

5. If spike recovery is greater than 125 percent or less than 75 percent and sample result is greater than RQL, qualify data as estimated (J).

6. If spike recovery is within the range of 30 to 74 percent and sample results are less than RQL, qualify data as estimated (UJ).

7. If spike recovery is less than 30 percent and sample results are less than RQL, qualify data as unuseable (R).

8. If the field blank was used for matrix spike analysis, check other QC data and exercise professional judgement to evaluate data.

D.12.7 Sample Result Verification

The objective is to ensure that reported quantitation results are accurate.

D.12.7.1 Criteria. The following criterion applies.

- Analyte quantitation shall be calculated as specified in the applicable method in Attachment I.

D.12.7.2 Procedure. The following procedure applies.

1. Examine raw data and verify correct calculation of sample results reported by the laboratory. Examine raw data for anomalies (e.g., baseline shifts, negative absorbance, omissions, legibility).

2. Compare digestion and distillation logs, instrument printouts, and strip charts to reported sample results.

3. Verify that there are no transcription or reduction errors (e.g., dilutions, percent solids, sample weights) on one or more samples.

4. Verify that results fall within calibrated range.

D.12.8 Field Duplicates

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision; therefore, the result may have more variability than laboratory duplicates, which measure only laboratory performance. It is

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expected that soil duplicate results will have a greater variance than duplicates of water matrices because of difficulties associated with collecting identical soil samples.

D.12.8.1 Criteria. There are no review criteria for field duplicate analyses comparability.

D.12.8.2 Procedure. The following procedure applies.

1. Identify field duplicate samples on field sample sheets.

2. Compare reported results for each sample and calculate RPDs if appropriate.

3. Provide reviewer comments with evaluation report of field duplicates.

D.12.9 Overall Assessment of Data for a Case

The data reviewer shall make professional judgements, express concerns, and comment on validity of the overall data package for a case. This is particularly appropriate when there are several QC criteria out of specification.

The additive nature of QC factors out of specification is difficult to assess in an objective manner, but the reviewer has a responsibility to inform users concerning data quality and limitations. Availability of DQOs is helpful in this review. The information will help the user avoid inappropriate use of data and yet not preclude all consideration of the data.

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APPENDIX E

ANALYTICAL LABORATORY PERFORMANCE REQUIREMENTS

E.1 INTRODUCTION

Analytical performance requirements shall be used as guidelines for evaluating laboratory capability to provide specific analytical services to FEMP. Ability to meet these requirements shall be audited prior to contract award as described in Section 12. Subsequent post-contract-award audits shall be performed to verify laboratory performance using the performance-evaluation sample results specified in subsection E.2 and Section 3.

E.1.1 Purpose

This appendix establishes performance requirements for laboratories doing analytical work for FEMP. Laboratories shall use sample preparation, analysis, and reporting methods specified in the FEMP Analytical Laboratory Methods Manual (Attachment I of the SCQ).

E.1.2 Scope

General requirements for laboratories performing analysis for FEMP are provided in the following subsections.

- Laboratory Approval (subsection E.2)
- Requirements (subsection E.3)
    - Equipment (paragraph E.3.1)
    - Sample Receipt and Documentation (paragraph E.3.2)
    - Preparation, Analysis, and Identification of Analytes (paragraph E.3.3)
    - Quality Assurance/Quality Control Procedures (paragraph E.3.4)
    - Reports and Deliverables (paragraph E.3.5)

E.1.3 FEMP Project Contact

The FEMP project contact and the laboratory project manager are project-specific functions, and shall be identified in the project-specific plan. Project correspondence shall be directed through these individuals.

E.1.4 Lab Contract Technical Representative

The lab contract technical representative is a FEMP individual or group tasked with dealing with a specific subcontractor laboratory on contract and organizational issues.

E.1.5 FEMP Manager of Site Sample Management

The FEMP Manager of Site Sample Management is an individual subordinate to the FEMP Sampling and Analysis Management Coordinator responsible for maintaining and updated the FEMP approved laboratory list and for coordinating audits with the designated FEMP QA organization.

E.2 LABORATORY APPROVAL

The FEMP sampling and analysis management coordinator shall maintain a list of analytical laboratories approved for FEMP sample analyses.

E.2.1 Requirements for an Approved Laboratory

A laboratory which demonstrates compliance with the following requirements shall be considered approved to perform work for the FEMP for the ASL and types of analyses considered. An approved laboratory:

1. Has been audited/surveyed by FEMP personnel to ensure compliance with these requirements and to document the compliance.

2. Has the necessary licenses and/or certifications to handle and process FEMP samples.

3. Has standard operating procedures (SOPs) in place which address sample receiving, login, storage, analysis, and disposal. Analysis SOPs shall meet the applicable requirements of Attachment I of the SCQ. Other specific SOPs shall also be required depending on the ASL involved, as dictated by the SCQ.

4. Has adequate building security and Chain-of-Custody system with applicable SOPs.

5. Has a document control system which addresses all SOPs and the Quality Assurance Manual.

6. Has a QA Program which addresses the applicable requirements of the most recent version of ANSI/ASCQ/E4-19xx, and the FEMP SCQ.

7. Can document personnel and laboratory experience in the analysis category (inorganic, organic, conventional, asbestos, radiochemical, geotechnical), including acceptable performance in performance evaluation programs. Analytical performance and financial stability will have been verified via reference checks with previous and/or current customers.

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8. Can demonstrate the ability to comply with all applicable QC requirements of the SCQ.

9. Can demonstrate the ability to comply with all applicable reporting requirements of the SCQ.

10. Can demonstrate the ability to comply with all other contractual requirements as will be set forth in technical Statements of Work. This shall include the statement that "All contractual requirements shall be met, except for the following:..." in all contract proposals. Any exceptions must be agreed upon by the individuals signing the letter described below. These exceptions shall in no case supersede the requirements of the SCQ.

11. Has a Program Management description which identifies the single point of contact at the laboratory, how FEMP sample will be tracked and processed on a daily basis, and how the lab will ensure compliance with all of the relevant SCQ requirements including QC and reporting.

12. Has laboratory and administrative programs in place which comply with the requirements of OSHA, e.g., use of MSDSs, a Chemical Hygiene Plan, a Radiation Safety Program (as applicable), and a Hazardous Waste Management Program.

E.2.2 Laboratory Performance Review

Each laboratory will be surveyed, prior to contract award, to ensure compliance with these items. All documentation received with contract proposals and during site visits shall be maintained in a laboratory specific file. The lab contract technical representative (CTR) shall also perform the following activities, at a minimum, to ensure the continued acceptable performance of each lab performing analyses for the FEMP.

1. Follow-up audits will be conducted, subsequent to award, at least annually consistent with Section 12 of the SCQ. All checklists, reports, and corrective action verification shall be maintained in the appropriate file. More frequent audits will be conducted as dictated by lab performance and/or the importance or number of analyses being performed.

2. Monthly performance reports will be submitted to the CTR by all laboratories. These reports will include:

   - A discussion of any problems encountered during the month as related to the processing of FEMP samples.

   - A review of samples processed, including identification of samples received, reported on time, reported late, in process, and an indication of holding time compliance.

- Charts or tables which summarize the performance on FEMP supplied blind samples during the month and over the life of the contract. This shall include a narrative which summarizes the performance.

- Copies of round-robin program results received during the month and an analysis of the performance.

- Mention of any reduced (or enhanced) ability to perform under the terms of the contract. This shall include new analysis capabilities, additional or reduced sample capacity, and personnel changes.

The CTR will review these reports, follow-up as necessary, document all resultant conversations with the lab, and file all of this information.

3. Face-to-face contacts between the CTR or designee and contract lab personnel at least semi-annually. This requirement can be met by the annual audit, a visit to the lab to check on samples (announced or unannounced) or a visit to the FEMP by laboratory personnel.

4. Phone calls to each laboratory processing samples shall occur at least weekly and will be documented.

5. Data packages received from the laboratories will be reviewed according to standardized checklists. Compliance with regulatory and contractual requirements shall be confirmed in each case.

E.2.3 Approved List of Laboratories

The approved laboratory list will include labs that are currently approved and whose approval is not current. The list can then be used for historical purposes. Only currently approved laboratories may perform work for FEMP.

This list will contain the following information:

- Date of issuance of the list.

- Revision number of the list.

- Laboratory name and location.

- Analysis category.

- ASL.

- Approval status - examples are currently approved and contracted, currently approved but not contracted, and not currently approved. A "not currently approved lab" is one whose approval has been discontinued or has lapsed. The details for this will have been provided in the letter described in Item D.

- Period of performance.

- Date of last audit.

- Date of next scheduled audit.

- Remarks.

Revision of the approved laboratory list will be accomplished as follows.

Because of changing needs, management or contract changes, or other unforseen circumstances, the approved laboratory list is expected to change over time.

Step 1: A member of the contract Source Evaluation Board (SEB) or the Site Sample Management employee responsible for the contract in question submits a letter to the FEMP Manager of Site Sample Management (SSM). The letter is entitled "Recommendation to Revise the Approved List of Laboratories to Perform Work for the FEMP" and includes what change is required and concurrence lines for the Manager of SSM and a representative of the designated FEMP QA organization (QA representative). The letter must also include a listing of the applicable ASLs, and the category of analyses affected.

Additions must include statements, and all applicable documentation (e.g., audit reports and licenses), that indicate compliance with all of the eleven requirements specified in Item A.

Deletions (designations of discontinued approval) must state reasons why. These include lapsed contract, audit not performed per frequency requirement, and poor performance. Poor performance can include disapproval, by the EPA, of work performed under non-FEMP contracts. A "poor performance" statement must include details.

Step 2: The manager of SSM and the QA representative sign the concurrence line.

Step 3: SSM personnel, by copy of the letter, revise the list.

Step 4: Controlled copies of the list are then distributed. The EPA receives a copy which includes a cover letter which indicates the changes made and which includes all attachments.

The list will be revised each time a change is necessary, but no more frequently than monthly.

A review of this approach to maintaining a list of approved labs shall be conducted at least annually. Changes will be incorporated into the SCQ as dictated by said review.

E.3 EQUIPMENT

Each laboratory must have equipment in top working order capable of performing the analyses for which it bids to perform for FEMP.

E.3.1 Inorganic Compound Analysis. The laboratory shall have equipment capable of performing inorganic compound analyses by specified methods in Attachment I (the FEMP Laboratory Analytical Methods Manual). The following equipment is required for certain methods.

- Inductively Coupled Plasma (ICP) emission spectrometer
- Atomic Absorption (AA) spectrometer with graphite furnace and cold vapor

E.3.2 Organic Compound Analysis. The laboratory shall have equipment capable of performing organic compound analyses by specified methods in Attachment I. The following equipment is required for certain methods.

- Infrared spectrometer
- Gas chromatograph/mass spectrometer
- Gas chromatograph/electron-capture detector
- Gas chromatograph/photo ionization detector
- Gas chromatograph/electrolytic conductivity detector
- Gas chromatograph/flame photometric detector
- Gas chromatograph/flame ionization detector
- High performance liquid chromatograph

E.3.3 Radiological Analysis. The laboratory shall have equipment capable of performing radiological analyses by specified methods in Attachment I. The following equipment is required for certain methods.

- Liquid scintillation counting systems

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- Alpha spectrometer systems
- Alpha/beta counting systems
- Germanium spectroscopy systems
- Alpha scintillation counting instruments
- Ultraviolet/visible spectrum

E.4 SAMPLE RECEIPT AND DOCUMENTATION

Following are general requirements for sample receipt and preparation. Specific procedures for receipt and preparation of samples are provided in Section 7.

E.4.1 Chain of Custody. Laboratory custody procedures shall be documented and implemented so that the following conditions are met for samples at all times prior to and during analysis. Procedures shall be consistent with Section 7. Documentation of sample custody from time of receipt to final laboratory disposition shall be maintained. A sample is considered in custody when one of the following are met.

- The sample shall remain in one person's possession;
- Or the sample shall be in that custody holder's view after being in holder's possession;
- Or the sample shall be in custody holder's possession and placed in a secure, controlled-access storage area by holder;
- Or the sample shall be in a designated secure area accessible to authorized personnel only.

E.4.2 Document Control. Document control ensures that data for specified sample sets are accounted for after completion of a project. The laboratory shall have written document control measures that shall be specified in the laboratory quality assurance plan in accordance with SCQ Sections 4 and 11. The following document control forms are required.

- Data sheets
- Logs or daily log forms

E.4.3 Standard Operating Procedures. The laboratory shall have written standard procedures for sample receipt, log-in, and storage. These procedures shall be subject to FEMP approval and in accordance with the SCQ.

E.5 PREPARATION, ANALYSIS, AND IDENTIFICATION OF ANALYTES

The laboratory shall demonstrate compability of preparing and analyzing samples and identifying constituents of concern by specified Attachment I methods. Quantitation limits for analyte targets are provided in the specified method.

E.6 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

The laboratory shall be responsible for performing Quality Assurance/Quality Control (QA/QC) procedures in strict accordance with Sections 4, 10, and 11 and the laboratory-specific contract, including specified holding times and other criteria. Quality Control (QC) samples for laboratory analysis are defined in Section 4 and listed in Table 2-2 in Appendix A.

Analytical laboratories shall be required to have an internal quality assurance plan and applicable standard operating procedures in place as specified in Section 12. Adherence to the elements of the plan shall be documented in audits.

The SCQ shall be a contract-specified attachment to the laboratory-specific quality assurance plan. Compliance with the SCQ shall be verified through project performance audits.

E.7 REPORTS AND DELIVERABLE ITEMS

Requirements for reports and deliverable items depend upon the specified Analytical Support Level (ASL) (Section 2). The following paragraphs summarize laboratory requirements.

E.7.1 Inorganic Compound Samples. The following report forms are required for inorganic sample reporting for ASL C data.

- Inorganic analysis data sheet
- Radiation Detection Limit (RDL) standard for Atomic Absorption (AA) and ICP
- Blanks
- Spike sample recovery
- Duplicates

The following data are required for inorganic sample reporting for ASL D data in addition to the preceding requirements for ASL C data.

- Initial and continuing calibration verification
- ICP interference check sample

- Post-digest spike sample recovery
- Laboratory control sample
- ICP serial dilution
- Analysis run log
- Preparation log

Requirements for ASLs B and E data shall be specified in project-specific plans.

E.7.2 Organic Compound Samples. The following report forms are required for organic sample reporting for ASL C data.

- Organic analyte data sheet
- Surrogate recovery forms
- Matrix spike/matrix spike duplicate forms
- Method blank summary
- Analyte resolution summary (pesticides only)
- Identification summary for single or multicomponent analytes (pesticides only)

The following data are required for organic sample reporting for ASL D data in addition to the preceding requirements for ASL C data.

- Instrument performance check
- Initial calibration data
- Continuing calibration check
- Calibration verification (pesticides only)
- Florisil check (pesticides only)
- Gel permeation chromatography calibration (pesticides only)
- Internal standard error and retention time summary for volatile organic analysis/base neutral analysis

Requirements for ASLs B and E data shall be specified in project-specific plans.

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E.7.3 Radiometric Samples. The following report forms are required for radiometric sample reporting for ASLs C or D data.

- Radiochemical data completeness checklist
- Data assessment summary report form
- Radiochemical analysis results

Requirements for ASLs B and E data shall be specified in project-specific plans.

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APPENDIX F

DATA MANAGEMENT PLAN

F.1 INTRODUCTION

This data management plan describes the FEMP data management systems that will be implemented to provide a centralized, consistent, accurate, and flexible data repository for FEMP. The purpose of the plan is to describe each subsystem of the data management system, linkages between subsystems, overall hardware and software environments, and general guidelines for future development of data management systems.

Data generated for the Remedial Investigation/Feasibility Study (RI/FS) are stored on a FLOW GEMINI-based software system that meets requirements of the currently approved FEMP RI/FS Data Management Plan. Data generated for other programs are subject to requirements of the Data Management Plan, which is an integral part of the Sitewide CERCLA Quality Assurance Project Plan (SCQ).

F.1.1 Role of Data Management

Environmental data have become a key product of environmental studies, and data collected at FEMP are critically important to analysis and decision making relative to the site. A data management system is essential for the following reasons.

F.1.1.1 <u>Volume of Data</u>. On large, complex sites like FEMP, the increasing volume of data becomes a management issue. The vast amount of data is growing rapidly with the rising number of ongoing characterization and monitoring programs. Data volume may also increase as new environmental regulations are promulgated. Manual filing and management systems are not adequate for handling the amount of data anticipated for FEMP.

F.1.1.2 <u>Compliance With Regulatory Controls</u>. Historic data generated in accordance with the RI/FS Work Plan are significant and necessary for the CERCLA process and subsequent records of decision. Data generated in support of other site programs are significant and potentially necessary for removal actions, Resource Conservation and Recovery Act (RCRA) closures, and other determinations necessary to ensure compliance with federal and state laws and regulations. These data may also provide supportive information for the RI/FS process.

Data generated under the SCQ are intended to integrate the requirements of all regulatory programs that apply to FEMP in order to produce comparable data useable on a site-wide level.

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One central computerized data repository helps to ensure that FEMP environmental data are accurately and completely maintained and that appropriate data are accessible for multiple, concurrent remediation and compliance efforts.

F.1.1.3 **Flexible and Timely Response to Data Queries.** FEMP environmental studies require that project data be examined in numerous ways, frequently within a very short time frame. Typically, sets of environmental data that are of interest for examination and preview cannot all be pre-defined at the outset of the project. The FEMP data management system uses relational data management software, thus it is supportive of the ad hoc nature of requests and short time constraints usually involved.

The FEMP environmental data management system was designed to address these needs through individual modules and collective integration. The goal is to provide a centralized data repository for a very large quantity of data of known quality that satisfy regulatory requirements and project DQOs and that can support a wide range of ad hoc and routine data requests for assessment and reporting in a timely manner.

Data qualifiers resulting from the data validation process (Appendix D) shall be present in the data repository and referenced whenever FEMP environmental data are used. The FEMP environmental data management system will allow attachment of data qualifiers to each piece of data, which can then be related to ASLs or DQOs. Qualifiers can be used to screen data when retrieval for a particular application is considered.

F.1.2 Life Cycle of FEMP Environmental Data

Guidelines for establishing DQOs and developing sampling plans, data transfer and handling procedures, sample analysis requirements, and data validation procedures are detailed in other parts of the SCQ. Each activity is summarized in the following paragraphs to illustrate overall flow of data within the system and to relate the system modules described in subsection F.2. The modules were constructed to manage data during each life cycle phase of a piece of environmental data. Figure F-1 (Appendix A) illustrates this life cycle.

F.1.2.1 **Data Quality Objectives.** Data are gathered and analyzed in different ways depending on its intended use. Preparation of DQOs is the necessary precursor to data collection activity (Section 2 and Appendix C).

F.1.2.2 **Preparation of Project-Specific Plans (PSP).** A PSP shall be developed for proposed data collection activities in compliance with SCQ requirements (Sections 1 and 6).

F.1.2.3 **Collection of Samples.** Sample collection shall be accomplished in accordance with the PSP and SCQ. Field sampling teams collect physical samples (e.g., soil or ground water) and package them for transport to an analytical laboratory. Required field

observations (e.g., temperature, pH, and specific conductance) are also measured and recorded, but no physical samples are sent to the laboratory. Each sample or piece of recorded data is referenced to an on-site or off-site location through the state of Ohio planar coordinate system (Sections 5 and 6).

F.1.2.4 **Transfer and Handling of Samples.** Samples collected on site for laboratory analysis are identified with a sample number, packaged, and transported to the laboratory. Custody and other records are maintained for sample tracking from time of collection through final disposition (Sections 5, 6, and 7).

F.1.2.5 **Laboratory Analysis and Reporting.** Sample analysis is performed at an on-site or off-site analytical laboratory. Analysis results, along with supplemental information on analytical techniques, dilutions, and chain-of-custody records, are documented. Laboratory results are transferred in standard hard copy and/or in electronic formats (Sections 7, 8, 9, 10, 11, and Attachment I).

F.1.2.6 **Data Verification and Validation.** A set of specified, standardized rules and associated Quality Control (QC) measures is used to validate sample results and assign data qualifier flags (Appendix D).

F.1.2.7 **Data Repository.** The FEMP Data Management System Results Database (DMSRD) supports direct loading of validated data from electronic media as well as manual data entry. The DMSRD is maintained using relational database management software. Validated data are loaded into the data repository, which is the heart of the FEMP environmental data management system. It is what most data users consider when thinking of the environmental database.

Manual data entry shall be performed in duplicate and the two sets of entered data shall be electronically compared. Discrepancies between the two sets will be resolved by comparison to the original data sheets and corrections made as necessary to entered data.

F.1.2.8 **Data Analysis.** Analysis results data are retrieved or accessed to support a wide range of activities including modeling, statistics, mapping and visual display, and summary tabular data listings. Some data analyses include assessment of the useability of existing data for current applications. The assessments may lead to definition of a need for additional sampling efforts, which connects the data analysis phase of the data life cycle to data requirements and sampling plan phases.

F.1.2.9 **Data Archiving and Storage.** Each piece of data in the FEMP environmental DMSRD is linked to the original hard-copy documents produced by analytical laboratories. Hard copies are kept in permanent storage and the electronic database is permanently archived in a neutral ASCII file format.

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F.2 FEMP ENVIRONMENTAL DATA MANAGEMENT SYSTEM

A collection of integrated environmental data management systems has been designed for FEMP to support the range of data-related activities previously outlined. These systems make up the FEMP environmental data management system to manage the complete set of sampling, project scheduling, QA/QC, and analytical results data, along with site maps and other spatially oriented data.

The data repository that stores analytical and field observation results, related QA/QC information, sampling station information, and cross references to original hard copy documents is central to the FEMP environmental data management system. Each of the other systems interface with this central repository either by using repository data as input or by serving as a data input point to the repository.

In the FEMP system, data are shared among applications, and redundant storage of a piece of data in more than one location in the repository is avoided when possible. Figure F-2 (Appendix A) shows how the various systems are integrated into the overall data management system and how they are interrelated. The following paragraphs contain brief descriptions of each of the computerized systems illustrated in Figure F-2 (Appendix A).

F.2.1 Automated Sampling and Analysis Program System

The Automated Sampling and Analysis Program system assists in reviewing data results and associated qualifiers to help identify data gaps that require additional sampling, aid in determining necessary non-routine samples, and facilitate development of PSPs for non-routine sampling. The automated sampling and analysis program includes the following subsystems.

- **Query and Report Facility** - Tailored to help identify data deficiencies and provide a profile of historical sampling efforts for user-defined locations and time frames

- **Detailed Logic Based on the SCQ and DQOs** - Produces recommendations for non-routine sampling activities when combined with the query and report facility

- **Reporting Facility** - Helps produce project-specific plans, sample analysis request/custody records, and bottle labels for non-routine sampling efforts

- **Interface to FACTS System** - Transfers data requirements identified for non-routine sampling activities and draws on Fernald Analytical Computerized Tracking System (FACTS) ORACLE data tables (subsection F.2.2) to assign unique sample identification numbers to newly required samples

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F.2.2 FACTS System

The FACTS supports sampling, laboratory analysis, and analytical reporting activities. FACTS includes the following modules.

- **Field Data Tracking System** - Used by sampling crews to collect and verify collection of key data fields including sample location identifier, collector initials, sample volume requirements, sample preservation, equipment calibration information, sample date and time, and chain-of-custody information

- **Laboratory Information Management System (LIMS)** - Used by the FEMP laboratory to document analytical results data and generate management reports, hard copy results summary reports, and results data files suitable for direct import into repository database

- **Sample Tracking System** - Used to track life history of samples through initial planning, sample collection, laboratory analysis, validation, and input to repository database. The subsystem also monitors schedule status of both routine and non-routine sampling activities on an ongoing basis. A key function of the sample tracking subsystem is the issuance of a sample identification number unique to each analytical sample taken. This identification is used in all other FEMP environmental data systems to cross-reference sample results data.

F.2.3 Data Validation System

Electronic data validation of commonly used analytical methods is an integral part of the FEMP data management system. Data from analytical laboratories shall be obtained in electronic and hard copy formats. Electronic data shall undergo a computerized data review that assigns the majority of data validation flags. Flags will be automatically input to the DMSRD.

F.2.4 ORACLE Results Database

The central DMSRD system is the ORACLE relational database management system results database, which serves as the repository for analytical results data, related QA/QC information, sampling station descriptors, field observations, and data qualifiers. The DMSRD is comprised of the following subsystems.

- **Executive Menu** - Ties DMSRD subsystems into a single, easy-to-use system with similar keystroke conventions, screen layouts, error messages, and menu layouts used in each subsystem

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- **Data Entry Screens** - Facilitate manual data entry of results data

- **Data Import Programs** - Facilitate loading of results data received electronically

- **Data Edit Screens** - Facilitate modifications to selected fields in the DMSRD (e.g., data qualifier fields)

- **Standard Output Reports** - Provide hard copies of results data and associated information in several pre-defined formats. Reports may be generated for subsets of the DMSRD through use of standard data queries.

- **Ad Hoc Queries** - Facilitate queries on results data via the ORACLE Structure Query Language (SQL), which provides a flexible, powerful means of selecting subsets of data from the DMSRD for viewing and analysis

- **Data Views** - Allow users to define windows into the DMSRD that combine selected data elements from disparate tables into a view that looks like a single table of data

- **Linkages to External Data Analysis Software Packages** - Many easy-to-use third-party software packages are used that directly read ORACLE data tables. Several external data analysis systems use the ORACLE DMSRD directly as a source of input data. A file import/export facility allows copies of results data to be extracted from ORACLE tables into files that can be input to software packages without being able to read ORACLE tables directly. It is also possible to extract data from the FLOW GEMINI system through or into the ORACLE database.

- **Data Security and Password Protection** - Provide, via built-in ORACLE functions, different levels of data access rights to users, ensuring that only selected data-center personnel can modify data and only in very clearly defined circumstances

F.2.5 INTERGRAPH ERMA System

The ORACLE DMSRD acts as an electronic file cabinet for FEMP environmental data to facilitate access to these data and to ensure that data are of known quality. ORACLE can be used to analyze results data to a limited extent. The SQL query language, when used by trained personnel, can provide useful data summaries to support data analysis.

For more extensive data analysis, external software packages are generally employed. The primary environmental data analysis subsystem in use at FEMP is the Intergraph Environmental Resource Management and Analysis (ERMA) system. Brief descriptions of ERMA subsystems follow.

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- **Microstation CADD Software** - One foundation of ERMA. Graphics-related data used by ERMA are stored in microstation design files, which can be enhanced in appearance using standard microstation Computer Aided Design and Drafting (CADD) menu commands.

