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Energy Systems Environmental Restoration Program
Y-12 Environmental Restoration Program

**Addendum to the Remedial Investigation Work Plan
for Bear Creek Valley Operable Unit 1 (S-3 Ponds,
Boneyard/Burnyard, Oil Landfarm, Sanitary Landfill I,
and the Burial Grounds, Including Oil Retention
Ponds 1 and 2) at the Oak Ridge Y-12 Plant,
Oak Ridge, Tennessee**

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OAK RIDGE Y-12 PLANT
Oak Ridge, Tennessee 37831-8169
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
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APPROVALS
ADDENDUM TO THE REMEDIAL INVESTIGATION
WORK PLAN FOR BEAR CREEK VALLEY OPERABLE UNIT 1
(DOE/OR/01-1161/V1&D2/A1)
QUALITY ASSURANCE PROJECT PLAN
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8. QUALITY ASSURANCE PROJECT PLAN

8.1 DATA QUALITY OBJECTIVES

QA objectives for data collection are developed from Data Quality Objectives (DQOs) for this project. The DQOs were developed using guidance contained in *Data Quality Objectives Process for Superfund* [EPA/540/6-93/071 (EPA 1993)].

The BCV OU 1 location poses two problems that the DQOs will address: (1) whether the wastes and soil contamination pose a risk to human health or the environment now or in the future and (2) if the wastes and contamination do pose a risk, what feasible alternatives exist for reducing the risk to acceptable levels.

A QC program for analytical data develops information that can be used to accomplish the following:

- Evaluate the accuracy and precision of analytical data to establish their quality.
- Indicate the need for corrective actions, when a comparison with existing regulatory or program criteria or data trends shows that activities must be changed or monitored to a different degree.
- Determine the effect of corrective actions.

Because the laboratory for this project has not yet been specified, the QC criteria included herein should be considered minimum requirements. When the laboratory or laboratories have been specified, the QC requirements defined herein will be communicated to those facilities in analytical services statements of work. Any minor changes to these requirements will be documented and approved through the variance system. Requirements for analytical documentation for the selected laboratory will be field screening support and summary analytical deliverable support.

The QA objectives for all analytical data are to obtain reproducible, precise, and accurate measurements consistent with the intended use of the data and the limitations of the sampling and analytical procedures. The reasons for QC are (1) to screen out data of unacceptable degrees of precision or accuracy and (2) to obtain data that will accomplish the objectives of this project. This QAPjP specifies the documentation and QA requirements applicable to these data; they are specified in Sect. 8.9.

8.1.1 Field Laboratory Analysis Data Quality Parameters

The DQOs for the plan determine the types and quality of field laboratory analysis and data quality parameters that will be required. Guides to measurements typical of the QC for field screening and field analytical support follow.

The collection and field screening/analysis of environmental samples are used for surface soil samples analysis of metals and PCB. These methods will provide field analytical support data. Additionally, field screening data will be generated by other field screening methods described in the remainder of this section.

8.1.1.1 Field screening support

Field screening support is used to generate field screening data that will be used to determine the extent of contamination at a site, to provide real-time health and safety monitoring, to allow screening/optimization of sampling, and to acquire qualitative measurements of ambient conditions. Analytical parameters typically specified for field screening data collection include the following:

- measurement of ambient temperature (soil/water/air),
- measurement of electrical conductivity (soil/water),
- measurement of pH (soil/water),
- measurement of salinity (water),
- measurement of dissolved oxygen (water),
- total organic vapor concentration [photoionization detector/flame ionization detector (PID/FID)] (air/soil/gas), and
- radiological monitoring (alpha/beta/gamma) (soil/air/equipment/personnel).

Calibration of field screening instrumentation, in accordance with the manufacturer's instructions as appropriate for the media and analytes of concern, is required before and upon completion of daily sampling. Positive response verification checks will be performed by the Health and Safety Officer, the Field Team Leader, or designee on these instruments for every 20 samples or every 4 h, whichever is more frequent. These checks consist of exposing the instrument to a source analyte (e.g., exposing a PID to a volatile organic source) and verifying a response. If no response is obtained, corrective action will be taken and documented and the instrument recalibrated. Results of calibration and response checks will be recorded in the instrument logbook.

Personnel responsible for using and/or maintaining particular instruments must maintain a log of calibration/response check procedures and performance. The Field Team Leader will inspect the logs, which will become part of the project records. Each operator must be trained in the proper use of the instruments, be familiar with their operation, be able to interpret data from them, and be able to produce documentation certifying these skills. This documentation will facilitate comparability between samples.

QC field screening support for sampling conducted during the investigation is met by the following:

- sampling procedures;
- site surveillance;
- use of standard sampling and monitoring devices;
- personnel training;
- documentation of sampling location, method, and media;
- reporting of results in appropriate units;

- consistent use of types of screening/monitoring instruments; and
- maintenance of measuring and test equipment (M&TE) and M&TE records.

8.1.1.2 Field analytical support

Field analytical support is used to provide real-time data for ongoing field activities, to identify samples for laboratory analysis, and to allow for a phased approach to sampling. Analytical parameters, instrumentation, and media typically specified for field analytical support data collection may include the following:

- VOC analysis (soil/water);
- inorganic compound analysis (mobile lab) (soil/water/air);
- pesticide/PCB and dioxin/furan analysis (soil); and
- special applications (e.g., down-hole monitoring, geotechnical applications).

Calibration of field analytical instrumentation, in accordance with the manufacturer's instructions as appropriate for the media and analytes of concern, is required before and upon completion of the daily analyses or as required by the appropriate EPA-recommended methodology. Documentation and QC procedures for field analyses are instrument- and analyte-specific.

QC field analytical support for field analysis conducted during the investigation is met by the following:

- sampling procedures;
- site surveillance;
- use of standard sampling and monitoring devices;
- personnel training;
- documentation of sampling location, method, and media;
- reporting of results in appropriate units;
- consistent use of types of screening/monitoring instruments; and
- stringent control limits for the daily QC checks.

8.1.2 Analytical Laboratory Data Quality Parameters

Analytical laboratory data will be generated for environmental samples to provide confirmed identification and quantification of organic and inorganic compounds and radionuclides in each sampled media. Analytical methods that may be used include EPA CLP, SW-846, and others as long as the QC information that is appropriate to DQOs is being reported and delivered.

8.1.2.1 Summary analytical deliverable support

Summary analytical support is used to provide confirmed identification and quantification of contaminants to determine the extent of contamination, to determine the presence or absence of contaminants with required detection limits, and to confirm the results of field screening and field analyses. Analytical parameters and media typically specified for this type of data documentation include:

- organic compound analysis (soil/water/air),
- inorganic compound and elemental analysis (soil/water/air),
- radionuclide analysis (soil/water/air), and
- TCLP.

Laboratory QC procedures will follow requirements specified in the appropriate EPA-recommended methodologies. Analytical protocols include calibration runs, surrogate standards, laboratory control standards, etc. External QA is employed in the form of field blanks, replicate and duplicate samples, and blind spikes, which may be submitted with the samples. Documentation requirements depend on the laboratory and type of analysis performed.

Accuracy, precision, and method detection limit (MDL) information is provided by adherence to SW-846 and/or EPA CLP.

Laboratories performing analyses must maintain a record of instrument calibration and QA/QC results. Such records may become part of the project records. Each operator must be trained in the proper use of the instrument, be familiar with the instrument's operation, be able to interpret data from the instrument, and have documentation certifying these skills.

8.1.2.2 Comprehensive analytical deliverable support

Comprehensive analytical support conforms to the EPA CLP for performing routine analytical services for analyses of all types of media. Deliverable protocol provides confirmed identification and quantification of contaminants to determine the extent of contamination and the presence or absence of contaminants with low required detection limits. QC provides documented data for risk assessment and remedial investigations. Analytical specifications and media that may require comprehensive analytical deliverables include:

- Hazardous Substance List organic compound analysis (soil/water/air),
- priority pollutant inorganic compounds and elemental analysis (soil/water/air),
- radionuclide analysis (soil/water/air), and
- TCLP.

Laboratory QC procedures will follow requirements specified in the current EPA SOW revision for CLP methodologies. Methods not included in the CLP will be expanded to meet CLP-type requirements. All raw data will be submitted. CLP routine analytical services protocols are very specific concerning QA/QC requirements and data package documentation. Routine analytical services deliverable packages contain information on initial and continuing

calibration, gas chromatograph/mass spectrophotometer tuning, surrogate percent recovery, matrix spike duplicates (MSDs), and spectra for every sample and blank. External QA is employed in the form of field blanks and replicate and duplicate samples submitted with the samples.

Precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters are described in Sect. 8.9.2. Routine analytical services documentation is sufficient to allow qualified personnel to review, verify, and validate analytical results and to assess data quality.

Comprehensive documentation will be maintained as part of the project records. Chemists must be trained in the proper use of the instrument, be familiar with the instrument's operation, be able to interpret data from the instrument, and be able to produce documentation certifying these skills.

8.2 SAMPLE COLLECTION PROCEDURES

Subsurface and surface soil, surface water, groundwater, and sediment sampling are proposed for BCV OU 1. Characterization efforts will focus on several potential contamination sources at the Burial Grounds, the Oil Landfarm, the Boneyard/Burnyard, and the S-3 Site. Prior to commencing field activities, a readiness review will be conducted by SAIC following SAIC QAAP 2.2. Energy Systems will conduct a readiness review following ER/C-P1610 (see Appendix E).

A field procedures manual will be prepared and controlled by SAIC and approved by Energy Systems Y-12 ER Project Manager, Y-12 ER Quality Assurance Specialist, SAIC Project Manager, and SAIC QA/QC Officer. The procedures manual will include procedures from Energy Systems *Environmental Surveillance Quality Control Program*, ES/ESH/INT-14, Rev. 4 (Kimbrough et al 1994); Energy Systems *ERWM Programs Intersite Procedures Manual*, ES/ER/INT-26/R1, and the SAIC Field Technical Procedures Manual. The Energy Systems procedures will be modified, as necessary, and submitted for Y-12 ER approval for ESP procedures with modifications and BCV OU 1 site/project specifications on the cover sheet in front of each procedure.

8.2.1 Soil Sampling

Soil sampling will be conducted in accordance with the ESP-303 series and SAIC procedures (Table 8.1).

8.2.2 Sediment Sampling

Sediment sampling will be conducted in accordance with the ESP-304 series (Table 8.1).

8.2.3 Surface Water Sampling

Surface water sampling will be conducted in accordance with the ESP-301 series (Table 8.1).

Table 8.1. Sample collection procedures

Procedure number	Subject activity	Issue date	Revision
<i>Activity series 301: surface water sampling</i>			
ESP-301-1	Water sampling using a dipper	8/30/88	0
ESP-301-4	Grab sampling with Kemmerer bottles	8/30/88	0
ESP-301-5	Stream flow measurements	8/30/88	0
<i>Activity series 302: groundwater sampling</i>			
ESP-302-1	Water level measurements using a water level indicator	8/29/88	0
ESP-302-5	Using a bladder pump	8/29/88	0
FTP-352	Groundwater sampling procedures: using a hydropunch	6/30/93	0
FTP-357	Groundwater sampling using micropurge and low flow sampling	TBA	
FTP-616	Installation, development and abandonment of temporary piezometers	TBA	
<i>Activity series 303: soil sampling</i>			
ESP-303-1	Soil sampling with a spade and scoop	8/30/88	0
ESP-303-2	Soil sampling with an auger	9/01/88	0
ESP-303-3	Soil sampling using a trier	8/31/88	0
ESP-303-4	Penetration test and split-barrel sampling	8/24/88	0
ESP-303-5	Subsurface soil sampling with shelby tubes	8/30/88	0
FTP-551	Soil sampling by direct push	TBA	
<i>Activity series 304: sediment sampling</i>			
ESP-304-1	Streambeds	8/29/88	0
<i>Activity series 307: field measurements</i>			
FTP-880	Field measurement procedures: pH, temperature, and conductance	8/29/88	0
ESP-307-5	Oxidation/reduction potential of water	8/29/88	0
FTP-750	Field measurement procedures: organic vapor detection	8/29/88	0
FTP-451	Field measurement procedures: operation of radiation survey instruments	1/31/90	0
FTP-701	Field measurement procedures: using a proton magnetometer	TBA	
FTP-710	Field measurement procedures: using the EM-31	TBA	

8.2.4 Groundwater Sampling

Groundwater sampling will be conducted in accordance with the ESP-302 series and SAIC procedures (Table 8.1).

8.2.5 Field Measurement of Physical Parameters

Field measurement of physical parameters will be conducted in accordance with the ESP-307 series and/or SAIC procedures (Table 8.1). Due to the wide variety and case-specific application of these types of instrumentation, each procedure will include manufacturer's instructions for specific instrument operation and maintenance procedures.

8.2.6 Sample Compositing and Special Sample Collection Procedures

Sample compositing and specialized sample collection procedures will be conducted in accordance with ESP-308 series or SAIC procedures.

8.3 SAMPLE PREPARATION AND ANALYSIS PROCEDURES

8.3.1 Sample Containers, Sample Preservatives, and Holding Times

The selection criteria for appropriate sample containers, sample preservatives, and holding times shall be in accordance with ESP-701. Types of sample containers and sample preservation methods used will be documented in the sampling logbook. Field and laboratory records will indicate the sample holding time before analysis (Table 8.2).

8.3.1.1 Sample packaging and transportation

Handling, shipping, and storage of samples and data resulting from field activities will adhere to custody (Sect. 8.4) and will ensure the integrity for analytical purposes is maintained. The procedures required to properly package, ship, handle, and store containers of environmental samples are described in ER/C-P2302.

8.3.1.2 Decontamination of equipment and devices

Decontamination of sample containers and sampling devices will be performed according to ESP-801, Section VI, C, pages 19 and 20. Sampling equipment will be decontaminated before use and between sampling locations/intervals. Each decontamination activity will be recorded in the field logbook. Equipment used during field activities, including drilling equipment, soil sampling equipment, and field test equipment will be decontaminated in accordance with ESP-802.

8.3.1.3 Sample identification and traceability

Each environmental sample collected during these investigations will be assigned a unique sample identifier, which will be permanently affixed to the sample container and recorded in the field logbook and on the chain-of-custody form. The identifiers used for samples will be established and maintained in accordance with ESP-501.

Table 8.2. Sample holding times, sample containers, sample preservation, and minimum sample size

Parameter	Matrix	Holding time ^a (from time of collection)	Container	Preservative ^b	Sample size ^c
Volatile organics	Water	14 d	Two 40-mL vials with Teflon-lined caps	HCl to pH < 2 Cool to 4°C	80 mL
	Soil	14 d	4-oz glass jar with Teflon-lined cap	Cool to 4°C	50 g
Extractable organics (semivolatile organics, or pesticides/PCBs)	Water	7 d, extraction 40 d, analysis	1-L amber glass with Teflon-lined cap	Cool to 4°C	1000 mL
	Soil	14 d, extraction 40 d, analysis	8-oz glass jar with Teflon-lined cap	Cool to 4°C	100 g
Metals (other than mercury)	Water, soil	180 d 180 d	1-L poly bottle 8-oz plastic jar	HNO ₃ to pH <2	900 mL 80 g
Mercury	Water, soil	28 d 28 d	Same containers as for metals	HNO ₃ to pH <2 Cool to 4°C	100 mL 10 g
Cyanide	Water, soil	14 d 14 d	500-mL poly 1-L poly bottle 8-oz plastic jar	Water NaOH to pH > 12, Cool to 4°C	1000 mL 10 g
Radionuclides	Water, soil	180 d 180 d	4-L cubitainer 8-oz poly jar	HNO ₃ to pH < 2	4 L 100 g
Anions ^d	Water	28 d	250-mL poly	Cool to 4°C	250 mL
Specific conductance	Water	Determine on site	Polyethylene	4°C	100 mL
Miscellaneous ^e	Water	24 hr ^e	250 mL poly	Cool to 4°C	500 mL
Nitrate/Nitrite	Water	28 d	250 mL poly	H ₂ SO ₄ to pH < 2 Cool to 4°C	250 mL
pH	Water, soil	Determine on site	In situ, beaker or bucket Polyethylene	None None	100 mL 10 g

Table 8.2 (continued)

Parameter	Matrix	Holding time ^a (from time of collection)	Container	Preservative ^b	Sample size ^c
Temperature	Water	Determine on site	In situ, beaker or bucket	None	100 mL
Soil moisture content	Soil	14 d	Polyethylene, glass	4°C	10 g
Percent organic matter, particle size, cation exchange capacity, ignitability, corrosivity, reactivity	Soil	28 d	Polyethylene, glass	4°C	100 g

^aHolding times are consistent with CLP validation guidelines.

^bDissolved metals require filtration before pH adjustment.

^cAdditional sample must be collected for matrix spike/matrix spike duplicate samples or matrix spike/duplicate.

^dAnions include chloride, sulfate, and fluoride.

^eMiscellaneous includes TSS (7-d hold time), TDS (7-d hold time), alkalinity (14-d hold time), and turbidity (48-h hold time).

Identification systems will ensure traceability of samples to the appropriate source. Sample identification shall be transferred to each subdivision when the sample is split.

8.3.1.4 Site surveying

Site surveying will be conducted to establish location and elevation of sampling points and monitoring well measuring points in relation to the appropriate plant or site grid. A licensed surveyor will be contracted to perform this effort.