- **Relational Database Linkages to ORACLE** - Via the Intergraph Relational Interface System (RIS) that provides linkage between ERMA and the ORACLE repository. ERMA also maintains its own data structures in ORACLE.

- **Statistical Analysis Capabilities** - Within ERMA and directly interfaced with the ORACLE DMSRD.

- **Geographic Information System Capability** - Within ERMA via Intergraph MGE software and used to facilitate spatially-related queries against the ORACLE DMSRD and to plot results on an appropriate site map

- **Hydrogeologic Analysis** - Supported in ERMA via direct linkages to software used to generate stratigraphic cross sections, correlation panels, thickness maps, structure maps, and distribution maps. Interfaces are also provided between ERMA and popular commercial contouring packages.

- **Modeling** - Supported in ERMA via interfaces with ground-water models such as the U.S. Geological Survey modular finite-difference ground-water flow model (MODFLOW).

F.3 FEMP SOFTWARE ENVIRONMENT

The core of the FEMP environmental data management system is the ORACLE relational database management system. The FEMP environmental data management system (except for the RI/FS FLOW GEMINI-based system) uses ORACLE for data storage and retrieval. The following general software characteristics are employed in environmental software applications.

F.3.1 Sitewide ORACLE Database

A sitewide ORACLE database that includes numerous data tables and data elements is maintained. A data dictionary that describes each ORACLE data table, data elements in each table, keyed data elements, definitions of each data table and each data element, and field characteristics for each data element is also maintained. In addition, entity relationship diagrams describe relationships among the ORACLE tables.

The sitewide ORACLE database is the repository for FEMP environmental software modules. It is the central repository, not only for environmental data, but also for information models that guide functional requirements and design decisions for future software applications developed for FEMP. The central ORACLE database provides a clear and concise definition of environmental data that can be easily communicated to multiple software application maintenance teams and data users.

The ORACLE database is normalized (minimized data redundancy) to the highest practical degree except when performance factors on key software applications require addition of redundant data elements to some data tables. This approach minimizes confusion and possibility for error when multiple groups of users access the same data elements in different applications.

F.3.2 Menus

When possible, ORACLE SQL*Menu software was used to develop executive menus for environmental software to provide users with similar "look and feel" across applications.

F.3.3 Data Input Standards

An absolute standard for data input modules was not employed for environmental software systems. Rather, certain general standards are enforced, recognizing that each specific application may have some unique data input needs requiring some deviation from other applications. The data input standards philosophy, then, is to apply the following general input standards.

- **Software Platform** - ORACLE SQL*Forms, Version 3, is used as the software development platform for FEMP environmental software modules when possible.

- **Data Editing and Verification** - Pre-defined field edits (templates) are used when possible to help screen data for valid entries on input screens.

- **Use of Pre-Defined Codes and Look-up Tables** - Look-up tables with pre-defined lists of valid codes are used when possible for coded data elements to help screen data for valid entries by forcing use of standard codes.

- **Required Fields and Field Completeness** - To the maximum extent possible, data elements are verified during data input for completeness, and required fields must be entered for a screen entry to be accepted into the database.

- **Error Messages** - The ORACLE SQL*Forms error-message-handling feature provides a clear and concise error message in a consistent fashion on input screens to inform users of input errors.

- **Double-Key Data Verification** - Manual data entry of analytical results data into the ORACLE DMSRD is accomplished via double-keying of data by separate data entry personnel, with the computer making the comparison between the entries.

F.3.4 Data Output Standards

Data reporting modules implemented in data systems are flexible and easy to use. They incorporate standard, high-level ORACLE query capabilities including searches, sorts, control breaks, and reformatting. Standard and customized program modules allow for both regular production reports and ad hoc (on demand) reports.

Standardized production reports use pre-defined query forms, are numbered to allow for easy user reference, and may be initiated from system menus. Ad hoc reports use the SQL query capability and SQR and EASY*SQR third-party software packages to generate reports on demand from the ORACLE data repository.

Other third-party software, such as ORACLE Add-in for Lotus 1-2-3, are used to extract data from the ORACLE data repository and format ad hoc reports.

F.3.5 Data Interface Standards

Data interface between separate environmental software systems is facilitated by sharing the common ORACLE data repository. The ORACLE database provides a seamless interface that does not require a multistep data export/import process to move data from one application system to the next. However, certain basic data interface capabilities between ORACLE-based systems and stand-alone or "orphan" systems, which exist primarily on microcomputers within specific FEMP organizations, are supported in the following manner.

- **ASCII File Creation** - Software tools produce ASCII data files extracted from the ORACLE data repository. The delimiter used between fields in these files may be user-defined, and character fields can be enclosed in quotes, dependent on data input requirements of the receiving software.

- **Spatial Data Link** - Primary linking fields for exporting spatial data from the ORACLE DMSRD to external orphan software are the station IDentification (ID) number and location X and Y coordinates.

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- **Temporal Data Link** - Primary linking fields for exporting temporal data from the ORACLE DMSRD to external orphan software packages are the sample ID number, date, and time.

F.4 HARDWARE REQUIREMENTS

The hardware environment for new systems development shall be compatible with existing site computer equipment. Current base hardware is a Digital Equipment Corporation VAX cluster comprised of a VAX 8550 and a VAX 6310 running under a VAX/VMS. Short and long term upgrades include installation of Multiple Processing Technology (MPX) and memory, storage, and various other peripheral upgrades.

F.4.1 Operating System

The current VAX cluster operates under VAX/VMS version 5.3. Software systems shall be fully compliant with upgrades in the operating system. Short term plans include an upgrade to VAX/VMS version 5.4.

F.4.2 Network Support

New system functionality shall co-exist successfully with existing network software as well as provide functional capacity to support future networking software.

F.4.3 Terminal Support

Systems will function, at a minimum, in a character-based environment with future migration capabilities to a Graphical User Interface (GUI) form.

F.4.4 Security

Security provisions for systems development shall conform to established site security guidelines. The system also considers integration of VAX/VMS security capabilities as well as other internal system-dependent security. For legal and financial reasons, security of data is essential. The entire sphere of data security is governed by the following major points.

F.4.4.1 <u>Data Access</u>. Users of the system shall be authorized and given limited access to data. When a user is removed from the project, their access rights shall be withdrawn.

F.4.4.2 <u>Document Procurement</u>. Documents associated with data gathered at the site are restricted from access by the public unless authorized by DOE. When documents are produced concerning data, access restrictions shall apply unless waived by DOE.

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F.4.4.3 **Passwords.** Passwords shall be assigned to each user, data screen, and database and shall be controlled by the database administrator. There are multiple levels of passwords, depending upon the degree of security necessary.

F.5 SOFTWARE DEVELOPMENT STANDARDS

New software developed in support of environmental data management activities shall follow a standard, structured software-development life-cycle methodology, which shall include the following tasks and deliverable items.

- Functional requirements analysis
- Preliminary software design
- Detailed software design
- Test plans
- Interim production cut-over
- Final production cut-over
- User-level and systems-level documentation
- Software maintenance plan

In addition, new software modules shall use ORACLE and standard ORACLE development tools for data management, menus, screens, reports, and queries.

APPENDIX G

(Reserved)

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APPENDIX H

(Reserved)

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APPENDIX I

FIELD CALIBRATION REQUIREMENTS

I.1 TYPE OF EQUIPMENT

Calibration requirements for the following types of field instrumentation are discussed in this appendix.

- pH meter
- Specific conductance meter
- Dissolved oxygen meter
- Redox Potential
- M-Scope (water level indicator)
- Thermometers
- Photo-ionization detector (HNu, TIP, OVM)
- Flame-ionization detector (OVA)
- Explosimeter
- Pressure transducers
- Hand-held radiological survey instruments

Table I-1 (Appendix A) provides a summary of calibration frequency and accuracy requirements for these measuring devices.

I.2 CALIBRATION REFERENCE STANDARDS

Calibration standards represent materials traceable to National Institute of Standards and Technology (NIST), EPA-certified standards, or the best quality materials available. Calibration certification verifies that measurement equipment is working properly in accordance to the applicable standard.

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The SCQ user is directed to refer to the manufacturer instruction manual, or to call the manufacturer when uncertain about the calibration requirements and/or procedures.

I.2.1 Geophysical Instruments

Instruments for quantitative geophysical measurement shall be calibrated by the manufacturer or authorized representative at least annually. Field calibration shall be performed or response checked, as applicable, in accordance with manufacturer instructions or Project-Specific Plans (PSP) each day of field use for both quantitative and qualitative instruments.

I.2.2 Flow Meters and Gauges

Instruments that measure flow rate and pressure shall be calibrated by the manufacturer or authorized representative at least annually. Field checks of calibration shall be performed each day of use in accordance with manufacturer instructions or PSP.

I.2.3 Colorimetric Indicator Tube Pumps

Colorimetric indicator tube pumps shall be calibrated by the manufacturer prior to purchase. Calibration shall be checked as recommended by manufacturer instructions or PSP.

I.2.4 Automatic Air Sampling Pumps

Air sampling pumps shall be calibrated by the manufacturer prior to FEMP use. Pump calibration shall be checked as recommended by manufacture instructions or PSP. The power source shall be within manufacturer specifications and checked at least annually.

I.3 CALIBRATION FREQUENCY

Field instruments shall be calibrated at frequencies specified in Attachment I (the FEMP Laboratory Analytical Methods Manual).

I.4 CALIBRATION PROCEDURES

I.4.1 pH

Calibrate pH meters in accordance with manufacturer instructions. Meters shall be direct-reading and temperature-compensating and capable of responding within 0.1 pH unit over a temperature range of - 2 to + 40 degrees Centigrade. Response time of the instrument shall not be greater than two minutes (Manigold, et.al., 1982).

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At a minimum, the following items shall be addressed.

1. Perform a power check and replace or recharge the battery as necessary.

2. Ensure that electrodes are filled with manufacturer-specified solution (usually potassium chloride).

3. Rinse electrodes with de-ionized water.

4. Calibrate pH meters at start of each sampling event with a neutral buffer (pH 7.0) and an acidic (pH 4.0) or basic buffer (pH 10.0), depending on expected pH range of sample.

5. Check calibration with a neutral (pH 7.0) buffer prior to measuring a sample in accordance with manufacturer instructions for use.

6. Record date of buffer expiration.

I.4.2 Specific Conductance

Specific conductance meters shall be direct-reading and temperature-compensating. The calibrated accuracy of the measuring system shall be capable of responding within three percent of full scale over a temperature range of -2 to +40 degrees Centigrade, and instrument response time shall be no greater than two minutes (Manigold, et.al., 1982). Two standards that bracket the expected conductivity of the water to be measured (e.g., 100 micromhos per centimeter (μmho/cm) and 1000 μmho/cm for natural waters) shall be used to check instrument response.

Calibrate instrument as follows.

1. Switch on instrument for a power check and calibrate to a known standard as specified in manufacturer instructions.

2. Replace battery when red-line adjustment cannot be accomplished or when meter indicates a low battery.

I.4.3 Dissolved Oxygen

Dissolved oxygen measuring instruments shall be capable of measuring within 0.2 milligram per liter (mg/L) over a water temperature range of - 2 to + 40 degrees Centigrade with a response time no greater than two minutes (Manigold, et.al., 1982).

Calibrate instruments as specified by manufacturer against water-saturated air.

I.4.4 Redox Potential

Calibrate redox potential (Eh) meters as follows.

1. Turn selector dial on pH/millivolt (mV) meter to **BATTERY CHECK**. The meter should read in the "battery OK" range. If it does not, charge or replace batteries before using.

2. If battery is charged, turn selector dial to **mV**, remove protective cap from redox electrode, and place electrode in ZoBell solution. Meter should read 400 to 450 mv standardized to 25 degrees Centigrade. Record reading.

I.4.5 Water Level Indicator (M-Scope)

1. Compare water level indicator tapes (electric or manual) to a standard length obtained from NIST on an annual basis or after being subjected to unusual stress (e.g., getting hung on a dedicated pump).

2. Discontinue use of tapes that deviate from the standard more than 0.1 percent.

I.4.6 Thermometers

1. Calibrate working thermometers annually against a NIST-traceable thermometer.

2. Discard thermometers with readings differing by $\pm$ 1 degree Centigrade.

I.4.7 Photo-Ionization Detector

1. Calibrate Photo-Ionization Detectors (PID) prior to each day of use.

2. Check instrument response prior to each use.

I.4.7.1 <u>**PIDs Without Flow Regulators**</u>. Calibrate as follows.

1. Fill a sampling bag of Tedlar or equivalent material with calibration gas of known concentration. The concentration should be within the range expected to be neasured.

2. Connect PID probe to sampling bag with flexible tubing.

3. Allow sample bag contents to be drawn into the probe and check response in parts per million (ppm).

4. Adjust span potentiometer to produce concentration listed on the span gas cylinder.

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5. Allow ion chamber to purge. If instrument reading is zero ± 0.5 ppm, instrument is calibrated.

6. If instrument is not calibrated, reset it at zero and repeat steps 1 through 5.

Probe Potential (eV)	Initial Span Potential Setting	Maximum Acceptance Potential Setting
9.5	5.0	1.0
10.2	9.8	8.5
11.7	5.0	2.0

7. If instrument still is not calibrated, return it for maintenance and recalibration by qualified individual only.

8. Document calibration results including the following information.

- Date inspected
- Name of person who calibrated instrument
- Instrument number (serial or other ID number)
- Results of calibration (ppm, probe eV, span potentiometer setting)
- Identification of calibration gas (source, type, concentration)

I.4.7.2 PID Canisters With Flow Regulator. Calibrate as follows.

1. Connect sampling hose to regulator outlet and other end of PID sampling probe.

2. Crack regulator valve.

3. Take reading after 5 to 10 seconds.

4. Perform steps 4 through 8 in paragraph I.4.7.1.

5. Check response of PID each time instrument power is turned on by placing a felt tip indelible marking pen near the probe and verify that instrument responds positively.

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I.4.8 Flame-Ionization Detector

The following calibration procedure shall be performed by qualified service technicians only annually, at the minimum.

I.4.8.1 Primary Calibration.

1. Remove instrument from instrument shell.

2. Turn on **ELECTRONICS** and **ZERO INSTRUMENT** switches on **X10** scale. Turn **GAS SELECT** dial to 300.

3. Turn on **PUMP** and **HYDROGEN** switches, ignite flame, and go to **SURVEY MODE**.

4. Introduce a methane standard near 100 ppm.

5. Adjust appropriate trimpot on circuit board until meter reads standard.

6. Turn off hydrogen flame and adjust meter needle to read 40 ppm. Calibrate at each times-10 mark with **CALIBRATION ADJUST** knob.

7. Switch to **X100** scale. Meter should indicate 0.4 on 1-to-10 meter marks (0.4 X 100 = 40 ppm). If reading is off, adjust with appropriate trimpot.

8. Return to **X10** scale and adjust meter needle to 40 ppm with calibration. Adjust knob if necessary.

9. At the **X10** scale, adjust meter to read 0.4 on 1-to-10 meter marks using **CALIBRATION ADJUST** knob. Switch to **X1** scale. Meter should read 4 ppm. If reading is off, adjust with appropriate trimpot.

I.4.8.2 Secondary Calibration. Perform secondary calibration as follows each day instrument is used.

1. Fill air sampling bag with certified methane calibration gas of known concentration.

2. Connect outlet of air-sampling bag to Flame Ionization Detector (FID) air-sampling line.

3. Record reading on calibration record.

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I.4.8.3 Documentation. Document calibration providing the following information.

- Identification of instrument calibrated (ID or serial number)
- Date of calibration
- Method of calibration
- Results of calibration
- Name of person who calibrated instrument
- Identification of calibration gas (source, type, concentration, lot number)

I.4.9 Explosimeter

1. Perform calibration using a known concentration of combustible gas, such as methane (one source - the Mine Safety Appliances Company).
2. Once gas is introduced into the instrument, adjust internal span control inside explosimeter.
3. If explosimeter cannot be adjusted to read the standard, replace detector filament.

I.4.10 Pressure Transducer

Return pressure transducers annually to manufacturer for recalibration.

I.4.11 Hand-Held Radiological Survey Instruments

Hand-held instruments are used to screen material and personnel for gross alpha, beta, or gamma radiation. Instruments shall be calibrated annually at a minimum and source-checked each day of use.

I.4.11.1 Preliminary Process.

1. Check instrument to be calibrated with another instrument to ensure there is no residual radioactive contamination.
2. Serialize probe to meter with which it is calibrated.
3. Check reproducibility of instrument with check source.

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NOTE

If instrument does not respond in a similar manner through several trials, electrical malfunction is likely.

I.4.11.2 Calibration.

1. Set the meter at zero.

2. For electronic calibration, pulse with pulse generator at 80 percent and 20 percent of full scale.

3. Set high voltage and run plateau if necessary.

4. Check efficiency with NIST-traceable radiation source.

5. Record data obtained during calibration.

6. If instrument accuracy is outside the limits of 75 to 150 percent of the source, return instrument to manufacturer for repair.

7. Place a sticker with calibration due date on instrument.

I.4.11.3 Miscellaneous Instrumentation. Any radiation/contamination detection instrumentation may be used to obtain Analytical Support Level A and B data, even though it is not specifically listed in this document, provided that the following requirements are met.

- Instruments are calibrated with vendor-recommended procedures.
- Radioactive sources used in calibration are traceable to NIST.
- Instruments are source-checked at least daily.
- Probes are capable of detecting the specified type of radiation at required levels.

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APPENDIX J

FIELD ACTIVITY METHODS

J.1 PURPOSE

This appendix prescribes field methods for producing data in compliance with DOE and EPA requirements and meeting Data Quality Objectives (DQO) for FEMP.

J.2 SCOPE

General procedures for field activities are provided in subsection J.4 as follows.

- Daily Logs (paragraph J.4.1)
- General Drilling Practices (paragraph J.4.2)
- Well Design, Installation, and Abandonment (paragraph J.4.3)
- Well Development (paragraph J.4.4)
- Geophysical Surveys (paragraph J.4.5)
- Aquifer/Permeability Testing (paragraph J.4.6)
- Well Maintenance (paragraph J.4.7)

Additional procedures may be provided in the Project-Specific Plans (PSPs) to provide detailed instructions applicable only to the specific project.

J.3 RESPONSIBILITIES

J.3.1 FEMP Project Manager

The FEMP Project Manager shall be responsible for safe and prompt completion of project activities and for securing permits required by state, local, or on-site authorities. Underground and above-ground utilities shall be located and avoided to protect drilling operations personnel from danger. Copies of permits and other applicable documentation shall be posted on site whenever drilling operations are being conducted.

J.3.2 Geologist In Charge

A qualified geologist, hydrogeologist, or geological engineer shall be responsible for on-site operations at each drilling rig and geophysical survey unit and for supervising personnel assigned to the activity. The geologist-in-charge shall be present whenever a borehole is being advanced and during well development activities.

The geologist-in-charge shall be responsible for preparation of subsurface boring logs that shall be generated for each boring, for complete and accurate generation of a daily log of project activities, and for preparing lithologic logs in the field.

J.4 PROCEDURES

J.4.1 Daily Logs

A daily log is a written record of activities and measurements conducted in the field by a team on a given date and may include daily field activity logs, boring logs, well-construction logs, media-specific sampling logs, photographs, and sketches. The log shall be in a bound book with printed, sequentially numbered pages or on sequentially numbered, printed daily log forms as specified by the PSP.

J.4.1.1 <u>Daily Log Entries</u>. The geologist-in-charge is responsible for entries in the daily log, which shall include the following information as applicable.

- Subject of field activity
- General work activity
- Unusual events
- Changes to plans and specifications
- Visitors on site
- Time, depth, and identification number of samples
- Chain-of-custody tracking number
- Surveillance observations and findings
- Calibration checks

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- Subcontractor progress and specifications
- Communication with regulatory agencies or others
- Weather conditions

J.4.1.2 Lithologic Logs. The geologist-in-charge is responsible for preparing lithologic logs in the field that provide the following information.

- Footage drilled
- Materials penetrated
- Depth to significant changes in lithology
- Samples collected (identified by depth, sample number, and collection method)
- Qualitative degree of saturation of each sample
- Depth to saturated zones and potential confining beds
- Fluid losses
- Surface casing used and method of installation
- Zones of unusual pressure gradients

An example of a lithologic log form is provided in Form J-1 in Appendix B.

J.4.1.3 Types of Field Activities. Daily entries in logs shall include, but not be limited to, the following types of field activities as applicable to the project.

- Footage drilled
- Materials used
- Sample collection start and completion times
- Samples collected
- Description of samples
- Bottom casing depth

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- Surveys conducted
- Decontamination activities
- Well construction
- Aquifer testing
- Special activities
- Well installation activities
- Unusual occurrences

J.4.1.4 Daily Log Completion. The following procedures shall be performed.

1. Record field measurements and comments on applicable forms and complete lines on the forms as applicable. If the information requested does not apply or is not known, insert an "NA" (not applicable) or "NK" (not known) as appropriate. Do not leave a line blank. Initial and date each page. If part of a page is left blank, draw a line across the empty area.

2. If steps or procedures were not performed as described in the PSP, state reason as completely as possible on form or submit an attachment if necessary to explain fully.

3. Identify photographs with project number, date and time taken (using 24-hour time), and a brief description on the back.

4. Place identified photographs in an album in easily retrievable fashion and file.

NOTE

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

5. As part of the daily log, generate activity-specific logs (e.g., subsurface boring logs, water sampling logs, sediment sampling logs) to document field conditions.

J.4.1.5 Filing Requirements. The following documentation of field activities shall be filed as indicated. These copies will provide adequate documentation of work activities if originals are destroyed, lost, or stolen.

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1. Send photocopies of daily log entries to the FEMP project manager or representative and others as required at least weekly.

2. Maintain originals of field records in the project central file. Keep photocopies of bound books in the central file until the book is complete and entered in the file system.

3. During performance of field program, maintain copies of field records in FEMP project manager file.

J.4.2 General Drilling Practices

Number, location, depth of borings, type of sampling, and testing required are dependent on intended use of the data. The type of drilling method selected for a particular project at FEMP depends on the intended use of the borehole and samples collected. Ability to acquire data of sufficient quality for intended use and personnel health and safety are primary factors considered when selecting a drilling method.

Guidelines for determining a particular drilling method shall be presented in PSPs. The FEMP project manager is responsible for determining that the drilling technique used is appropriate for site conditions and project objectives. The chosen drilling method shall reflect the FEMP policy of waste minimization. Drilling methods that may be selected include, but are not limited to, the following.

- Cable-tool
- Hollow-stem auger
- Drive casing
- Spin casing
- Direct mud rotary
- Air rotary with casing driver
- Air rotary with swing-out, under-reaming bit and casing advancer
- Reverse-air or mud rotary

Drilling operations shall be conducted as follows.

1. Decontaminate drilling equipment before each use as specified in Appendix K to prevent contamination of the borehole and after each use to prevent off-site transport of contaminants.

2. Minimize introduction of contaminants into the environment and spreading of contaminants between zones.

3. Set surface casing when a potentially contaminated zone is drilled prior to reaching the target zone.

4. When drilling through areas where near-surface contamination is indicated from past experience or during screening of samples while drilling, grout surface casings in place and make them part of the permanent installation. The borehole diameter shall be at least four inches larger than the diameter of the surface casing to allow for an adequate grout seal.

5. In outlying areas not suspected of being contaminated, advance large diameter temporary casings as necessary for bore-hole control.

6. Minimize production of fluids, cuttings, and other waste by using above-ground mud pits, drums, or plastic-lined structures for containment of drilling fluids and cuttings unless otherwise specified in PSPs.

NOTE

The water source approved for use in drilling operations at FEMP is the plant potable water system.

7. Use only an approved water source during drilling operations.

NOTE

Use of additives in drilling fluids is discouraged except in unusual circumstances.

8. If an additive is to be used, obtain prior approval from the FEMP project manager.

9. Analyze a sample of the additive for parameters of interest, and review analysis results for potential impact on objectives of the data-collection program.

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10. Collect cuttings or core samples at frequency specified in the PSP in accordance with the requirements for subsurface soil sampling in Appendix K.

The geologist-in-charge shall include in the daily log the information specified in paragraph J.4.1.2 and prepare lithologic logs in the field that provide the following information.

J.4.3 Well Design, Installation, and Abandonment

For clarity, the term "well" shall include ground water sampling points such as four-inch diameter monitor wells, above-ground and surface-finished piezometers, and former production wells.

The FEMP project manager is responsible for locating wells and for selecting the appropriate portion of an aquifer so that project objectives defined in the PSP are met. The geologist-in-charge is responsible for overseeing well installation in the field and for properly documenting construction details.

The following procedures are required to ensure quality control of well design and installation and successful completion of field drilling investigations for hydrogeological and future water quality information.

J.4.3.1 <u>Materials</u>. Use the following materials for construction of wells.

1. Use 316 stainless-steel well casing with flush-thread joints below the water table.

NOTE

Use of glues or solvents is prohibited.

2. Use schedule-40 PolyVinyl Chloride (PVC) or 316 stainless-steel casing with flush-thread joints for piezometers and above the water table in wells if preferred.

3. Use two to fifteen-foot sections of commercial wire-wound stainless steel screens with flush-thread joints compatible with the well casing (minimum three square inches open area per foot of screen). Determine size of screen openings based on effective grain size of monitored zone and filter pack size suggested by Aller (1989).

NOTE

Screen openings shall be capable of catching between 85 and 100 percent of filter pack materials to allow accurate measurement of hydraulic properties, minimize turbulence during sample collection, and optimize capacity to develop the

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well completely and efficiently. Slotted or wound PVC screens with flush-thread joints compatible with the well casing may be used in piezometers. However, hydraulic data collected from piezometers shall be carefully evaluated to determine whether measurements are representative of the aquifer or of well materials.

4. Use well-sorted quartz sand for filter pack material.

NOTE

Selection of filter pack grain size is a function of grain size distribution in the natural formation.

5. Multiply the median formation grain size by a factor of two to arrive at a suitable filter pack grain size (Driscoll 1986).

6. Obtain one quart or one liter of a representative sample of each type of proposed filter-pack material from contractor for approval prior to use.

NOTE

Typically, graded sand meeting requirements of American Society for Testing and Materials C-33 for fine aggregate (concrete sand) is sufficient.

7. Describe each filter pack sample in terms of lithology, grain size distribution, and source (company where purchased, lot number, and pit or quarry of origin). Place description in project files.

8. Set bentonite pellet seals in the annulus directly above the filter pack in wells screened across the water table. Use pellets one-quarter to one-half inch in diameter.

9. Record brand name and lot numbers of bentonite in project files.

10. Use an annular grout consisting of a slurry of high-solids bentonite (e.g., Volclay) mixed to manufacturer specifications.

11. Reserve a sample of each type, brand, and size of backfill material used during the project for potential analysis of contaminants of interest.

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J.4.3.2. Well Construction. Immediately (within 8 hours) after drilling is complete and the borehole has been cleaned of cuttings, construct well as follows.

1. Place desired length of screen and casing inside open borehole, temporary casing, or hollow-stem augers.

2. Place filter pack in annular space between screen/casing and temporary casing or augers by the tremie line method as follows.

   a. Insert a small diameter pipe to the desired depth.

   b. Pour or pump the filter pack in place under hydraulic pressure.

   3. Raise the tremie pipe so that it remains 0.5 to 3 feet above the top of the filter pack.

3. Make periodic measurements to check uniform placement of filter pack.

4. Record depth to top of filter pack to nearest 0.1 foot.

5. Remove temporary casing gradually and install backfill materials so that bottom of the temporary casing is kept below the top of backfill material.

6. Backfill glacial drift wells and wells screened across water table of the regional aquifer (1000- and 2000-series wells) as follows.

   a. Install a filter pack to a height of two to five feet above the screen.

   b. Place a five-foot sodium bentonite pellet plug on top of filter pack.

   c. Hydrate pellet seal with five to ten gallons of water from an approved source.

   d. Install a high-solids bentonite grout seal from top of bentonite seal to within 30 inches of ground surface.

7. Backfill wells screened in the middle and at the bottom of the regional aquifer (3000- and 4000-series wells) as follows.

   a. Install a filter pack to a height of approximately five feet above the screen.

   b. Place a high-solids bentonite grout to within 30 inches of ground surface using pumps and tremie line method.

8. For above ground completions, finish top of well casing with 24 to 30 inches of casing stickup, a vented stainless-steel cap, or an airtight cap and vent hole not more than six inches from top of casing.

9. Finish ground-flush completions with an airtight cap.

10. File a notch approximately one-half inch deep at top of each well casing, measure elevation of base of notch, and reference each water-level measurement to the elevation.

11. Install the following minimum protection around wells.

    a. Ground-flush installations

        (1) Ensure that completions are either water tight or free-draining (containing a drainage layer of coarse sand at the bottom of the flush-mount box).

        (2) Provide a well cap with lock.

        (3) Install a protective cover secured with bolts that prevent precipitation from entering the protective casing.

        (4) Install manhole-type boxes large enough to accommodate the well casing, well cap, and a lock.

    b. Above-ground installations

        (1) Use a five-foot-long black iron pipe, minimum one-quarter-inch thick, and at least four inches greater in diameter than the well casing as a protective casing.

        (2) Place well casing within four inches of top of protective casing.

        (3) Fit protective casing with a hinged cap, hasp, and lock.

        (4) Drill a drain hole in the oversleeve one foot above land surface.

        (5) Place a mixture of cement, sand, and potable water in a ratio approximately 1:4:0.5 (by weight) between well riser and outer protective casing to a height just below the drain hole to allow water entering the annulus to drain.

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NOTE

To limit movement of pad by frost heaving, pour pad and annular backfill in one operation.

(6) Install a three-foot square by six-inch thick, wire-reinforced, concrete pad around the protective casing with at least two inches, but not more than three inches, of the pad below grade. Backfill upper 30 inches of borehole annulus with concrete.

c. All installations

(1) Paint protective casings with high-visibility orange paint.

(2) Mark well location on well protector in three places as follows.

- On inside of cover with enamel-type paint
- Welded, stamped, engraved, or permanently painted on top of locking cover or flush-mount cover
- Engraved or marked with indelible marker on outside of well cap.

NOTE

Guardposts may be necessary in high traffic areas or where vegetation or debris obscures the well casing.

(3) If guardposts are necessary, install three-inch-diameter steel posts, radially located around the well at four-foot intervals, two feet below ground surface, and four feet (minimum) above surface. Concrete in place and fill guardposts with concrete or cement grout.

12. Regrade and restore disturbed drilling areas.

13. Prepare a well completion log (Form J-2, Appendix B) that includes the following information.

- A sketch of each well installation showing the following.
  - Bottom of the boring by depth from surface grade
  - Screen location
  - Granular backfill, seals, grout, and cave-in
  - Centralizers if used
  - Top of riser relative to ground surface
  - Details of well protection and above-ground completion
- Composition of grout, seals, and granular backfill
- Screen length, slot size (in inches), and slot configuration (wound or machine slotted)

J.4.3.3 Dedicated Equipment. Use of dedicated ground-water sampling equipment is encouraged in cases where the following conditions exist.

- High concentrations of contaminants are present at a well site, making handling and decontamination of sampling equipment a problem
- Well access is a problem
- Fixed equipment that cannot be decontaminated is used

Types of equipment that may be dedicated to a sampling location include, but are not limited to, the following.

- Bladder-type sampling pumps
- Submersible impeller-type purge pumps
- Submersible piston-type purge pumps
- Packers
- Hoses
- Bailers

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- Water-level measurement equipment

The following procedures apply when installing, maintaining, and using dedicated sampling equipment.

NOTE

Equipment that requires special handling, shall be installed and maintained only by manufacturer-trained personnel.

1. Store sampling equipment in well casing between uses or pull it from the well and store it in a designated storage structure. If stored outside the well, designate the well (by well number) to which it is dedicated.

2. Decontaminate equipment removed from a well as specified in Appendix K prior to re-installation.

NOTE

Maintenance may include decontamination to remove mineral precipitation or biological growths.

3. Perform maintenance as specified by manufacturer or, if specifications are not available, on a set schedule based on past usage or when performance is declining.

J.4.3.4 **Well Abandonment.** The objectives of well abandonment procedures include the following.

- Elimination of physical hazards
- Prevention of ground-water contamination
- Conservation of aquifer yield and hydrostatic head
- Prevention of intermixing of subsurface waters
- Compliance with reasonable property owner requests

The following procedures shall apply when abandoning a well.

1. If well casings and screens must be removed for an adequate seal, remove well casing and screens by pulling or overdrilling prior to grouting the borehole.

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NOTE

Overdrilling is required when flowing sands are encountered.

a. If casing is to be overdrilled, the outside diameter of the drilling tool shall be at least as large as the original borehole.

b. If screen material is considered relatively inert in the hydrogeologic environment, overdrilling may be terminated at the top of the monitored zone, leaving the screen and filter pack in place.

c. If screen and filter must be removed, continue overdrilling to bottom of original borehole before grouting.

2. Remove annular fill material before grouting.

3. If well casing and screen are pulled from the borehole, make provisions (e.g., fill the borehole with drilling mud) to prevent borehole collapse within evacuated area.

4. Measure the open depth of the borehole using the tremie pipe and calculate the volume of grout needed to fill the borehole to a depth of 30 inches below grade.

5. If the tremie pipe can be inserted to the original depth, proceed as follows.

   a. Grout the borehole by the tremie method from the bottom up.

   b. Measure the volume of grout added.

   c. If significantly more grout is added than that calculated in step 4 (i.e., 25 percent), stop grouting and consult the FEMP project manager.

6. If the tremie pipe cannot be inserted to the original depth of the borehole, overdrill the boring with a bit at least as large as the original borehole to the original depth before grouting. (Use measurements from original drilling records.) Insert grout to within 30 inches of land surface and allow to harden for 24 hours.

7. Use a concrete plug to fill uppermost 30 inches of the borehole.

8. Insert a metal pin to mark the abandoned well site.

9. Record materials used and materials removed from the borehole.

10. Dispose of removed material as specified in the PSP for well abandonment.

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J.4.4 Well Development

Wells shall be developed to yield accurate aquifer test results and ground-water samples representative of aquifer conditions. Well development may be conducted using bailers, submersible pumps, bladder pumps, or peristaltic pumps. Surging techniques using surgeblocks are recommended in relatively high-yield aquifers. Excessive drawdown should be avoided, reducing the purge rate if necessary.

The FEMP project manager shall specify the well development method in the PSP where sufficient historical data exists to make an informed decision. Where historical well development data are lacking, the well development method shall be based on observed aquifer response during drilling.

The following procedure applies when developing a well.

1. Decontaminate equipment and materials used for well development as specified in Appendix K before each use.

2. Develop well as soon as possible after well installation, but no sooner than 48 hours after grouting is completed.

3. Continue development until the water is visually clear and temperature, pH, and specific conductance have stabilized.

4. As a minimum, attain the following well conditions.

   a. If the boring was made without use of drilling fluid water, remove five times the standing water volume in the well (water in well screen and casing plus saturated filter pack).

   b. If recharge is so slow that required amount of water cannot be removed in a reasonable amount of time, or the water remains discolored, or it contains visible particulates after the five-volume removal, contact the FEMP project manager or representative for direction to use an alternate procedure based on recommendation of the field representative.

   c. If it appears necessary to add water to the well to assist development, obtain written approval from the FEMP project manager before proceeding.

NOTE

Do not use chemicals (e.g., dispersing agents, disinfectants, or acids) during well development.

d. If the boring was made or enlarged using drilling fluid (water), remove five times the measured amount of total fluids lost while drilling plus five times the standing water volume. If slow recharge, discolored, or particulate-laden water is a problem, proceed as in step b.

5. During development, attempt to remove standing water from points near the bottom of the well screen and from the top of the water column.

6. If problems are encountered during development, promptly notify the FEMP project manager or representative.

7. Record field measurements and comments on applicable data reporting forms. If some steps or procedures are not performed as specified, state the reason as completely as possible on the form or in an attached statement. Include the following data on the form.

   a. Well designation (location ID)

   b. Date of well installation

   c. Date and time of well development (start and finish)

   d. Static water level before and after development

   e. Quantity of water removed and time of removal

   f. Depth to bottom of the well inside the casing before and after development

   g. Physical character of removed water including changes during development of temperature, turbidity, pH, specific conductance, color, and odor at regular intervals

   h. Physical characteristics of removed sediments including lithology and grain size

   i. Descriptions of equipment used including type and size/capacity of pump and/or bailer used

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j. Description of surge techniques used

J.4.5 Geophysical Surveys

Geophysical methods shall be chosen based on project objectives. See Environmental Protection Agency (1987) for a brief description of commonly used methods.

Specific techniques for conducting geophysical surveys by borehole logging or surface methods shall be provided in the PSP based on the following guidelines.

J.4.5.1 **Borehole Geophysical Logging.** Borehole geophysical methods are used to acquire information about subsurface geological characteristics such as the following.

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

A minimum of one quality control duplicate run shall be made with each tool used on each project where borehole geophysical logging is specified. When performance of the logging operation has met project objectives, the geophysical team leader shall sign and date completed logging forms (step 4).

The following procedure applies generally to geophysical surveys and logging of activities.

1. Clean and decontaminate downhole tools and cables prior to downhole logging operation and between each borehole as specified in Appendix K.

2. Calibrate logging equipment and provide the FEMP project manager with applicable documentation before and after survey calibrations.

3. Properly clean and decontaminate logging equipment at conclusion of operation.

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NOTE

The FEMP project manager or representative shall ensure that specified originals and copies of logs are placed in project files. The team leader shall record progress of logging activities.

4. Complete applicable forms and record unusual occurrences in the daily log as follows.

   a. Include remarks on the log header.

   b. Identify the log run on the log header.

   c. Enter logging speed, length of tool and resolution, borehole identification, and team member names on the log header.

   d. Mark each curve on the log using a unique line format for every curve.

   e. Mark the vertical scale in feet and record total depth of the borehole at the bottom of the log.

   f. Identify and graduate the horizontal scale for each log run, labeling a minimum of every ten grid spaces horizontally on the log.

5. Transfer copies of data to the FEMP project manager or representative for distribution, analysis, and archiving. Transmit magnetic recordings generated during the course of downhole logging along with results of logging runs immediately. (Recordings shall be in a format specified by the FEMP project manager or designee.)

J.4.5.2 <u>Surface Geophysical Surveys</u>. Surface geophysical methods provide subsurface information without the need for excavation. Information that can be obtained includes the following.

- Delineation of contaminant plumes
- Identification of high-permeability zones
- Location of disposal areas
- Location of subsurface anomalies
- Identification of subsurface utilities and stratigraphic data

The PSP shall specify the geophysical method and instruments to be used, grid spacing, time

frame for survey, information desired, and frequency of duplicating lines for quality control purposes.

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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 in the PSP.

The following general procedures are applicable for surface geophysical surveys.

1. Operate instruments as specified in manufacturer instructions or in the PSP.

2. If manufacturer instructions are not used, provide justification for this variance as specified in Section 15.

3. Provide the following information on project-specific logging forms.

   - Date of activity
   - Times survey was begun and finished
   - Times of breaks in activity
   - Temperature variations
   - Descriptions of variation from an established line caused by topography or vegetation; crossing of drainage features; crossing of swampy areas; instrument settings, calibrations, or malfunctions; and operators.

J.4.6 Aquifer/Permeability Testing

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 also be specified in the PSP. Every aquifer test should be considered unique.

Following are requirements for hydraulic tests to characterize certain properties of hydrogeologic units (e.g., hydraulic conductivity, transmissibility, and storability). 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 data for pumping and monitoring wells

- Water temperature, pH, and specific conductance
- Test interval

J.4.6.1 General Test Procedure. The following general procedure shall be performed in addition to procedure specified in the PSP.

1. Use equipment specified in the PSP based on approximations of the properties of interest from previous drilling and testing data.

2. Record the following information as applicable for each test.

   - Type of test (e.g., slug test, specific-capacity test)
   - Type of data recorded (e.g., recovery or drawdown)
   - Test well identification
   - Identification and relative position of observation wells including a diagram
   - Depth and length of screened or open interval
   - Diameter of both well casing and boring
   - Known or estimated thickness of the aquifer
   - Static water level
   - Start and completion times of test
   - Start and completion times of pumping if applicable
   - Drawdown versus time measurements
   - List of equipment used including pumps, hoses, slugs, transducers, data loggers, and water level measurement devices
   - Weather conditions including duration and intensity of precipitation
   - Testing personnel

3. Maintain complete original test records in project files and make copies available to hydrogeologists and field representatives who performed the test.

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4. Prepare a diagram of equipment used in each aquifer or permeability test (by the responsible hydrogeologist). Indicate the tubing dimensions, depth of water intake, and location of gauges and packers. Include the diagram in the data records of each test.

5. Calibrate gauges, flowmeters, and other instrumentation used and check for proper operation before use.

6. Obtain copies of calibration documentation from the instrument or testing service company; maintain calibration records consisting of laboratory measurements, and, if performed, on-site zero adjustment and/or calibration. Include these records in the project file.

7. If a weir or an orifice is used to measure flow volumes or rates, check these devices on site using a vessel of known volume and a stopwatch. Document accuracy before testing proceeds.

8. Install equipment and demonstrate to the hydrogeologist that it is in proper working order and performing to specifications before start of pumping test.

9. If past monitoring data indicate that the water does not contain hazardous constituents or possess characteristics of hazardous waste as defined by the Resource Conservation and Recovery Act, dispose of water pumped from the well during the aquifer or permeability test in the general sump and treat it in the FEMP wastewater system.

NOTE

Direct questions about whether water from a certain well constitutes a hazardous waste to FEMP environmental compliance personnel.

10. Make special storage arrangements prior to removing water that may contain hazardous waste.

11. Decontaminate equipment used in boreholes, wells, or piezometers as specified in Appendix K prior to use and between each test site.

J.4.6.2 Borehole Hydraulic Testing for Aquifer Characteristics. The following procedures apply for determining hydraulic parameters of aquifers using slug tests and pumping tests. Generally, the procedures in paragraph J.4.6.1, steps 1 through 9, apply to both slug tests and aquifer pumping tests. If there are variations to the following procedures, they shall be specified in applicable PSPs.

Slug Tests - Slug tests are a quick and inexpensive method of estimating the hydraulic conductivity or transmissibility near the screened zone of the well.

1. Use the following equipment to conduct a slug test.

NOTE

A number of water-level measuring devices may be used for measuring depth to water in a well. Accurate readings can be obtained with electric water-level indicators, pressure transducers, or weighted tapes. Avoid water-level measurement by the weighted-tape method except when conducting tests of intervals suspected of having a very low K value. It may be difficult to obtain enough readings for analysis of the tests if the water level recovers quickly in a short period of time.

- Water level measuring device
- Known volume of slug (solid cylinder or volume of water added or removed) that will fit into the well, borehole, or container to add or remove a known volume of water
- Timer accurate to one second or a pressure transducer and data-logger combination
- Semi-log graph paper and indelible pen or pencil and paper or verified slug-test analysis software

2. Record the following information before beginning the test.

- Site identification and well or borehole location
- Location and elevation of reference point from which water depth measurements are made
- Elevation of ground water with respect to reference point
- Date and time of test

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- Well depth, screen length, riser pipe radius, well screen radius, radius of gravel pack plus well screen or borehole depth and radius
- Thickness of ground water zone to be tested
- Volume of slug added or removed
- Type of measuring device used
- Names of personnel conducting test

3. Determine static water level in well by periodically measuring depth to water for several minutes and taking average of readings.

NOTE

It is important to remove or add the volumes as quickly as possible because the analysis assumes that an instantaneous change in volume is created in the well.

4. Instantaneously introduce or remove a slug of known volume to displace water level.

NOTE

The number of depth/time measurements necessary to complete the test are variable, but it is critical to make as many measurements as early as possible in the test.

5. Assign time zero to the moment of volume addition/subtraction, measure, and record depth to water and time of each reading. Measure depth to the nearest 0.01 foot.

NOTE

Time required for slug test completion is a function of volume of the slug, hydraulic conductivity of the formation, and type of well completion. Slug volume shall be large enough that a sufficient number of water level measurements can be made before water level returns to equilibrium. Length of test may range from less than a minute to several hours.

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6. Continue measuring and recording depth/time until water level returns to equilibrium or, for slowly recovering wells, until a sufficient number of readings have been made to clearly show a trend on a semi-log plot of time versus depth.

7. If the FEMP project manager, EPA, and Ohio Environmental Protection Agency approve addition of water to the monitoring well, use water from an uncontaminated, tested source. Transport water in a clean, approved container.

8. Decontaminate bailers and measuring devices prior to the test as specified in Appendix K.

9. If tests are performed on more than one monitoring well, avoid cross contamination of wells by using decontamination procedures specified in Appendix K.

Aquifer Pumping Test - 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. Aquifer characteristics that may be obtained from pumping tests include hydraulic conductivity, transmissibility, and specific yield for unconfined aquifers and storage coefficient for confined aquifers.

Equipment, personnel, and time commitments needed for pumping tests are greater than those for slug tests. Constant-rate discharge, variable-rate, and injection tests are types that may be used. Test method and procedures shall be specified in the PSP.

Equipment needed for pumping tests includes the following items.

NOTE

Pumps are commonly of the submersible or turbine type and are sized consistently with expected aquifer conditions. The well should be developed prior to testing.

- One or more completed observation well/piezometer hydraulically connected to the pumped test aquifer and completed to specifications for the particular test

- Orifice, weir, flow meter, container or other type of water measuring device to accurately measure and monitor discharge from the pumped well

- Pipe to transport pumped water from pumping well to holding tank or effluent location

- Valve on discharge pipe to control pumping rate

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- Outlet valve near well head for water quality sampling
- Depth-to-water measuring devices for each observation and pumping well (may include steel tapes, electric sounding probes, Stevens recorders, or pressure transducers)
- Thermometer and other necessary water quality equipment
- Watches capable of reading to the nearest second, stopwatch, or pressure transducers with data loggers
- A 3-by-5-cycle log and 5-cycle semi-log graph paper or appropriate, verified computer software, and necessary hardware
- Indelible pens or pencils and form for recording times and drawdown measurements at each well
- Appropriate references and calculator for field determinations
- Barometer or recording barograph for tests conducted in confined aquifers

The following general procedure applies to pumping tests.

1. Prior to the test, monitor water levels in the observation well to measure diurnal fluctuations. (Number of wells and the monitoring period shall be specified in PSPs.)

2. Record the following information during the test.

    - Identification numbers or locations of pumped well and each observation well
    - Location and elevation of each well
    - Location and elevation of reference point from which water depth measurements are made and elevation of ground surface with respect to the reference point
    - Weather conditions
    - Method of measurement
    - Date and time of test

- Well depth, pump depth, screen length, well radius, and radius of filter pack plus well screen for each well

3. Calibrate measuring equipment used for pumping tests before use.

4. Maintain calibration records that consist of laboratory measurements and on-site zero adjustment and/or calibration performed.

5. File copies of calibration documentation with test records.

6. When a weir or an orifice is used to measure flow rates, check it on site with a container of measured volume and stopwatch. Verify the accuracy of the meters before proceeding with the test. Check meters hourly during the test, and document each check.

7. Record changes in barometric pressure during the test, preferably with an on-site barograph, to correct water levels for fluctuations that may occur as a result of changing atmospheric conditions.

8. Measure water levels to provide data required to meet test requirements. Early in the test, ensure that sufficient personnel are available to collect at least ten measurements per log cycle (i.e., 1-to-10 and 10-to-100 minutes) at each selected observation well, or install a pressure transducer and data logger at each well to collect the data at the given frequency.

9. Measure water level recovery after pumping stops to verify results obtained during drawdown portion of the test. Measure recovering water levels in the pumped well and in observation wells for a period of time immediately following cessation of pumping.

10. Perform monitoring during recovery period as specified in PSP.

J.4.7 Well Maintenance

It is important to maintain ground-water monitoring wells in order to extend the life of the wells and provide representative levels and samples of ground water surrounding the wells. The following aspects of well maintenance shall be addressed.

- Well evaluation
- Redevelopment
- Maintenance check lists

- Well head protection

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The FEMP prime operating contractor shall be responsible for well maintenance activities, conducting a maintenance survey of ground water monitoring wells, and evaluating well maintenance aspects such as water quality, structural integrity, and well-head protection. Well maintenance activities shall comply with applicable regulatory and site requirements.

J.4.7.1 Well Evaluation. Existing ground-water monitoring wells shall be evaluated for the ability to provide representative samples and may include the following activities.

- On-site inspections
- Review of existing well installation documentation
- Review of well history (whether it produced consistently clear or turbid samples). (Wells with irreconcilable turbidity or lacking information on design and construction may be abandoned under circumstances described in paragraph J.4.3.4.)
- Review of ground water sampling field records
- Down-the-hole camera inspections
- Review of other sources of information that may be applicable to a specific well
- Review of the hydraulic characteristics of the aquifer adjacent to the well that shall include pump and slug tests to determine the following.
    - **Pump Tests** - for aquifer characteristics, degree of hydraulic interconnection between different water-bearing units, and recharge rates
    - **Slug Tests** - for in-situ hydraulic conductivity of low-permeability formations through addition or removal of an inert solid of known volume

J.4.7.2 Well Inspection and Repair. The following procedure shall be conducted at each well as applicable to that specific well.

1. Ensure that guard posts are in good repair.
2. Inspect ground surrounding well for the following conditions and repair as required.
    - Ground must be free of depressions and channels that allow surface water to collect and flow towards well head.
    - Surrounding area must be clean of debris and foreign material that could leach

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contaminates into subsurface or otherwise interfere with well sampling.

3. Inspect locking lids for the following conditions and repair or replace as applicable.

- Lid must open with minimal effort.
- Eyelets on lid and protective casing must align for easy removal of padlock.
- Ensure integrity of hinge and seal on lids, which must also serve as sanitary seal.
- Padlocks must be free of accumulated debris within key slot and locking mechanism.
- Padlocks must operate freely.
- Padlocks must be installed with key-slot down to prevent rainwater from entering locking mechanism.

4. Inspect the well caps for the following conditions and repair or replace them as applicable.

- Cap must be free of spider and insect debris, molds, fungi, or anything that could affect representativeness of water samples.
- Above-ground caps must fit securely and vent hole must be clear.
- Ground-flush caps must be water-tight to prevent surface water from entering well.

5. Inspect protective casing for the following conditions and repair or replace it as applicable.

- Structural integrity - Casing must be free of corrosion and cracks.
- Casing must be reasonably plumb with ground surface.
- Paint must be bright orange.
- Well identification number must be painted in white or welded to the top of lid.
- Drain hole must be clear allowing water caught between protective casing and well casing to escape.
- Structurally sound concrete surface seal and pad around protective casing must

be free of voids, cracks, and depressions where it contacts ground surface

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6. Inspect well casing for the following conditions and repair as required.

- Casing must be free of spider or insect debris.
- Sharp edges - recondition edges as required.
- Grout between well and protective casings must be free of cracks and structurally intact.

7. Inspect well and well records for the following conditions and remedy as appropriate.

a. Well development and size of screen openings causing sediment accumulation at bottom of well - remove sediment that significantly affects well performance.

NOTE

For wells less than 25 feet deep, sediment may be removed using a centrifugal pump with an intake hose to suck sediment from well bottom. For deeper wells, a bailer or hose with a foot valve are suggested for sediment removal.

b. Accumulation of chemical, physical, or biological incrustation on well screens. Remove incrustation or replace screen as appropriate. Do not use chemicals to remove incrustation.

8. Evaluate wells for reduced yield by comparing present yield to installation data, previous yield, and past pumping tests.

9. Inspect wells for blockage caused by sampling equipment lodged in well (e.g., purge pumps and bailers). Evaluate removal of such equipment on an individual basis.

10. Prior to performing maintenance at a designated location, develop a PSP that provides the following information.

- Scope of maintenance activity
- Work schedule and completion date
- Manpower and materials required

- Decontamination procedures and other measures to ensure well integrity
- Decontamination procedures (Section 5) required for equipment that may enter the well casing or otherwise contaminate the well.
- Required documentation of field activities as follows:
  - Daily log (paragraph J.4.1) submitted to FEMP within one day of task conclusion
  - Weekly progress reports including photocopies of log entries
  - Well abandonment report documenting compliance with applicable EPA and Ohio Environmental Protection Agency regulations and FEMP Sitewide CERCLA Quality Assurance Project Plan
  - Final report in specified format documenting evaluation and maintenance activities and addressing plan objectives

J.5 REFERENCES

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APPENDIX K

SAMPLING METHODS

K.1 PURPOSE

The purpose of this appendix is to provide methods for sampling activities that result in data that comply with DOE and EPA requirements and meet Data Quality Objectives (DQO) for FEMP.

K.2 SCOPE

Procedures for the following sampling programs and projects at FEMP are provided in this appendix.