8.3.1.5 Field variance system

Procedures cannot fully encompass all conditions encountered during a field investigation. Variances from operating procedures, the work plan, the sampling and analysis plan, and/or health and safety plan will, therefore, likely occur and must be documented on a field change order (FCO) form following ER/C-P1719 and noted in the appropriate logbooks. The Y-12 ER Project Manager may give verbal approval for the field change, if the risk issue is minor, until the FCO is reviewed and categorized. If a variance is anticipated (e.g., due to a change in field instrumentation), the applicable procedure should be modified and the change noted in the field logbooks.

Any variances from the health and safety plan must be approved by the Health and Safety Officer. Copies of the field change order forms and a field change order log will be maintained by the sampling teams until the fieldwork is complete. Field Change order forms and log will be included in the project file and the subcontractor's Central Records Facility.

Routine (minor) FCO will be completed in the field, noted on the FCO log, then routed through the FCO Coordinator for delivery to the Energy Systems Y-12 ER Project Manager and QA Specialist for signature approval. A verbal approval from the Y-12 ER Project Manager or designer will be noted in the field logbook.

Emergency or urgent (major) FCOs will be delivered to the Y-12 ER Project Manager and QA Specialist for immediate signature approval, then forwarded to the FCO Coordinator.

8.3.2 Analytical Procedures

Environmental samples collected during this projects will be analyzed for potential contaminants of concern using EPA-approved methods where applicable (Table 8.3).

The approved methods and protocols that may be used by the analytical laboratory are provided in the following documents:

- *Test Methods for Evaluating Solid Wastes* (EPA 1986);
- *Methods for Chemical Analysis of Water and Wastes* (EPA 1983);
- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980a);
- *Eastern Environmental Radiation Facility Radiochemistry Procedure Manual* (EPA 1984);
- *CLP SOWs for Organics and Inorganics* (EPA 1990b,c);
- 40 CFR 136, Appendix A;

Table 8.3. Analytical methods, parameters, and quantitation limit goals for surface water/groundwater and soil/sediment samples

Parameters	Analytical methods		Quantitation limit goals ^a	
	Water	Soil/sediment	Water (µg/L)	Soil/sediment (µg/kg)
Volatile organic compounds (VOCs)	CLP SOW ^b	CLP SOW ^b		Low soil/sediment ^c
Chloromethane			10	10
Bromomethane			10	10
Vinyl chloride			10	10
Chloroethane			10	10
Methylene chloride			5	5
Acetone			10	10
Carbon disulfide			5	5
1,1-Dichloroethene			5	5
1,1-Dichloroethane			5	5
1,2-Dichloroethene (total)			5	5
Chloroform			5	5
1,2-Dichloroethane			5	5
2-Butanone			10	10
1,1,1-Trichloroethane			5	5
Carbon tetrachloride			5	5
Bromodichloromethane			5	5
1,2-Dichloropropane			5	5
cis-1,3-dichloropropene			5	5
Trichloroethene			5	5
Dibromochloromethane			5	5
1,1,2-Trichloroethane			5	5
Benzene			5	5
trans-1,3-dichloropropene			5	5
Tribromomethane			5	5
4-Methyl-2-pentanone			10	10
2-Hexanone			10	10
Tetrachloroethene			5	5
Toluene			5	5
1,1,2,2-Tetrachloroethane			5	5
Chlorobenzene			5	5
Ethylbenzene			5	5
Styrene			5	5
Xylenes (total)			5	5
Additional compounds:				
Trichlorotrifluoroethane			10	10

Table 8.3 (continued)

Parameters	Analytical methods		Quantitation limit goals ^a	
	Water	Soil/sediment	Water (µg/L)	Soil/sediment (µg/kg)
Semivolatile organic compounds (SVOCs)	CLP SOW ^b	CLP SOW ^b		Low soil/sediment ^c
Phenol			10	330
bis(2-Chloroethyl) ether			10	330
2-Chlorophenol			10	330
1,3-Dichlorobenzene			10	330
1,4-Dichlorobenzene			10	330
1,2-Dichlorobenzene			10	330
2-Methylphenol			10	330
2,2'-Oxybis(1-chloropropane)			10	330
4-Methylphenol			10	330
N-nitroso-di-n-dipropylamine			10	330
Hexachloroethane			10	330
Nitrobenzene			10	330
Isophorone			10	330
2-Nitrophenol			10	330
2,4-Dimethylphenol			10	330
bis(2-Chloroethoxy) methane			10	330
2,4-Dichlorophenol			10	330
1,2,4-Trichlorobenzene			10	330
Naphthalene			10	330
4-Chloroaniline			10	330
Hexachlorobutadiene			10	330
4-chloro-3-methylphenol			10	330
2-Methylnaphthalene			10	330
Hexachlorocyclopentadiene			10	330
2,4,6-Trichlorophenol			10	330
2,4,5-Trichlorophenol			25	800
2-Chloronaphthalene			10	330
2-Nitroaniline			25	800
Dimethylphthalate			10	330
Acenaphthylene			10	330
2,6-Dinitrotoluene			10	330
3-Nitroaniline			25	800
Acenaphthene			10	330
2,4-Dinitrophenol			25	800
4-Nitrophenol			25	800
Dibenzofuran			10	330

Table 8.3 (continued)

Parameters	Analytical methods		Quantitation limit goals ^a	
	Water	Soil/sediment	Water ($\mu\text{g/L}$)	Soil/sediment ($\mu\text{g/kg}$)
2,4-Dinitrotoluene			10	330
Diethylphthalate			10	330
4-Chlorophenyl-phenyl ether			10	330
Fluorene			10	330
4-Nitroaniline			25	800
4,6-Dinitro-2-methylphenol			25	800
N-nitrosodiphenylamine			10	330
4-bromophenyl-phenylether			10	330
Hexachlorobenzene			10	330
Pentachlorophenol			25	800
Phenanthrene			10	330
Anthracene			10	330
Carbazole			10	330
Di-n-butylphthalate			10	330
Fluoranthene			10	330
Pyrene			10	330
Butylbenzylphthalate			10	330
3,3'-Dichlorobenzidine			10	330
Benzo(a)anthracene			10	330
Chrysene			10	330
bis(2-Ethylhexyl)phthalate			10	330
Di-n-octylphthalate			10	330
Benzo(b)fluoranthene			10	330
Benzo(k)fluoranthene			10	330
Benzo(a)pyrene			10	330
Indeno(1,2,3-cd)pyrene			10	330
Dibenzo(a,h)anthracene			10	330
Benzo(g,h,i)perylene			10	330
Pesticides	CLP SOW^b	CLP SOW^b		Low soil/ sediment
alpha-BHC			0.05	1.7
beta-BHC			0.05	1.7
delta-BHC			0.05	1.7
gamma-BHC (Lindane)			0.05	1.7
Heptachlor			0.05	1.7
Aldrin			0.05	1.7
Heptachlor epoxide			0.05	1.7

Table 8.3 (continued)

Parameters	Analytical methods		Quantitation limit goals ^a	
	Water	Soil/sediment	Water (µg/L)	Soil/sediment (µg/kg)
Endosulfan I			0.05	1.7
Dieldrin			0.10	3.3
4,4'-DDE			0.10	3.3
Endrin			0.10	3.3
Endosulfan II			0.10	3.3
4,4'-DDD			0.10	3.3
Endosulfan sulfate			0.10	3.3
4,4'-DDT			0.10	3.3
Methoxychlor			0.5	17.0
Endrin ketone			0.10	3.3
Endrin aldehyde			0.10	3.3
alpha-Chlordane			0.05	1.7
gamma-Chlordane			0.05	1.7
Toxaphene			5.0	170.0
Dioxin/Furans				
2,3,7,8-TCDD	SW 8290	SW 8290	.01 ng/L	.001-0.2
PCBs	CLP SOW ^b	CLP SOW ^b		Low soil/sediment ^c
Aroclor-1016			1.0	33.0
Aroclor-1221			2.0	67.0
Aroclor-1232			1.0	33.0
Aroclor-1242			1.0	33.0
Aroclor-1248			1.0	33.0
Aroclor-1254			1.0	33.0
Aroclor-1260			1.0	33.0
Metals (target analyte list)	CLP SOW ^d	CLP SOW ^d		(mg/kg)
Aluminum			200	20
Antimony GFAA			3	0.3
Arsenic GFAA			5	0.5
Barium			200	20
Beryllium			5	0.5
Cadmium			5	0.5
Calcium			5000	500
Chromium			10	1
Cobalt			50	5
Copper			25	2.5
Iron			100	10

Table 8.3 (continued)

Parameters	Analytical methods		Quantitation limit goals ^a	
	Water	Soil/sediment	Water (µg/L)	Soil/sediment (µg/kg)
Lead GFAA			3	0.3
Magnesium			5000	500
Manganese			15	1.5
Mercury CVAA			0.2	0.02
Nickel			40	4
Potassium			5000	500
Selenium GFAA			5	0.5
Silver			10	1
Sodium			5000	500
Thallium GFAA			5	0.5
Vanadium			50	5
Zinc			20	2
Additional elements:				
Molybdenum			40	2
Tin			50	5
Common anions			(mg/L)	(mg/kg)
Nitrate-nitrite	E353.2 ^c	NA	0.2	NA
Chloride	E325.1 ^c	NA	1.0	NA
Sulfate	E375.4 ^c	NA	5	NA
Fluoride	E340.2 ^c	NA	0.1	NA
Miscellaneous				
TSS	E160.2 ^c	NA	10	NA
TDS	E160.1 ^c	NA	10	NA
ALK	E310.0 ^d	NA	NA	NA
Turb	E180.1 ^d	NA	0.1 NTUI	NA
Indicator parameters				
Total organic carbon (TOC)	E415.1/E41 5.2 ^e	NA	1	NA
Radionuclides			(pCi/L)	(pCi/g dry)
Gamma spectrometry	EPA 901.1 ^f	EPA 901.1 ^f		
Gamma scan ^g			g	g
Alpha spectrometry	EPA 907.0 ^f	EPA 907.0 ^f		
Americium-241			0.1	0.1
Plutonium-238,239,240			0.1	0.1
Thorium-228,230,232			1	1
Uranium-234,235,238			1	1
Neptunium-237			0.1	0.1

Table 8.3 (continued)

Parameters	Analytical methods		Quantitation limit goals ^a	
	Water	Soil/sediment	Water (µg/L)	Soil/sediment (µg/kg)
Strontium-90	EPA 905.1 ^f	EPA 905.1 ^f	1	1
Technetium-99	E-Tc-01		30	30
Gross alpha	EPA 900.0 ^f	EPA 900.0 ^f	10	20
Gross beta	EPA 900.0 ^f	EPA 900.0 ^h	5	20

NA = not applicable.

^aThese are expected quantitation limits based on reagent grade water or a purified solid matrix. Actual quantitation limits may be higher depending on the nature of the sample matrix. The limit reported on final laboratory reports will take into account the actual sample volume or weight, percent moisture (where applicable), and the dilution factor, if any. The quantitation limits for additional analytes attached to the Target Analyte List of CLP SOWs may vary, depending on the results of laboratory studies.

^bContract Laboratory Program, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, EPA Document OLM01.8. Quantitation limits are contract-required quantitation limits with the exception of additional organic compounds. Minimum quantitation limits stated in the table will be reported by the laboratory.

^cMedium soil/sediment contract-required quantitation limits are 120 times the low soil/sediment contract-required quantitation limits for volatile organic compounds and 30.3 times the low soil/sediment contract-required quantitation limits for semivolatile organic compounds. Estimated detection limits for metals in soil are based on a 1-g sample diluted to 100 mL.

^dContract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, EPA Document ILM01.1. Determination limits are contract-required detection limits except for tin and molybdenum. Minimum detection limits stated in the table will be reported by the laboratory.

^eMethods for Chemical Analysis of Water and Wastes, U.S. EPA. EPA-600/4-79-020 revision March 1983.

^fPrescribed Procedures for Measurement of Radioactivity in Drinking Water, U.S. EPA, EPA-600/4-80-032, latest version.

^gThe subcontracted laboratory will resolve and quantify nonspecified gamma-emitting radionuclides. These nonspecified gamma-emitting radionuclides should be detected and semiquantitatively determined based on photon yield and energy relative to the ¹³⁷Cs MDL and standard.

^hNephelometric Turbidity Units.

- 40 CFR 141.30;
- 40 CFR 136, Appendix C;
- APHA, *Standard Methods for the Analysis of Water and Wastewater*; and
- *EML Procedures Manual*, HASL-300 (Krey and Beck 1992).

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is greater than zero. The MDL actually achieved in a given analysis varies depending on instrument sensitivity and interferences. Contracts will be established with analytical laboratories to analyze environmental samples collected during these investigations. Each contract laboratory that analyzes samples will provide quantification limits for each constituent analyzed.

Laboratory equipment QA/QC will be drawn from the supporting laboratory's (or laboratories') QA plan(s).

8.4 SAMPLE CUSTODY

8.4.1 Field Documentation

An integral part of the QA/QC plan for the field activities will be to maintain current, accurate, and complete field records including logbooks, chain-of-custody forms, and airbills. Field logbooks (e.g., Field Health and Safety, Site Activity, M&TE, Decontamination, Sampling Management logbook for each activity) shall be of hardcover construction. All information pertinent to field activities will be recorded. Each page must be signed and dated. Entries in the logbooks or on the data forms will be made in water resistant black or blue ink and will include the information specified in ESP-501, Sect. VII, Part D methodologies. Corrections must be marked out with a single line, dated, and initialed. Field logbooks will be copied once a week with the copies remaining in the SAIC offices. When the fieldwork is complete, copies will be made of the completed logbooks, the copies entered into the SAIC Control Records Facility and the Project File, and a copy forwarded to the Y-12 ER Project Manager.

Appropriate field data forms will be prepared. No blank spaces should appear on completed forms. If information requested is not applicable, the space shall be marked "N/A."

Chain-of-custody procedures require documentation of sample possession from the time of collection to time of disposal. These procedures allow the possession and handling of samples from the time of collection through analysis and final disposal to be traced.

Samples will be accompanied by the original completed Chain-of-Custody Form (see Appendix F). Should a sample be split, another copy will remain with the sample. As the samples are transferred, the present custodian and the new custodian will complete the required sections of the record as well as note any discrepancies. This Chain-of-Custody Form will remain with the sample from the field while it is being transported to the laboratory, and it will be checked upon receipt at the laboratory. The laboratory will retain a copy of the

form, and the original will be sent to the designated subcontractor personnel. This original will be routed to the Central Records Facility and used in the final analytical report.

8.4.1.1 Field custody procedures

Sample custody will be initiated at the time of sample collection. Field samples will be identified by sample tags and appropriate labels. Descriptions of sampling activities and sample identification data will also be recorded in field logbooks. Field chain-of-custody forms containing the same information will be completed for each set of samples. A line item on the sample chain-of-custody form will be completed for each sample, and the sampling technician will confirm by signature the completeness of the information on the form. Each individual who assumes responsibility for the samples will sign and date the chain-of-custody form.

Field custody procedures include the following steps:

- Before sampling begins, the QA/QC Officer, or designee, will instruct sampling personnel on the chain-of-custody and sample labeling procedures, as necessary.
- A chain-of-custody form, which corresponds to the sample identification label, will be initiated in the field for each sample.
- Each time sample custody is transferred, the person relinquishing the sample and the new custodian will sign the chain-of-custody form and note the date and time.
- The analyses to be performed for each sample will be recorded on the chain-of-custody form accompanying the samples to the laboratory.
- The Field Team Leader will confirm that proper custody procedures are followed during the fieldwork and that results were documented in the appropriate field logbooks.

8.4.2 Shipping Custody Procedures

Sample custody will be maintained by personnel until custody is transferred to a common carrier/air freight company, if applicable. Shipments sent by common carrier/air freight will have a bill of lading/air bill accompanying them with the original chain-of-custody form packed in the containers. These bills will be maintained as permanent records, and the air bill number will be noted on the chain-of-custody form. The common carrier/air freight company delivers samples and transfers custody to particular analytical laboratories, where their intralaboratory chain-of-custody procedures will be in effect. If the Y-12 Plant Analytical Services Organization (ASO) is used to analyze the samples, the samples will be delivered by a sample team member to the ASO.

8.4.3 ASO Custody Procedures

Upon receipt at the ASO, each sample identification will be compared to the information contained on the chain-of-custody form. If discrepancies exist, appropriate notes (signed and dated) will be made on the chain-of-custody form and the Project Manager or designated person will be notified.

At receipt and initial inspection of samples and accompanying forms, the following items will be checked:

- Seals and tapes on the transportation container to verify that they are unbroken.
- Sample containers in the transportation container to ensure that they are intact and at correct temperature.
- External activity with radiation survey instruments and smear surfaces for removal of contaminants.
- The pH of preserved samples (except VOAs).
- The identification on the sample bottles to verify that it corresponds to the entire description on the chain-of-custody form.
- The number of sample containers received to verify that it is equal to the number of samples listed on the chain-of-custody form(s).

If there are discrepancies, the Project Manager or designee shall be called immediately to rectify them. Discrepancies will be recorded on appropriate forms and incorrect information marked out with a single line, initialed, and correct information added.

Once samples are in the possession of the ASO, their internal chain-of-custody and sample handling procedures will be followed. If samples are to be shipped from one laboratory to another, proper chain-of-custody and packaging procedures will be maintained. Anticipation of reanalysis requires proper preservation of samples following analysis. Samples requiring refrigeration will remain refrigerated.