- Aqueous Samples (subsection K.4)
  - Natural water
  - Ground water
  - Surface water
  - Waste water
- Solid Matrix Environmental Samples (subsection K.5)
  - Surface soil
  - Sediment
  - Subsurface soil
  - Drum sampling
- Gaseous Matrix Samples (subsection K.6)
  - Clean Air Act monitoring
  - Radon

- General Area Air
- Organic and inorganic contaminants in the field
- DOE-required air monitoring for off-site exposure

- Biological Samples (subsection K.7)
  - Milk, fish, soil/grass, and produce
  - Biological study
- Miscellaneous Samples (subsection K.8)
  - Paint chips
  - Wood
  - Concrete
  - Dust
- Sample Collection Forms (subsection K.9)
- Field Storage and Shipment of Samples (subsection K.10)
- Decontamination (subsection K.11)

Additional procedures may be submitted to provide detailed information on applicable sampling programs.

K.3 RESPONSIBILITIES

K.3.1 FEMP Project Manager

The FEMP project or program manager is responsible for scoping the project through the Project-Specific Plan (PSP). The PSP shall provide the following information.

- Criteria for determining the location and number of samples to be collected (including background)
- The Analytical Support Level (ASL) of the samples

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- Sample collection procedures
- Health and safety requirements
- Sample handling and shipping requirements
- Sample analytes

The FEMP project manager is responsible for timely and accurate completion of the project and for compliance with the PSP and this Sitewide CERCLA Quality Assurance Project Plan (SCQ). However, implementation of the PSP may be delegated to other project personnel.See Glossary for definitions of programs and projects.

K.3.2 Sampling Team Leader

The sampling team leader is responsible for implementing requirements of the PSP including the following.

- Ensure that team members follow specified procedures.
- Ensure that work is completed in a safe and efficient manner.
- Ensure that documentation is maintained and completed as specified in the FEMP Sitewide CERCLA Quality Assurance Project Plan.
- Ensure communication with the FEMP project manager or designee concerning progress.
- Assume initial custody of project samples and transfer custody to the FEMP project contact as specified in Section 7.

K.3.3 Sampling Team Members

Members of the sampling team are responsible for performing sampling activities under the supervision of the team leader and as specified in PSPs. They shall observe health and safety requirements and communicate information on progress and concerns to the team leader.

K.3.4 FEMP Project Contact

The FEMP project contact is responsible for the following activities.

- Issuing requests for analysis prior to collection of the samples

- Distributing sample and shipping containers along with required preservatives to sampling teams
- Communicating with off-site laboratories
- Resolving discrepancies between sample shipments and documentation
- Receiving custody of samples from team leaders and ensuring that chain-of-custody records are complete from the time of initial sample transfer through packaging
- Arranging shipment of samples to the laboratory
- Receiving laboratory reports
- Documenting final disposition of samples

The FEMP project contact is responsible for timely and accurate completion of these tasks; however, performance of the tasks may be delegated to other project personnel.

K.4 AQUEOUS SAMPLE COLLECTION METHOD

Wells currently referred to as piezometers at FEMP are often used as monitoring wells; therefore, for the purposes of this document both piezometers and monitoring wells shall be referred to as monitoring wells.

Aqueous samples include natural and waste waters. For the purpose of this document ground water and surface water are defined as natural waters. Water collected after use or in storm sewers will be treated as waste water. Specific matrices sampled at FEMP are as follows.

- Ground water from monitoring wells and private wells
- Surface water from the Great Miami River, Paddys Run, other natural surface water bodies and the storm-water outfall ditch
- Remediation process waste water from manhole 175, 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 to manhole 175

Samples shall be collected for analytical parameters in order of stability. The order of sample collection shall be as follows (U.S. Environmental Protection Agency, 1989b).

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- Field measurements of temperature, pH, specific conductance, alkalinity, dissolved oxygen, and redox potential
- Volatile organic compounds
- Total organic halogens (TOX)
- Total organic carbon
- Extractable organic compounds [acid and base neutral extractables, pesticides, and PolyChlorinated Biphenyls (PCBs)]
- Total metals
- Dissolved metals
- Phenols
- Cyanide
- Sulfate and chloride
- Turbidity
- Nitrate and ammonia
- Radionuclides

K.4.1 Field Analytical Method for Natural Water Samples

Temperature, pH, and specific conductance shall be measured in the field and documented on ground-water and surface-water sample collection forms. Determinations shall be performed 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. Dissolved oxygen, alkalinity, and redox potential are also commonly performed field measurements.

K.4.1.1 <u>Temperature</u>. Surface water and ground water temperature are required to normalize data from other analytical determinations such as pH, specific conductance, alkalinity, and dissolved oxygen. If properly collected, temperature is also useful as a tracer for determining recharge and mixing relationships and for tracking plumes.

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As a minimum, a standard thermometer accurate to ± 1 degree Centigrade or a metal-cased, direct-reading thermocouple with a normal range of zero to 50 degrees Centigrade accurate to ± 1 degree Centigrade is required. Total response time shall be less than two minutes (Manigold, et.al., 1982).

The procedure for measuring temperature of water samples follows.

1. Obtain temperature readings by partially immersing the thermometer in a sample for one minute. Obtain a minimum of two consecutive readings on each sample.

2. Collect temperature readings used to describe aquifer conditions in situ or from a flowing pump discharge as near to the source as possible.

3. If measurements cannot be made in situ or in a flow box, collect a sample in an insulated flask and insert a thermometer. Allow it to equilibrate for one to two minutes. Discard the sample and immediately refill the flask, insert the thermometer, and read the temperature (Manigold, et.al., 1982).

4. Read water temperature during and after well evacuation and after sample collection on unpreserved samples.

5. Immediately document readings for each sample on field measurement or collection forms.

K.4.1.2 pH. The pH of a solution is defined as the negative logarithm of hydrogen ion activity in moles per liter and is a measure of effective hydrogen ion concentration. The pH value determines the basic or acidic nature of a body of water.

The following apparatus is required for pH measurements.

- Standard pH meter (battery operated) or a combination meter that is direct reading and temperature-compensating with an expanded scale capable of measuring pH to the nearest 0.05 unit

- Combination electrode

- Three standard buffer solutions: pH 10.0, pH 7.0, and pH 4.0

The procedure for measuring the pH of water follows.

1. Calibrate pH meters in accordance with manufacturer instructions. Meter shall be accurate to within 0.1 pH unit over a temperature range of -2 to + 40 degrees Centigrade, and response time of the instrument shall not be greater than two minutes (Manigold, et.al., 1982).

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2. Ensure that the electrode is filled with manufacturer-specified solution (usually potassium chloride).

3. Rinse electrode with de-ionized water.

4. If meter does not automatically correct for temperature, make correction in accordance with manufacturer instructions.

5. Record date of buffer expiration.

6. Calibrate pH meter at start of each sampling event with a neutral buffer (pH 7.0) and an acidic (pH 4.0) or basic (pH 10.0) buffer, depending on expected pH range of the sample (Appendix I).

7. Check calibration with a neutral buffer prior to measuring a sample in accordance with manufacturer instructions for calibration.

8. Transfer sample into an appropriate container, or use an in-situ or flow-through sampling system.

9. Ensure that electrode is properly attached to pH meter and that the filling hole is exposed to sample solution.

10. Insert electrode approximately one inch into sample solution and allow it to remain in the sample solution for approximately two minutes. Stir sample if a flow-through chamber is not used.

11. Read pH value on meter to nearest 0.1 unit.

12. Rinse electrodes with de-ionized water between each measurement and do not allow the bulb to dry out between measurements.

13. Never move or touch connecting cables during pH measurement.

K.4.1.3 <u>Specific Conductance</u>. Specific conductance is the ability of a solution to carry an electric current under specific conditions. This characteristic indicates concentration of dissolved solids in water. Because specific conductance is sensitive to a number of variables, the measurement shall be made in the field, either in-situ (e.g.,directly in a well or stream) or as soon as possible after sample collection.

The following apparatus is required.

- Conductivity cell or probe

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- Temperature-compensating conductivity meter
- Two known standards bracketing the expected conductivity of the sample solution to be measured

Determine the specific conductivity of sample as follows.

1. Calibrate the measuring system (Appendix I). The instrument shall be accurate to within three percent of full scale over a temperature range of - 2 to + 40 degrees Centigrade and a response time less than two minutes (Manigold, et.al., 1982).

2. Switch on instrument for a power check. Replace battery when red line adjustment cannot be accomplished or when the meter indicates a low battery.

3. Calibrate to a known standard in accordance with manufacturer instructions each day of use. Verify calibration within a known standard between measurements.

4. Rinse probe with de-ionized water.

5. Insert probe into sample in accordance with manufacturer instructions.

6. Measure temperature of sample with thermometer or thermocouple (paragraph K.4.1.1) if the conductivity cell or probe does not automatically compensate for temperature and record the value.

7. Switch meter to appropriate scale and record readings in micromhos per centimeter (μmhos/cm).

8. If necessary, correct specific conductance values for temperature using appropriate temperature correction factors.

9. Rinse probe with de-ionized water between each measurement.

10. Store specific conductance probes in accordance with manufacturer instructions between use.

K.4.1.4 <u>Dissolved Oxygen</u>. The dissolved oxygen concentration affects redox potential of water and chemical behavior of aqueous constituents. Physical, chemical, and biochemical activities in water may affect dissolved oxygen levels. Measurement of dissolved oxygen is useful in tracking contaminant plumes, determining surface-water/ground-water interaction, and locating contaminant source areas.

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Dissolved oxygen is normally measured in the field by immersing a membrane electrode in the water. Oxygen gas molecules diffuse through the membrane into a measuring cell at a rate proportional to concentration of molecular oxygen in the water. Inside the sensor, oxygen reacts with an electrolyte and is reduced spontaneously or by an applied voltage, depending on the instrument. Current that is generated is directly proportional to concentration of molecular oxygen in the water outside the sensor.

The following apparatus is required to measure dissolved oxygen.

- Direct-reading, temperature-compensating, auto-calibrating, battery-operated, dissolved-oxygen meter
- Oxygen-sensitive membrane electrode (polarographic or galvanic), which usually includes two solid metal electrodes separated from test solution by a selective membrane (commonly polyethylene or fluorocarbon)
- Replacement electrode
- De-ionized water for calibration and instrument cleaning

Determine the dissolved oxygen concentration of water sample as follows.

1. Calibrate instrument as specified in manufacturer instructions (Appendix I). Instrument shall be capable of responding within 0.2 milligrams per liter (mg/L) over water temperature range of - 2 to + 40 degrees Centigrade and shall have a response time of less than two minutes (Manigold, et.al., 1982).
2. Measure temperature at time of dissolved oxygen reading (paragraph K.4.1.1).
3. Rinse probe with distilled water.
4. Insert probe into sample and allow sufficient sample flow across membrane surface to overcome erratic responses of instrument.
5. Record readings from meter.
6. Calibrate electrode between each use to eliminate interference from gases other than oxygen.
7. Rinse probe with de-ionized water between each measurement.
8. Store probe in distilled, de-ionized water.

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K.4.1.5 Alkalinity. Alkalinity is a measure of the acid buffering capacity of a water sample and is formally defined as the equivalent sum of bases that are titratable with a strong acid. Because alkalinity concentration is affected by changes in temperature, pH, and degassing, the alkalinity analysis shall be performed in the field as soon as possible after collection. Also, alkalinity measurements require a semi-controlled environment (wind-free, stable work platform), so they shall be conducted in mobile or field laboratories. Uranium and other radionuclides form carbonate complexes; therefore, an accurate determination of carbonate concentration is necessary to quantify radionuclide mobility in water.

The end point of the carbonate titration (where carbonate has been converted to bicarbonate) is approximately pH 8.3. The end point of the bicarbonate titration (bicarbonate converted to carbon dioxide and water) is near pH 4.5. Bicarbonate and carbonate concentrations are determined by electrometric titration. A strong acid of known concentration is added to a water sample while the pH of the sample is monitored. Using the volume of acid of a known concentration needed to reach the end point, the concentration of bicarbonate and carbonate is calculated by the Brown, Skougstad, and Fishman (1970) method.

The following apparatus is required.

- pH meter that can be read to 0.05 units
- Combination pH electrode
- pH buffer solutions: 4.0, 7.0, and 10.0
- 50-milliliter (mL) buret with 0.1-mL graduations
- 25- and 50-mL volumetric pipets (class A)
- Magnetic stirrer and small teflon stir bar
- Buret stand and clamp
- Semi-controlled environment (laboratory trailer or equivalent)
- 250-mL beaker
- Standardized sulfuric or hydrochloric acid approximately 0.02 normal solution

Measure alkalinity as follows.

1. Before starting titration (paragraph K.4.1.2), calibrate pH meter daily as specified in manufacturer instructions.

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2. Check calibration between samples with a 7.0 buffer solution.

NOTE

Acid and sample must be approximately the same temperature.

3. Immerse a securely stoppered bottle of acid in a bath of sample fluid for 20 minutes to adjust acid temperature to that of sample. Do not use that portion of sample again in the analysis.

4. Fill buret with acid from temperature-regulated bottle (step 3), open stopcock, and drain some acid to remove air bubbles.

5. Keep buret full with acid between titrations to prevent development of a film inside buret.

6. Place clean, dry, teflon stir bar into clean, dry 250-mL beaker.

7. With a clean, dry, class A pipet, siphon 50.0 mL of filtered sample into beaker.

8. Rinse pH electrode only with de-ionized water, and discard the rinse water.

9. Place beaker in center of stirring plate; gently lower electrode into beaker until the electrode tip is fully immersed in the sample. Position buret over beaker.

10. Start the stir bar and swirl gently so that the sample is mixing, but a vortex is not formed. Turn the pH meter to **READ** and all the pH readings to **EQUILIBRATE**. Record initial pH of sample to nearest 0.05 pH unit.

11. Record the volume of acid in the buret to nearest 0.01 mL.

12. Slowly add acid to the sample. Allow the sample pH to equilibrate before adding additional acid. If sample pH is not near an endpoint (i.e., pH is greater than 9 or is between 5 and 8), add acid titrant in volumes sufficient to lower the pH by 0.2 to 0.5 units.

NOTE

Very small additions of acid may cause large changes in sample pH.

13. As the pH of the sample nears the endpoint (i.e., between pH 8 and 9 or between pH 4 and 5), add acid titrant a drop at a time allowing 15 to 20 seconds for equilibration between drops.

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14. Once the endpoint pH is reached, record the final volume of acid in the buret and the final sample pH.

15. Continue adding acid to the sample until its pH is within a range of 3.0 to 3.5. Record the final volume of acid in the buret and the final sample pH.

16. To clean glassware and the stirring bar, proceed as follows.

    a. Soak in soapy water bath at least one hour.

    b. Rinse with copious amounts of tap water.

    c. Rinse three times with de-ionized water.

    d. Allow to air dry before use.

17. Rinse the pH electrode with de-ionized water and discard the rinse water. Store the electrode in accordance with manufacturer directions.

18. For each sample, prepare a plot of pH as a function of acid titrant volume in milliliters.

19. Determine end points graphically (Manigold, et.al., 1982).

20. Perform calculations as specified in Manigold, et.al.(1982).

K.4.1.6 Redox Potential. A chemical reaction in which an element undergoes a loss or a gain of electrons is referred to as oxidation or reduction, respectively. Redox (Eh) is a measure of aqueous electron concentration and is controlled by reactions involving elements present in more than one oxidation state. Chemical behavior and mobility of many aqueous constituents are influenced by the redox potential of surface and ground water. Physical, chemical, and biochemical processes in water also affect Eh.

Eh is measured in the field by immersing a combination electrode in water. The electrode consists of a noble metal (usually platinum) redox and a reference electrode (usually silver/silver chloride) combined in one body. Eh measurement is based on potential difference between the constant voltage reference electrode and variable voltage of the platinum electrode. Voltage of the platinum electrode is dependent on the concentration of electrons in solution. For ground water, Eh is measured using a flow box or similar device that prevents atmospheric contamination of the water sample.

Reference solutions with known Eh are used to standardize and check accuracy of the electrode system. The potassium ferric-ferro cyanide solution described by ZoBell (1946) is the standard recommended. Preparation of reference solutions shall be documented when prepared.

The following apparatus and reagents are required to measure Eh.

- Orion 401 specific-ion meter or equivalent
- Orion combination electrode 96-78-00 or equivalent and Orion electrode filling solution 90-00-01 or equivalent (Thimble platinum and separate reference electrodes are also suitable.)

WARNING

HANDLE THE ZOBELL REFERENCE SOLUTION WITH CARE. IT IS POISONOUS.

- ZoBell reference solution - Dissolve 1.4080 gram of potassium ferrocyanide $K_4Fe(CN)_6$ $3H_20$ (0.00333M), 1.0975 gram of potassium ferricyanide $K_3Fe(CN)_6$ (0.00333M), and 7.455 grams of potassium chloride KC1(0.10M) in distilled water to make one liter. This solution is stable for several months but shall be kept in a black plastic bottle and out of sunlight as much as possible. It has a standard potential of + 428 millivolts at 25°C. Record the date on the bottle and initial it.
- Ring stand, clamp holder, and universal V-jaw clamp
- Eh cell
- Plastic 100-mL beaker
- Water bath for ZoBell solution (plastic pail or bottom half of a one-gallon plastic bottle) ar a flow box
- Thermometer
- Equipment for measuring dissolved oxygen (paragraph K.4.1.4)
- Small strips of crocus cloth for polishing platinum electrode

Determine Eh of water as follows.

1. Fill combination electrode with filling solution (Orion 90-00-01 or equivalent). Depress body and let some of the fluid drain to waste.

2. Bring ZoBell solution to temperature of sample by immersing closed bottle in a bath of sample water or a flow box. Record temperature.

3. While the ZoBell solution is equilibrating to the sample temperature, determine the presence of dissolved oxygen in the water sample. If dissolved oxygen is greater than 0.05 mg/L, do not proceed with the Eh measurement (paragraph K.4.1.4).

4. If dissolved oxygen is less than 0.05 mg/L, proceed to step 5.

5. Place combination electrode in the ZoBell solution that has equilibrated to sample temperature.

6. Plug electrode leads into meter and turn function switch on meter to millivolt mode. Allow several minutes for electrode to equilibrate while keeping bottle of solution in water bath. Record reading.

7. If reading differs by more than 10 millivolts of the theoretical value at that temperature (Manigold, et.al., 1982), replace reference electrode fluid and repeat measurement.

8. If the second measurement reading is not within 10 millivolts of the theoretical value, polish platinum end of electrode with crocus cloth and recheck reading.

9. If reading is still off, replace electrode.

10. If reading is within $\pm$ 10 millivolts of the theoretical value, rinse electrode with de-ionized water and proceed to step 12.

11. Properly contain and dispose of the rinse water.

12. Place electrode in Eh cell and let water flow through the cell. Ensure that air bubbles are removed from system.

NOTE

Filler hole on side of electrode shall be above top of Eh cell.

13. Use control valve on inlet to ensure that head of sample is below level of reference electrode and change the potential of the system.

14. Clamp Eh cell onto ring stand.

15. Turn function switch on meter to millivolt mode and allow water to flow through cell until readings stabilize.

NOTE

Stabilization usually occurs within 20 minutes, but may require an hour or more.

16. Turn off sample flow to prevent streaming potential and immediately record reading. (This is the observed Eh of the sample.)

17. Record the following data on the data record form.

    - Sample temperature
    - Observed potential of ZoBell solution, in millivolts, relative to reference electrode at sample temperature
    - Theoretical potential of reference electrode system and ZoBell solution, in millivolts, relative to the standard hydrogen electrode at sample temperature (Manigold, et.al., 1982)
    - Observed potential of sample in millivolts

18. Calculate Eh relative to the standard hydrogen electrode as follows.

    a. Check the electrode by calculating the difference between observed potential and theoretical potential of ZoBell solution relative to reference electrode.

$$B - C = \text{difference} \qquad \text{(Eq. 1)}$$

Where:

B = observed potential of ZoBell solution

C = theoretical potential of ZoBell solution

b. If the difference is less than ± 10 millivolts, proceed to step 18.

c. If difference is greater than ± 10 millivolts, follow steps 7, 8, and 9 for remedial measures.

19. Calculate Eh of the system as follows.

$$E - B + D = \text{Eh value of system} \qquad \text{(Eq. 2)}$$

Where:

E = observed potential of sample

D = theoretical potential of reference electrode in ZoBell solution relative to hydrogen electrode at measurement temperature.

20. Report Eh value [either positive (+) or negative (-)] to nearest 10 millivolts (mV). The following field example may help clarify the procedure (G. Ehrlich, H. Reeder, W. Wood, 1971).

<u>Example</u>: Artificial-recharge site well 539 feet deep, 6-inch diameter, finished in the Prairie duChein aquifer. Pumping 10 gal/min for 22 hours. Temperature of water from well is 10.0° C. Observed potential of ZoBell solution relative to combination reference-platinum electrode, at 10° C was + 215 mV. Theoretical potential of ZoBell solution relative to this electrode system, at 10° C is + 207 mV. The 8-mV difference was considered small, and the decision was made to proceed with measurements. The observed potential of the water sample after system stabilized in 30 minutes was - 120 mV. The data record showed the following.

Sample temperature: 10° C

Observed potential of ZoBell solution relative to reference electrode at sample temperature: + 215 mV

Theoretical potential of ZoBell solution relative to reference electrode at sample temperature: + 207 mV

Theoretical potential of reference electrode system and ZoBell solution, relative to standard hydrogen electrode at sample temperature. . . .+ 461 mV

Observed potential of sample: - 120 mV

This was calculated as follows.

$$B - C = (+ 215) - (207) = + 8 \text{ mV} \qquad \text{(Eq. 3)}$$

$$Eh_{sys} = E - B + D = (- 120) - (215) + (461) = + 126 \text{ mV}$$

K.4.2 Ground-Water Sampling

Ground-water sampling is currently conducted at FEMP for the following.

- Remedial Investigation/Feasibility Study (RI/FS)
- Resource Conservation and Recovery Act (RCRA)
- Radiological Environmental Monitoring
- Safe Drinking Water Act

K.4.2.1 <u>Water-Level Measurements</u>. 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 base flow to streams, and calculate the volume of water in a borehole or well. The following are requirements for collecting water-level data from wells including water-level measurements prior to sampling. Ground-water levels are measured at off-site private wells and at on-site and off-site FEMP monitoring wells. Private wells are commonly used for water supply purposes and may be equipped with a pump, discharge line, and wiring.

Ground-water level in private wells shall be measured as follows.

1. Obtain permission from owner prior to arrival on site and request that owner not use the well for an hour or so prior to designated arrival time. Arrive at designated time.

2. Obtain well construction information from owner if not previously obtained. Specifically request information on well depth, materials, age, screened interval, method of installation, and installer. If information is not available, document that fact.

3. Upon arrival at the well, check for visible physical damage. Scan area around well for unusual materials or circumstances (e.g., recently discarded trash, old oil cans, animal burrow). Record observations on daily log.

4. Remove well cap or cover from access hole.

5. Check water level measuring instrument for proper operation. Take care not to measure water level in pump discharge line. Lower measurement probe until water is reached. Be aware of obstacles in the well casing.

6. Raise probe above water level, shake it slightly, then lower it again and recheck. If measurements do not agree within 0.02 feet, repeat measurement until cause of discrepancy has been determined and agreement of measurements within $\pm$ 0.02 feet has been obtained.

7. Record value and time. Use a 24-hour format for measurements.

8. If water level has not stabilized after use, as indicated by successively higher measured water levels in the well, measure the water level at approximately one-minute intervals until three successive readings agree within 0.02 feet or until 20 readings have been collected.

9. Record value and time of all measurements.

10. Replace well cover.

11. Decontaminate water-level measurement probe between each well as specified in subsection K.11.

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Water level of monitoring wells shall be measured as follows.

1. If the well is off site, notify owner prior to arrival.

2. Upon arrival at the site, check well for physical damage, unusual materials, or circumstances (e.g., recently discarded trash, old oil cans, signs of animal burrowing). Record observations in daily log.

NOTE

At some well sites, preliminary monitoring for volatile gases around the well cap may be required. These sites shall be identified in PSPs and procedures shall be provided for monitoring.

3. Remove lock from monitoring well and remove well cap.

4. Check water-level measuring instrument for proper operation (M-Scope or equivalent). Lower measurement probe until water is reached.

NOTE

When probe touches water, a buzzer sounds, a meter needle deflects, or a light appears, depending on meter type.

5. Raise probe above water level and shake it slightly, then lower it again, and recheck. If measurements do not agree to within 0.02 feet, continue to remeasure until cause of discrepancy has been determined or agreement of measurements has been obtained (Appel, et.al., 1980). Be aware of obstacles in the well casing.

6. Record depth to water to 0.01 feet from measuring point, (e.g. top of well casing, top of protective casing, top of sanitary seal) as recommended by the EPA (1986a). Record measuring point on water-level measurement form.

7. Replace well cover and lock protective lid.

8. Decontaminate water-level-measurement probe between each well as specified in subsection K.11.

K.4.2.2 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 shall meet certain requirements in order for subsequent data to be used for the CERCLA program. To ensure that these objectives are achieved, the following minimum guidelines and techniques are required during sample withdrawal. Additional requirements may be included in PSPs.

1. Upon arrival at well site, determine whether the lock is secure. Inspect well for signs of tampering or forced entry. Check the surrounding area for unusual occurrences such as recently disposed trash or animal burrows. Record observations on daily log.

2. Set up sampling van and equipment to avoid interference with sampling activity.

3. Place plastic sheeting on ground if necessary to prevent spillage of water and to avoid contamination of equipment by contact with ground or other uncontrolled surfaces.

4. Avoid effects of the following conditions to ensure representative samples of ground water (U.S. Environmental Protection Agency, 1989b).

   - Sample temperature may change rapidly after it is brought to the surface. This change may affect chemical reaction rates, reverse cationic and anionic exchanges on solids, and alter microbial growth rates.

   - The pH may change from loss of carbon dioxide through degassing or adsorption, which could affect alkalinity and oxidation of certain compounds.

   - Dissolved gases may be lost as a result of a pressure change.

   - Organic samples may be affected by volatilization, adsorption, photodegradation, or contamination from sampling materials or airborne gases.

5. Complete a ground-water sample collection form for each sample with information specified in subsection K.9 plus the following data.

   - Description of water level measuring point

   - Depth to water

   - Sounded depth of well

   - Depth of well from well construction diagram

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- Well casing diameter and borehole diameter from well construction diagram
- Monitored interval and screen length
- Calculated well volume
- Actual volume removed during purging and maximum rate of purge
- Depth to pump intake at start and finish of pumping

6. If cleaning solvents or internal combustion engines are used at a site when a well is open, place them downwind of the well or far enough away that fumes are diluted beyond the detection limit of a calibrated Photo-Ionization Detector (PID) or Flame-Ionization Detector (FID). Locate the sampling van downwind of the well.