8.4.3.1 Sample labeling

Sample labels and tags will contain sufficient information to identify the sample in the absence of other documentation. The label and tag will be directly affixed to the sample container, will be completed with black water resistant ink, and will follow ESP-501.

Refer to Sect. 7.5 for details concerning the sample numbering system and preparation of pre-printed sample labels. In the event samples arrive damaged or custody seals are broken, a nonconformance report (Sect. 8.11.2) will be initiated. The Project Manager will be advised and will make a decision as to the fate of the nonconforming sample(s) and initiate corrective actions. The laboratories will retain tags in their project files.

8.5 CALIBRATION PROCEDURES AND FREQUENCY

All M&TE will be calibrated against certified equipment and/or standards having known valid traceability to nationally recognized standards. M&TE shall be calibrated, adjusted, and maintained at prescribed intervals and/or before use (see Table 8.4). If no nationally recognized standards exist, the basis for calibration will be documented.

Table 8.4. Level I instrument uses, detection limits, and calibration^a

Instrument	Uses	Detection limits	Calibration	Comments
Total organic vapor meters	Sample screening for VOCs	PID—0.2 ppm benzene	1 point—PID benzene daily	Action level must be stated in work plan
	Soil gas screening	FID—1.0 ppm methane	1 point—FID methane daily	Instrument cannot differentiate naturally occurring compounds from contaminants
	Health and safety screening	Daily calibration	Verification check every 20 samples Verification at end of day	PID cannot detect compounds with ionization potentials >11 eV
Radiological monitoring	Monitoring of beta-gamma surface, gross gamma, alpha surface contamination levels	Daily calibration check varies by equipment	Daily source check per manufacturer Recertification (6 months)	Validation labels include minimum and maximum acceptable levels
Indicator kits (colormetric)	Field screening for a variety of analytes	Varies kit by kit	Check color response with level of analyte	Need to check expiration dates
	Gross quantitation	One-time check		One analyst should conduct the test to ensure consistency in interpretation Interferences from other compounds are possible
pH kits (litmus paper)	Field screening—water only	N/A	Check color response with known pH standards of 4.0, 7.0, 10.0	Instrument is not to be used on samples to be submitted for analysis One-time check for each lot of kits is necessary

Table 8.4 (continued)

Instrument	Uses	Detection limits	Calibration	Comments
pH meters	Field screening—water and soil	N/A	2 point with standards at pH 7.0 and 4.0 or pH 7.0 and 10.0 daily	Accuracy is to ± 0.5 pH units
Conductivity meter	Determining conductivity of water	N/A	1 point in 0.01 in KCl solution	Calculations and acceptance criteria must be available in the field
Dissolved oxygen meter	Determining amount of dissolved oxygen in water	N/A	To manufacturer instructions	Calculations must be available in the field
Thermometer	Determining temperature of sample cooler	1°C	Calibrated by manufacturer; will be field checked	None

^aPID = photoionization detector, FID = flame ionization detector, N/A = not applicable, VOCs = volatile organic compounds.

8.5.1 Field Instrument Calibration Procedures and Frequency

A list of all M&TE to be used, along with a schedule for calibration, will be prepared before initiating fieldwork. Field instrumentation will be calibrated according to the procedures specified in the manufacturer's operating manual or more frequently should the conditions dictate it for the particular instrument. Instrument logbooks or notebooks will be established and maintained by the cognizant field team members, Field Team Leader, or the Health and Safety Officer, as appropriate.

8.5.2 Laboratory Instrument Calibration Procedures and Frequency

Laboratory equipment will be calibrated according to the procedures specified in the analytical methods and in the operating manual for the particular instrument. Calibration frequency will be based on the analytical methods employed, type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience.

For those cases for which analyses are governed by EPA CLP protocols, the calibration frequencies and procedures as designated in the CLP routine analytical services SOW will be followed. In this scenario, the calibration requirements in the CLP routine analytical services SOW take precedence.

For laboratory equipment, Class A volumetric glassware will be used to prepare calibration standards, bench standards, samples for analysis, etc. Class A glassware may be purchased with known accuracy per American Society of Testing and Materials specifications.

It should be noted that other nonanalytical instrumentation (such as thermometers) must be properly maintained and calibrated. The temperatures of ovens and refrigerators used in sample handling will be recorded and the control limits defined. If these limits are not met, corrective action will be required. All calibration and maintenance records will be kept with the equipment if practical. Otherwise, they will be maintained by the laboratory QA personnel.

8.5.3 Equipment Categories

Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other means. All equipment will be categorized as one of the following:

- Category A—Casual devices and systems (e.g., rulers, tape measures, graduated cylinders) that are not to be calibrated in service (i.e., not calibrated other than by the manufacturer).
- Category B—Routine devices and systems (e.g., balances, spectrophotometers) that are to be included in a regular calibration recall program.
- Category C—Field experiment devices and systems (e.g., pH meters, turbidimeters) that are to be calibrated before, during, and after use.

The appropriate category decal with the identification number and the due date of the next calibration will be attached to the equipment. If this identification is not possible, records traceable to the equipment will be readily available for reference.

8.5.4 Calibration Failures

Scheduled periodic calibration of equipment will not relieve personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, he/she should remove the device from service, initiate a nonconformance report, tag it so it is not inadvertently used, and notify project management. If equipment is found to be out of calibration, the appropriate project management personnel will evaluate and document (in the instrument logbook) the validity of previous inspection or test results and the acceptability of similar equipment previously inspected or tested. The responsible supervisor will ensure the devices that are out of calibration are (1) tagged or segregated from other equipment and (2) disposed of or not used until they are calibrated. Any equipment that is consistently found to be out of calibration will be repaired or replaced. Any such action should be recorded in the instrument logbook or notebook.

All standards used for equipment calibration will be traceable to the EPA, National Institute of Standards and Technology, or a commercially available certified standard. The source of the standard used must be documented in a calibration logbook.

8.5.5 Calibration Records

Calibration data will be recorded in the instrument logbook or notebook. The information will include the date, operator, signature, and standard that was used. Records will be prepared and maintained for each piece of calibrated equipment to indicate that established calibration procedures have been followed. The appropriate project management personnel will ensure that records of calibration data are kept current. Records for field equipment used will be maintained by the Field Team Leader and the Health and Safety Officer and kept in the project files. Records for laboratory equipment used will be maintained by the laboratory supervisor and kept in the project files.

8.6 PREVENTIVE MAINTENANCE PROCEDURES/SCHEDULES

Any equipment (an inclusive term for tools, gauges, instruments, and other items that require specific preventive maintenance) will be serviced and documented as specified by the manufacturer's recommended schedule.

All service will be performed by qualified and trained individuals. The operators are responsible for seeing that the equipment is scheduled for service, serviced, and properly maintained. Properly maintained equipment helps reduce unnecessary "downtime."

A complete list of equipment will be developed by the operator, and the parts or replacement equipment will be immediately available (either from the supplier/manufacturer or on site). Having replacement equipment or critical spare parts available minimizes "downtime."

The implementation of a preventive maintenance program depends on the specific instruments and equipment used for the field. SAIC will ensure a preventive maintenance program that includes the following:

- a list of the instruments and equipment that are included in the program, including backup alternatives;
- the frequency of maintenance, taking into consideration the manufacturer's recommendations and/or previous experience with the equipment. The frequency should be stated in terms of monthly, quarterly, etc.;
- for each instrument in the program provide the following:
 - external service contracts,
 - items to be checked and/or serviced during maintenance,
 - directions for performing maintenance (if external service is not provided, or if directions are not stated in the manufacturer's instrument manuals).

Preventive maintenance will be documented. A file will be maintained for each instrument at the SAIC office. The instrument file should include, at a minimum:

- external service contracts;
- a checklist of items to be serviced and directions for maintenance or manufacturer's instrument manuals;
- a record of periodic maintenance; and
- comments noting any replacement of parts, observed deterioration, etc.

Equipment used throughout the laboratory must be controlled through a calibration program. Calibration of analytical balances must be performed by a trained and qualified instrument technician using weights traceable to National Institute of Standards and Technology specifications. The gas chromatograph/mass spectrophotometer instruments must be calibrated, tuned, and operated in accordance with EPA CLP protocol OLM01.8 (EPA 1990c), which also meets the criteria specified in other EPA documents and the *Federal Register*. The ICP, atomic adsorption spectroscopy, gas chromatograph, and similar instruments must be calibrated and operated in accordance with requirements of the procedure being employed. The calibration of all equipment must be performed or verified with each analysis run, and the record of calibration for each analysis must be maintained as a permanent record. Any deviation from the calibrations required by the appropriate EPA method must be approved using an FCO that is authorized by the SAIC Project Chemist, the Y-12 ER QA Specialist, and the Y-12 ER Project Manager.

Volumetric glassware must be used to prepare calibration standards, bench standards, and samples for analysis; therefore, the glassware used for these preparations must be of known accuracy. The glassware must be purchased in accordance with federal and American Society for Testing and Materials specifications.

The standards used for instrument calibration, internal controls, bench standards, spike solution, and traceability of sample analyses to these specific standards must be documented.

8.7 DATA REDUCTION AND REPORTING

Data reduction and reporting will be in accordance with the *Environmental Restoration Quality Program Plan*, ES/ER/TM-4/R3 (Energy Systems 1993c). The data reduction will

follow the guidelines of the EPA CLP SOWs (EPA 1990b, 1990c) and the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1990a). Generally, results must be expressed to two significant figures. The results for aqueous samples must be expressed in milligrams per liter or micrograms per liter, and the results for nonaqueous samples must be expressed on a dry weight basis in milligrams per kilogram, micrograms per kilogram, or micrograms per gram. The moisture content of samples must also be reported.

Table 8.5 depicts data set deliverables for summary and comprehensive documentation. In addition to following field and laboratory documentation and QA/QC procedures, data may be verified using a variety of computerized checks for reasonableness. These procedures will ensure that data are entered, encoded, manipulated in a consistent way, and available in a usable format.

8.7.1 Field Data Reduction and Reporting

Data collected during field activities will be evaluated by checking the procedures used and comparing the data to previous measurements. The QA/QC Officer or designee and appropriate field personnel will be responsible for checking field QC sample results to ensure that field measurement and sampling protocols have been observed. These reviews will check date and time sampled, preservation, standard operating procedures, calibration method and frequency, and chain-of-custody documentation.

Reviewers are responsible for ensuring that data reduction calculations are documented and checked by qualified personnel. Written reports including reduced and summarized data may include the raw data in appendixes. Specific calculations used for data reduction may also be included.

8.7.2 Laboratory Data Reduction

In general, the analyst will process the data, either manually or by inputting the data into a computer. All computerized programs used to reduce and analyze data should be in compliance with software QC [Energy Systems 1990 (Sect. 2.19)] and appropriate Energy Systems procedures. For manually processed data, all the steps in the computation must be provided, including equations used and the source of input parameters such as response factors, dilution factors, and calibration constants. If calculations are not performed directly on the data sheet or chromatogram, the calculations must be provided on company letterhead paper and attached to the data sheets. All pages of the calculations must be signed and dated by the analyst performing the calculations.

For data input by an analyst and processed using a computer, a copy of the input must be kept and uniquely identified with the project number and other pertinent information as necessary. The samples to which the data processing refers must be clearly stated, and the input must be signed and dated by the analyst performing the input.

When processing data acquired through the use of instrumentation, the analyst must verify that the correct project, sample numbers, calibration constants, response factors, units, and numerical values used for detection limits are present.

Table 8.5. Data set deliverables for summary and comprehensive documentation*

Method requirements	Deliverables
<i>Requirements for all methods</i>	
Holding time information and methods requested	Signed chain-of-custody forms
Discussion of laboratory problems	Case narratives
LCS with results on control charts (run with each batch of samples processed)	Control charts
<i>Organics</i>	
Sample results	CLP Form 1 or equivalent
Surrogate recoveries. Surrogates to be used in volatiles, semivolatiles, pesticides/PCBs. For volatiles by GC, surrogate names should reflect the appropriate surrogate used	CLP Form 2 or equivalent
Matrix spike/spike duplicate (will be 1 spike and spike duplicate per 20 samples of similar matrix)	CLP Form 3 or equivalent
Method blank data	CLP Form 4 or equivalent
GC/MS tuning for volatiles/semivolatiles	CLP Form 5 or equivalent
GC/MS initial calibration data for volatiles/semivolatiles	CLP Form 6 or equivalent
Pesticide/PCB calibration data if calibration factors are used	CLP Form 9 or equivalent
For volatiles by GC, initial calibration data: If calibration factors are used If a calibration curve is used	CLP Form 8D or equivalent, with five columns for multilevel calibration factors A plot of the calibration curve is required and a linear regression determination, with flagged correlation coefficient, if it is less than 0.995
For volatiles by GC, continuing calibration data; if calibration factors are used, calibration factors and their percent differences from the initial calibration must be reported; retention time (RT) windows and analyte RTs for the analytes must be included on this form	CLP Form 9 or equivalent
GC/MS continuing calibration data: No chromatograms or mass spectra are presented for calibration; these data should be filed in the laboratory and available if problems arise in reviewing/validating the data	CLP Form 7 or equivalent
GC/MS internal standard area data	CLP Form 8 or equivalent
Second column confirmation for all GC work when compounds are detected above reporting limits	CLP Form 10 or equivalent for all positive hits
Complete copy of all laboratory raw data information [i.e., chromatograms, bench notes, etc. (Comprehensive Documentation)]	Raw data

Table 8.5 (continued)

Method requirements	Deliverables
<i>Metals</i>	
Sample results	CLP Form 1 or equivalent
Initial and continuing calibration	CLP Form 2 or equivalent
Method blank taken through digestion (1 per 20 samples of same matrix)	CLP Form 3 or equivalent
ICP interference check sample	CLP Form 4 or equivalent
Spike sample recovery (1 per 20 samples of similar matrix)	CLP Form 5A or equivalent
Postdigestion spike sample recovery for ICP metals (only done if predigest spike recovery exceeds CLP limits)	CLP Form 5B or equivalent
Postdigestion spike for graphite furnace atomic absorption	Recovery noted on raw data
Duplicates (one per 20 samples will be split and digested as separate samples)	CLP Form 6 or equivalent
LCS	CLP Form 7 or equivalent
Standard addition. The decision process outlined in CLP (p. E-3) will be used to determine when standard additions are required	CLP Form 8 or equivalent
Holding times	CLP Form 10 or equivalent
Complete copy of all laboratory raw data information [bench notes, computer printouts, etc. (Comprehensive Documentation)]	Raw data
<i>Wet chemistry</i>	
LCS (one/batch)	Control charts
Method blank (one/batch)	Report result
Sample results	Report result
Spike/spike duplicate	Percent recovery and percent RPD
Continue calibration check	Recovery and percent difference
Complete copy of all laboratory raw data information [strip chart graphs, calculation sheets, run logs, etc. (Comprehensive Documentation)]	
<i>Radiochemical analysis</i>	
Sample results	Report results
Initial calibration	Efficiency determination
Efficiency check	Percent difference from calibration
Background determinations	Report results
Minimum detectable activity	Report results
Method blank	Report results
Spike recovery results	Spike added and percent recovery
Internal standard results	Standard added and percent recovery

Table 8.5 (continued)

Method requirements	Deliverables
Duplicate results	Report results and percent RPD
Self-absorption factors (α , β)	Report factors
Complete copy of all laboratory raw data information [instrument run logs, bench notes, instrument output, etc. (Comprehensive Documentation)]	Raw data

^aLCS = laboratory control standard, CLP = contract laboratory program, PCB = polychlorinated biphenyl, GC = gas chromatograph, MS = mass spectrometry, ICP = inductively coupled plasma.

After required chemical analyses have been completed, the samples will be maintained at a temperature of 4°C for at least 2 weeks after expiration of the appropriate holding time. The laboratory will be responsible for disposal of all laboratory-generated wastes. Upon the receipt of written notification from the subcontractor's Project Manager, the laboratory will return unused sample portions to the project.

8.8 QC CHECKS

8.8.1 Field QC Checks

The number of required QC samples per site is based on a set minimum percentage. The number of QC samples to be collected may change from site to site; however, the types of field QC samples remain constant. The types of QC samples are trip blanks, equipment rinsates, field blanks, and field duplicates.

In defining the number of field blanks required, it is important to note that a sampling event is from the time sampling personnel arrive at the site until personnel leave for more than 24 h. For example, sampling personnel go to a site for 10 d, conduct soil borings, and install groundwater wells. During this visit, soil and water samples are collected. The crew leaves the site for 2 months and later returns to collect another set of groundwater samples over a 3-d period. Two sampling events have occurred: a 10-d event and a 3-d event.

8.8.1.1 Trip blanks

Trip blanks are used to detect contamination by VOCs during sample shipping and handling. Trip blanks are 40-mL VOA vials of analyte-free water that are generally filled in the laboratory, transported to the sampling site, and returned to the laboratory with VOA samples. Trip blanks are not to be opened in the field. One trip blank is to accompany each cooler containing VOA samples. Each trip blank is to be stored at the laboratory with associated samples and analyzed with those samples. Trip blanks are only analyzed for VOCs. Trip blanks are also sent with soil samples; however, because the blanks cannot be analyzed through the use of soil methods, they are analyzed and reported as water samples.

8.8.1.2 Field blanks

Field blanks are samples of the potable water source and analyte-free water that are used in the decontamination and cleaning of equipment used in sample collection. Analyte-free water will be sampled per lot number. The decontamination potable water source will be sampled once in each event.