7. Measure depth to ground water in the well as specified in paragraph K.4.2.1. Measure total depth of monitoring well to the nearest 0.01 foot (U.S. Environmental Protection Agency, 1986a) and compare it to well construction diagrams.

8. Compare total depth measurement to depth indicated on well construction diagram to verify well identity and to determine if silting into the screened portion of the well has occurred. If an identity discrepancy or silting is discovered, immediately refer the matter to the FEMP project manager for resolution. Document the resolution.

NOTE

Evacuation of at least three well volumes of water in concert with stable pH, specific conductance, and temperature measurements, or evacuation of the well to dryness is recommended for a representative sample. (One well volume is defined as the volume of water standing in the well casing, screen, and saturated filter pack under static conditions.)

9. Evacuate stagnant water from monitoring well prior to sample collection with a stainless-steel submersible pump, stainless steel or teflon bladder pump, peristaltic pump, or by bailing with teflon or stainless-steel bailer. Place discharge hoses between the sampling van and the well on clean plastic sheeting.

10. Take a minimum of four sets of pH, temperature, and specific conductance measurements when purging three well volumes from a monitoring well (U.S. Environmental Protection Agency, 1986b).

NOTE

A well is considered dry if it does not recover sufficiently within 24 hours after purging to yield a complete sample.

11. Do not take samples from dry wells. Document well condition on field log.

12. Evacuate monitoring well if it can be pumped or bailed dry and allow it to recover prior to sample withdrawal. The evacuation rate shall be low enough to prevent excessive agitation of recharge water (U.S. Environmental Protection Agency, 1986a) based on hydraulic characteristics of the well. Avoid excessive pumping that can cause samples to be non-representative.

13. If a pump is used to purge a monitoring well prior to sample collection, lower pump intake to a depth of five to ten feet below water level in the casing but above well screen where possible. Initially purge well from this depth so that fresh water from screened interval will move upward through casing and completely flush well. Ensure that pumping rate is low enough to prevent significant agitation and that it is less than maximum pumping rate used during monitoring-well development.

14. If pumping of air (caused by excessive drawdown of the well water level) occurs, reduce pumping rate. If it continues, lower pump intake five to ten feet within the well if possible and reduce pumping rate further to prevent excessive drawdown.

15. When pump and lines are removed from a well, place them on clean plastic sheeting to ensure that they do not come in contact with the ground.

CAUTION

Do not allow unpermitted release of evacuated water to the environment.

16. Collect water produced during evacuation of monitoring wells in appropriate containers.

17. Collect excess water generated during sampling of monitoring wells in appropriate containers.

18. Dispose of water that is believed (based on past sampling data) not to contain constituents classed as hazardous waste under RCRA.

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19. Store water that has unknown constituents and is potentially a hazardous waste in a designated area until classification is determined (based on an analysis of the water for Toxicity Characteristic Leaching Procedure (TCLP) parameters) and a disposal method chosen. Observe RCRA requirements for duration of storage.

20. As soon as the well recovers sufficiently to permit sampling, collect samples in accordance with the stability and volatility of parameters to be tested in the following order (U.S. Environmental Protection Agency, 1989b).

- Field measurements (temperature, pH, and specific conductance)
- Volatile organic compounds
- Total organic halogens
- Total organic carbon
- Extractable organic compounds (acid and base neutral extractables, pesticides, PCBs)
- Total metals
- Dissolved metals
- Phenols
- Cyanide
- Sulfate and chloride
- Turbidity
- Nitrate and ammonia
- Radionuclides

21. If the well is purged with a submersible pump, collect samples specified in the PSP from pump discharge prior to removing pump from well and before collection of bailed samples. This prevents handling the pump twice and eliminates the need for pump decontamination between well evacuation and sample collection.

22. Use the pump discharge to evacuate and sample wells with limited access and dedicated pumps. (Data from such wells may be qualified for certain purposes.)

23. Decontaminate purge pump, lines, and other equipment used in ground-water sampling between wells following procedures in subsection K.11.

24. Take field measurements at well site on unpreserved samples as described in paragraph K.4.1. Keep samples collected for field measurements separate from samples preserved for shipment to laboratory.

25. Collect samples for specific parameters as specified in paragraph K.4.2.3.

26. Filter samples at well site.

27. Number and label samples as specified in Section 7.

28. Store and preserve samples as specified in Table 6-1 (Appendix A).

29. Complete Site-wide Analysis Request/Custody Record (SAR/CR) (Form 7-1, Appendix B) as specified in Section 7.

K.4.2.3 <u>**Parameter-Specific Sampling Procedures**</u>**.** Perform ground-water sample collection from monitoring wells for Volatile Organic Compounds (VOCs), acid and base-neutral extractable organic compounds, total and dissolved metals, general chemistry, and radiological parameters in accordance with the following procedures.

Volatile Organic Compounds - Collect VOC samples as follows.

1. Collect samples for VOC analyses using a stainless-steel or teflon bailer or stainless-steel and/or teflon bladder pump or a Grundfos Redi-Flo 2 pump operated at 0.1 liter per minute or less.

2. Perform sample collection in a manner to minimize turbulence and volatilization of VOCs. Operate bladder pumps at a maximum of 0.1 liter per minute.

3. Collect samples in 40-mL screw-cap vials with Teflon-lined septa. Fill sample vials to overflowing with a visually apparent meniscus present above the rim of the vial and seal without air bubbles. Avoid excessive overfilling of pre-preserved vials.

4. Visually check each vial for air bubbles by inverting and sharply tapping it against the hand. If air bubbles are present, top off sample bottle and recheck it for air bubbles. When no air bubbles are present, place sample in a cooler maintained at four degrees Centigrade, plus or minus two degrees.

5. Complete appropriate field documentation in accordance with subsection K.9 or as specified in the PSP.

6. Preserve samples as specified in Table 6-1 (Appendix A).

7. Pack samples for shipping as specified in subsection K.10.

Acid and Base-Neutral Extractable Compounds and Pesticides/PCBs (Semi-Volatile) - Collect semi-volatile compound samples as follows.

1. Collect samples for semi-volatile analysis with a stainless-steel or teflon bailer or a stainless-steel and/or teflon bladder pump or Grundfos Redi-Flo pump.

2. Because some semi-volatiles are susceptible to photo-degradation, use one-liter amber-glass sample bottles with teflon-lined caps as specified in Table 6-1 (Appendix A). Fill the bottles to the neck and seal.

3. Complete appropriate field documentation.

4. Preserve samples by cooling to four degrees Centigrade plus or minus two degrees and store in a dark place as specified in Table 6-1 (Appendix A).

5. Pack samples for shipment as specified in subsection K.10.

Total Metals - Prepare total metal samples as follows.

1. Collect samples for total metals using a peristaltic pump, stainless-steel or teflon bailer, and stainless-steel and/or teflon bladder pump or Grundfos Redi-Flo pump. If specified in PSP, collect samples through discharge of submersible pump used to purge monitoring well.

2. Fill one-liter polyethylene sample bottles to neck and seal as specified in Table 6-1 (Appendix A).

3. If pre-preserved containers are not used, add approximately one mL of concentrated nitric acid per 1000 mL of sample after sample is placed in an appropriate container. (A one 1-mL ampule of acid per sample may be used to simplify handling of acid.)

NOTE

Do not immerse pH paper in sample container.

4. Test sample by administering it to pH paper drop by drop to determine if sample pH is less than 2.0.

5. If pH is not less than 2.0, add a sufficient amount of preservative drop by drop until desired pH range is achieved.

6. Tape pH paper to sample container and document in applicable sample record.

7. Complete appropriate field documentation.

8. Preserve samples by cooling to four degrees Centigrade plus or minus two degrees as specified in Table 6-1 (Appendix A).

9. Pack samples as specified in subsection K.10.

Dissolved Metals - Prepare dissolved metals samples as follows.

1. Collect samples for dissolved metals using a peristaltic pump, stainless-steel or teflon bailer, stainless-steel and/or teflon bladder pump, or Grundfos Redi-Flo pump. If specified in PSP, collect samples through discharge of a submersible pump used to purge monitoring well.

NOTE

In-line filters that attach directly to pump or bailer discharges are preferred (Stolzenburg and Nichols, 1986). If not available, use a Millipore filtration apparatus, or equivalent, equipped with a hand or electrical vacuum pump.

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2. Use 0.45-micron filters to prepare dissolved metals water samples.

3. Conduct filtering at well site, and record on field documentation forms the method used including use of prefilters.

4. Clean or rinse filtering apparatus as specified in subsection K.11.

5. Discard the first 100 to 150 mL of filtrate from each sample to rinse the filter and filtration apparatus of contaminating substances (Manigold, et.al., 1982).

NOTE

In-line, multiple-stage filters are preferred, but a Millipore or equivalent system may be used. Pore size of prefilters shall be based on lithology of the adjacent formation and amount of sediment in the water. Initial pore size shall be 1.0 micron with a doubling of size for each additional larger filter needed.

6. If water is extremely turbid, use one or more stages of prefilters as necessary. If it is still not possible to filter the sample through a 0.45 micron filter, do not collect the dissolved metals sample.

7. Record whether sample is collected and identify prefilters used in sampling log.

8. Immediately transfer filtered sample to a one-liter polyethylene plastic bottle containing one mL of concentrated nitric acid preservative per 1000 mL of sample.

9. If pre-preserved containers are not used, add approximately one mL of concentrated nitric acid per 1000 mL of sample after sample is placed in an appropriate container.

NOTE

Do not immerse pH paper in sample container.

10. Test sample pH by administering sample drops one at a time to pH paper to determine if sample pH is less than 2.0.

11. If pH is not less than 2.0, add preservative drop by drop until desired pH is achieved. Seal bottle with plastic cap fitted with polyethylene liner.

12. Complete specified field documentation.

13. Preserve samples as specified in Table 6-1 (Appendix A).

14. Pack samples for shipping as specified in subsection K.10.

General Chemistry Parameters - Prepare samples for general chemistry parameters (i.e., major cations and anions and physical parameters) as follows.

1. Collect samples for general chemistry parameters using a peristaltic pump, stainless-steel or teflon bailer, stainless-steel and/or teflon bladder pump or Grundfos Redi-Flo pump, and, if specified in PSP of procedures, through the discharge of a submersible pump to purge the monitoring well.

2. Fill appropriate sample bottles to the neck and seal.

3. Check samples that require acids or bases for preservation for proper pH range as specified in Table 6-1 (Appendix A).

NOTE

Do not immerse pH paper in sample.

4. If pH is not within the specified range, add appropriate preservative drop by drop to achieve desired pH value.

5. Complete specified field documentation.

6. Preserve samples as specified in Table 6-1 (Appendix A).

7. Pack samples for shipping as specified in subsection K.10.

Radionuclides - Prepare samples for general radionuclides as follows.

1. Collect samples for radionuclides using a peristaltic pump, stainless-steel or teflon bailer, stainless-steel and/or teflon bladder pump or Grundfos Redi-Flo pump. If specified in the PSP, collect samples from the discharge of a submersible pump used to purge the monitoring well.

2. Flush sample lines and equipment with sample medium to minimize radionuclide adsorption effects.

3. Use sample containers made of Teflon, polyethylene, or Polyvinyl Chloride (PVC) as specified in Table 6-1 (Appendix A) to minimize radionuclide losses by adsorption unless tritium is a parameter of interest. If so, use a glass container with a tritium-seal cap (Korte and Kearl, 1984).

NOTE

Avoid collection of suspended sediments when possible.

4. If it is necessary to determine dissolved radionuclides, filter water samples in the field through a 0.45-micron membrane filter as soon as possible after collection using in-line, 0.45 micron filtration if available (Stolzenburg and Nichols, 1986).

5. If in-line filtration is not available, use containers without preservative to initially collect samples prior to filtration.

6. Transfer samples to containers and preserve them after filtration has been performed.
7. If samples are collected for analysis of total radionuclide concentrations, do not filter.

8. Tightly secure sample container lids.

9. Complete specified field documentation.

10. Preserve samples as specified in Table 6-1 (Appendix A).

11. Pack samples for shipping as specified in subsection K.10.

K.4.2.4 <u>Sampling Ground Water from Private and Other Production Wells</u>. Private wells near FEMP were sampled as part of the Radiological Environmental Monitoring Program (REMP) and RI/FS. DOE has authorized sampling of private wells by FEMP personnel on request. Wells may be sampled during a routine project or upon request of the property owner. Data collected from private wells may be qualified for certain uses.

Property owner approval shall be obtained and notification made before sampling a private well. Requirements of individual property owner license agreements shall be reviewed prior to each sampling round and complied with during sampling. Sampling shall be conducted only at the time agreed to by the owner. If additional visits to the site are necessary, the property owner shall be notified before each visit or arrangements shall be made for continuing access. Communications with the property owner shall be documented either in a daily log or a telephone conversation log.

Procedures for collecting water samples from private or other production wells shall be included in PSPs. Minimum elements of these procedures shall be as follows.

1. Record in the daily field log location of well relative to nearby buildings, drainage features, cultivated areas, equipment storage areas, leach fields and septic tanks, and other pertinent features.

2. Acquire available well construction information from the owner, including driller; date drilled and installed; total depth; depth to water; casing type, diameter, and length; pump age, type, and size; description of plumbing and electrical equipment; types of treatment systems; and location.

3. Determine whether well is the primary source of water for the household, and document approximate volume of use.

NOTE

Amount of flushing required depends on frequency of well use.
One minute of flushing at full capacity is the minimum required.

4. Flush system before collecting sample to remove stagnant water from lines and wellbore. Use a graduated container or bucket and approximate flow rate at full capacity.

5. Use sample containers and preservatives specified in Table 6-1 (Appendix A), and collect samples as near to the wellhead as possible upstream from treatment units.

6. Decontaminate equipment as specified in subsection K.11.

7. Maintain chain-of-custody documentation as specified in Section 7.

K.4.3 Surface-Water Sampling

Surface-water sampling is currently being conducted at FEMP in accordance with National Pollutant Discharge Elimination System (NPDES) requirements and as part of routine monitoring of Paddys Run and the Great Miami River. Samples have also been collected in support of RI/FS. The following procedures are applicable to collection of water samples from streams, ponds, lakes, rivers, springs, and seeps. Two different techniques are used for collecting surface water samples: grab sampling and composite sampling.

K.4.3.1 Grab Sampling. For grab sampling, proceed as follows.

1. Use clean sample containers and appropriate preservatives approved for specific parameters as specified in Table 6-1 (Appendix A).

2. Choose a point of sampling so that a representative sample is obtained. Choose the sampling point with respect for information desired and with local conditions.

3. Collect samples beginning at the farthest downstream location and work up-stream to prevent contamination during sample collection. Avoid surface debris and artificial turbulence during sample collection.

NOTE

Sampling depth shall be approximately 15 centimeters (6 inches) below water surface if possible. When sampling from a bridge, platform, or boat, it may be necessary to use a bailer or a peristaltic pump to collect sample.

4. Use unpreserved containers (grab bottle, ladle, teflon bailer) to collect samples directly from a body of water where water depth is sufficient and access conditions permit. If depth is not sufficient, use a teflon or stainless-steel beaker, ladle, scoop, or bailer.

5. Use a peristaltic pump or Kemerer sampler to collect non-volatile samples.

6. Grasp grab bottle securely at the base with one hand and plunge it mouth down into the water, avoiding surface debris. Position bottle opening towards the current flow and away from the collector's hand, the shore, or the side of the sampling platform or boat. Tip bottle slightly upwards to allow air to exit and the bottle to fill. Collect a sufficient amount of sample to perform required analyses.

7. Fill sample bottles as specified per parameter in subsection K.4. If a sample bottle is used for collection, cap bottle prior to removal from water. The grab bottle and the sample bottle shall be of the same materials or approved equivalent.

8. After removal of grab bottle from water, transfer sample to the container with preservative.

9. When more than one grab bottle volume of sample is required to fill necessary sample containers, distribute sample portions equally among individual sample containers to provide homogeneity of collected sample.

10. Perform field measurements as specified in paragraph K.4.2.1 or filter unpreserved samples immediately after collection. If a peristaltic pump is used to collect samples, use an in-line filter (preferred by Stolzenburg and Nichols, 1986).

11. Complete specified field documentation.

12. Preserve samples as specified in Table 6-1 (Appendix A).

13. Pack samples for shipping as specified in subsection K.10.

K.4.3.2 Composite Sampling. Composite samples may be collected with automatic sampling equipment, or may be collected manually as grab samples (paragraph K.4.3.1) and composited. Currently, there are no composite, natural surface-water samples being collected at FEMP. Procedures for collection of composite samples shall be included in PSPs. Samples for unstable parameters, such as volatile organic compound, radon, or TOX shall not be composited.

K.4.3.3 Parameter Specific Sampling Procedures. Perform surface-water sample collection for VOCs, acid and base-neutral extractable organic compounds, total and dissolved metals, general chemistry parameters, and radiological parameters in accordance with the following procedures.

Volatile Organic Compounds

1. Collect samples for VOC analysis directly into unpreserved 40-mL vials with teflon-lined septa caps where possible or use stainless steel, teflon, or glass scoops, ladles, buckets, or bailers if circumstances require.

2. If collecting the sample directly into the vial, secure cap on the vial before removing it from the water.

3. If another method of sample collection is used, follow steps 3 through 7 for VOCs in paragraph K.4.2.3.

4. Follow steps 4 through 7 for VOCs in paragraph K.4.2.3.

Acid and Base-Neutral Extractable Organic Compounds

1. Collect samples directly into one-liter, amber-glass bottles with teflon-lined screw caps when possible. Cap the bottle while still submerged, remove it from the waterbody, pour out water in the bottle neck, and recap.

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2. If the sample cannot be collected directly into the bottle, use a stainless steel, teflon, or glass scoop, ladle, bucket, or bailer to collect the sample. Fill the sample container as specified in step 2 for acid and base-neutral extractable organic compounds, paragraph K.2.3.

3. Follow steps 3 through 5 for acid and base-neutral extractable organic compounds, paragraph K.2.3.

Total Metals

1. Collect samples for total metals directly into an unpreserved, one-liter polyethylene bottle when possible. Cap bottle while it is still submerged, remove it from the water, pour out water in the neck of the bottle, and recap.

2. If the sample cannot be collected directly into the bottle, use a stainless-steel, teflon, or glass scoop, ladle, bucket, or bailer or a peristaltic pump with polyethylene or teflon tubing and follow step 2 for total metals in paragraph K.4.2.3.

3. Follow steps 3 through 9 for total metals in paragraph K.4.2.3.

Dissolved Metals

1. Proceed according to steps 1 or 2 (as applicable) for total metals in paragraph K.4.3.3.

2. Proceed as in steps 2 through 15 for dissolved metals in paragraph K.4.2.3.

General Chemistry Parameters

1. Collect samples for general chemistry parameters directly into an unpreserved container specified for that parameter in Table 6-1 (Appendix A) when possible. Cap the bottle while it is still submerged, remove it from the water, pour out water in the neck of the bottle, and recap.

2. If the sample cannot be collected directly into the bottle, use a stainless-steel, teflon, or glass scoop, ladle, bucket, or bailer or a peristaltic pump with polyethylene or teflon tubing. Follow step 2 for general chemistry parameters in paragraph K.4.2.3.

3. Follow steps 3 through 7 for general chemistry parameters in paragraph K.4.2.3.

Radionuclides

1. Collect samples for radionuclides directly into unpreserved container specified for that radionuclide or group of radionuclides in Table 6-1 (Appendix A) when possible.

2. Proceed as in steps 4 through 11, paragraph K.4.2.3, for radionuclides

3. If the sample cannot be collected directly into the specified container, collect the sample using a teflon, polyethylene, PVC, or stainless-steel scoop, ladle, bucket, or bailer or a peristaltic pump with the teflon or polyethylene lines. Proceed as in steps 2 through 11 for radionuclides, paragraph K.4.2.3.

K.4.4 Waste-Water Sampling

Waste-water sampling is regulated by the Ohio Environmental Protection Agency (OEPA) under the Clean Water Act (CWA). The FEMP permit defines the regulation for waste-water sampling as the version of 40 Code of Federal Regulations (CFR) in effect on 1 July 1989, the effective date of permit. Sampling and analysis requirements are regulated pursuant to 40 CFR 136.

Samples are collected, preserved, and analyzed as specified in PSPs. Data are collected in accordance with permit-specific requirements. Samples are also collected for DOE environmental monitoring and to fulfill requirements of the 1986 Federal Facility Compliance Agreement. DQOs for ongoing waste-water sampling are in Appendix C.

An NPDES sampling plan was 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 analytical laboratory.

The NPDES permit requires continuous monitoring of effluent for pH at every location except the general sump and for flow when a discharge occurs at each location. Meters are in place to fulfill this requirement. Flow meter information for each of the NPDES outfalls that require reporting of total daily flow are taken at the following stations.

- 4001 - Six-inch parshall flume. Charts located in MH-175 structure. Flow is annunciated to MH-175 control panel.

- 4002 - No meter. Depth of discharge flow is measured. When depth of flow and geometry of the spillway is known, flow can be calculated.

- 4601 - Flow is measured by a V-notch weir. Charts are located in the building adjacent

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to the contact basin. Flow is annunciated to sewage treatment plant LCP-2.

- 4602 - No meter required. Discharge from general sump is a batch discharge to MH-175. By knowing geometry of tank and recording depth of tank before and after discharge and the time, a flow volume and rate can be determined.

- 4603 - N/A. The clearwell discharges to the bio-surge lagoon and subsequently to BioDeNitrification (BDN) towers.

- 4604 - Venturi meter. Charts and annunciation are at MH-34 and LCP-4.

- 4605 - In line magmeter at each BDN to Effluent Treatment System (ETS) chlorine contact tank. Reading is taken at beginning of first shift and end of third shift and the difference is the flow reported. Flow from the BDN to the ETS is totaled at the control panel in the BDN control room. Flows are recorded on log sheets kept in the BDN control room.

- 4606 - In line magmeter. Charts and annunciation are at the storm water retention basin and LCP-3.

Periodic calibration is essential because of the sensitivity of pH monitors. Samples shall be collected six times daily (twice per shift) when a continuous monitor is used to check accuracy of pH monitors. Records documenting results of samples are maintained in the boiler plant office.

Custody record preparation is initiated in advance of sampling rounds to ensure that the person conducting the sampling has a clear knowledge of samples required and that documentation of samples is complete. Sample bottles are assembled and labeled in advance for intended locations and sample parameters. Preservatives are added, and bottles are transported to sample locations in coolers.

Most samples are collected with automatic samplers. Grab samples are required for oil, grease, and cyanide. Samples from the general sump shall be collected by the grab method because general sump discharge is a batch discharge and is not amenable to automatic sampling. When more than one batch discharge from the general sump occurs, a sample from each discharge shall be collected and composited. Samples for unstable parameters, such as volatile organic compounds, shall not be composited. Following is the basic procedure for NPDES sample collection.

1. Obtain custody record and sample numbers.

2. Obtain and mark new sample bottles to reflect sample numbers on the custody record.

3. Review sample schedule and add preservatives indicated to sample bottles.

4. Place bottles in coolers and transport them to the sampling location.

NOTE

Automatic samplers shall be turned off before taking samples and restarted when sampling is finished.

5. Fill bottles for composite samples from the automatic sampler, and pour excess water from sampler back into the waste water stream.

6. Take grab samples by lowering sample bottle into applicable tank or effluent stream.

NOTE

Be sure that the appropriate sample bottle (with prepared label) is filled.

7. If more than one general sump tank is discharged during the NPDES sampling day, collect one sample bottle from each discharged tank and combine it with equal volumes of samples from the remaining tank discharges.

8. Once the required samples have been obtained at each sampling point, immediately transfer them to the Water Treatment Plant (WTP).

9. Seal sample bottles with security tape upon receipt at WTP.

10. Affix a computer-generated label to applicable bottles.

NOTE

The label shall contain the analytical sample number, customer sample number, customer name, date of sample, and location from which sample was taken. Form 7-2 (Appendix B) is an example of the label.

11. Once samples have been collected, accumulated, sealed, and labeled, transfer them to sample receiving laboratory in the FEMP Analytical Laboratories Building.

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Automatic samplers can be programmed for either time-dependent or flow-dependent sampling. The NPDES permit requires that samples be flow-dependent. To activate the sampler, a 0-to-20-mA signal is sent from a flow-measurement device to the sampler. The program must be reset each time the sampler is re-activated.

The procedure to program the sampler is located at the sampler. Table 6-1 (Appendix A) specifies the type of sample bottle required and preservation instructions.

FEMP standard operating procedures are implemented for waste-water sampling and analysis and are available upon request from the DOE Fernald Office (FO).

K.4.5 DOE Required Effluent Monitoring

The following program elements are to be reflected in FEMP site documentation as guidance/requirements in the development and use of liquid and air monitoring systems for compliance with DOE Order 5400.5.

K.4.5.1 General Criteria and Monitoring Requirements

Facility operators shall provide monitoring of liquid waste streams adequate to (a) demonstrate compliance with applicable requirements of DOE 5400.5, Chapter II, paragraphs 1a, 1d, 2a and 3; (b) quantify radionuclides released from each discharge point; and (c) alert affected process supervisors of upsets in processes and emission controls.

Provisions for monitoring of liquid effluent during an emergency shall be considered when determining routine liquid effluent monitoring program needs.

K.4.5.2 Performance Standards for Liquid Effluent Monitoring Systems

The selection or modification of a liquid effluent monitoring system shall be based on a careful characterization of the source(s), pollutants(s) (characteristic and quanties), sample collection system(s), treatment system(s), and the final release point(s) of the effluents.

For new facilities or facilities modified in a manner that could affect effluent release quantity or quality or the sensitivity of monitoring or surveillance systems, a preoperational assessment shall be made to determine the types and quantities of liquid effluents expected and to establish the associated effluent monitoring needs of the facility.

The performance of the effluent monitoring systems shall be sufficient for determining whether effluent releases of radioactive material are within the Derived Concentration Guidelines specified in DOE 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that order.

The required detection levels of the analysis and monitoring systems shall be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.

Sampling systems shall be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends and to satisfy needs to quantify releases.

Monitoring and sampling systems shall be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration. They shall be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.

Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) shall be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.

Sampling/monitoring lines and components shall be designed to be compatible with the chemical and biological nature of the liquid effluent.

K.4.6 Collection of QA/QC Samples

QA/QC samples commensurate with the specified ASL and project-specific DQOs shall be collected and analyzed with aqueous samples.