8.8.1.3 Equipment rinsates

Equipment rinsates are samples of analyte-free water passed through decontaminated sampling equipment. They are used as a measure of decontamination process effectiveness. Equipment rinsates will be collected at a rate of 5% of the samples collected per matrix per event (i.e., 1 to 20 samples collected equals 1 equipment rinsate; 21 to 40 samples collected equals 2 equipment rinsates). Matrices for this purpose are considered to be soils, sediments, groundwater, and surface water. Equipment rinsates are analyzed for the same analytes as the associated samples. Equipment rinsates are reported as water samples.

Representative numbers of equipment rinsate samples will be sent to the mobile laboratory and the fixed analytical laboratory. Each laboratory will receive equipment rinsates in proportion to the number of routine samples received.

8.8.1.4 Field duplicates

Additional samples may be taken near the field sample co-located to determine total measurement error variance. Field duplicates for water samples will be collected simultaneously. Samples submitted for VOA will not be homogenized. Field duplicates will be taken at the rate of one for every 20 samples.

8.8.2 Laboratory QC Procedures

To ensure data quality, laboratory quality control samples, data review, and data validation are used to measure the quality of the sampling and analysis process. A quality control operation or component is only useful if it can be measured or documented. The components of analytical QC that are defined in this section are related to the analytical batch or to those samples that are analyzed together with the same method sequence, the same lots of reagents, and the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar composition. All QC data and records specified in this section will be reported as part of the data deliverables package. These procedures will be performed at least once with each analytical batch with a minimum of 1 per 20 samples.

The types of laboratory QC samples are method blanks, LCSs (blank spikes), MSs, MSDs, and duplicates. These samples are defined in the following sections. More detailed ER Division requirements are found in *Requirements for Quality Control of Analytical Data* (DOE 1990a).

8.8.2.1 Method blanks

Method blanks are used to determine the existence and magnitude of possible contamination encountered during sample preparation and analysis. They consist of analyte-

free water for water samples and clean sand or soil for soil samples if available. They are carried through the entire analytical procedure with the samples. At least one method blank must be prepared with each batch of samples. A batch cannot exceed 20 samples and is determined by the number of samples of similar matrix that can be processed simultaneously through the entire preparation process. Analysis is performed for the same analytes as those associated with the respective environmental samples.

8.8.2.2 Matrix spikes/matrix spike duplicates

An MS is an aliquot of a sample spiked with known quantities of analytes and subjected to the entire analytical procedure. It is used to indicate the appropriateness of the method for the matrix by measuring recovery. An MSD is a second aliquot of the same sample as the MS with known quantities of compounds added. The purpose of the MSD, when compared to the MS, is to determine method precision. Precision is the measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions. MSs and MSDs will be performed per 20 samples of similar matrix.

8.8.2.3 Duplicate samples

Duplicate samples are identical splits of individual samples that are analyzed by the laboratory to test for method reproducibility or precision. These samples are split in the laboratory during sample preparation. Duplicates are used mainly for inorganic analysis, while MSDs are used for organics. Duplicates will be performed per 20 samples of similar matrix.

8.8.2.4 Surrogate spikes

A surrogate spike is prepared by adding a pure compound to a sample before extraction. The compound in the surrogate spike should be of a similar type to that being assayed in the sample. The purpose of a surrogate spike is to determine the efficiency of recovery of analytes in the sample preparation and analysis. The percent of recovery of the surrogate spike is then used to gauge the total accuracy of the analytical method for that sample.

8.8.2.5 Laboratory control sample

The laboratory will use an LCS system to monitor sample preparation and analysis.

The laboratory will employ an LCS program that monitors sample preparation and analysis. The LCS program will be monitored through the use of control charts. The purpose of this program is to demonstrate that the laboratory process for sample preparation and analysis is in control. This type of program is required for all ER Waste Management projects.

An LCS is a laboratory blank with a known amount of analyte(s) added or a commercially available standard consisting of known analyte concentrations representative of the contaminants to be determined. Analytes selected for spiking should be representative of the compound class. It is suggested that these criteria be followed.

- For VOCs and semivolatile organic compounds the method blank surrogate standards can be used as the LCS. All surrogates in the method blank must be monitored on control charts.

- For pesticides, at least two target compounds are added to a blank other than the method blank. These compounds are monitored on control charts.
- For PCBs, at least one target Aroclor is added to a blank other than the method blank. The compound is monitored on a control chart. If pesticides and PCBs are both being determined, it is recommended that a single LCS with both pesticide and PCB spikes be used.
- For metals determined by ICP, an LCS must be monitored by means of control charts for at least three metals.
- For metals determined by atomic absorption (graphite furnace atomic absorption, furnace atomic absorption, and cold vapor atomic absorption), an LCS must be monitored by means of a control chart for each element.
- For wet chemical and radiochemical methods, an appropriate LCS for each method must be used (e.g., for cyanide, a control standard of sodium cyanide from a source other than that used for calibration may be spiked into water and analyzed with the water samples). The value for the control is monitored on the control chart.

The LCS matrix should be comparable to the sample matrix (i.e., analyze water control samples when water samples are analyzed).

In the LCS, problems encountered with matrix effects and sample nonhomogeneity will be minimized through the use of blank water and well characterized soil. This information, used in conjunction with sample MS recoveries, can aid in determining whether an out-of-control condition is due to laboratory problems or matrix problems.

Five percent of the samples will be LCSs, which may vary depending upon analytical method.

8.9 DATA VALIDATION PROCEDURES

8.9.1 ASO Data Verification and Validation

Data verification/validation is a systematic process for evaluating a body of data against a defined set of criteria to provide assurance that the data are adequate for their intended use. The evaluation process consists of data screening, range checking, auditing, verification, flagging, and quality evaluation. Specifically, data will be evaluated per derived DQO requirements. This will include review of sample custody forms, photocopied pages of laboratory notebooks, and data forms completed by laboratory staff, including: sample weights, dilutions, laboratory data reduction, instrument logs, and raw data, as necessary. The final task report will certify that the data have been verified/validated and qualified in accordance with the defined process.

Analytical data generated during and following field activities will be reviewed by the laboratory(s) and reported per the systematic requirements identified and defined in Sect. 8.3. The analytical laboratory(s) will not perform data verification/validation. Verification/ validation is independent of the analytical laboratory data review.

Data validation will be consistent with the specifications as outlined in *Requirements for Quality Control of Analytical Data for the Environmental Restoration Program* (ES/ER/TM-16). All project data will be evaluated to ensure a complete, consistent, and usable project data set.

8.9.1.1 Data validation approach

Data validation will be performed to ensure that the precision and accuracy of the analytical data are adequate for their intended use. Because the greatest uncertainty in a measurement is often a result of the sampling process and inherent variability in the environmental media rather than the analytical measurement, validation will be performed only to the level necessary to minimize the potential of using false positive or false negative concentrations in the decision-making process (i.e., to assure accurate identification of detected versus non-detected compounds). This approach is consistent with the DQOs for the project and with the methods, listed in Sect. 1.8.7.1, for determining COCs and calculating risk.

All deliverables will be verified to ensure completeness and compliance with the laboratory statement of work. A minimum of 10% of project data will be evaluated by data validation criteria consistent with the guidelines in TM-16 related to a comprehensive data deliverable. The 10% subset of the project data will be selected with respect to sample medium, analytical method, analytical laboratory, and project schedule (i.e., sample data packages will be selected throughout the project). The remaining 90% of the project data will be validated based on an adjusted set of TM-16 summary data deliverable validation criteria as described in Sect. 8.9.1.2.

8.9.1.2 Data validation rationale

The data validation criteria listed below have been determined as critical in the evaluation of analytical data usability. These are a subset of the comprehensive TM-16 data validation criteria that, based on analytical process knowledge, contribute significantly to the qualification and associated uncertainty of the reported results. Evaluation of this subset will allow identification of potential false positive or negative results. Because these criteria are associated with random rather than systematic error, they require evaluation throughout the analytical measurement process. They cannot be comprehensively determined by reviewing only a portion of the data. Consistent with the data quality requirements as defined in the DQOs and based on the above rationale, all project data and associated QC must be evaluated on these criteria and qualified as per the outcome of the review. The criteria by which the data will be evaluated are discussed in Sect. 8.9.1.3.

The data validation categories to be evaluated are as follows.

Organics	Inorganics	Radiochemistry
Holding times	Holding times	Holding times
Blanks	Blanks	Blanks
Surrogate recovery	Laboratory control sample	Laboratory control sample
Internal standards	Furnace atomic absorption QC	Sample specific chemical or tracer recovery

Organics	Inorganics	Radiochemistry
Calibration	Calibration	Calibration
Sample reanalysis		
Secondary dilutions		
Case narrative	Case narrative	Case narrative

While the categories just listed are those that most impact the determination of data usability, it is also necessary to evaluate whether any systematic errors are occurring during the analytical process that could adversely affect the sample results. Therefore, some portion of the data must be evaluated against the additional criteria. Because the laboratory(s) will be reviewed, audited, and approved based on extensive selection criteria prior to providing analytical support to the project and because they will be subject to periodic audits during the project, selection of a minimum of 10% of the data packages for complete TM-16 validation will adequately identify any systematic problems. The 10% subset of data packages will be selected across media, methods, laboratories, and time to ensure an adequate sampling of the process. If a systematic problem is discovered in the 10% subset, additional data packages will be reviewed based on the problem criterion to determine the extent of and resolve the problem. This approach to validation will result in a minimum of 10% of the data packages being validated to comprehensive TM-16 criteria and the remaining 90% of the data packages being reviewed based on adjusted TM-16 validation criteria.

8.9.1.3 Adjusted data validation criteria

Holding Times. Evaluation of holding times ascertains the validity of results based on the length of time from sample collection to sample preparation or sample analysis. Verification of sample preservation must be confirmed and accounted for in the evaluation of sample holding times. The evaluation of holding times is essential to establishing sample integrity and representativeness. Concerns regarding physical, chemical, or biochemical alteration of analyte concentrations can be eliminated or qualified through this evaluation.

Blanks. The assessment of blank analyses is performed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks apply to any blank associated with the samples, including field, trip, equipment, and method blanks. Contamination during sampling or analysis, if not discovered, results in false positive data.

Surrogate Recovery. System monitoring compounds are added to every sample, blank, MS/MSD, and standard. They are used to evaluate extraction, cleanup, and analytical efficiency by measuring recovery on a sample-specific basis. Poor system performance as indicated by low surrogate recoveries is one of the most common reasons for data qualification. Evaluation of surrogate recovery is critical to the provision of reliable sample-specific analytical results.

Calibration. The purpose of initial and continuing calibration verification analyses is to verify the linear dynamic range and stability of instrument response. Relative instrument response is used to quantitate the analyte results. If the relative response factor is outside acceptable limits, the data quantification is uncertain and requires appropriate qualification.

Internal Standards. Internal standards are utilized to evaluate and compensate for sample-specific influences on the analyte quantification. They are evaluated to determine

whether data require qualification due to excessive variation in acceptable internal standard quantitative or qualitative performance measures. For example, a decrease or increase in internal standard area counts for organics may reflect a change in sensitivity that can be attributed to the sample matrix. Because quantitative determination of analytes is based on the use of internal standards, evaluation is critical to the provision of reliable analytical results.

Sample Reanalysis. When instrument performance-monitoring standards indicate an analysis out-of-control, the laboratory is required to reanalyze the sample. If the reanalysis does not solve the problem (i.e., surrogate compound recoveries are outside the limits for both analyses), the laboratory is required to submit data from both analyses. An independent review is required to determine which is the appropriate sample result.

Secondary Dilutions. When the concentration of any analyte in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and reanalyzed. The laboratory is required to report data from both analyses. When this occurs, an independent review of the data is required to determine the appropriate results to be used for that sample. An evaluation of each analyte exceeding the calibration range must be made, including a review of the dilution analysis performed. Results chosen in this situation may be a combination of both the original results (i.e., analytes within initial calibration range) and the secondary dilution results.

Laboratory Control Samples. The laboratory control sample (LCS) serves as a monitor of the overall performance of the analytical process, including sample preparation, for a given set of samples. Evaluation of this standard provides confidence in or allows qualification of results based on a measurement of process control during each sample analysis.

Furnace Atomic Absorption QC. Duplicate injections and furnace post-digestion spikes are evaluated to establish precision and accuracy of individual analytical determinations. Because of the nature of the furnace atomic absorption technique and because of the detailed decision tree and analysis scheme required for quantitation of the elements, evaluation of the QC is critical to assuring reliable analytical results.

Sample-Specific Chemical or Tracer Recovery. Laboratory performance on individual samples subject to chemical process and separation is established by means of spiking with tracer quantities of other radioisotopes of the same element or carrier quantities of an inactive isotope of the same or a chemically similar element. This process is analogous to surrogate or internal standard recovery, dependent on the analyte and method being evaluated, and is a common reason for data qualification.

8.9.2 Project Data Quality Assessment

The data quality indicator parameters, PARCC, will be used to evaluate data quality and quantity. Reviewers are responsible for ensuring that data reduction calculations follow appropriate data calculation procedures, are documented, and are checked by qualified personnel. Written reports, including reduced and summarized data, will include the raw data in appendixes. Specific calculations used for data reduction will also be included.

Both qualitative and quantitative criteria are used as indicators of the quality of the data. In determining data usability, especially in the decision-making process, the integrity and

authenticity of the data must be evaluated and the analytical uncertainty must be determined. These parameters will be evaluated for the entire project data set.

The following procedures will be used to assess data precision, accuracy, and completeness. These equations apply to both field and laboratory measurements.

8.9.2.1 Precision

Precision is defined as the reproducibility or degree of agreement between duplicate measurements under a given set of conditions. The closer the measurements approach each other, the more precise the measurement. The level of precision is determined by calculating the relative percent difference (RPD) between the two measurements using the following equation:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100\%,$$

where

S = analyte concentration of the original sample and
D = analyte concentration of the duplicate sample.

Precision is determined using MS/MSD analyses. The laboratory will select one sample in twenty to split into three aliquots. The first aliquot will be analyzed routinely for the parameters of interest; the other two aliquots will be spiked with known quantities of the parameters of interest before analysis. The RPD between the two spike results will be calculated and used as an indication of the precision of the analyses performed.

When the analyte of interest provides a measurable quantity without spiking, precision determinations can be obtained through duplicate analysis comparisons. Field duplicate samples are evaluated as an indication of overall precision. This evaluation measures variability introduced during both field sampling and laboratory analysis.

Analytical precision goals for the proposed radiochemical and inorganic parameters will be ≈ 20 RPD. Goals for analytical precision for organic parameters will be those identified in the analytical methods for specific analytes. In general, these range up to 25 RPD (volatile organics) and 50 RPD (semivolatile organics) in soils. If analytical precision goals are exceeded, a determination will be made through the data validation process relative to the useability of that information.

8.9.2.2 Accuracy

Accuracy is defined as the degree of difference between measured values and the true values. Sampling accuracy will be maximized by adhering to the QAPjP. All procedures used will be documented as SOPs or Analytical Operating Procedures (AOPs). Analytical measurement accuracy is evaluated through implementation of analyte matrix spike or standard reference material determinations. The following equation will be used to calculate percent recovery (%R):

$$\%R = \frac{A_r - A_o}{A_f} \times 100\%,$$

where

A_r = total compound or element concentration detected in the spiked sample,
 A_o = concentration of the compound or element detected in the unspiked sample, and
 A_f = concentration of the compound or element added to the sample.

For situations in which a standard reference material (SRM) is used rather than or in addition to MS analyses, the following equation will be used:

$$\%R = \frac{C_m}{C_{sm}} \times 100\%,$$

where

C_m = measured concentrate of SRM and
 C_{sm} = actual concentration of SRM.

A recovery of 100% is equivalent to 100% accuracy. Values varying from 100% may indicate a sample matrix effect and a false reading. A periodic program of sample spiking is required (e.g., 1 MS and 1 MSD per 20 samples).

The proposed radiochemical and inorganic accuracy goals for this investigation will be 80% to 120% as expressed in recovery of known analytical spikes into the sample media. Analytical accuracy goals for organic parameters will be those identified in the CLP analytical methods for specific analytes.

In general, volatile organic compound spike recoveries range between 60% and 150% in soils, while semivolatile organic compound spike recoveries range between 20% and 140%. In the event analytical accuracy goals are exceeded, a determination will be made through the data validation process relative to the usability of those data.

8.9.2.3 Representativeness

Representativeness expresses the relative degree to which the data depict the characteristics of a population, parameter, sampling point, process condition, or environmental condition. The objective of this study is to accurately represent the chemical concentrations of target analytes.

Representative samples for this investigation will be acquired through implementation of approved sampling and analytical procedures that will generate data representative of the sampling point location. Sampling procedures are designed to minimally impact the sample obtained, so that conditions representative of the sampling location will be maintained. Analytical methods will be selected that most accurately represent the true concentration of the parameter of interest. The accumulation of QC procedures and information (i.e., RPD values, blank QC concentrations, MS percent recoveries, etc.) employed for a given analysis combine to exhibit the representativeness of the data generated.

The goal for representative sample data will therefore be met through the proper documentation of field and analytical protocols. If these procedures and methods cannot be implemented, the appropriate corrective action documentation will encompass the impact on the representativeness of the information. When review of the data and documentation determines that the data are nonrepresentative, the information will be qualified in its use or will not be used by the project. Statistical formulas may be implemented to further define sample population, parameter, or process characteristics relative to representativeness.

8.9.2.4 Completeness

Completeness is the measure of the amount of data obtained from a measurement process that achieves the project goals compared to the amount of data planned to be obtained by the project.

The following are three measures of completeness determined for this investigation.

Sample Collection:

$$\text{Completeness} = \frac{\text{Number of sample points sampled}}{\text{Number of sample points planned}} \times 100\%.$$

Field Measurements:

$$\text{Completeness} = \frac{\text{Number of valid field measurements made}}{\text{Number of field measurements planned}} \times 100\%.$$

Laboratory Analysis:

$$\text{Completeness} = \frac{\text{Number of valid laboratory measurements made}}{\text{Number of laboratory measurements planned}} \times 100\%.$$

Completeness goals established for this project for sample collection and field measurements are 95%. If these goals are not met, the necessity for resampling will be determined on a case-by-case basis. The completeness goal for laboratory analysis for this project is 90% overall. For critical data points, which consist of background sample locations, the completeness goal for sample collection, field measurements, and laboratory analysis is 100%. If review of the data and documentation determines that the data are incomplete, the impact relative to the project objectives will be assessed and documented.

To complete the intent of this project, all data will be validated against the reduced Level C criteria, with a minimum of 10% of the data validation being completed at Level D, to determine its useability. For determination of completeness in this project, all data not flagged as rejected by the validation process will be considered valid.

Additional formulas and statistically generated data may be utilized to further define data set completeness.

8.9.2.5 Comparability

Comparability expresses the confidence with which one data set can be compared with another. Comparability of the data generated in this investigation will be obtained through the implementation of the identified protocols for sampling and analysis of samples. Use of traceable reference materials as laboratory standards, expression of results in standard concentration units, and successful participation by the laboratories in external performance evaluation programs will enable the data produced through this investigation to be compared with future data sets, if required.

8.10 AUDITS AND SURVEILLANCES

Audits are performed to review and evaluate the adequacy of field and laboratory performance and to ascertain whether the QA/QC plan is being completely and uniformly implemented. Planned and scheduled audit will be performed to verify compliance with all aspects of the QA program and to determine the program's effectiveness. Energy Systems audits will be conducted in accordance with ESS-QA-18.0 and ESP-QA-18.1. An SAIC audit may be conducted in accordance with SAIC QAAP 18.1 and will be performed by personnel who do not have direct responsibility for performing the activities being audited.

Surveillance activities include monitoring and observing documents and work activities to provide an effective real-time means of evaluating the adequacy and effectiveness of methods for achieving quality and for assessing the quality of final results. Energy Systems surveillances will follow ER/Y-I1600. SAIC surveillances will be conducted in accordance with SAIC QAAP 18.3 and will identify the root cause on any NCR issued.

At least one surveillance will be scheduled to include observation of all procedures implemented.

Field surveillances will be conducted to assess technical and quality activities including sampling, instrumentation use, equipment decontamination, sample shipment, and field record maintenance.

8.11 CORRECTIVE ACTION

Energy Systems corrective actions to audit/surveillance findings and nonconformances will be managed in accordance with ESS-QA-16.0, 16.1, 16.2, 16.3, 16.4 and ESS-QA-15.0 and 15.1. SAIC corrective actions to audit/surveillance findings and nonconformances will be managed in accordance with SAIC QAAP 15.1 and 16.1. The Y-12 ER Project Manager will be notified when a nonconformance is documented and furnished a copy as soon as possible. Copies of nonconformances and their dispositions will be forwarded to the Y-12 ER Project Manager for placement in the Y-12 ER Records Center (DMC). Nonconformance Reports issued as a result of an audit or surveillance will identify the root cause of the problem.

8.12 QA REPORTS TO MANAGEMENT

All QA records concerning the project (e.g., internal and external correspondence, sampling and analysis plan, QAPjP, field logbooks and forms, chain-of-custody forms, data packages, audit reports, surveillance reports, nonconformance reports, corrective action reports, etc.) will be submitted to the Central Records Facility for dual storage and retrieval.

Table 8.6 is the ER Records Checklist to indicate the BCV OU 1 project records to be submitted to the ER DMC. Records concerning the project will be forwarded to the Y-12 ER Project Manager for placement in the Y-12 ER DMC during the project. A complete copy of the project file will be submitted to the Y-12 ER Project Manager at the end of the period of performance.

Table 8.6. Bear Creek OU 1 field sampling environmental restoration checklist

Item*	Reqd	QA	Item*	Reqd	QA
Financial/Scheduling			Plans and Planning Documents		
Financial Plan			Federal Facility Agreement		X
Engineering Service Order		X	Primary Document (RFI/RWP -ROD)	X	X
Activity Data Sheets (ADS)			FFA Secondary Docs. (RFI/RWP-ROD)		X
Current Year Work Plans		X	Public Information Fact Sheets		X
Cost Estimating Backup			Public Legal Notices/Newspaper Articles		
Baseline		X	Public Comments		X
Baseline Change Control		X	Procedures (Modified)		X
Project Schedules		X	Best Management Practices Plan		X
Progress Tracking System Report			Closure Plan		X
Cost Performance Reports			Community Relations Plan		X
Monthly Budget Review			Configuration Management Plan		X
Monthly/Qty/Annual Progress Reports			Contingency Plan		X
DOE Directive		X	Data Management Plans (Program)		X
Subcontractor Progress Reports			Data Management Plans (Project)		X
NEPA Documentation			Field Sampling Plans	X	X
Archeological Survey		X	Health and Safety Plan	X	X
Critical Habitat Survey		X	Mobilization Plan		X
Wetlands Survey		X	Program QA Plan		X
Threatened/Endangered Animal Species Survey		X	Project Management Plan		X
Site Historical Preservtn Office Survey		X	Project QA Plan	X	X
Environmental Checklist	X	X	Records Management Plan		X
Request for Categorical Exclusion (CX)	X	X	Safety Action Plan		X
Response (eg., CX Approval)	X		Sampling and Analysis Plan	X	X
Environmental Assessment (EA)		X	Security Plan		X
Action Description Memorandum (ADM)		X	Systems Engineering Plan		X
Analyses/Assessment/Evaluation			Waste Management Plan	X	X
Risk/Problem Analysis		X	Permits		
Preliminary & Final Safety Analysis		X	Air Permits (PSD Permit/Clean Air Act)		X
Safeguards & Security Evaluation		X	Aquatic Resource Alterations Permit		X
Life Cycle Cost Analysis			Asbestos Removal Permit		X
Maintenance Assessment		X	Burning Permit		
Self-Assessments		X	Const. Safety-Work Permit EP-D-08		X
Value Engineering Study		X	Corp of Engrs 404 Permit (Corp.-Major)		X
Service Subcon. S & H Proc (PC 164)	X	X	Excavation/Penetration Permit EP D-06	X	X
Site Location Selection		X	NPDES Permit Sec 402 (Outfall)		X
Contracts			RCRA Permit (Permit-By-Rule)		X
Statement of Work (SOW)	X	X	TSCA Permit (PCBs, Asbestos, Freon)		X
SOW Amendments	X	X	Waste Disposal Permit 2109	X	X
Cost Estimate/Proposal Info	X	X			
Technical Cost/Business Proposal Info	X				
Monthly Cost Information	X				
Invoices	X	X			

Table 8.6 (continued)

Item*	Reqd	QA	Item*	Reqd	QA
Reviews/Audits/Verifications			Surveys		
Operational Readiness Review	X	X	Site Survey		X
Audits/Surveillances/Corrective Actions	X	X	Industrial Hygiene Survey		X
Verification Matrix Review		X	Health Physics Survey (Assessment)		X
Davis-Bacon Review	X	X	Topographical Survey		X
Legal Review		X	Fire Protection Survey		X
Inspection Reports		X	Geotechnical Survey		X
Classification Review		X			
DOT/Shipping Documents		X			
Design			Reports and Documentation		
Constructibility Assessment		X	System Requirements Document		X
Constructibility Review		X	Field Change Orders	X	X
Design to Cost Review		X	Justification for Continued Ops. Approval		X
Review		X	Closure Summary Report		X
Professional Engineer Stamping of Design		X	Supporting Technical Documents (Eg., maps)		X
Design Criteria/SOW		X	Data Summary Sheets		X
Design Reviews & Design Review Record		X	Field Data Sheets	X	X
Analyses and Calculations		X	Field Logbooks	X	X
Shop (Vendor) Drawings		X	Field Equip. Calibration/Mntnce Records		X
Design Specifications		X	Hydrogeologic & Geophysical Test Data		X
Design/Installation Drawings		X	Boring and Well Construction Logs		X
Design Change Requests		X	Analytical Data Packages	X	X
Design Deviation Reports		X	Computer Aided Mfg. (CAM) Data Packages		X
As-Built (As-Constructed) Drawings		X	Site Background Documents		X
Test Plans		X	Topo., Aerial, and Hydrogeologic Maps		X
Procurement			Modeling/Software Control Documentation		X
Lease/Buy Decision	X	X	Correspondence addressing Performance	X	X
Proposal Evaluations	X	X	Comments and Responses	X	X
Procurement Documents	X	X	Photographs		
Technical Reviews and Documentation	X	X	Operable Unit Bibliography		
Receiving Inspections of Procured Items	X	X	Videos		
Vendor Certifications	X	X			
Construction			Training Records		
Permits		X	Technical Staff Resumes	X	X
Construction Job Instructions		X	Training Requirements		X
Cost Estimates and Control		X	Individual Training Summaries		
Schedules and Control		X	Training Records	X	X
Training		X	Record of Qualification		X
Certified for Construction Package		X			
Construction Management Plan		X	Design Const. Reports & Docs.		
Health and Safety Review		X	Design Basis Report		X
Testing and Test Reports		X	Project Validation		X
Acceptance Reports		X	Periodic Proj Reviews & Status Reports		X
Nonconformance Report Status		X	Construction Completion Report		X
			Construction Proj. Requirements Summaries		X
			Constr. Eng. (Title III) Test/Insp Reports		X
			As-constructed Verification (Title III Insp)		X

APPROVALS
ADDENDUM TO THE REMEDIAL INVESTIGATION
WORK PLAN FOR BEAR CREEK VALLEY OPERABLE UNIT 1
(DOE/OR/01-1161/V1&D2/A1)
HEALTH AND SAFETY PLAN
AUGUST 1994

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9. HEALTH AND SAFETY PLAN

This Health and Safety Plan (HSP) addresses the performance of remedial investigation field work on the Bear Creek Valley Operable Unit 1 (BCV OU 1). The purpose of this plan is to establish site-specific health and safety requirements to be followed by all personnel involved in conducting on-site work for this project. The field work will be conducted in accordance with relevant DOE and Y-12 Plant Safety and Health Standards and the SAIC Environmental Compliance and Health and Safety Program. Section 9.1, Site Health and Safety Checklist presents condensed site hazards and controls; Sect. 9.2, Supplemental Information, presents more general information, and where appropriate, justifications for requirements in Sect. 9.1. The first section is designed to be read and easily understood by all project personnel. The second section contains information aimed at those who desire a more in-depth understanding of the Health and Safety Program.

The levels of protection and the procedures specified in this plan are based on the best information available from historical data and preliminary evaluations of the area. Therefore, these are the minimum health and safety requirements to be observed by all personnel engaged in this project. Unforeseen site conditions or changes in scope of work may warrant a reassessment of protection levels and controls. All adjustments that result in decreases in protective measures must have prior approval of the relevant Y-12 Health and Safety office, the Y-12 ER Project Manager, and the SAIC Health and Safety Manager. Such changes will be approved and documented through the issuance of field change orders.

The field phases of this project will begin in late summer or early fall of 1994 and should be completed in late fall. The field crew will consist of 5 to 15 personnel. These personnel will include SAIC and subcontractor employees. An SAIC Field Operations Manager will be on site at all times and will be in charge of SAIC personnel and SAIC subcontractor personnel.

9.1 SITE HEALTH AND SAFETY CHECKLIST

9.1.1 Site Description

The BCV OU 1 is located at the west end of the Y-12 Plant. This plan addresses the Bear Creek Burial Grounds (BCBGs), Oil Retention Ponds (ORPs) I and II, Oil Landfarm, Boneyard/Burnyard, Sanitary Landfill I (SL I) and the S-3 ponds. The units in BCV were used for the disposal of waste oils, mop water, uranium-contaminated materials, thorium-contaminated materials, mercury-contaminated materials, acids, salts, solvents, asbestos debris, and other contaminated material. In most cases, open earthen trenches were filled and either burned or buried. The S-3 ponds were treated with acid and lime for bioremediation. The ponds were drained and filled with soil, then paved to create a parking lot.

Disposal records indicate a wide assortment of hazardous and nonhazardous materials have been disposed of in the various disposal facilities. Much of the disposal material was contaminated debris. Records also indicate that flammable and reactive materials were exposed to the atmosphere (emptied from containers or containers were ruptured) and were burned or reacted prior to burial.

Prior sampling of surrounding soils, groundwater, and sediments indicated elevated concentrations of a number of materials. These include total uranium (maximum concentrations 225 $\mu\text{g/g}$), PCBs (maximum concentrations 1448 $\mu\text{g/g}$), beryllium (maximum concentrations 290 $\mu\text{g/g}$), and perchloroethylene (maximum concentrations 8.4 $\mu\text{g/g}$).

The planned tasks include nonintrusive surveys (land surveys, radiological surveys, etc.), monitoring well installation, subsurface soil sampling, surface soil sampling, groundwater sampling, surface water sampling, and equipment decontamination. None of the planned activities include penetrating the former burial trenches so potential chemical and radiological exposures will be limited to materials that may have migrated from the disposal sites.

For additional information on the site and site tasks, see Chaps. 1 and 2 of this document.

9.1.2 Site Organization

The project personnel are organized to ensure clarity of responsibility for health and safety tasks. The Y-12 Project Manager is responsible for the overall coordination and performance of the project. The SAIC Health and Safety Manager is responsible for reviewing site health and safety plans, determine if proposed plan changes meet relevant health and safety requirements, and verify that on-site project execution provides a safe and healthful work environment through on-site audits. The Site Health and Safety Officer (SHSO) is responsible for monitoring site health and safety, verifying the hazards of planned work, making health and safety decisions, and reporting unexpected hazards and noncompliance with the Health and Safety Program to the field manager, the project manager, and the health and safety manager. The SAIC Field Operations Manager is responsible for on-site enforcement of the health and safety plan and coordination of SAIC activities during any emergencies. The SAIC Project Manager is responsible for ensuring that the appropriate personnel and equipment are available to perform site work safely. These personnel are identified in Table 9.1.

Table 9.1. Appropriate personnel to perform site work

Title	Name	Phone
Y-12 Project Manager	Judy A. Hodgins	(615) 576-2368
SAIC Health and Safety Manager	Steve Davis	(615) 481-4755
SAIC SHSO and alternates	Paul Eldridge, Mike Crenshaw, Steve Davis	(615) 481-4600
SAIC Field Manager	Gregory Schank	(615) 481-8760
SAIC Project Manager	William Kegley	(615) 481-8738

9.1.3 Tasks

The following planned tasks are indicated with a Y, and tasks that will not be performed are indicated with an N.

1. Y Groundwater sampling
2. N Test pit excavation
3. Y Geophysical surveying
4. N Penetrometer testing
5. Y Monitoring well installation
6. Y Surface water sampling
7. N Land clearing
8. Y Land surveying
9. Y Radiation surveying
10. Y Equipment decontamination
11. Y Soil boring/sampling
12. Y Surface soil sampling
13. N Air sampling
14. N Drum sampling
15. N Biota sampling
16. N Sludge sampling

9.1.4 Task-Specific Hazard Evaluation and Controls

This section presents task-specific hazard evaluations and controls. The hazard evaluations are organized into general categories such as physical hazards and electrical hazards. A numerical ranking of 0 to 4 is used to indicate the presence and probability/severity of a hazard. The following define the rankings: 0—the hazard is not posed by the planned tasks at this site or the impact of that hazard is insignificant; 1—the worst case potential for exposure is less than relevant action limits, and the potential for a serious injury is very low even without controls; 2—the worst case potential for exposure is less than threshold limit values, and the potential for a serious injury is low and controllable with standard operating procedures; 3—the worst case potential for exposure is greater than the threshold limit values and the potential for a serious injury is moderate and controllable with specific controls; 4—the probability of encountering that hazard is high, as is the probability for a serious adverse outcome if nothing is done to control the hazard. The final part of this section presents task-specific hazard controls based on these hazard evaluations.

The planned tasks are divided into the following five groups based on similarities in potential hazards.

- monitoring well installation and soil boring/sampling;
- groundwater sampling and surface water sampling;

- surface soil sampling;
- geophysical surveying, land surveying, and radiation surveying; and
- equipment decontamination.

The hazard evaluations for each of these groups are presented under each category of hazard.

9.1.4.1 Physical hazards

Tasks: Monitoring Well Installation and Soil Boring/Sampling.

<u>3</u>	Heat stress	<u>0</u>	Enclosed space	<u>0</u>	Ergonomic hazards
<u>1</u>	Cold stress	<u>1</u>	Explosive/flammable	<u>2</u>	Heavy lifting
<u>3</u>	Noise	<u>0</u>	Oxygen-deficient	<u>1</u>	Tripping/falling
<u>0</u>	Confined space	<u>3</u>	Electrical equipment	<u>0</u>	Vibration

Tasks: Groundwater Sampling and Surface Water Sampling.