Trip blanks shall be included with each shipping container of aqueous samples to be analyzed for VOCs or radon unless specifically omitted in PSPs. Trip blanks may be specified in PSPs for other parameters. Trip blanks shall be prepared in a controlled environment and accompany the sample containers through collection, shipping, and handling. Organic-free de-ionized water shall be poured into the sample container specified in Table 6-1 (Appendix A) for the parameter of interest.

VOC vials shall be filled so that there is no headspace (step 1, paragraph K.4.2.3). Other containers shall be filled to the neck and sealed.

Field blanks are prepared at the sampling site by pouring organic-free de-ionized water into the sample containers specified in Table 6-1 (Appendix A) for parameters of interest. Field blank samples shall be collected as specified in the following steps in paragraph K.4.2.3.

- **Volatile Organic Compounds** - Steps 3 through 7
- **Acid and Base-Neutral Extractable Organics** - Steps 2 through 5
- **Total Metals** - Steps 2 through 9
- **Dissolved Metals** - Steps 2 through 15
- **General Chemistry Parameters** - Steps 2 through 7
- **Radionuclides** - Steps 3 through 11

Equipment rinsate samples are collected after decontaminating equipment by pouring or pumping organic-free, de-ionized water through the sample collection device (e.g. bailer, pump) and then pouring it into the specified container. Collect samples as specified in the following steps in paragraph K.4.2.3.

- **Volatile Organic Compounds** - Steps 3 through 7
- **Acid and Base-Neutral Extractable Organics** - Steps 2 through 5
- **Total Metals** - Steps 2 through 9
- **Dissolved Metals** - Steps 2 through 15
- **General Chemistry Parameters** - Steps 2 through 7
- **Radionuclides** - Steps 3 through 11

Duplicate and split samples are collected in the same manner as the actual samples, except that the sample is evenly distributed between the containers. This helps ensure homogeneity between the original sample and the duplicate or split.

Preservative blanks are prepared in a controlled environment by filling an appropriate container with organic-free, de-ionized water, properly preserving it, and submitting it to the analytical laboratory. Containers shall be filled as specified in subsection K.4.2.3.

Container blanks are empty containers submitted to the laboratory to be checked for constituents of concern as specified in Section 4.

For laboratory use as matrix spike/matrix spike duplicates, a triple volume of sample shall be collected every twentieth sample or every sampling round, whichever is more frequent. These samples shall be collected and handled in the same manner as the other samples.

QA/QC samples are subject to the same documentation, labeling, chain-of-custody, and shipping and handling requirements as all other samples.

K.5 SOLID MATRIX ENVIRONMENTAL SAMPLES

K.5.1 Surface Soil Sampling

As part of routine monitoring, FEMP will collect surface soil samples prior to excavation in order to characterize soil for presence of hazardous or radioactive constituents. Surface soils are generally sampled with manually operated equipment and are usually within three feet of land surface.

The following general procedures are applicable to surface-soil sampling.

1. Decontaminate sampling equipment prior to use, preferably at a designated central staging area at FEMP. Specific equipment to be used shall be based on project objectives and specified in the PSP. Perform decontamination in the field only if circumstances prevent decontamination at the staging area.

2. Clean equipment as specified in subsection K-11.

3. Remove grass and other vegetation from sample collection area prior to sampling. Do not collect other surface material such as large rocks or trash unless specified in the PSP.

4. When sampling for constituents deposited through air transport, collect only the upper two inches of soil.

5. When sampling for constituents transported by surface water, collect samples in six-inch intervals to the depth specified in PSPs. Size of sampling tool shall be sufficient to collect required volume within the depth interval limitation. Collect sufficient sample and rinsate volumes to perform required analyses as defined in PSPs.

6. Collect samples with a trowel, scoop, coring device, or shovel of an inert material relative to material to be sampled and to analytes of interest as specified in the PSP.

7. Transfer samples directly from the gathering tool to sample containers specified in Table 6-1 (Appendix A). Record deviations from these requirements and provide detailed justification.

8. Collect samples for VOC analysis from a depth of three inches or more so there is less chance for constituents of concern to volatilize or photo-degrade except when sampling the location of a fresh spill. Do not composite samples collected for VOC analysis.

9. Transfer VOC samples directly to standard Volatile Organic Analysis (VOA) vials or two-ounce, wide-mouth VOA jars with teflon-lined septa lids. Fill containers as full as possible to minimize headspace.

10. Transfer soil samples collected for other organic or inorganic analyses to appropriate glass containers (Table 6-1, Appendix A) with screw cap closures.

11. Provide a trip blank to accompany each set of VOA samples collected to the field and back to the laboratory as specified in Section 4.

12. As specified in Table 6-1 (Appendix A), store samples requiring refrigeration in the field in an ice chest cooled with artificial icing material and maintained at approximately four degrees Centigrade, plus or minus two degrees.

13. Label samples and complete chain-of-custody records, field collection reports, and laboratory requests for analysis.

A mixing or compositing procedure for solid materials is designed to ensure homogeneity within a sample and to ensure that composite samples undergo the same degree of mixing. When compositing is required, adhere to the following procedures unless specifically modified in PSPs. Do not composite samples to be analyzed for unstable parameters such as VOCs.

1. Remove sample from collection device and place it in a container or on a flat surface constructed of an inert material relative to the constituents of concern.

2. When a sufficient volume of sample has been collected, divide the entire volume into relatively even quarters.

3. Mix opposite quarters together, and then mix resulting halves together. All of the material will then be regrouped into a single volume.

4. Repeat steps 2 and 3 and then place sample in appropriate containers.

K.5.2 Sediment Sampling

Sediments are materials that have been transported from their place of origin by fluid action and redeposited. Sediment sampling in Paddys Run and the Great Miami River is conducted for routine characterization because stream sediments are of most interest at FEMP.

Specific sampling stations shall be documented in PSPs (Section 6). The following practices are applicable to sediment sampling.

1. Prior to sampling sediments in a stream, decontaminate the sampling device as specified in subsection K.11. Equipment used shall be selected based on project objectives and specified in PSPs.

2. When traverse sampling of rivers and large streams is necessary, use a clamshell dredge, trowel, or similar device for sediment collection.

NOTE

Collect sediments from the station farthest downstream first and work upstream.

3. Collect sediment sample to a depth of approximately six inches below sediment/water interface. Avoid collecting large rocks or trash.

4. If the purpose for sampling is monitoring of recent or ongoing activities, ensure that recently deposited sediments are collected based on stream geomorphology.

5. Collect a sufficient amount of sample to perform required analyses as specified in the PSP.

6. Transfer sample directly to a stainless-steel pan for thorough mixing prior to placing it in sample container.

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NOTE

Do not mix samples collected for volatile organic analysis, but transfer them directly to the specified container.

7. Store samples requiring refrigeration in the field in an ice chest filled with commercially available icing material, maintaining the sample at approximately four degrees Centigrade, plus or minus two degrees.

8. Label samples and complete chain-of-custody records, field collection reports, and laboratory requests for analysis.

The mixing or compositing procedure is designed to ensure homogeneity within the sample. When mixing is required, adhere to the following procedure unless it is specifically modified in PSPs. Do not composite samples collected for analysis of unstable parameters, such as VOCs.

1. Remove sample from collection device and place it in a container or on a flat surface constructed of an inert material relative to the constituents of concern.

2. When a sufficient volume of sample has been collected, divide it into approximately even quarters.

3. Mix opposite quarters together, then mix resulting halves together. Regroup all the material into a single volume.

4. Repeat steps two and three before placing the sample in appropriate containers.

K.5.3 Subsurface Soil Sampling

Subsurface soil samples are collected for RI/FS and RCRA.

K.5.3.1 <u>Collection of Unconsolidated Subsurface Samples</u>. Adhere to the following procedures when collecting unconsolidated subsurface materials.

1. Decontaminate sampling equipment as specified in subsection K.11. Do not place sampling equipment directly on the ground or on other potentially contaminated surfaces prior to insertion into the boring. Place it on a clean plastic sheet adjacent to or around the boring. Take care that potentially contaminated excess sample does not contact the ground.

2. Collect subsurface samples using a split-spoon sampler, thin-wall tube, vibra-core, core barrel, or other appropriate method, select a drilling method based on project objectives and in compliance with drilling requirements in Appendix J, and use equipment specified in the PSP.

3. Collect undisturbed soil avoiding caving materials at the base of the borehole.

4. If cavings are present in the upper part of a sampler, discard this material prior to packaging samples for shipment.

5. Advance borings as specified in PSPs.

6. Collect samples at specified intervals in accordance with PSPs.

NOTE

Because of its ability to maintain the physical integrity of samples collected from depth, a coring tool is commonly used to collect unconsolidated subsurface samples. The tube is generally a thin-wall steel tube (Shelby tube) from one to three inches in diameter and 12 to 36 inches long.

7. Lower an appropriate sampling device consisting of a threaded coupling to fit a standard drill rod and a replaceable Shelby tube sampler down the borehole and push it into undisturbed material at the bottom of the boring. See ASTM-D-1587-83 for sampling procedures and equipment.

8. Leave samples that are to be tested for physical characteristics requiring undisturbed soil in the Shelby tube. Cap the tube ends and tape and seal the cap with wax.

9. Send sample to a FEMP-approved geotechnical laboratory for analysis.

NOTE

Split-tube or split-spoon samplers may be used for sample collection when undisturbed samples are not required.

10. Collect subsurface split-spoon samples in accordance with the following requirements. See ASTM-D-1586-84 for sampling equipment and method.

    a. Lower an appropriate clean sampling device consisting of a threaded coupling to fit a standard drill rod and a replaceable split-spoon sampler down the borehole. Push or drive it into undisturbed material at the bottom of the

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boring. While driving sampler, record number of blows required to advance it every six inches.

b. Remove sampling device from the boring, open it, and screen sample for VOCs and radionuclides using appropriate field instrumentation.

c. Screen for VOCs with a photo-ionization or a flame-ionization detector as follows. (See paragraph K.4.4 for operating requirements.)

(1) Split sample lengthwise, open it, and place the probe within one centimeter (cm) of inner surface of sample.

(2) Screen entire length of sample at a rate no greater than two cm per second. Record background reading, range observed while screening, and approximate average.

d. After VOC screening has been completed, screen for radionuclides with an alpha meter and a beta/gamma meter. Place probe approximately one cm from sample surface and screen approximately two cm of sample length per second. Record background reading, range observed while screening, and approximate average.

11. Describe sample, remove it from sampler, and transfer it to appropriate containers for shipment to the laboratory. If samples are to be composited, mix as specified in paragraph K.5.1.

12. Place samples requiring refrigeration in a cooler maintained at four degrees Centigrade, plus or minus two degrees.

13. Take subsurface soil samples collected for volatile organic analysis from interior of sample and transfer them as soon as possible to standard VOA vials or jars. Fill containers completely to minimize headspace. If samples are to be collected for VOC analysis without field screening, brass, stainless steel, or aluminum split-spoon liners may be used to minimize head space. Cap and seal the filled liners, label properly, and ship liners as the sample.

14. Transfer subsurface soil samples collected for other organic or inorganic analyses to glass containers with screw cap lids.

15. Complete sample label, chain-of-custody record, field collection report, and laboratory requests for analysis in the field.

16. Decontaminate split-spoon sampler and other sampling equipment such as trowels, pans, and gloves between each use as specified in subsection K.11.

17. Prepare samples for shipment.

18. Use appropriate screening method from paragraph K.5.3.2 to assign priorities to samples shipped for radiological analysis.

K.5.3.2 Field Screening of Samples for Radioactive Contamination. Following are uniform measurement techniques for screening subsurface soil samples for radioactive contamination and instructions for determining which samples shall be analyzed for radiological parameters. The procedure also describes 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. An example of such instrumentation is a portable multi-channel analyzer with associated sodium iodide detector. Screening shall be performed using field instruments specified in PSPs. Perform assay procedure as follows.

1. Calibrate instrument in accordance with applicable procedure.

2. Perform a five minute background count and calculate the time required to obtain the desired minimum detectable activity.

3. Count sample for the predetermined count time and record net counts or count rate.

4. Select samples for radiological analysis based on results of screening at frequency specified in the PSPs.

5. Select samples for laboratory analysis that exhibit the highest relative readings for a given location and horizon.

K.5.4 QA/QC Samples for Soil and Sediment Analyses

The following are basic requirements for QA/QC samples for soil and sediment analyses.

Trip Blanks

1. Include trip blanks with each shipping container of soil and sediment samples analyzed for VOCs unless specifically omitted in PSPs.

2. Prepare and handle trip blanks as specified in paragraph K.4.5.

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Rinsate Samples

1. Obtain equipment decontamination samples by pouring organic-free, de-ionized water over the equipment and collecting it in the container specified in paragraph K.4.5 for aqueous samples.

Duplicate and Split Samples

1. Collect samples in the same manner as actual samples, except that samples shall be composite and evenly distributed between containers while filling.

2. Do not composite samples for VOC analysis.

Container Blanks

1. Submit empty containers to the laboratory to check for constituents of concern (Section 4).

Matrix Spike/Matrix Spike Duplicates for laboratory use

1. Collect a triple volume of sample every twentieth sample or every sampling round, whichever is more frequent, and handle it in the same manner as other samples.

QA/QC samples are subject to the same documentation, labeling, chain-of-custody, and shipping and handling requirements as other samples.

K.5.5 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 a RCRA waste. PSPs shall describe objectives for drum sampling, representative drum selection criteria, analytical testing requirements, statistical analyses for drum sample testing (e.g., confidence levels), and disposal plans.

K.5.5.1 <u>Sampling and Analysis</u>. The FEMP Waste Analysis Plan was prepared in accordance with the requirements of Ohio Administrative Code (OAC) 3745; 40 CFR 264, 268, and 270. The sampling and analysis section of the Waste Analysis Plan describes procedures used at FEMP to characterize waste in order to manage it appropriately.

K.5.5.2 <u>Analytical Parameters and Rationale</u>. A waste stream shall be analyzed for those parameters most likely to yield the maximum amount of chemical and physical information. In addition, specific analyses are selected based on historical knowledge, knowledge of the waste generation process, and the constituents suspected to be in the waste. The waste parameters selected shall represent those characteristics necessary to manage the

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waste in compliance with the FEMP Part B permit application requirements.

K.5.5.3 **Test Methods.** When process knowledge is insufficient to identify a waste stream as hazardous, additional information shall be requested or analytical methods applied to make the determination. Sample preparation and analytical methods are specified in the Part B permit application.

K.5.5.4 **Sampling Procedures.** Basic requirements for the drum sampling process follow.

NOTE

Because drum samples are taken from top to bottom, only the boring location on the top surface needs to be random.

1. Select a boring position within the drum cross section just prior to taking the sample.

2. Collect sample using one of the following techniques.

   a. Use a **grain sampler** for free-flowing particulate solids that are easy to penetrate and collect sample as follows.

      (1) Ensure that grain sampler is in closed position with slots in the outer tube face up.

      (2) Insert sampler diagonally at a point near the side of the drum, through the center, and to a point opposite the entry point.

      (3) Rotate inner tube of sampler to the open position, collect sample, and rotate inner tube to closed position.

      (4) Withdraw sampler from drum and place it in a horizontal position with slots in the outer tube facing up.

      (5) Rotate inner tube to the open position and place the sample collected in an appropriate container as specified in Table 6-1 (Appendix A).

   b. Use a **pipe sampler** for moist or otherwise cohesive particulate solids that can be pulled out as a core and collect sample as follows.

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NOTE

Pipe sampler shall be long enough to reach bottom of sampled drum.

(1) Insert sampler diagonally through the contents of drum and rotate once or twice to cut a core of material.

(2) Ensure that slot is face up and slowly withdraw the sampler.

(3) Ensure that entire length of pipe contains material. If it does not, repeat steps (1) and (2).

(4) Use a clean stainless steel spatula and push the material out of sampler into an appropriate container as specified in Table 6-1 (Appendix A).

(5) Place a lid on container **before** collecting the next sample.

(6) Repeat steps (1) through (5) to collect samples from the other seven grid points in the drum.

NOTE

Clear plastic composite liquid waste samplers (COLIWASAs) are suitable for liquid wastes at FEMP. Only if plastic is noticeably attacked (softened) by a solvent waste, is it necessary to use a glass COLIWASA (paragraph K.5.4.6).

c. Use a COLIWASA to collect full depth samples from drums of liquid waste.

(1) Adjust locking mechanism of sampler, if necessary, to ensure that neoprene rubber stopper provides a tight closure.

(2) Place stopper rod handle in the T-position and push it down until handle is against the locking block.

NOTE

If liquid level in sampler tube is lower than level outside sampler, it is being lowered too fast and a nonrepresentative sample will be obtained.

(3) Slowly lower COLIWASA vertically into drum so that the levels of liquid inside and outside the sampler tube remain even.

(4) When stopper hits bottom of drum, push sampler tube downward against stopper to close sampler.

(5) Turn T-handle upright with one end tight on locking block to lock sampler in closed position.

(6) Slowly withdraw sampler with one hand while wiping outside of it with a clean, disposable cloth.

(7) Dispose of cloth in a manner consistent with suspected drum constituents.

(8) Place end of COLIWASA into an appropriate composite sample container.

(9) Empty sampler by slowly pulling lower end of T-handle away from locking block.

3. Transport sample to analytical laboratory under chain-of-custody protocols specified in Section 7.

4. Upon sampling completion of a drum lot, clean sampler at a level III decontamination as specified in Appendix J.

NOTE

It is not necessary to clean sampler between drums within the same lot (i.e., same waste stream).

5. Document sampling activities by completing a daily log including the following specific items.

- Daily field log form or log book
- Chain-of-custody record

K.5.5.5 Glass COLIWASA. If it is necessary to use a glass COLIWASA, proceed as follows.

1. Insert inner tubing of the glass COLIWASA inside the sheath.

NOTE

If liquid in sampler tube is lower than the level outside the sampler, the sampler is being lowered too fast and a nonrepresentative sample will be obtained.

2. Slowly lower COLIWASA vertically into drum, keeping the ground glass end away from hole in bottom of sheath, so that the levels of liquid inside and outside the sampler tube remain even.

3. When sheath hits bottom of drum, push the inner tube downward so that ground glass end seals the end of the sheath.

4. Slowly withdraw COLIWASA with one hand and wipe the outside of the sampler with a clean, disposable cloth. Dispose of cloth consistent with suspected drum constituents.

5. Place end of COLIWASA into the appropriate composite sample container.

6. Empty sampler by pulling inner tube upward causing ground glass end to separate from the outer tube bottom.

7. If an organic analysis is required, follow procedures in paragraph K.4.5.

K.5.5.6 Liquid Volatile Organic Analysis Sample Collection. If VOC analysis of a liquid sample is required, collect sample as follows.

NOTE

For VOC analysis, no air bubbles can be present in septum bottle.

1. Carefully fill a septum bottle with sample liquid to lip of bottle.

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2. Slide teflon spectrum across lip of the bottle covering the opening, and then screw plastic lid on bottle.

3. Check bottle for air bubbles by turning it upside down.

4. If air bubbles are present, empty bottle and repeat steps 1, 2, and 3 until no air bubbles are present.

K.6 GASEOUS MATRIX SAMPLES

Air sampling conducted at FEMP includes stack sampling for compliance with the Clean Air Act (CAA), radon sampling, 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.

K.6.1 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 millirem (mrem) in one year to any individual shall be monitored and inspected at least weekly as specified in the Clean Air Act, 40 CFR 61, and DOE 5400.5. Total uranium analysis shall be performed as specified in Analytical Laboratories Method Number 3002. Stack sampling shall be conducted as follows.

1. Review stack log for installed filter number and prescribed flow rate and record it on stack sampler inspection report form (Form K-1, Appendix B).

2. Observe control panel of dust collector and record the following available data on stack sampler inspection report form.

NOTE

On dust collectors equipped with multipoint isokinetic samplers, flow rate adjustments to the sampler are not made during filter changeout. Obtain flow rate information before changeout.

a. Record high and low pressure from differential pressure chart.

b. Record counts per minute (cpm) from the Ludlum stack monitor reading in the BEFORE INSPECTION column.

c. Record stack alarm set point.

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3. Check Ludlum stack monitor for proper operation and source response as specified in applicable procedures and record results on Ludlum radiation stack monitor inspection report form (Form K-2, Appendix B).

4. At stack sampler, verify that stack sampler, vacuum tubing, and other sampling equipment is operating properly. If defects are found, record them on stack sampler inspection report form and notify shift supervisor.

5. Determine existing sampling rate by inserting a rotameter between vacuum line and filter holder and record sampling rate under RATE-ACTUAL on stack sampler inspection report form.

6. Adjust sampling rate to prescribed rate if necessary. If prescribed rate cannot be achieved, record this on the stack sampler inspection report form (Form K-1, Appendix B).

7. Strike cone section of filter holder several times around the periphery to dislodge material clinging to inside of cone.

8. Loosen the three fasteners and carefully lower bottom section of filter holder.

9. Visually inspect stack filter. During inspection and handling of stack filter, ensure that there is no loss of filtered material or any contamination from foreign sources.

10. If filter appears to be clean, re-install it and notify shift supervisor. However, if the filter is scheduled for replacement, remove and bag it; and install a new filter. When re-assembling filter holder assembly, tighten fasteners sufficiently to prevent a vacuum leak at sealing surface.

    a. Notify shift supervisor and record new filter number on stack sampler inspection report form.

    b. Prepare request for analysis of total uranium and retain a copy for records.

    c. When analysis results are received, calculate total uranium losses as follows.

$$\frac{\text{Total Uranium (mg) x Conversion Factor supplied by IH}}{1000} = \text{Loss in kilograms}$$

    d. Notify the shift supervisor of calculated loss and record the supervisor's name, time of notification, and calculation results on final stack sampler results form (Form K-3, Appendix B).

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11. If filter appears to be lightly soiled or laden with material, remove filter and bag it. Install a new filter and record new filter number on inspection/change report. When re-assembling filter holder assembly, tighten fasteners sufficiently to prevent a vacuum leak at sealing surface.

    a. Notify shift supervisor of filter condition. If plant is not operating and there is no shift supervisor available, notify Security to contact the area supervisor for notification.

    b. Immediately initiate and time stamp the final stack sample results form (Form K-3, Appendix B).

    c. Request analysis for total uranium on an expedited basis with results to be forwarded immediately upon completion. Maintain a copy of the request for records.

    d. When results are received, immediately calculate total uranium loss as described in step 10, c.

    e. Notify shift supervisor of calculated loss in person or over the telephone and record supervisor's name, time of notification, and calculation results on the final stack sampler results form.

12. Re-check Ludlum reading and flow rate. Adjust flow rate to prescribed cpm if necessary and record Ludlum reading in the **AFTER** column on stack sampler inspection report form.

13. If required rate cannot be obtained, record it on stack sampler inspection report form and contact shift supervisor for corrective action instructions.

14. Follow up to confirm that proper flow has been obtained and notify shift supervisor if flow rate has been readjusted.

15. Remove rotameter and reconnect vacuum line to sampler.

16. Complete stack sampler inspection report form (Form K-1, Appendix B) and final stack sampler results form (Form K-3, Appendix B) and check for accuracy.

17. Record filter number if replaced, sampling date, and analytical results in dust collector stack sampling log (Form K-4, Appendix B).

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K.6.2 Radon Sampling

Various federal regulations (40 CFR Parts 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. Details of this measurement method are given in 40 CFR, Part 61, Appendix B, Method 115. Method 115 also references an EPA document written by Hartley and Freeman, which describes the Large-Area, Activated-Charcoal Collector (LAACC) in detail and gives general field methods for its use. Radon sampling shall be conducted as follows.

1. Examine the area to be measured prior to conducting measurements to determine the number of locations required and to identify problems that may arise during sampling.

NOTE

The required measurement density is determined by the intended use of the measurement results. Method 115 requires a minimum of 100 measurements per source.

2. To obtain radon flux measurements that are representative of long term average radon emissions, observe the following restrictions.

   a. Do not initiate measurements within 24 hours after a rainfall. If rainfall occurs during the measurement period, the measurement becomes invalid if seal around lip of collector has washed away or if collector is surrounded by standing water.

   b. Do not perform measurements when ambient temperature is below two degrees Centigrade or when the ground is frozen.

3. Prior to use, thoroughly purge the activated charcoal to be used in the radon LAACCs by heating in an oven at 110 degrees Centigrade for approximately four hours. Keep the charcoal in a radon-resistant, sealed container until ready to use in LAACC.

4. Obtain a blank by sealing in a sample can approximately 180 grams of the same charcoal to be used to load the LAACCs at same time that LAACCs are loaded. Label can with the word "BLANK", the date and time it was sealed, and initial. A minimum of one blank is required for each batch of LAACCs to be exposed in the field.

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5. Assemble LAACC as follows.

   a. Remove retaining ring and cover pad from LAACC.

   b. Spread a minimum of 180 grams activated charcoal evenly over support grid. The correct amount of charcoal is most easily obtained by using an empty sample can as a measuring container. One level can of six-by-six mesh charcoal is approximately 190 grams.

   c. Replace cover pad and retaining ring.

   d. If LAACC is not placed on the measurement surface immediately, keep it in a radon-resistant, sealed container such as a length of 12-inch-diameter PVC pipe fitted with end caps.

6. Expose LAACC as follows.

   a. Clean surface on which collector is to be placed of vegetation and large pebbles that might prevent a good seal between collector and soil.

   b. Place collector on surface to be measured; and, to ensure a good seal between surface LAACC, pack one to two inches of soil around lip of collector.

   c. Record collector number, sample IDentification (ID), date, time, and location in the field log. Initial entry.

   d. Expose LAACC for 24 hours ($\pm$ two hours), then remove it from measurement surface.

   e. Record date and time of removal in the log and initial the entry.

7. Remove collected LAACCs to a staging area away from the measurement area to recover exposed charcoal.

8. Remove charcoal from LAACC and place it in an approved can as soon as possible, proceeding as follows.

   a. Remove retainer ring and cover pad from LAACC.

   b. Gently pour charcoal from LAACC onto a mixing pad being sure to obtain all activated charcoal from the LAACC.

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c. Mix charcoal on mixing pad and transfer it to an empty can. Seal can with sealer and affix a label with sample IDentification (ID), location, dates, and times placed and retrieved. Initial label.

9. Prepare cans for return to laboratory for gamma ray analysis and return them to the laboratory as soon as possible to minimize loss of measurable activity. (Rn-222 has a half life of only 3.825 days.)