<u>2</u>	Heat stress	<u>0</u>	Enclosed space	<u>0</u>	Ergonomic hazards
<u>1</u>	Cold stress	<u>0</u>	Explosive/flammable	<u>0</u>	Heavy lifting
<u>0</u>	Noise	<u>0</u>	Oxygen-deficient	<u>1</u>	Tripping/falling
<u>0</u>	Confined space	<u>0</u>	Electrical equipment	<u>0</u>	Vibration

Tasks: Surface Soil Sampling.

<u>3</u>	Heat stress	<u>0</u>	Enclosed space	<u>0</u>	Ergonomic hazards
<u>1</u>	Cold stress	<u>0</u>	Explosive/flammable	<u>2</u>	Heavy lifting
<u>0</u>	Noise	<u>0</u>	Oxygen-deficient	<u>1</u>	Tripping/falling
<u>0</u>	Confined space	<u>1</u>	Electrical equipment	<u>0</u>	Vibration

Tasks: Geophysical Surveying, Land Surveying, and Radiation Surveying.

<u>2</u>	Heat stress	<u>0</u>	Enclosed space	<u>0</u>	Ergonomic hazards
<u>1</u>	Cold stress	<u>0</u>	Explosive/flammable	<u>0</u>	Heavy lifting
<u>0</u>	Noise	<u>0</u>	Oxygen-deficient	<u>1</u>	Tripping/falling
<u>0</u>	Confined space	<u>0</u>	Electrical equipment	<u>0</u>	Vibration

Tasks: Equipment Decontamination.

<u>2</u>	Heat stress	<u>0</u>	Enclosed space	<u>0</u>	Ergonomic hazards
<u>1</u>	Cold stress	<u>1</u>	Explosive/flammable	<u>2</u>	Heavy lifting
<u>2</u>	Noise	<u>0</u>	Oxygen-deficient	<u>1</u>	Tripping/falling
<u>0</u>	Confined space	<u>0</u>	Electrical equipment	<u>0</u>	Vibration

9.1.4.2 Safety/construction hazards

Tasks: Monitoring Well Installation and Soil Boring/Sampling.

<u>0</u>	Trenching	<u>0</u>	Excavating	<u>2</u>	Heavy equipment
<u>1</u>	Hoisting/rigging	<u>0</u>	Elevated work	<u>2</u>	Welding/cutting
<u>0</u>	Ladders	<u>3</u>	Underground hazards	<u>3</u>	Overhead hazards

Tasks: Groundwater Sampling and Surface Water Sampling.

<u>0</u>	Trenching	<u>0</u>	Excavating	<u>0</u>	Heavy equipment
<u>0</u>	Hoisting/rigging	<u>0</u>	Elevated work	<u>0</u>	Welding/cutting
<u>0</u>	Ladders	<u>0</u>	Underground hazards	<u>0</u>	Overhead hazards

Tasks: Surface Soil Sampling.

<u>0</u>	Trenching	<u>0</u>	Excavating	<u>0</u>	Heavy equipment
<u>0</u>	Hoisting/rigging	<u>0</u>	Elevated work	<u>0</u>	Welding/cutting
<u>0</u>	Ladders	<u>1</u>	Underground hazards	<u>0</u>	Overhead hazards

Tasks: Geophysical Surveying, Land Surveying, and Radiation Surveying.

<u>0</u>	Trenching	<u>0</u>	Excavating	<u>0</u>	Heavy equipment
<u>0</u>	Hoisting/rigging	<u>0</u>	Elevated work	<u>0</u>	Welding/cutting
<u>0</u>	Ladders	<u>0</u>	Underground hazards	<u>0</u>	Overhead hazards

Tasks: Equipment Decontamination.

<u>0</u>	Trenching	<u>0</u>	Excavating	<u>0</u>	Heavy equipment
<u>0</u>	Hoisting/rigging	<u>0</u>	Elevated work	<u>0</u>	Welding/cutting
<u>0</u>	Ladders	<u>0</u>	Underground hazards	<u>0</u>	Overhead hazards

9.1.4.3 Chemical hazards

See Table 9.2 for a listing of the potential chemical exposures.

Tasks: Monitoring Well Installation and Soil Boring/Sampling.

<u>3</u>	Volatile organics	<u>1</u>	Inorganics	<u>1</u>	Carcinogens
<u>1</u>	Corrosives	<u>1</u>	Reproductive toxicants	<u>1</u>	Mutagens/teratogens
<u>1</u>	Metals	<u>0</u>	Asbestos	<u>0</u>	Other

Tasks: Groundwater Sampling and Surface Water Sampling.

<u>1</u>	Volatile organics	<u>1</u>	Inorganics	<u>1</u>	Carcinogens
<u>2</u>	Corrosives	<u>1</u>	Reproductive toxicants	<u>1</u>	Mutagens/teratogens
<u>0</u>	Metals	<u>0</u>	Asbestos	<u>0</u>	Other

Table 9.2. Chemical hazards

Chemical	TLV/PEL/activity or DAC/STEL/IDLH ^a	Health effects/ potential hazard ^b	Chemical and physical properties ^c	Exposure route(s)
Acids used to stabilize water samples (hydrochloric and nitric)	TLV: C10 and 2 ppm, STEL: NA and 4 ppm IDLH: 100 and 100 ppm	Irritation of eyes, skin, mucous membranes	Liquids with pungent odors; FP NA; IP > PID range	Inhalation Ingestion Contact
Beryllium (and other metals)	TLV: 0.002 mg/m ³ IDLH: 10 mg/m ³ STEL: NA	Respiratory stress, fatigue, eye irritation, suspected human carcinogen	Grey-white solid; FP NA; IP NA	Inhalation
Corrosive and reactive materials (exact materials unknown)	TLV: unknown STEL: unknown IDLH: unknown	Irritation, potential reactivity	Unknown	Inhalation Ingestion Contact
Isopropyl alcohol (used for sampling equipment decontamination)	TLV: 400 ppm STEL: 500 ppm IDLH: 12000 ppm	Irritation, dizziness	Colorless liquid with rubbing alcohol odor; FP 53° F; IP 10.10 eV	Inhalation Ingestion Contact
Nitric acid	TLV: 2 ppm STEL: NA IDLH: 100 ppm	Irritation, delayed pulmonary edema	Liquid with an acrid suffocating odor; FP NA; IP 11.95 eV	Inhalation Ingestion Contact
PCBs	TLV: 0.5 mg/m ³ STEL: NA IDLH: 5 mg/m ³	Classified by NIOSH as a carcinogen, eye irritation, acne-form dermatitis	Usually mixed with oil as dark liquid; FP NA; IP NA; VP 0.00006 mm	Inhalation Absorption Ingestion Contact
Perchloroethylene (and other chlorinated solvents)	TLV: 50 ppm STEL: 200 ppm IDLH: 500 ppm	Classified by NIOSH as a carcinogen, eye irritation, dizziness	Colorless liquid with chloroform odor; FP NA; IP 9.32 eV	Inhalation Ingestion Contact

Table 9.2 (continued)

Chemical	TLV/PEL/activity or DAC/STEL/IDLH ^a	Health effects/ potential hazard ^b	Chemical and physical properties ^c	Exposure route(s)
Plutonium (isotope unknown)	$7 \times 10^{-12} \mu\text{Ci/mL}$ (representative)	Carcinogenic, mutagenic, teratogenic	Variable, depends on compound	Inhalation Ingestion Absorption Injection
Thorium (isotope unknown)	$1 \times 10^{-12} \mu\text{Ci/mL}$ (representative)	Carcinogenic, mutagenic, teratogenic	Variable, depends on compound	Inhalation Ingestion Absorption Injection
Uranium (isotope unknown)	$2 \times 10^{-11} \mu\text{Ci/mL}$ (representative)	Carcinogenic, mutagenic, teratogenic	Variable, depends on compound	Inhalation Ingestion Absorption Injection

^aFrom 1993-1994 Threshold Limit Values, 1990 NIOSH Pocket Guide to Chemical Hazards, and ICRP 30.

^bFrom 1990 NIOSH Pocket Guide to Chemical Hazards.

CNS = central nervous system; NA = not available; CVS = central vascular system; PEL = permissible exposure limit; DAC = derived air concentration; SOL = solubility; FP = flashpoint; STEL = short-term exposure limit; GI = gastrointestinal tract; TLV = threshold limit value; IDLH = immediately dangerous to life and health; TWA = time weighted average; IP = ionization potential; UEL = upper explosive limit; LEL = lower explosive limit; VP = vapor pressure.

Tasks: Surface Soil Sampling.

<u>2</u>	Volatile organics	<u>1</u>	Inorganics	<u>1</u>	Carcinogens
<u>0</u>	Corrosives	<u>1</u>	Reproductive toxicants	<u>1</u>	Mutagens/teratogens
<u>0</u>	Metals	<u>0</u>	Asbestos	<u>0</u>	Other

Tasks: Geophysical Surveying, Land Surveying, and Radiation Surveying.

<u>1</u>	Volatile organics	<u>0</u>	Inorganics	<u>1</u>	Carcinogens
<u>0</u>	Corrosives	<u>1</u>	Reproductive toxicants	<u>1</u>	Mutagens/teratogens
<u>0</u>	Metals	<u>0</u>	Asbestos	<u>0</u>	Other

Tasks: Equipment Decontamination.

<u>1</u>	Volatile organics	<u>1</u>	Inorganics	<u>1</u>	Carcinogens
<u>0</u>	Corrosives	<u>1</u>	Reproductive toxicants	<u>1</u>	Mutagens/teratogens
<u>0</u>	Metals	<u>0</u>	Asbestos	<u>0</u>	Other

9.1.4.4 Ionizing radiological hazards

Tasks: Groundwater Sampling, Geophysical Surveying, Monitoring Well Installation, Surface Water Sampling, Land Surveying, Radiation Surveying, Equipment Decontamination, Soil Boring/Sampling, and Surface Soil Sampling (controlled area entry).

<u>0</u>	Radiation	<u>0</u>	High radiation	<u>0</u>	Very high radiation
<u>2</u>	Contamination	<u>0</u>	High contamination	<u>0</u>	Fixed contamination
<u>2</u>	Soil contamination	<u>0</u>	Airborne radioactivity	<u>0</u>	

9.1.4.5 Biological/vector hazards

Tasks: Groundwater Sampling, Geophysical Surveying, Monitoring Well Installation, Surface Water Sampling, Land Surveying, Radiation Surveying, Equipment Decontamination, Soil Boring/Sampling, and Surface Soil Sampling.

<u>2</u>	Wildlife	<u>2</u>	Plants	<u>0</u>	Medical waste
<u>0</u>	Bacteria	<u>2</u>	Parasites	<u>2</u>	Ticks

9.1.4.6 Sanitation

Tasks: Groundwater Sampling, Geophysical Surveying, Monitoring Well Installation, Surface Water Sampling, Land Surveying, Radiation Surveying, Equipment Decontamination, Soil Boring/ Sampling, Surface Soil Sampling.

<u>4</u>	Need toilets	<u>4</u>	Need washing facilities
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9.1.4.7 Illumination

Tasks: Groundwater Sampling, Geophysical Surveying, Monitoring Well Installation, Surface Water Sampling, Land Surveying, Radiation Surveying, Equipment Decontamination, Soil Boring/Sampling, and Surface Soil Sampling.

0 Inadequate Lighting

9.1.4.8 Task-specific hazard controls

This section presents task-specific hazard controls. The tasks are organized into groups based on similar hazards and controls as shown in Table 9.3.

9.1.5 General Hazard Controls

The following is a complete description of general hazard controls.

9.1.5.1 Engineering controls

Drilling and sampling will not take place in known disposal trenches. Any indication that a trench or similar disposal site has been breached will require work stoppage. Chemicals brought on site will be maintained in sound containers.

9.1.5.2 Training

Table 9.4 gives a complete description of training requirements.

9.1.5.3 Medical surveillance

All on-site workers will be enrolled in a medical surveillance program to comply with the requirements of 29 *CFR* 1910.120. The frequency of medical examinations will be at least annually for routine site workers (100 or more hours on site each year) and at least biannually for auditors and managers who spend less than 100 h on site each year.

9.1.5.4 Site control

Exclusion zones will be established around any operation where access control is needed to protect personnel from chemical, physical, or radiological hazards or to control the spread of contamination. Only authorized personnel will be allowed to enter. As a minimum, exclusion zones will be established around drill rigs during drilling. Exclusion zones will be established around other tasks, such as surface soil sampling if unauthorized personnel have ready access to the sample area or if the sample collection will take more than 1 h. Exclusion zones will be large enough (equal to height of mast or derrick for drill rigs) to preclude injury or unacceptable exposure to anyone outside the exclusion zone. No eating, drinking, using tobacco, chewing gum, or applying cosmetics will be permitted in the exclusion zone. Workers in exclusion zones will abide by a "buddy system."

Table 9.3. Task-specific hazard controls

Step	Hazard	Controls
<i>Monitoring well installation and associated subsurface soil sampling</i>		
1. Site drill rig	General physical hazards	Level D; hardhat, safety glasses, safety shoes Good housekeeping
	Radiation	Comply with radiation work permit PPE as required for area Doffing as required for area
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Electric shock	Clearance of overhead utilities by the distances specified in the DOE Hoisting and Rigging Manual
2. Drill and collect subsurface soil samples	General physical hazards (rotating machinery, suspended loads, moving equipment, slips, falls)	Hard hat within exclusion zone, safety glasses, safety shoes Lifting in compliance with DOE Hoisting and Rigging Manual Site control Barricading/posting work area Dual kill switches on rig
	Noise	Administrative controls in accordance with Energy Systems SPP 619 (minimize exposure) Hearing protection within 10 ft of operating rig
	Fire/explosion	ABC fire extinguisher Monitoring of fugitive gases
	Exposure to chemicals	Level C, minimize contact, no drilling into disposal sites
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Electric shock	Clearance of overhead utilities by distances specified in DOE Hoisting and Rigging Manual Completion of penetration/excavation permits

Table 9.3 (continued)

Step	Hazard	Controls
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
3. Finish well (install casing and related hardware)	General physical hazards (rotating machinery, suspended loads, moving equipment, slips, falls)	Hard hat within exclusion zone, safety glasses, safety shoes Site control Barricading/posting work area
	Noise	Administrative controls in accordance with Energy Systems SPP 619 (minimize exposure) Hearing protection within 10 ft of operating rig
	Fire/explosion	ABC fire extinguisher Monitoring of fugitive gases
	Exposure to chemicals	Level C Minimize contact
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Electric shock	Clearance of overhead utilities by distances specified in DOE Hoisting and Rigging Manual Completion of penetration/excavation permits
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
	Hotwork (oxyacetylene torch may be used to cut some well casings)	PPE—long sleeve shirt, heat-resistant gloves, goggles or hood with shade factor of at least 3 Exclude unnecessary personnel Completion of hot work permit
<i>Surface and groundwater sampling (well opening, sample collection, sample processing)</i>		
1. Sample collection	General physical hazards (slips, falls)	Level D; hardhat if overhead hazards are present, safety glasses, safety shoes, field work clothes

Table 9.3 (continued)

Step	Hazard	Controls
	Exposure to chemicals	Latex inner gloves, nitrile or PVC outer gloves Minimal contact
	Animal hazards (bees, ticks, wasps, snakes)	Pants taped to boots or tucked into socks Visual observation for snakes
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
2. Sample preparation and packaging	General physical hazards (slips, falls)	Level D; hardhat if overhead hazards are present, safety glasses, safety shoes, field work clothes
	Exposure to chemicals (acids for preserving samples)	Safety glasses or goggles, surgical gloves, portable emergency eyewash
	Animal hazards (bees, ticks, wasps, snakes)	Pants taped to boots or tucked into socks Visual observation for snakes
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
<i>Surface soil sampling (hand auger operation, sample processing)</i>		
1. Sample collection and packaging	General physical hazards (slips, falls)	Safety shoes, safety glasses if full- face respirator not used, hardhat if overhead hazards are present, work gloves as appropriate
	Exposure to chemicals	Level C Minimal contact

Table 9.3 (continued)

Step	Hazard	Controls
	Animal hazards (bees, ticks, wasps, snakes)	Pants taped to boots or tucked into socks Visual observation for snakes
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
<i>Nonintrusive surveys [geophysical surveys, physical (location) surveys, radiological surveys]</i>		
1. Conduct surveys	General physical hazards (slips, falls)	Level D; safety glasses, hard hats if overhead hazards are present, safety shoes, field work clothes
	Exposure to chemicals	Minimize contact with potentially contaminated soil
	Animal hazards (bees, ticks, wasps, snakes)	Pants taped to boots or tucked into socks Visual observation for snakes
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
<i>Equipment decontamination (hot water washing, soap and water washing, isopropanol washing)</i>		
1. Pressure washing	General physical hazards (slips, falls, equipment handling)	Level D; safety glasses or goggles, hard hats if overhead hazards are present, nitrile or PVC gloves, safety shoes, field work clothes
	Noise (spray washer)	Hearing protection when within 10 ft of operating pressure washer

Table 9.3 (continued)

Step	Hazard	Controls
	Release of contaminants to the environment during cleaning	Containment system dependent on contaminant levels
	Exposure to chemicals	Safety glasses or goggles, nitrile or PVC outer gloves, latex inner gloves, Tyvek or company coveralls
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact
2. Isopropanol rinse	General physical hazards (slips, falls, equipment handling)	Level D; Safety glasses or goggles, hard hats if overhead hazards are present, nitrile or polyvinyl chloride (PVC) gloves, safety shoes, field work clothes
	Release of contaminants to the environment during cleaning	Rinse performed in metal tubs and rinsate collected for appropriate disposal
	Fire/explosion (isopropyl alcohol)	Control of ignition sources Control of flammable materials (quantities limited to single-day use) ABC fire extinguisher Flammables stored in flammables cabinet if more than 10 gal
	Exposure to chemicals	Safety glasses or goggles, Tyvek or company coveralls
	Temperature extremes	Consumption of electrolyte replacement fluid Compliance with ESS-IH-134 Frequent breaks when temperature exceeds 80°F
	Radiation	Compliance with radiation work permit PPE as required for area Decontamination (as required) Minimize contact

PVC = polyvinyl chloride; WBGT = wet bulb globe temperature.

Table 9.4. Training requirements

Training	Worker	Supervisor	Site visitor (unescorted)	Site visitor (escorted)
General Employee Training	✓	✓	✓	✓
Radiation Worker (radiological contamination areas) Frisking, Donning & Doffing	✓	✓	✓	×
SARA/OSHA (40 h)	✓	✓	×	×
SARA/OSHA (24 h)	×	×	✓	×
SARA/OSHA Annual Refresher (8 h)	✓	✓	✓	×
SARA/OSHA Supervisors Training (8 h)	×	✓	×	×
General Hazard Communication Training (contained in 40 or 24 h)	✓	✓	✓	×
Respiratory Protection (required only if respirators are worn; contained in 40 h)	✓	✓	✓	✓
Pre-entry Briefing	✓	✓	✓	✓
Site-specific Hazard Communication (contained in site access briefing)	✓	✓	✓	✓
Safety Briefing (daily and whenever conditions or tasks change)	✓	✓	×	×

✓ = Required; × = not required.

9.1.5.5 Decontamination and contamination control

Where an exclusion zone is established to prevent the spread of contamination, a contamination reduction zone (CRZ) will also be established and personnel and equipment taken out of the exclusion zone will be verified free of contamination, appropriately decontaminated, or packaged to prevent the spread of contamination (equipment) and decontaminated at a central decontamination facility. Equipment decontamination will consist of washing with detergent and water or steam cleaning. Where the exclusion zone is established to prevent the spread of chemical or radiological contamination, personnel will doff protective clothing (consistent with standard health physics requirements) prior to entering the support zone. Personnel decontamination will consist of at least a field wash of hands and face before eating or drinking. A clean support zone will surround the CRZ, and all eating, drinking, smoking, etc. will take place in this zone. The exclusion zone and CRZ will be clearly delineated by barricade tape and/or radiological control rope and signs. A designated entry and exit point will be established and marked.

Level D decontamination. Employees will wash face and hands prior to eating or drinking.

Level C decontamination. If the protective clothing is not contaminated (or suspected to be contaminated) and all monitoring instruments are measuring no more than background levels of contaminants in the breathing zone, decontamination will consist of washing the face and hands prior to eating or drinking. If protective clothing is contaminated (or suspected to be contaminated), a sequential "step-off" decontamination (doffing) process will be used in the CRZ. This will be followed by washing the hands and face.

Level B decontamination. Employees will use a sequential "step-off" decontamination line in the CRZ. This will be followed by washing the hands and face.

Radiological doffing/decontamination. Radiological protective clothing doffing and personnel decontamination will follow established Y-12 Plant Health Physics protocols for the relevant area and task.

9.1.6 Personal Protective Equipment

9.1.6.1 Level D

Level D will be used for nonintrusive tasks that pose no significant chemical exposure hazard. Task-specific hazards may require the modification of these basic requirements. See the Task-Specific Hazard Controls Section. Radiological protective clothing will comply with the relevant radiation work permits and radiological posting.

Tasks: Groundwater Sampling, Geophysical Surveying, Nonintrusive Work Associated With Monitoring Well Installation (siting drill rig only), Surface Water Sampling, Land Surveys, Radiation Surveys, Equipment Decontamination—"Y" indicates that the item is required, "N" indicates that the item is not required, and "C" indicates that the SHSO may require this item on a contingency basis, depending on the specific hazards of the task.

Clothing:

	<u>Y</u>	Company coverall	<u>Y</u>	Tyvek	<u>N</u>	Other
	<u>N</u>	Saranex	<u>N</u>	PVC		
Head:	<u>C</u>	Hard hat	<u>Y</u>	Safety glasses	<u>C</u>	Goggles
	<u>C</u>	Splash shield	<u>C</u>	Ear plugs	<u>N</u>	Other

Hard hats will be worn only around overhead hazards. Ear plugs will be used if noise levels exceed 85 dBA. Splash shields will be worn if any task presents a splash hazard to the face.

Gloves:	<u>C</u>	Nitrile	<u>C</u>	PVC		Neoprene
	<u>C</u>	Latex	<u>N</u>	Vinyl		Other

Clothing:

<u>Y</u> Company coverall	<u>Y</u> Tyvek	<u>N</u> Other
<u>N</u> Saranex	<u>N</u> PVC	
<u>C</u> Work		

Chemical protective gloves will be required for some tasks.

Footwear:	<u>Y</u> Steel-toed leather	<u> </u> Chemical overboots
	<u>N</u> Steel-toed rubber	<u> </u> Other

Action levels for changes. The SHSO will upgrade the required protection to Level C if the air monitoring action levels are exceeded or will add specific items such as PVC gloves if evidence of significant unanticipated exposure hazards is observed.

9.1.6.2 Level C

Level C will be used for all intrusive tasks. Task-specific hazards may require the modification of these basic requirements (see the Task-specific Hazard Controls Section). Radiological protective clothing will comply with the relevant radiation work permits and radiological posting.

Tasks: Intrusive Work Associated With Monitoring Well Installation (everything except siting drill rig), Soil Boring/Sampling, Surface Soil Sampling

"Y" indicates that the item is required, "N" indicates that the item is not required, and "C" indicates that the SHSO may require this item on a contingency basis, depending on the specific hazards of the task.

Respirator:	<u>Y</u> Half-face	<u>Y</u> Full-face
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Full- or half-face respirators with organic vapor, acid gas, and HEPA cartridges will be worn.

Clothing:	<u>N</u> Company coverall	<u>Y</u> Polyethylene Tyvek	<u> </u> Other
	<u>Y</u> Saranex Tyvek	<u>N</u> PVC	

Polyethylene or saranex Tyveks will be worn.

Head:	<u>C</u> Hard hat	<u>Y</u> Safety glasses	<u>C</u> Goggles
	<u>N</u> Splash shield	<u>C</u> Ear plugs	<u>N</u> Other

Hard hats will be worn only around overhead hazards. Ear plugs will be worn within 10 ft of an operating drill rig and in any area where noise levels exceed 85 dBA. Safety glasses will be worn if a full-face respirator is not used.

Gloves:	<u>Y</u> Nitrile	<u>Y</u> PVC	<u>N</u> Neoprene
	<u>Y</u> Latex	<u>N</u> Vinyl	<u>N</u> Other
	<u>C</u> Work		

Respirator: Y Half-face Y Full-face

Full- or half-face respirators with organic vapor, acid gas, and HEPA cartridges will be worn.

PVC or nitrile gloves will be worn over latex inner gloves. Work gloves will be added over these gloves if tasks present a cut or abrasion hazard.

Footwear: N Steel-toed leather C Chemical overboots
Y Steel-toed PVC N Other

Steel-toed PVC boots or steel-toed leather boots with overboots will be worn.

Action levels for changes. The SHSO will upgrade the required protection to Level B or stop work if any of the air monitoring action levels are exceeded or if he/she observes evidence of significant unanticipated exposure hazards.

9.1.6.3 Level B

Level B may be used as a contingency for tasks that pose significant chemical exposure hazards. Radiological protective clothing will comply with the relevant radiation work permits and radiological posting.

Tasks: Current plans do not call for use of Level B for any task. If conditions requiring Level B protection are encountered, work will be stopped and the appropriate personnel (Y-12 Plant Industrial Hygiene or the SAIC Health and Safety Manager, SAIC SHSO, Y-12 Plant Project Manager, SAIC Project Manager) will be contacted. If the exposure cannot be controlled in any other way, and if the appropriate personnel are in agreement, work may continue with Level B being used.

"Y" indicates that the item is required, "N" indicates that the item is not required, and "C" indicates that the SHSO may require this item on a contingency basis, depending on the specific hazards of the task.

Respirator: N SCBA Y Airline with escape bottle
Clothing: N Company coverall N Tyvek Other
Y Saranex Y PVC

Hooded PVC or Saranex coveralls will be worn.

Head: C Hard hat N Safety glasses Goggles
N Splash shield C Ear plugs Other

Hard hats will be worn only around overhead hazards. Ear plugs will be used if noise exceeds 85 dBA.

Gloves: Y Nitrile Y PVC N Neoprene
Y Latex N Vinyl N Other
C Work

Respirator: N SCBA Y Airline with escape bottle
 Clothing: N Company coverall N Tyvek Other

PVC or nitrile gloves will be worn over latex inner gloves. Work gloves will be worn over these for any task that poses a cut or abrasion hazard.

Footwear: N Steel-toed leather C Chemical overboots
 Y Steel-toed PVC N Other

Footwear will consist of steel-toed PVC boots or steel-toed leather boots with chemical resistant overboots.

Action levels for changes. The SHSO will not upgrade beyond Level B. If site conditions call for Level A protection, work will be stopped and the planned tasks will be reassessed.

9.1.7 Monitoring Requirements

9.1.7.1 Direct reading instruments

Table 9.5 assigns the direct reading instruments for the various tasks.

Table 9.5. Direct reading instruments to be used at BCV OU 1

Instruments	Tasks	Frequency	Action limits and responses
LEL meter	5, 11	Continuously	$\geq 10\%$ LEL; stop work or reassess
O ₂ Meter	None		
Colorimetric detector tubes	1, 5, 6, 11, 12	If PID > 1 ppm	> 0 ppm benzene; perform benzene personal air sampling
Photoionization detector	1, 5, 6, 11, 12	Continuously	> 1 ppm; benzene detector tube > 5 ppm; level C > 20 ppm; stop work, reduce concentration, or use Level B
Mercury vapor monitor	1, 5, 6, 11, 12	greater than once per 10 min	> 0.025 mg/m ³ ; stop work, reassess
Alpha meter	5, 11, 12	cuttings and sample removal	≥ 500 cpm/100cm ² ; contact Y-12 Plant Health Physics
Beta/gamma meter	11, 12	sample removal	≥ 100 cpm/100cm ² ; contact Y-12 Plant Health Physics
Area radiation monitoring (survey performed by Y-12 Plant Health Physics)	All	Prior to site work	Standard Y-12 Plant administrative dose and contamination limits; Standard Y-12 Plant controls
Direct reading dosimeter	None		
Noise meter	5, 10, 11	initially	≥ 85 dBA; hearing protection
Other (Specify)			

9.1.7.2 Personal monitoring

Table 9.6 discusses the personal monitoring analyses.

Table 9.6. Personal monitoring to be used at BCV OU 1

	Tasks	Frequency	Action limits and responses
Whole-body dosimetry	All on site	continuously	Y-12 Plant adm. limits; reassess
Extremity dosimetry	None		
Whole-body count	None		
Urinalysis/bioassay	1, 5, 6, 11, 12	pre- and post-project	Y-12 Plant adm. limits; reassess
Chemical air sampling	1, 5, 6, 11, 12	>0 ppm benzene detector tube	>0.5 ppm benzene; stop work, reassess
Radiation air sampling (PAM)	None		

9.1.8 Emergency Preparedness

The Plant Shift Superintendent (PSS) will be contacted (911 from a plant phone or 574-7172 from a cellular phone) in the event of any site emergency. The PSS will coordinate and supply emergency services such as ambulance, emergency medical care, fire fighting, security, and hazardous materials response. Additional emergency telephone numbers are shown below.

Y-12 Plant Guard Department	574-7272
Y-12 Plant Medical	574-1577
Y-12 Plant Industrial Hygiene	576-7172
Y-12 Plant Health Physics	574-3547
Y-12 Plant Industrial Safety	574-1562
Methodist Medical Center of Oak Ridge	481-1190

The SHSO will perform the following pre-emergency tasks before starting field activities.

- Locate nearest plant telephone and alarm station.
- Confirm and post emergency telephone numbers.
- Post site map (contained in Chap. 1) of work areas marked with evacuation route and hospital.
- Inventory and check out on-site emergency equipment and supplies.

9.1.9 Emergency Equipment

<u>Y</u>	First aid kit(s)	<u>Y</u>	Emergency eyewash	<u>Y</u>	Cellular phone or radio
<u>Y</u>	Fire extinguisher(s)	<u>N</u>	Deluge shower	<u>N</u>	Other

9.2 SUPPLEMENTAL INFORMATION

This portion of the health and safety plan is designed to supplement the checklist presented in Sect. 9.1. The information in Sect. 9.2 is organized to mirror Sect. 9.1 and address the relevant health and safety programs that support the field work and to provide justification, where necessary, for judgements presented in the checklist.

9.2.1 Site Description

The BCV OU 1 was used for the treatment, storage, and disposal of hazardous wastes and metals. All of the sites are considered hazardous with the Boneyard/Burnyard and BCBGs posing the greatest threats due to the properties of the chemicals and contaminants placed in these areas.

The BCBGs are divided into sections. BCBG-B and the Walk-In-Pits (WIPs) received picric acid, uranium, and thorium saw-fines. The S-3 ponds, Oil Landfarm, and ORPs all received oils, heavy metals, coolants, depleted uranium, acids, and other wastes. The Sanitary Landfill I was used for the disposal of nonhazardous waste. Records indicate that administrative controls were in place to prevent accidental dumping of hazardous wastes at this site. The chance of encountering hazardous materials at the landfill is slim, but precautions will be taken for safety reasons. For additional information see Chaps. 1 and 2 of this document.

9.2.2 Site Organization

The ER Project Manager is responsible for managing the remedial investigation. This includes:

- maintaining project costs and schedule,
- coordinating efforts with various plant organizations,
- providing budget forecasts and resource commitments,
- coordinating the support personnel required for field activities and ensuring that these personnel have received appropriate training,
- notifying the Shift Superintendent of plans and scheduled activities for the site, and
- defining sampling and analysis parameters for investigation.

The SAIC Health and Safety Manager's duties include:

- determining the initial level of protective clothing needed at each site;
- reviewing the Health and Safety Plan; and
- providing guidance to the Field Operations Manager and SHSO, as needed.

The SAIC SHSO will coordinate health and safety activities in the field. The SHSO will perform the following duties:

- verify that protective measures in use (including protective clothing) are adequate for current conditions;
- notify the Field Operations Manager of any unexpected conditions or hazards;
- notify the Field Operations Manager of all instances of noncompliance with this Health and Safety Plan or with Y-12 Plant safety procedures;
- provide site personnel with information on site hazards;
- maintain a list of Y-12 Plant and subcontractor phone numbers;
- ensure that all site personnel know how to obtain emergency aid from the Y-12 Plant Shift Superintendent's office;
- perform on-site air monitoring;
- stop work if an unsafe situation occurs;
- conduct site-specific health and safety briefings; and
- maintain copies of Material Safety Data Sheets (MSDSs) for hazardous materials brought on site.

The SAIC Field Operations Manager will be responsible for enforcing compliance with this Health and Safety Plan. Specific health- and safety-related responsibilities include:

- coordinating on-site operations,
- minimizing the number of personnel in the exclusion zone,
- stopping work if any unsafe condition exists,
- coordinating with the SHSO to ensure safe operations, and
- obtaining excavation/penetration permits.

The SAIC Project Manager is responsible for overall project execution. The responsibilities of the Project Manager include:

- coordinating with ER personnel, including project manager;
- ensuring implementation of this document (RIWP including the HSP);
- maintaining auditable project documentation of all required records; and
- ensuring that a qualified SHSO is designated.

9.2.3 Tasks

A variety of field tasks will be performed as part of this investigation. These can be subdivided into sampling activities and surveys. Samples will be collected and analyzed for surface soils, subsurface soils, surface water, and groundwater. The soil sampling activities will include drilling and sampling soil borings and collecting shallow soil samples using a hand auger. Subsurface soil samples will be collected with a conventional mechanical auger system or a direct-push method. Groundwater will be sampled from wells constructed during this project and from existing wells. The various types of surveys include visual, geophysical, physical (location), and radiological.

9.2.4 Task-Specific Hazard Assessment and Controls

This section contains additional information on the severity and appropriate control measures for the hazards indicated in Sect. 9.1. Note that if a particular hazard was marked 0 in the checklist the corresponding hazard control section will not be completed.

BCV OU 1 was used for the treatment, storage, and disposal of hazardous wastes and metals. All of the sites are considered hazardous, though the Boneyard/Burnyard and Burial Grounds pose the greatest threats because of the properties of the chemicals and contaminants that were known to or that may have been placed in these areas. Hazards directly related to the Boneyard/Burnyard include potential exposure to uranium, organic compounds, acids, and metals in soil and groundwater in the area of trenches that were filled and covered with soil. Hazards associated with the Burial Grounds include all the hazards listed for the Boneyard/Burnyard. BCBG-B and the WIPs contain picric acid and uranium fines, which at the time of disposal were pyrophoric. The disposal practices and intrusion of groundwater into the buried wastes should have eliminated the potential pyrophoric threat. The S-3 Site, Oil Landfarm, and ORPs all present lesser hazards. Oils, PCBs, heavy metals, depleted uranium, acids, and other wastes were disposed of at these sites.