K.6.2.1 Long-Term Radon Sampling in Air. The following instructions for collection of samples to determine long-term radon-222 (Rn-222) concentrations in air under ambient outdoor conditions are as specified in H. W. Alter and R. L. Fleisher (1981) "Passive Integrating Radon Monitor for Environmental Monitoring," Health Physics, Volume 40, p. 693, and "Instruction for Track-Etch^R Type F Radon Detectors", Terradex Corporation, Walnut Creek, California.

Perform sampling at frequency and locations specified in the PSP and in accordance with the following procedures.

1. Submit an order for purchase and readout of detectors specifying delivery date two weeks prior to planned installation and include the following specifications.

   a. Quantity of detectors required (enough to install a minimum of two detectors at each location and at least ten detectors for known exposures and background determinations)

   b. Requirement that all detectors in the order be produced from same batch of film

   c. Type F configuration

   d. Maximum readout area for outdoor monitoring (Terradex film detector - 19.3 mm^2)

   e. Results of readouts in picocuries per liter (pCi/l) and in either tracks/mm^2 or total tracks.

2. Inspect shipment of film detector cups upon arrival from distributor as follows.

   a. Check aluminum bags for holes or tears.

CAUTION

DO NOT open sealed aluminum bags until they are installed at monitoring location.

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b. Check bag contents by feeling along entire length of bag for crushed cups.

3. Firmly mount protective canister (shield) on post or other suitable location, two to three meters high, where there are no obstructions to free flow of air past detector. Generally, canister shall be mounted on north side of mounting post avoiding building walls, highway structures, or large signs. Alternatively, the detector with the protective canister surrounding the plastic cup may be placed inside a larger stand-alone shelter. Canisters shall be installed so that the entire detector is at least six inches from any obstruction and with the open mouth facing down. The stand-alone shelter shall be open to allow for free air flow. Detectors must be mounted firmly to avoid movement within the shelter.

4. At monitoring location, open one bag and remove enough film detector cups to enable installation of an appropriate number of replicates. Close bag after removing cups.

CAUTION

DO NOT touch film. If film is touched, discard it and use a different cup and detector.

5. Visually inspect film detector to ensure that it is securely fastened to bottom of cup. If not, secure it.

6. If film is discarded, note serial number of breached cup on field data sheet and indicate what happened in the comments section.

7. Using one filter with the shiny side out, cover mouth of cup.

8. Using one red covering and holding filter taut, firmly push cover ring over the two sets of ribs of the cup.

9. Ensure that cover is fully seated around cup rim, the filter covers the entire mouth of cup, there are no large wrinkles in the filter, and that the filter has not been torn or punctured by assembly.

10. Install film detector cup at monitoring location inside the protective canister.

11. Enter serial number of film detector cup, date bag was opened, date installed, site number, and location on the field data sheet.

12. Schedule installation of film detector cups so that all cups can be installed immediately when a bag is opened. Save aluminum bags for use when film detector cups are retrieved. Do not use film detector cups that have been stored in an open bag overnight.

13. Remove film detector cup from canister, wipe off dust or dirt from outside of cup, and remove red cover ring and filter from mouth of cup.

14. Hold filter up to the light and record visible damage (e.g., pinholes, scratches, tears) in comments section of data sheet.

15. Visually inspect film on bottom of cup and record discoloration or damage to the film in comments section of data sheet.

16. Enter date removed next to the correct serial number on field data sheet.

17. Place film detector cup in aluminum bag. Stack exposed cups in bag until it is full (10 cups, maximum), then insert empty cup provided into the last film detector cup with a yellow plastic separator sheet. If an end cup is not provided, place the yellow plastic separator sheet over the mouth of the last film detector cup and secure it with one of the red coverings.

18. Fold open end of aluminum bag and seal it with tape.

19. After retrieving exposed detectors, proof-read field data sheets to ensure that detector serial number, date opened, date installed, date removed, site number, and location are recorded in proper columns and that comments are legible.

20. Ensure that aluminum bags containing exposed detectors are sealed and have no pinholes or tears.

21. Transcribe data from field data sheets to vendor data sheets and complete vendor pre-shipping checklist. Specify readout sensitivity and special handling instructions.

22. Include data sheets with detectors and ship detectors to vendor for readout.

K.6.2.2 **Short-Term Radon Sampling in Air.** This procedure describes methods for 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 described are in accordance with DOE Order 5480.1, 10 CFR 20, and U.S. EPA standards 40 CFR 192. Sampling shall be performed at the frequency and locations specified in the PSP as follows.

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1. Perform sampling of 24, 48, or 72 hours integrated sample of ambient air as follows.

   a. Place radon gas bag at sampling location and turn on pulse pump.

   b. Record date and time of start-up on sample collection log and on gas bag.

   c. To fill 44-liter bag, use the following pump cycles.

Sample Time (Hours)	Pump Interval (Seconds)
24	5
48	12
72	15

   d. Secure and protect sampling equipment from inclement weather conditions and vandalism.

   e. After completion of sampling period, turn off pulse pump and record date and ending time on sample collection log and on gas bag.

   f. Take gas bag to counting room for transfer of air sample to an SC-6 scintillation cell.

   g. Using a small piece of tygon tubing, attach an evacuated SC-6 cell to valve on gas bag in series with a 0.45-micron filter. Open valves to transfer air into cell. Transfer at least three cell volumes to provide a representative sample.

   h. Record date and time of sample transfer on label of SC-6 cell and on sample collection log.

   i. Place SC-6 cell in sample holding area for counting in a SAC-R5 alpha counter. See calibration and counting procedures for use of SAC-R5 and SC-6 scintillation cell radon counting system. (Results of the count are used to determine radon gas concentration in pCi/L in the integrated sample.)

2. Perform soil gas sampling (radon flux measurements).

   a. Position a special 55-gallon drum section over sampling point and, with a downward twisting motion, countersink the barrel one to two inches into the soil or otherwise seal the drum to the ground.

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b. Attach a 50-cubic centimeter (cc) syringe to valve assembly, open valve, and rapidly pump syringe ten times.

c. Close valve, remove syringe, and attach an evacuated SC-6 cell with a piece of tygon tubing with in-line 0.45-micron filter.

d. Open valve on drum, then open valve on SC-6, and fill the SC-6 cell.

e. Close valve on SC-6 cell and close barrel valve.

f. Record time and date for sample.

g. Record cross-section area of drum as the sample area. (A 55-gallon drum with a diameter of 22.5 inches has an area equivalent to 0.256 m^2.)

NOTE

The first sample is considered a background sample. The second sample represents radon buildup over the 45-minute sampling time.

h. After 45 minutes, repeat steps b through g using a second evacuated SC-6 cell.

i. Submit samples to counting lab for counting. (Radon concentration is determined by counting in a SAC-R5 alpha counter. Results are used to determine the radon flux ratio, which is expressed in pCi/m^2-sec.)

3. Perform instantaneous air sampling.

a. Collect instantaneous or "spot" air samples using an evacuated SC-6 scintillation cell.

b. At the sampling location, collect a sample by opening the valve on a SC-6 cell that has an in-line 0.45-micron filter connected to the valve by means of a small piece of tygon tubing.

c. Record location, date, and time of collection on SC-6 cell label.

d. Transfer filled SC-6 cell to counting lab for counting in a SAC-R5 alpha counter. (Results in pCi/L are used to determine concentration of radon in the sample.)

K.6.3 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 follows using both instrumentation that includes a pump with an appropriate filter set at a designated location (e.g., the breathing zone of workers) and counting instruments to determine amount of collected contaminants.

1. Prior to taking a sample, determine amount of activity required for sample.

2. Base sample collection time on pump flow rate and parameters in step 1 so that ten percent of derived air concentration is detected if present.

3. Record start time of sample collection and flow rate.

4. When collection is complete, turn off pump and record the end time.

5. Count filter media on appropriate instrument. Record elapsed time between time of counting and time that filter was removed from pump.

6. If necessary, recount sample and follow applicable procedure for determining long-lived, radon or thoron concentrations.

Continuous Air Monitors (CAM) are used to provide real-time air monitoring as required by DOE Order 5480.11. There are several different types of CAMs in use at the site and each must be operated in accordance with applicable documented procedures. These instruments are generally used as warning devices and do not normally produce data useable by the FEMP CERCLA group. However, instruments equipped with strip charts may be used for tracking ambient airborne levels of radioactive contaminants.

K.6.4 Monitoring for Organic and Inorganic Contaminants in the Field

Air monitoring is done to screen samples for organic analysis in the field and to protect workers from organic and inorganic contaminants in accordance with FEMP and OSHA requirements. Types of equipment used and contaminants detected include the following.

- A PID and FID for organic vapors relative to a standard gas

- Colorimetric Indicator Tubes (CIT) for parameter-specific organic and inorganic vapors

- Explosimeters for combustible gases, usually calibrated relative to methane

- Filter pumps and petrographic microscopes for quantification of asbestos contamination

- Portable gas chromatographs for quantification of specific parameters.

Portable air monitoring equipment shall be permanently labeled with a unique identification number. Calibration gases used shall be in the approximate expected range of contaminants to be measured, as most monitoring equipment response is not linear throughout the range of operation. Calibrations shall be checked on a daily or per-use basis consistent with the requirements of Appendix I. Instrument response shall be checked at each use and rechargeable batteries recharged after each day of use and checked prior to the start of each work day. The manufacturer, batch number, type, and response range shall be recorded for disposable materials used, such as air filters and CITs.

K.6.4.1 **Photo-Ionization Detector.** The PID is the standard field instrument for monitoring the work zone for organic and certain inorganic vapors, screening samples for organic analysis, and performing head space measurements on wells. The instrument may be affected by humidity and electromagnetic fields, and certain older instruments may be affected by wind speed into the probe. Common PIDs include the HNu PI-102, the Photovac TIP and TIP II, and the Environmental Instruments OVM.

The PID shall be calibrated to a standard gas of known response (usually isobutylene) and measurements normalized to calibrated units of the gas. Readings shall be qualified to indicate the standard gas (e.g., 10 ppm of isobutylene). Because different gases have different responses to a PID, the concentration of a particular gas cannot be quantified unless it is known that only one ionizable gas is present and wavelength of the PID bulb, ionization potential of the gas, and response factor for that gas at wavelength of the bulb are known. When a mixture of gases is measured, only the relative response of the mixture to the standard is known. When a PID is used, the following items shall be addressed.

1. Check the calibration with a known standard on a daily basis and record the response on an instrument log (Appendix I). If a declining trend in instrument response is noted or if the response is not within ten percent of the standard, recalibrate the instrument.

2. Prior to each use, verify the response of the instrument to an organic vapor source such as an indelible marker and allow the instrument to purge itself of the vapor before continuing use.

3. Change the filter, as applicable, on a monthly basis or more often under high-use or harsh conditions. Record the last cleaning or replacement on the instrument log.

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4. Clean the lamp and ion chamber on a PID or the burn chamber on a FID (paragraph K.6.4.2) monthly or more often under high-use or harsh conditions. Record cleanings on the instrument log.

5. Set zero either with ultra-pure air or by operating the instrument in a known "clean" area. Measure background readings at the site before start of work.

6. When monitoring for health and safety purposes, consider background readings as part of the total.

7. When screening samples for organic contaminants, the background contribution from ambient air or the container in which the sample is placed must be accounted for. Container blanks shall be analyzed at a frequency of at least 1 per 20 measurements when glass or stainless steel containers are used. Container blank measurements shall be made on every container when plastic or teflon containers are used. Record all background and container blank measurements .

8. When screening samples for organic contaminants, both the maximum reading and the stabilized reading shall be recorded. If the reading has not stabilized after approximately 20 seconds, this shall also be recorded. Background measurements shall be subtracted from the total readings as part of data reduction.

9. Sample preparation and handling when screening for organic contaminants are a function of the sample matrix; expected concentrations of contaminants, field conditions, and the intended data use. These items shall be addressed in PSPs when this type of measurement is specified.

K.6.4.2 **Flame-Ionization Detector.** A FID is used to detect organic compounds using a hydrogen flame-ionization source. Like the PID, a FID measures total concentration of ionizable compounds rather than parameter-specific concentrations. Responses of different compounds may vary from the calibration gas. Because of the requirement for a hydrogen gas source, special labeling and packaging are required to ship a FID.

A commonly used FID is the Century Systems OVA. FIDs are generally capable of measuring concentrations of total ionizable constituents down to concentrations of 0.1 ppm with reasonable accuracy. The constituents ionized by an FID are not limited by wavelength. Therefore, a wider range of constituents, including methane (which will not be measured by a PID) will be included in total concentrations relative to a PID. Therefore, total concentrations measured with a FID ar not directly correlatable to the measured by a PID. When a FID is used, items 2 through 9 listed in paragraph K.6.4.1 shall be addressed.

K.6.4.3 **Colorimetric Indicator Tubes.** CITs are used to detect a wide variety of organic and inorganic gases and vapors. Individual tubes can be used only once and only for specific elements or compounds. Also, many tubes are useful only in a specified concentration

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range. Either manual or automatic pumps may be used; however, only tubes manufactured for a specific pump may be used with that pump. Detailed instructions for use accompany each box of tubes.

Prior to using CITs, check the pump for leaks by inserting an unopened tube into the pump and operating it. A sufficient vacuum shall be present to prevent further operation of the pump until the tube is removed. If a sufficient vacuum is not present, recheck the pump with another unopened tube. If test still fails, repair or replace pump.

Care shall be taken when handling broken glass from opened tubes. Used CITs shall be disposed of properly.

Different tubes have different response times, so it is important that activities depending on the result of the CIT response be curtailed until the response is complete.

The use of CITs is dependant on the types and concentrations of contaminants expected. If the use of CITs is required, the types of tubes and pumps shall be specified in the PSP. Operating requirements shall be as directed by the manufacturer of the particular tube and pump specified.

K.6.4.4 **Explosimeters.** Explosimeters are used to test an atmosphere for concentration of combustible gases and vapors. When used in confined spaces, an explosimeter shall always be used with an oxygen meter. The explosimeter will only detect presence of explosive gases and vapors, not dusts or mists. Most explosimeters are calibrated relative to methane gas (Appendix I). If a there is a potential for encountering a gas or vapor that is more explosive than methane, make adjustments in the alarm settings to increase the sensitivity of the instrument. Never set the initial alarm setting higher than ten percent of the lower explosive limit.

K.6.4.5 **Filter Pumps.** Filter pumps are used to collect particulates from the air. Size filters to collect the particulates of interest using prefilters if necessary. Check pumps for leaks by blocking the intake to see if a vacuum forms. Filters are quantified for asbestos analysis by point-counting fibers or particles of interest with a petrographic microscope. Other types of measurements rely on weight change of the filters or quantification of chemical changes. Record the filter manufacturer, filter size, installation and removal time, beginning and ending flow rate, and length of pump operation time on the daily field log when use of a filter pump is specified in a PSP.

K.6.4.6 **Gas Chromatographs.** Portable gas chromatographs are commonly outfitted with PIDs or FIDs and a separating capillary or packed column attached to the intake. A sample is injected into the carrier stream and separated on the basis of molecular size. As each individual compound reaches the detector, the instrument responds. Standards are used to determine how long it takes compounds of interest to traverse the column and to calibrate the response of the instrument on a parameter-specific basis. Portable gas chromatographs

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provide constituent specific concentrations in a short time. If the use of a portable gas chromatograph is specified in a PSP, operating procedures shall also be included.

Portable air monitoring equipment shall be permanently labeled with a unique identification number. Calibration gases shall be in the approximate expected range of measured contaminants because most monitoring equipment response is not linear throughout the range of operation (Appendix I). Calibrations shall be checked daily or per-use. Instrument response shall be checked at each use and rechargeable batteries recharged after each day of use and checked prior to the start of each work day. The manufacturer, batch number, type, and response range shall be recorded for disposable materials used (e.g., air filters and CITs).

K.6.5 DOE-Required Air Monitoring.

The goal of air sampling at a site is to adequately characterize air-related contaminant exposures. At a minimum, sampling results shall be adequate for predictive short-term and long-term modeling. When long-term inhalation exposures are required, sample results shall be representative of the long-term exposure points. This requires an air sampling program of sufficient temporal scale to encompass the range of meteorological and climatic conditions potentially affecting emissions and of sufficient spatial scale to characterize associated air concentrations at potential exposure points.

Potential exists for exposure to air particulates from past and present releases, both directly from the facility and from re-suspension of materials following deposition. Uranium is the primary particulate constituent of concern making particulate air sampling an important part of the environmental surveillance program in order to comply with applicable dose limits. Selection of air monitoring type depends on emission sources investigated and exposure routes evaluated. For example, if dust inhalation is an exposure pathway of concern, the monitoring equipment shall be able to collect respirable dust samples.

Air sampler locations 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. In general, indicator locations shall not be placed in valleys, near structures that would affect measurements, in areas of different geology, or in areas 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.

Air samplers shall be mounted in locked, all-weather stations with the sampler discharge located to prevent recirculation of air. The air sampling system shall have a flow rate meter. The air sampling rate shall not vary by more than 20 percent, and total air flow or total running time shall be indicated. Linear flow rate across air particulate filters shall be maintained between 20 to 50 meters per minute (m/min).

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Air sampling systems shall be leak-tested, flow-calibrated (Appendix I), tested, and inspected routinely according to a written procedure (DOE/EH-0173T, Summary 5q). Flow calibration shall be at least as often as suggested by the manufacturer. If the projected dose equivalent from inhalation of particulates exceeds 20 percent of the regulatory limit (two mrem), a particle-size analysis of the emission shall be conducted at least annually (DOE/EH-0173T, Summary 5f).

Selection of the filter type for collection of air particulates shall be based on site-specific needs. As a minimum, collection efficiency, particle size selectivity, ease of radiochemical analyses, and cost shall be considered when selecting filters.

Performance standards for air-sampling are as follows.

- Airborne emissions from the FEMP shall be evaluated and their potential for release of radionuclides assessed. Based on this assessment, decisions shall be made regarding necessary effluent monitoring systems; the rationale shall be documented. The potential for emissions shall include consideration of the loss of emission controls while otherwise operating normally.

- For new facilities or facilities modified in a manner that could affect effluent release quantity or quality or the sensitivity of monitoring or surveillance systems, a preoperational assessment shall be made to determine the types and quantities of liquid effluents expected to establish the associated airborne emission monitoring needs of the facility.

- The performance of the airborne emissions monitoring systems shall be sufficient for determining whether the releases of radioactive material are within the limits or requirements specified in DOE 5400.5.

- Sampling and monitoring systems shall be calibrated before use and recalibrated anytime they are subject to maintenance or modification that may affect equipment calibration.

- Sampling and monitoring systems shall be recalibrated at least annually and routinely checked with known sources to determine that they are consitently functioning properly.

- Provisions for monitoring of airborne emissions during accidental situations shall be considered when determining routine airborne emission monitoring program needs.

- Diffuse sources (ie., area sources or multiple point sources in a limited area) shall be identified and assessed for their potential to contribute to public dose, and shall be considered in designing the site emissions monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g., 10%) of the

dose to members of the public resulting from site operations shall be identified, assessed, documented, and verified annually.

- Airborne emission sampling and monitoring systems shall demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.

- To the extent practicable, samples shall be extracted from the effluent from a location and in a manner that provides a representative sample using multiport probes if necessary.

- To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding established limits, when continuous monitoring systems are required they shall have alarms set to provide timely warning.

Meteorologic monitoring shall be completed to assess potential off-site impacts for releases of airborne contamination. Assessments may be completed for actual, projected, or accidental releases. Necessary data shall be obtained from on-site instrumentation. Instruments that may be used include wind speed, wind direction, ambient and dewpoint temperature, precipitation, and barometric pressure measuring devices. Sensors and on-site measurement locations shall be determined based on a PSP and DQOs.

K.7 BIOLOGICAL SAMPLING

Biological sampling is conducted at FEMP to evaluate radiological parameters (e.g., uranium) in selected flora and fauna. Following is a description of procedures for ongoing biological studies and key elements for a work plan for future studies.

K.7.1 Ongoing Sampling

Ongoing biological sampling at FEMP is conducted for milk, fish, produce, game, meat, and grass. Sampling methods follow.

K.7.1.1 General Methods. Following are methods that are generally applicable for collection of biological samples for FEMP. Methods specific to each sample type are presented in the following paragraphs.

1. For off-site properties, obtain permission from property owner and arrange a date and time to collect samples.

2. Obtain appropriate sample equipment, containers, and preservatives as specified in Table 6-1 (Appendix A) or in PSPs.

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NOTE

Sampling shall include collection and testing of field QA/QC blanks as required by PSP.

3. Collect biological samples as specified in paragraphs K.7.1.2 through K.7.1.5, or for materials not covered, specify collection method in PSP.

4. Document sample collection activities in a bound field log and complete request for sample analysis, summary of biological sampling, and chain-of-custody records.

5. Handle samples as specified in Section 7 and send samples to laboratory for testing.

K.7.1.2 Milk Samples. Proceed as follows when collecting milk samples.

1. Provide sample containers to dairy operator and request they be filled with whole milk.

2. Observe filling of sample bottles by operator.

3. Place filled sample containers into cooler and refrigerate at two to six degrees Centigrade.

K.7.1.3 Fish Samples. Proceed as follows when collecting fish samples.

1. Collect fish using electro-fishing methods at the designated water body locations.

2. Complete a sampling site survey that includes water depths, number of collected fish, family and species of fish, and frequency distribution.

3. If whole fish specimens require testing, freeze fish for transportation to laboratory.

4. If fish fillets are required, cut fish flesh from back bone to provide sufficient sample quantity for analysis and freeze fillets for transportation to laboratory.

K.7.1.4 Grass Samples. Proceed as follows when collecting grass samples.

1. Plan to sample soil/grass several days in advance and provide sufficient flexibility in schedule to avoid sampling during a wet period or within 48 hours of precipitation.

2. Select a sampling location that has not been disturbed by recent activity.

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3. Collect two soil samples as specified in subsection K.5: one from a depth of zero to five centimeters (cm) and the second from five to ten cm.

NOTE

It may be necessary to collect grass samples from several locations in the same general area to obtain a sufficient quantity.

4. Collect grass samples as near as possible to the soil sample location. Do not cut clover, weeds, dry grass, or roots.

5. Using clean scissors, cut grass at ground surface without getting soil in the sample.

K.7.1.5 Produce Samples. Proceed as follows when collecting samples of farm and garden produce.

1. Complete sampling prior to fall harvest.

2. Select samples from locations that have not been recently disturbed.

3. At a given farm garden, select samples of the same produce type from six locations, if available, and combine them into one sample. If there is insufficient produce, collect from as many locations as possible; and, if necessary, augment the sample with leaves and stems from the produce plant.

4. Collect a sample of fertilizer used on plants if available.

K.7.1.6 Meat Samples. Meat samples are obtained from domestic animals (e.g., cattle) and game (e.g, deer). The body parts sampled will vary depending on the constituents of concern and shall be specified in the PSPs.

K.7.2 Target Compound Identification

Target compounds are 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 review of soil, sediment, ground water, surface water, and air test data relative to Applicable or Relevant and Appropriate Requirements (ARAR) and ambient water quality criteria. Detailed methodology for comparison is presented in the EPA Risk Assessment Guidance Manual (U.S. Environmental Protection Agency, 1989c).

K.8 MISCELLANEOUS SAMPLES

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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 each ASLs A through E.

Media samples shall be collected at sample point locations specified in PSPs. Each sample shall be placed in appropriate sample containers as identified in the PSP and labeled as specified in Section 7.

The following methodology shall be used to collect solid debris samples from construction, renovation, and demolition (paint chip, wood, concrete, and dust) for radiological and chemical analyses.

K.8.1 Paint Chip Samples

1. Place clean plastic sheeting on ground, concrete, or floor surface within sample area.

2. Use a decontaminated putty knife or paint scraper and remove loose paint material from host surface.

3. Collect chips in a stainless-steel pan or tray and transfer them to an appropriate sample container (Table 6-1, Appendix A, or PSPs) with a stainless steel-scoop or spoon.

4. Seal container with custody tape, label it, and submit samples to FEMP analytical laboratory with chain-of-custody record.

K.8.2 Wood Samples

1. Place clean plastic sheeting on ground, concrete, or floor surface within sample area.

2. Use a rotary drill and decontaminated wood bit and collect wood cuttings in a clean stainless-steel pan or tray.

3. Transfer wood cuttings from pan or tray with a stainless-steel scoop or spoon to appropriate sample container.

4. Seal container with custody tape, label it, and submit samples to FEMP analytical laboratory with chain-of-custody record.

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K.8.3 Concrete Samples

1. Place clean plastic sheeting on ground, concrete, or floor surface within sample area.

2. Use Milwaukee rotary drill and decontaminated coring bit and collect concrete cuttings in a clean stainless steel pan or tray.

3. Transfer cuttings from pan or tray with a stainless-steel scoop or spoon to appropriate sample container.

4. Seal container with custody tape, label it, and submit samples to FEMP analytical laboratory with chain-of-custody record.

K.8.4 Dust Collector Residue Samples

1. Place clean plastic sheeting on ground, concrete, or floor surface within sample area.

2. Use a decontaminated stainless-steel scoop to collect samples.

3. Transfer dust residue to appropriate sample container.

4. Seal container with custody tape, label it, and submit samples to FEMP analytical laboratory with chain-of-custody record.

K.9 SAMPLE COLLECTION FORMS

Complete a sample collection form (Form 5-2, Appendix B) for each sample including specific information about the sample collected and information indicated on the forms plus the following data.

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

- Sample numbers
- Description of sample containers (e.g., three 40 mL-glass vials)
- Parameters to be analyzed
- 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

K.10 FIELD STORAGE AND SHIPMENT OF SAMPLES

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 will be considered a hazardous substance and shipped accordingly.

DOT has regulatory responsibility for the safety of hazardous materials transported off site by any means. Regulations for packaging, marking, labeling, and shipping of hazardous substances are promulgated by DOT and described in 49 CFR 171 through 177 (1991).

Samples shipped by common carrier or through the United States Mail must comply with DOT Hazardous Materials Regulations [49 CFR 172 (1991)]. The person sending such material is responsible for ensuring compliance as applicable.

RadioActive Materials (RAM) samples are, by definition, hazardous and are subject to specific stringent regulations governing their transportation. RAM transportation is regulated by DOT under the Transportation Safety Act of 1974. Samples collected from process waste water streams, drums, and bulk storage tanks or soil, sediment, and water samples from areas suspected of being highly contaminated may need to be shipped as hazardous material.

The Nuclear Regulatory Commission (NRC) is responsible for governing transportation of RAM. Specifically included in NRC responsibilities is approval of certain types of packages

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(type B and fissile). DOE Orders require shipment compliance with applicable DOT and NRC rules or to provide equivalent safety to the public.

Chain of custody requirements are discussed in detail in Section 7.

K.10.1 Field Storage

Procedures for storage of samples in the field are as follows.

1. Keep samples cool and away from direct sunlight.

2. As soon as samples requiring refrigeration are collected, filtered as necessary, and preserved, ensure that sample container lids are secure before storing them in an ice chest.

3. Store samples in chests packed with artificial icing material maintaining a temperature range of two to six degrees Centigrade.

NOTE

> Special precautions, procedures, and secondary containment areas within laboratories are necessary when samples classified other than environmental are received. If there is doubt as to the classification of a sample, it is considered hazardous and handled and shipped accordingly.

4. Ship samples promptly to the laboratory to avoid exceeding holding times as specified in Section 7.

5. Transport samples in a manner that protects the integrity of the sample and also prevents detrimental effects from the potentially hazardous nature of the samples.

K.10.2 Sample Container Preparation

Sample containers for all analyses will be purchased precleaned. Suppliers will be required to provide containers which have been cleaned in accordance with "Specifications and Guidance for The Preparation of Contaminant Free Sample Containers." (U.S. EPA April 1990). Suppliers will also be required to provide supporting QC summary documentation to demonstrate that the containers are contaminant free.

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K.10.3. Sample Preservation

Methods of preservation are relatively limited and intended to accomplish the following.

- Retard biological action
- Retard hydrolysis of chemical compounds and complexes
- Reduce volatility of constituents
- Reduce absorption effects

Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

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.

The DOT Office of Hazardous Materials, Materials Transportation Bureau, has determined that hazardous materials regulations do not apply to sample preservatives that do not exceed the following concentrations (U.S. Environmental Protection Agency, 1986b).

- HCl in water solutions at concentrations of 0.4 percent by weight or less
- $HgCl_2$ in water solutions at concentrations of 0.0004 percent by weight or less (pH about 1.96 or greater)
- HNO_3 in water solutions at concentrations of 0.15 percent by weight or less (pH about 1.62 or greater)
- H_2SO_4 in water solutions at concentrations of 0.35 percent by weight or less (pH about 1.15 or greater)
- NaOH in water solutions at concentrations of 0.080 percent by weight or less (pH about 12.30 or greater)
- H_3PO_4 in water solutions at concentrations yielding a pH range between 2 and 4

K.10.4 Environmental Samples

Samples collected and designated environmental samples as specified in the FSP 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 must not exceed the reportable quantity listed in Table K-1 (Appendix A). If it does, the sample must be reclassified as a hazardous material in accordance with DOT Hazardous Materials Tables, 49 CFR (1991), and the sample must be shipped accordingly as a corrosive substance.

Shipment of nitric acid is forbidden on aircraft unless packaged in accordance with 49 CFR 173 (1991).

When samples are dispatched to the laboratory for analysis, separate chain-of-custody and request-for-analysis records shall accompany each set of samples. Process sample sets for shipment as follows.

1. Upon receipt of original sample containers in the field in boxes or coolers, note whether the custody tape is properly affixed to the package or the attached chain-of-custody record for shipping empty containers to the field.

2. Keep lids on original sample containers until they are used for sampling. Do not mix lids. If lids are contaminated, dispose of both lid and container.

3. After a sample is placed in a container, secure it with a custody seal and place it in a plastic bag to minimize potential for contamination by vermiculite or other packing material. Sample containers placed in a box with cardboard separators need not be placed in plastic bags (e.g., subsurface soil sample jars are returned to their original shipping container, a cardboard box with cardboard inserts).

CAUTION

Do not, under any circumstances, use locally obtained material such as sawdust or sand. Do not use ice or earth as packing material.

4. Initially fill metal or plastic picnic-type coolers used for shipping refrigerated/preserved samples with approximately three inches of vermiculite or other suitable (non-combustible, absorbent packing) material.

5. Place breakable (e.g., glass) sample containers in a cooler and isolate them from contact with one another using protective material such as bubble wrap or new, unused paint cans. Keep cooler closed except when placing samples in cooler.

6. Pack containers in coolers with commercially available artificial icing material. If unavailable, use ice placed in a new, zipper-type, plastic freezer bag.

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NOTE

Dry ice is classified as an ORM-A hazard by DOT and there is no labeling requirement for samples thus preserved.

7. If dry ice is used for coolant, the following procedures apply.

   a. Mark each package on at least one side with the designations "ORM-A" and "Dry Ice" or "Carbon Dioxide, Solid" and "Frozen Diagnostic Specimens."

   b. Package samples in accordance with other requirements of 49 CFR 173 (1991).

   c. Make advance arrangements between the shipper and each carrier.

8. After packing container with coolant, fill remaining space in cooler with vermiculite or suitable substitute.

9. Transport original chain-of-custody record and request for analysis to laboratory along with samples. Hand carry records or place them in a plastic bag and tape it to bottom of cooler lid for shipment with the samples to a laboratory. (See Section 7 for detailed chain-of-custody and request-for-analysis requirements.)

   a. Padlock or seal containers for shipment as appropriate. Wrap filament tape around container with custody seals affixed on front and back of cooler to prevent access to the container without breaking the seal. Use other appropriate custody seals for other containers.

   b. Address shipping containers to laboratory with indelible pen or ink.

NOTE

Do not mark individual samples within each package with hazard warning labels for environmental samples.

   c. If a hazard warning label is applied to container, mark and label the shipping package accordingly.

   d. Arrange for transportation of samples, and, when custody is relinquished by field personnel to shipper, notify receiving laboratory custodian by telephone of expected time of arrival and holding-time constraints for sample analysis or extraction.

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e. Attach shipping waybill to chain-of-custody record and provide appropriate shipping papers.

f. Upon receipt by laboratory sample management personnel, examine shipping container contents and record on chain-of-custody record whether all containers are present and custody seals on all sample containers are intact as specified in Section 7.

10. See PSP for additional requirements.

K.10.5 Packing and Transporting Hazardous Waste Samples

The following are basic steps for handling, packaging, labeling, and shipping hazardous substance samples.

K.10.5.1 **Hazard Classification.** Select hazard classification of the material from table in 49 CFR 172 (1991). If more than one class is shown for the shipping name, determine the class by definition.

K.10.5.2 **Proper Shipping Name.** Select proper shipping name and materials from the Hazardous Materials Table (HMT) in 49 CFR 172 (1991).

K.10.5.3 **Identification Number.** Select the IDentification (ID) number that corresponds to the proper shipping name and hazard class from table in 49 CFR 172 (1991). Enter applicable ID numbers on shipping documents and display them on packaging as required.

K.10.5.4 **Mode of Transportation and Modal Restrictions.** Certain modes of transportation are forbidden for shipment of some substances (e.g, nitric acid may not be transported on aircraft). The mode of transportation may affect packaging, quantity per package, marking, labeling, shipping papers, or certification.

K.10.5.5 **Proper Packaging.** See table in 49 CFR 172 (1991) for authorized exceptions and specific packaging authorization. When selecting packaging for transport, the following shall be considered.

- Type of sample
- Sample integrity requirements
- Quantity per package
- Necessary cushioning material or absorbent materials

- Proper pressure
- Outage

Standard general requirements for packages used to ship hazardous materials are contained in 49 CFR 173 (1991). In general, packages shall be designed and constructed so that, under normal transportation conditions, there will be no release of the hazardous material and the effectiveness of the packaging will not be reduced. 49 CFR 173 (1991) states that, where there are no detailed specifications for packaging, the hazardous substance shall be enclosed in strong, tight packaging that does not leak or have its effectiveness reduced.

K.10.5.6 **Shipping Documentation.** Basic requirements for preparing shipping documentation for hazardous materials include proper shipping name, hazard classification, ID number, total quantity, and the shipper certification. Provide information on shipping papers required by 49 CFR 172 (1991). See 49 CFR 172 through 172 (1991) for additional requirements.

K.10.5.7 **Certification.** Authorized personnel will certify, by printing on the shipping papers, that the materials being offered for shipment are properly classified, described, packaged, marked, and labeled and are in proper condition for transport as specified in the applicable DOT regulation [49 CFR 172 (1991)]. See 49 CFR 172 (1991) for surface shipment and for air shipments.

K.10.5.8 **Marking the Package.** Apply markings specified in 49 CFR 172 (1991). Requirements for packaging of 110 gallons or less are identified in 49 CFR 172 (1991) and include the following.

- Shipping name
- Identification number
- FEMP name and address
- Laboratory name and address
- Inhalation hazard if required [49 CFR 173 (1991)]
- Name and address required on all packages

K.10.5.9 **Labeling.** See the table in 49 CFR 172 for required labeling, additional labels, location of labels, and packaging of samples.

The Hazardous Materials Tables in 49 CFR 172 (1991) identify proper labels for hazardous materials. Labeling requirements in at 49 CFR 172 (1991) are in specific sections as follows.

- **49 CFR 172.400(a) (1991)** - Labels specified for hazardous materials shipment
- **49 CFR 172.401 (1991)** - Labels affixed to packages even though not required by regulations, provided they represent hazards of material in the package
- **49 CFR 172.406(a) (1991)** - Label location on the package
- **45 CFR 172.406(c)** - Positioning of two or more labels
- **49 CFR 173.3a (1991)** - Inhalation hazard/poison label requirements
- **49 CFR 172.404(b) (1991)** - Label requirements when two or more packages containing compatible hazardous materials are packaged within the same overpack

K.10.6 Radioactive Samples

In general, most samples collected at FEMP are classified as radioactive for transport purposes; however, certain samples may fall into categories for which special packaging and shipping restrictions are mandated. Guidelines for determining the category to which a particular sample shipment belongs and for selecting a suitable mode of shipment and appropriate packaging follow.

Potentially radioactive samples shall be screened as specified by individual laboratory licensing requirements before they can be accepted for analysis. The method for screening in Attachment I shall be followed when applicable. Laboratory-specific license requirements shall take precedence over this requirement.

Regulations impose limits on 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, the limits are expressed as two quantities, A1 and A2, which refer to the maximum permissible activity for radionuclides in special form and normal form radioactive materials, respectively. The samples from FEMP fall into the latter category so the A2 value sets the activity limits for packages of samples. In those cases where contaminated material shipments are designated "low specific activity" or "limited quantity," some fraction of the A2 value will normally apply.

Table K-2 (Appendix A) lists 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 49 CFR 173 (1991).

Determination of permissible quantities for samples of contaminated waste from FEMP is more complicated than simple reference to A2 values because such material contains a mixture of radionuclides for which two rules apply. A mixture of radionuclides from a single decay chain is considered to be a single radionuclide if the following criteria apply.

- Parent and daughters are present in their naturally occurring proportions (e.g., in secular equilibrium)
- No daughter has a half-life longer than 10 days or a half-life longer than the parent radionuclide.

The A2 quantity applied is that of the parent radionuclide (49 CFR 173 (1991) for such mixtures.

For those mixtures in which the identity and activity of radionuclides is known, the permissible quantity for each radionuclide shall be such that the following equation is true.

$$F_1 + F_2 + \ldots + F_k \ldots F_n \leq 1$$

Where:

F_k is the ratio of the total activity of the kth radionuclide to its A1 or A2 quantity [49 CFR 173 (1991)].

K.10.7 Low-Specific-Activity Materials

Low-Specific-Activity (LSA) materials include 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, and material in which the radioactivity is essentially uniformly distributed and does not exceed certain prescribed concentration limits. The limits for radionuclides of the uranium decay series, beginning with Thorium-230, are listed in Table K-3 (Appendix A) . In general, these concentrations shall 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 arises when the shipment is consigned "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 that shall be met include the following [49 CFR 173 (1991)].

- Shipment shall be consigned as "Exclusive Use", unloaded from the conveyance in which it was originally loaded, and accompanied by written instructions for the maintenance of Exclusive-Use shipping controls. LSA materials shall not be shipped by air.

- Material shall be packaged in strong, tight packages that will not leak under normal transport conditions. Each package shall be marked "Radioactive - LSA."

- Package shall not exceed limits for removable radioactive contamination and radiation level.

- The transport vehicle shall be appropriately placarded unless the shipment consists solely of unconcentrated uranium and thorium ores.

K.10.8 Limited Quantities of Radioactive Material

Limited quantity shipments of radioactive material shall meet the requirements specified in 49 CFR 173 (1991). If the activity per package does not exceed 10^{-3} of the A2 quantity of the radionuclide, then it is exempt from specification packaging and from the associated shipping paper, marking, and labeling requirements. Instead, the package need only comply with the following requirements.

- Material shall be packed in strong, tight packages that will not leak under normal transport conditions. The outside of the inner packaging or the outside of the packaging itself when there is no inner packaging shall be marked "Radioactive."

- The package shall not exceed limits for removable radioactive contamination and radiation level.

- The package shall be certified acceptable for transport by an enclosed notice in or attached to the package. The notice shall state name of consignor and include the following statement.

  "This package conforms to conditions and limitations specified in 49 CFR 173.421 (1991) for excepted radioactive material, limited quantity, n.o.s., UN2910."

K.10.9 General Requirements for Packaging Radioactive Materials

The type of packaging for a radioactive material shipment depends upon general requirements in 49 CFR 173 (1991) and specific requirements for the shipping category (type A or B). Unless otherwise specified, shipments of radioactive materials shall comply with requirements of 49 CFR 173 (1991) as follows.

- Packages shall be tamper-sealed.
- The smallest outside dimension of a package shall be four inches.
- Packages shall be designed to maintain shielding efficiency and leak tightness under normal transport conditions. Internal bracing or cushioning shall be adequate.
- Decay heat generated within the package shall not cause deterioration of the package.
- Surface temperatures of the package shall not exceed 122 degrees Fahrenheit for mixed loadings or 180 degrees Fahrenheit for vehicles in sole use.
- Pyrophoric materials shall meet packaging requirements in 49 CFR 173 (1991). Pyrophoric radioactive liquids shall not be shipped by air.
- Each package shall be designed for easy handling and proper security in or on a conveyance during transport.
- The external surface of each package shall be easily decontaminated as far as practical.
- Liquid radioactive material shall be packaged in leak-resistant and corrosion-resistant inner containment vessels. In addition, the package shall maintain its integrity if subjected to drop test, contain enough material to absorb twice the volume of liquid from a secondary leak, and provide a corrosion-resistant containment vessel.
- There shall be no significant, non-fixed radioactive contamination on the exterior surface of the package.

Prior to each use, the following examinations and tests of the packaging are required.

- Proper labeling for contents
- Physical condition
- Closure device inspection

- Instructions followed
- Closure and valves secured
- Leak tests
- Radiation limits
- Contamination limits
- Temperatures at equilibrium

K.10.9.1 **Type A Package.** FEMP shall maintain on file for at least one year after the latest shipment a complete certification with supporting safety analysis demonstrations that the packaging design, packaging construction methods, and materials were in compliance with specifications. The file shall also relate the contents of the packages shipped to the contents used for testing purposes. The following specifications apply to type A packages.

- General radioactive materials requirements in 49 CFR 173 (1991)
- Type A design requirements in 49 CFR 173 (1991)
- Type A performance tests in 49 CFR 173 (1991)
- Type A test for liquids and gases (required only when form of material is liquid or gas) in 49 CFR 173 (1991)

Type A quantities shall be packaged in specification 7A type A general packaging requirements (49 CFR 173, 1991). Each package shall comply with applicable requirements of 49 CFR 173 (1991). Each package shall be designed and constructed to comply with the standards for type A packaging and specific requirements in 49 CFR 178 (1991).

Marking on the outside of each package shall comply with 49 CFR 178 (1991) and shall include the following: "USA DOT-7A Type A and Radioactive Materials." FEMP shall also comply with number size and additional marking requirements of 49 CFR 173 (1991).

Type B packaging may be used for type A quantities [49 CFR 173 (1991)]. Type A packaging for fissile materials is listed in 49 CFR 173 (1991).

K.10.9.2 Type B Package. It is not anticipated that samples from FEMP will require Type B packaging, but if it is required, the following quality assurance and quality controls will be adhered to as a minimum.

- Type A criteria shall apply plus adequate provisions for certain serious accident conditions with resultant limited loss of shielding and essentially no loss of containment.

- Each type B package for fissile materials shall meet the test requirements prescribed in 10 CFR Part 71 for ability to withstand accident conditions during transportation. Type B packaging requirements for fissile materials are listed in 49 CFR 173 (1991).

NOTE

Type B packaging is used for both type B quantity and highway-route-controlled quantity shipments.

- Type B packaging shall comply with requirements for type A packaging plus test conditions and requirements specified in 49 CFR 173 (1991).

K.10.10 Marking and Labeling Radioactive Samples

K.10.10.1 Marking. General requirements for marking packages containing radioactive material include the following.

- Container specification number and name/address (or symbol) of company (specification containers only) (49 CFR 173 (1991).

- Proper shipping name and identification number (UN or NA) for packages with rated capacity of 110 gallons or less [49 CFR 172 (1991)]

- Markings in English and printed on or affixed to the surface of a package or on a label tag or sign [49 CFR 172 (1991)]

- Gross weight if greater than 110 pounds [49 CFR 172 (1991)]

- Plain, durable marking on outside of package in letters at least half an inch high with the words "Type A" or Type B" as applicable [49 CFR 172 (1991)]

- FEMP and FEMP address [49 CFR 172 (1991)]

- Marked "THIS SIDE UP" or "THIS END UP" for liquids packaged with closures

upward [49 CFR 172 (1991)]

K.10.10.2 Labeling. Label selection shall be based on actual radiation levels at surface and at one meter, the transport index [49 CFR 173 (1991)], and, if applicable, the fissile characteristics of the package. The proper category of the label shall be determined using Table K-4 (Appendix A).

If the sample contains a hazardous substance, a hazardous substance label is required in addition to the radioactive label (e.g., nitric acid solution of radioactive material). Place the labels next to each other on the package, and provide two radioactive labels per package on opposite sides of the package. Each label shall contain the following information.

- Contents (radionuclides)
- Number of curies
- Transport index (on yellow II or III labels only)

K.10.10.3 Shipping Documentation. General requirements for shipping documentation are specified in 49 CFR 172 (1991) and are as follows.

- Shipping name
- Hazard class
- ID number
- Quantity

Radioactive requirements for shipping papers are specified in 49 CFR 172 (1991) and are as follows.

- Radionuclide (chemical) abbreviation permitted by chemical symbol
- Physical and chemical form if not in special form
- Activity of each package in curies, millicuries, or microcuries
- Package labeling hazard class and category
- Transport index for packages labeled radioactive yellow II and yellow IIIa

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- Fissile data class I, II, or III or "Fissile Exempt"
- For DOE/NRC approved packages, a notation of the package identification marking

K.10.11 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 mrem/h as specified in 49 CFR 173 (1991). Following are the permissible radiation levels for various shipping categories.

- **Limited Quantity Packages** - Radiation level at any point on the external surface of the package does not exceed 0.5 mrem/h [49 CFR 173 (1991)].
- **LSA Packages** - Radiation level of packages transported as "Exclusive Use" does not, at any time during transport, exceed the following limits [49 CFR 173 (1991)].
  - 200 mrem/h on the accessible external surface of the package or 1,000 mrem/h if the following criteria are met:
    - The shipment is made in a closed transport vehicle
    - The package is secured so that its position remains fixed during transport
    - No unloading/loading operations occur between the beginning and end of transport
  - Ten mrem/h at any point on the outer surface of the transport vehicle
  - Ten mrem/h at any point two meters (6.6 feet) from the outer surfaces of the transport vehicle
  - Two mrem/h at any normally occupied position in the transport vehicle (This provision does not apply to private motor carriers when personnel operate under a radiation protection program.)
- **Other Packages** - Radiation level does not exceed 200 mrem/h at any point on the external surface of the package, and the transport index does not exceed ten.

Maximum permissible limits for removable radioactive contamination allowed on a package are specified in 49 CFR 173 (1991) and are summarized as follows. The following limits apply to any area of 300 square centimeters.

- 10^{-5} micro Ci/cm^2 or 22 disintegrations per minute (dpm)/cm^2, for beta/gamma-emitting radionuclides, radionuclides with half-lives less than 10 days, natural uranium, natural thorium, Uranium-235, Uranium-238, Thorium-232, and Thorium-228 and Thorium-230 when contained in ore, and physical concentrates

- 10^{-6} micro Ci/cm^2 or 2.2 dpm/cm^2 for other alpha-emitting radionuclides

Exclusive-use consignments of radioactive material shall not exceed these limits at the beginning of transport and shall not exceed ten times the limits at any time during transport [49 CFR 173 (1991)].

K.10.12 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.

NOTE

> The only exception to this requirement is if a shipment of radioactive materials is made under DOE auspices, is escorted by personnel specially designated by or under the authority of DOE for the purpose of national security, and is exempt from the regulations in 49 CFR 170 through 189 (1991) and 49 CFR 177 (1991).

K.11 DECONTAMINATION

Equipment shall be decontaminated in order to limit introduction of contaminants from equipment to sampled media, limit cross-contamination between sampling points, and protect worker health and safety. The following decontamination procedure is 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. Clean dedicated equipment as necessary.

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Cleaning procedures are required to be followed and documented by field personnel. Variations from procedure shall have prior approval of the FEMP project manager and Quality Assurance (QA) officer. Reason for the variation, its nature, and the subsequent procedure to be used shall be described in detail on 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 readily available. If decontamination must be conducted in the field, the circumstances dictating this action shall be documented either in a PSP or in the daily field log.

K.11.1 Cleaning Materials

Requirements for decontamination materials are based on those specified in the ***Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual***, 1 April 1986, Region IV Standard Operating Procedure (SOP)] of the U.S. Environmental Protection Agency Region IV. A similar guidance document is not available for Region V (Craig Thomas, U.S. Environmental Protection Agency, Region V, telephone conversation, January 3, 1991). Variations from specified materials shall be recorded on the daily field log and the samples potentially affected shall be indicated.

The following materials shall be used during decontamination activities.

- Standard phosphate-free laboratory detergent such as Liquinox or Micro
- Pesticide-grade methanol cleaning solvent
- Potable water from FEMP water system
- Certified de-ionized water (may be purchased or produced on site by passing potable water through a standard deionizing resin column) that contains no metals or other inorganic compounds at or above the analytical detection limit of an Inductively Coupled Plasma (ICP) spectrophotometer scan as defined by the EPA Contract Laboratory Program (CLP)
- Certified de-ionized, organic-free water (may be purchased or produced on site by passing de-ionized water through an activated carbon filter) that contains no pesticides, extractable organic compounds, and less than 50 microgram per liter (μg/L) of volatile organic compounds as measured by a low-level Gas Chromatography/Mass Spectrometer (GC/MS) scan as defined by the EPA CLP
- A 0.02 normal hydrochloric or sulfuric acid solution (replaces nitric acid specified by the Region IV SOP for safety reasons)

K.11.2 General Equipment Cleaning Procedures

Following are descriptions of the three levels of decontamination identified for this project. The level of decontamination required for a project shall be specified in the PSP.

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1. **Level I Decontamination** - Only equipment, tools, and other items that do not come in contact with sampled media shall be cleaned as follows.

   a. Steam clean or use high-pressure potable water to wash down the designated items.

2. **Level II Decontamination** - Most equipment is designated for level II cleaning as follows.

   a. Rinse with potable water.

   b. Wash with a phosphate-free laboratory detergent and potable water solution, steam-clean, or wash with high-pressure potable water.

   c. Rinse with potable water.

   d. Rinse twice with certified de-ionized organic-free (ASTM Type II) water.

NOTE

Do not cover equipment used to sample for organic parameters with plastic. If aluminum foil is used, wrap equipment with the shiny side out. Do not use aluminum foil if aluminum contamination may be a problem.

   e. Air dry and immediately cover with plastic or aluminum foil.

   f. Ensure that decontaminated equipment remains covered from the time decontamination is complete until use.

3. **Level III Decontamination** - If visible contamination by organic chemicals, metals, radionuclides, or other inorganic contaminants of concern to the project or contamination detectable by screening with field instruments occurs, level III cleaning is required as follows.

   a. Rinse with potable water.

   b. Wash with a phosphate-free laboratory detergent and potable water solution, steam-clean, or wash with high-pressure potable water.

   c. Rinse with potable water.

   d. Rinse with acid solution.

   e. Rinse with potable water.

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f. Rinse with approved solvent (methanol).

g. Triple rinse with certified de-ionized organic-free (ASTM Type II) water.

h. Air dry in a relatively dust-free environment if time permits. Otherwise, cover with plastic or aluminum foil.

K.11.3 Drilling Equipment Decontamination

1. Follow level II procedure for drilling equipment that contacts contaminated subsurface material (i.e., augers, drill rods, drill casings, split spoons, auger teeth, drill bits, core barrels) when moving between drill sites.

2. Use level III procedure if screening with field instruments indicates gross contamination.

3. Clean split spoons between sampling intervals if a sufficient quantity are not available for the entire boring. Follow level II procedure when drilling in background areas, and follow level III procedure in areas where contamination is suspected based on visual inspection or screening with field instruments.

4. Determine decontamination level for drilling rig wheel wells, tires, mast, and other potentially contaminated items based on the next usage. If the rig is to remain in the same Operable Unit (OU) area (i.e., the contaminant levels are the same or higher based on existing data), decontamination is not required.

5. Follow level I cleaning procedure if the rig is moved to a cleaner area or to a different OU.

K.11.4 Submersible Pumps and Lines

1. Decontaminate exterior of submersible pumps and lines at level II.

CAUTION

If a pump becomes grossly contaminated through use at a well, dedicate it to that well.

2. In the final rinse, pump at least five times the amount of de-ionized water through the system as required to fill it.

K.11.5 Filtering Apparatus

1. If in-line filters are not used, remove the used filter and clean sample filtering apparatus at level II.

2. Do not use filters for more than one sample and do not reuse in-line filters.

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K.11.6 Water-Level Measurement Probes

1. Between uses, clean the portion of water-level measuring equipment that contacts ground water at level II.

K.11.7 Verification of Decontamination Effectiveness

Ensure that decontamination measures are effective as follows.

1. Collect samples of final decontamination rinse at a minimum frequency of 1 per 20 for decontamination of equipment for each type of activity specified in the PSP.

NOTE

More frequent sample collection may be required under some circumstances based on results of previous rinsate sample analyses, activities performed, or as required by PSPs.

2. Visually inspect equipment for gross contamination (e.g., caked-on mud, grease on threads, organic odor) or screen with field instruments. If evidence of contamination is present, reclean at appropriate level for its intended use.

3. If grossly contaminated equipment is intended for use at a different sampling point, after it has been cleaned, collect rinsate samples.

4. Visually inspect equipment before use and clean at appropriated level for its intended use.

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