None of the planned tasks involve penetrating the burial sites so the potential for adverse effects from the buried wastes is limited to materials that have migrated. Any indication that a sampling activity (or any activity) has exposed a burial site will require an immediate work stoppage.

9.2.4.1 Physical hazards

Temperature extremes. Tasks: All. During work shifts, the average daily high temperature is 80°F; the average daily low temperature is 60°F.

Work load: ___ Light ___ X Moderate ___ Heavy

Controls: Field activities conducted during the summer or winter pose a hazard because of temperature extremes. Physical demands placed on investigative personnel may be compounded through the use of protective clothing/equipment, moderate to heavy workloads, ambient air temperatures, relative humidity, and exposure to non-ionizing radiation. These hazards will be managed as required by Energy Systems Standard "Management of Temperature Extremes" (ESS-IH-134).

Two important factors will help personnel function in hot environments: acclimatization and consumption of fluids. Acclimatization of workers to hot environmental conditions may require up to a week. During this period especially, workers should concentrate on maintaining a balanced diet, consuming plenty of fluids (while outside contaminated areas) throughout the day, and remaining aware of signs of heat-related illness. Headaches, dizziness, high body temperature, and increased heart rate are all early warning signals of heat stress. Unscheduled breaks will be taken at any time one or more employees reports symptoms of heat-related illness. It is imperative that the SHSO be informed if a worker experiences these symptoms.

Administrative controls, such as changes in work shifts, will be considered to reduce the risk of heat-related stress. A work/rest regimen will be established if the ambient temperature

exceeds 80°F. The SHSO will develop the work/rest regimen in accordance with best professional judgment using the current heat stress threshold limit value (TLV) published by the American Conference of Governmental Industrial Hygienists as a guideline. If the work/rest regimen as specified in the TLV booklet is exceeded, physiological monitoring will be conducted. To continue work in a heat stress environment in excess of the TLV, the employee's pulse rate following a break must be no greater than 90 beats per min.

Critical factors in preventing cold stress disorders are adequate clothing and staying dry. Cold water conducts body heat more readily than air and can induce hypothermia in a very short time. The SHSO and Field Operations Manager will ensure the capability to quickly move individuals who become wet to a sheltered, warm area.

Noise. Tasks: Monitoring Well Installation, Equipment Decontamination, Soil Boring/Sampling. The sound level should not exceed >85 dB(A). Noise source(s) include drill rig(s) and the pressure washer.

Controls: Exposure to noise in excess of 85 dB (A scale) poses a threat of hearing damage. Employees exposed at >80 dB (A scale) over an 8-h shift will be enrolled in a hearing conservation program to include hearing protection, audiometry, and training. Noise hazard areas (exposures greater than 85 dBA) will be posted to indicate the noise hazard and the requirement for hearing protection.

Confined/enclosed spaces. Tasks: None.

Confined/enclosed space entry ☐ Low risk ☐ High risk

Spaces to be entered: _____

Controls: Permit, standard procedures, atmospheric testing.

Fire/explosion. Tasks: Monitoring Well Installation, Equipment Decontamination. Flammable hazards include vehicle fuel, isopropanol, and a very small potential for flammable concentrations of site contaminants.

Controls: Minimize quantities of isopropanol to <5 gal, exclude ignition sources (flame, standard electrical motors, gasoline engines) from area of flammable hazards, test for %LEL, and stop work if >10%.

Oxygen-deficient atmosphere. Tasks: None.

Description: _____

Controls: Test for oxygen concentration, stop work if concentrations are <19.5% or >22.5%.

Electrical hazards. Tasks: Monitoring Well Installation, Soil Boring/Sampling. Electrical hazards include overhead lines, underground utilities.

Controls: A variety of controls will be used: ground drill rigs; maintain minimum distances from power lines; >1 ft when in transit with boom lowered and secured, 10 ft from 0-50 kV, >17 ft from 51-200 kV, >22 ft from 201-350 kV, >27 ft from 351-500 kV, >35 ft from 501

to 750 kV, and >45 ft from 751-1000 kV; and obtain penetration/excavation permits for all drilling. Before the start of drilling, all underground utility lines, other underground structures, and above-ground utility lines must be clearly delineated in the selected work area. The SHSO will ensure that the proper excavation/penetration permit, including utility review and survey, has been acquired before sampling, drilling, or excavation activities begin. No drilling will be conducted during thunderstorms. If electrical hand tools are used ground fault circuit interrupters will be used to minimize the electrocution hazard.

Ergonomic hazards. Unassisted heavy lifting (>75 lb) is the greatest ergonomic hazard. Tasks: Monitoring Well Installation, Equipment Decontamination, Soil Boring/Sampling

Controls: The primary ergonomic hazards that may exist will be lifting heavy loads, Personnel should always position themselves properly and lift from the legs when attempting to lift equipment. Personnel should rely on their buddy to assist in lifting loads that are too heavy for one person to properly lift and carry. Back strain, the most common ergonomic hazard in the field, may be easily avoided provided on-site workers always ask for assistance when needed.

9.2.4.2 Safety/construction hazards

Approximate dimensions of area to be excavated: None

Equipment to be used: Drill rigs

List known or suspected underground hazards: Various utilities

Controls: Approved excavation/penetration permit, safety glasses, hard hat, safety shoes.

Controls: No personnel under elevated loads, hard hats required for work near drill rigs. During activities involving heavy equipment (drill rigs), care will be taken to avoid overhead equipment, falling or flying objects, or being caught between moving and idle pieces of machinery. Mechanical lifting will comply with the *DOE Hoisting and Rigging Manual*.

9.2.4.3 Chemical hazards

Tasks: Monitoring Well Installation, Equipment Decontamination, Soil Boring/Sampling, Surface Soil Sampling.

Chemical hazards present as site contaminants, decontamination fluids, or sample additives are presented in the checklist. The list consists of chemicals known or suspected to have been disposed of in the disposal sites that are also known or suspected to have contaminated (migrated into) the surrounding areas. Unless otherwise specified, a specific chemical is present as a site contaminant. Prior sampling results indicate that the probability of chemical exposure in excess of half any TLV is very low, given the planned site tasks. Current plans do not call for drilling or sampling into disposal sites. If the drill rig accidentally penetrates a disposal site, the probability for exposures in excess of the TLVs is more significant.

Because of the nature of the sampling activities, workers may encounter some of the following chemicals:

- metals;
- oils (hydraulic fluids, PCB-contaminated oils);
- uranium and uranium-contaminated materials;
- thorium-contaminated materials;
- beryllium and beryllium-contaminated materials;
- laboratory wastes; and
- plutonium wastes.

Controls: Level C PPE will be used for intrusive site work. Site control will be used to exclude unnecessary personnel from contaminated areas. Air monitoring will be conducted to verify acceptable air concentrations. Work will be stopped if a disposal site is breached. MSDSs for chemicals brought on site will be maintained at the site, and all chemicals brought on site will be labeled per 29 *CFR* 1910.1200.

9.2.4.4 Ionizing radiation

Tasks: Groundwater Sampling, Geophysical Surveying, Monitoring Well Installation, Surface Water Sampling, Land Surveying, Radiation Surveying, Soil Boring/Sampling, Surface Soil Sampling.

Description of hazard: Some of the planned site tasks will take place in contamination areas

Radiation type: Y Alpha Y Beta/Gamma

Anticipated dose rate: (maximum) <0.005 rem/h mR/h; (average) background mR/h

Contamination level >1 × values in Table 2.2 of the DOE RADCON Manual.

Controls: Compliance with radiation work permit and site posting, beta/gamma and alpha monitoring of drill cuttings and samples, airborne monitoring of airborne radioactivity area, work planning, proper doffing/decontamination per standard Y-12 Plant Health Physics procedures. All personnel will be issued a thermoluminescent dosimeter (TLD) upon entering the Y-12 Plant site. During sampling activities, downhole equipment and material will be surveyed when removed from the sample point.

9.2.4.5 Biological/vector hazards

Tasks: Groundwater Sampling, Geophysical Surveying, Monitoring Well Installation, Surface Water Sampling, Land Surveying, Radiation Surveying, Soil Boring/Sampling, Surface Soil Sampling.

Description: Much of this work will take place in the summer months, and ticks, mosquitoes, snakes, and poison ivy may be present.

Controls: Long pants will be worn and the cuffs will be tucked into socks or taped to shoes; snake-proof leggings will be worn in areas where the ground cannot be seen. Work areas will be mowed if possible. Employees will avoid heavy cover. If heavy cover cannot be avoided,

employees will wear snake-proof leggings during warmer months. Employees will not handle or otherwise disturb wildlife.

9.2.4.6 Sanitation

Tasks: All

<u>Y</u>	Supplemental potable water required?
<u>N</u>	Supplemental toilet facilities required?
<u>Y</u>	Supplemental washing facilities required?
<u>N</u>	Change rooms required?

Potable water and portable toilets will be provided.

9.2.4.7 Illumination

Tasks: None. No planned tasks will take place at night or in areas of poor lighting.

Controls: Supplemental lighting may be needed if night work becomes necessary. Outside operations will commence no earlier than 15 min after sunrise and conclude no later than 15 min prior to sunset. Since most activities will be conducted during daylight hours, supplemental field illumination will not be required. However, if activities require outside work to be done at night, a minimum of 5 ft-c will be required. Office areas will be illuminated at 30 ft-c or more.

9.2.5 General Hazard Controls

9.2.5.1 Engineering controls

Drilling and sampling will not take place in known disposal trenches. Any indication that a trench or similar disposal site has been breached will require work stoppage. Chemicals brought on site will be maintained in sound containers. A flammables cabinet will be used to store flammable supplies if the quantity on site exceeds 10 gal.

9.2.5.2 Training

Current (refreshers as appropriate) OSHA 40-h health and safety training, as specified in 29 *CFR* 1910.120, will be required for all employees engaged in hands-on hazardous waste operations. Occasional visitors must have the 24-h hazardous waste health and safety training. Supervisors will also receive the 8-h hazardous waste supervisor course.

All site workers will receive a pre-entry briefing that addresses the site hazards (including information required by 29 *CFR* 1910.1200 for chemicals brought on site), appropriate control measures, emergency procedures, the Health and Safety Plan (also made available to all personnel), and the names and methods to contact the individuals responsible for site safety. The pre-entry briefing will also include hazard controls such as written procedures, protective clothing, location and use of fire extinguishers, exclusion zone rules, etc. Two versions of this briefing will be used. The site worker version will contain full information on site hazards,

hazard controls, and emergency procedures. A shortened version will be used for visitors who will be on site for short times and who will not do hands-on work. This shortened version will contain the hazard information that is directly relevant to the purpose of the visit. Signatures of those attending and the type of briefing must be entered in the field logbook before site access will be granted. Note that casual visitors (package deliverers, observers, etc.) to the support zone will not be required to have the access briefing.

At least one person on site will be trained in first aid and bloodborne pathogens if emergency medical care is more than 5 min away.

Once the project begins, routine (normally daily) safety briefings will be held. Site workers must also have completed the Energy Systems General Employee Training and Energy Systems Radiation Worker II Training (if entering a radiological control zone).

Respirator users must have completed respirator training. This is normally covered in the 40 hour hazardous waste course. Prior to any respirator use taking place, the SHSO will verify that each respirator user has had respirator training and will present a refresher session on respirator use.

9.2.5.3 Medical surveillance

All hazardous waste field personnel will participate in a medical surveillance program to meet the requirements of 29 *CFR* 1910.120.

The medical surveillance program will consist of the following required physical examinations:

- at preassignment;
- periodic (once every 12 months for routine site workers, once every 18 months for occasional site workers, and once every 24 months for visitors and auditors unless the attending physician believes the longer interval to be inappropriate);
- at termination of hazardous waste work; and
- after an injury or overexposure.

Medical examinations for hazardous waste operations personnel will include the following:

- medical and work history;
- physical examination;
- audiogram;
- blood chemistry (SMAC 24);
- complete blood count;
- chest X-ray (posterior, anterior, and lateral), initially and every 5 years thereafter;
- electrocardiogram (optional);
- pulmonary function test (spirometry);

- urinalysis;
- visual acuity; and
- other tests as directed by the examining physician.

If the SHSO suspects that an individual has been exposed to a significant level of hazardous materials, he/she will notify the SAIC Health and Safety Manager and the Y-12 Plant ER Project Manager and request that either Y-12 Plant medical personnel or the subcontractor's physician examine the individual to determine the impact of the exposure.

9.2.5.4 Site control

The SHSO will be responsible for establishing the site control zones, as necessary, around areas that present physical, chemical, and/or radiological hazards. The SHSO will also consult with the Y-12 Plant Health Physics Department prior to establishing work zones when radioactive material/contamination is involved. Implementation of the site control zones will help to minimize the number of employees potentially exposed and to minimize the potential for the spread of radiological or chemical contamination. The SHSO will monitor the implementation of the required site control work rules and will report any deviations from prescribed practice to the Field Operations Manager or stop work, as appropriate.

Site control zones will be established in a number of locations over the site. The exact locations will vary depending on the final selection of sampling points; therefore, it is not possible to illustrate the exact locations or extent of site control zones. The following sections describe the situations that will require the establishment of site control zones.

Zone 1: Exclusion zone. The exclusion (contamination) zone is the area where the greatest potential exists for exposure to contamination or physical hazards. The periphery of the exclusion zone will be identified by barricade tape or rope suspended above the ground. This rope or tape will be red for chemical contamination and yellow and magenta for radiological contamination. An entry and exit checkpoint will be visually defined to regulate the flow of personnel and equipment. The entry and exit checkpoint will be delineated with barricade tape/rope. The number of people and equipment in the exclusion zone will be minimized to control physical hazards and the spread of contamination.

The following standard rules will apply to all entry into the exclusion zone:

- The SHSO or Field Operations Manager must approve entry into the exclusion zone.
- All personnel entering the exclusion zone will wear the prescribed level of protective clothing.
- All items and related paraphernalia intended to be placed on the face or in the mouth (cigarettes, lighters, matches, chewing tobacco, food, cosmetics, etc.) are prohibited in the exclusion zone.
- All personnel in the exclusion zone will follow the buddy system.

Exclusion zones will be established around drilling sites, areas of heavy equipment use, equipment decontamination stations, radiological contamination areas, and all activities where chemical/radiological contamination is a significant potential hazard. At a minimum, the

exclusion zone will be large enough so that no part of an overturned drill rig would fall outside the zone. A larger exclusion zone will be used, as necessary, to protect bystanders and the public from chemical or other hazards. Exclusion zones for other activities will be appropriate to the hazard and surroundings. Tasks that will be completed quickly, have no potential for entry or unauthorized entry, or that pose no significant physical or chemical hazards will not be cordoned off by a formal exclusion zone.

Zone 2: Contamination reduction zone. A contamination reduction (buffer) zone will be established, as necessary, outside the exclusion zone to provide a transition from and a buffer between the exclusion zone and the support zone. A contamination reduction zone will be established if respiratory protection is used, if the exclusion zone is a radiological contamination zone, or if significant surface chemical contamination is present or suspected. An entry and exit checkpoint will be visually defined at the periphery of the zone to regulate the flow of personnel and equipment. The entry and exit checkpoint and the perimeter of the zone will be delineated with the use of ropes/barricade tape and signs.

All personnel entering the contamination reduction zone will wear the prescribed level of protective clothing required for that zone. Entry into the buffer zone is prohibited without the approval of the Operations Manager or SHSO. All items intended to be placed on the face or in the mouth (e.g., cigarettes, chewing tobacco, food, cosmetics, etc.) are prohibited in the contamination reduction zone. Doffing of protective clothing and personnel decontamination will occur at the boundary between the exclusion and contamination reduction zones.

Zone 3: Support zone. The support zone is the clean and relatively safe area surrounding the exclusion and contamination reduction zones. Entry requirements for the support zone consist of those required for entry into the general area of the Y-12 Plant. Primary functions of the support zone are:

- staging area for clean equipment and supplies and
- location for support services [e.g., office trailers, laboratory trailers, eating area(s), toilet facilities, parking, visitor area(s), etc.].

Site visitors. Visitors to the site shall abide by the following:

- Visitors shall be instructed to stay outside the exclusion and contamination reduction zones and remain within the support zone during the extent of their stay, unless entry has been approved by the SHSO.
- Visitors requesting entry to the exclusion or contamination reduction zones must wear appropriate PPE for entry into the zone and abide by the appropriate work rules. If respiratory protective devices are necessary, visitors must produce evidence that they have medical approval for respirator use, respirator training, and have been fit tested for the type and size respirator to be used within the past 12 months.
- Visitor inspection of the contaminated area shall be at the discretion of the Field Operations Manager.

9.2.5.5 Decontamination and contamination control

Decontamination will be conducted to the extent necessary to protect personnel and control the spread of contamination. Decontamination will not be conducted upon exiting areas that do not pose a contamination risk. The appropriateness of decontamination methods (or lack of) will be verified by the SHSO through visual observation and use of monitoring instruments.

All noncontaminated disposable clothing will be packaged daily in a marked plastic garbage bag on site and disposed of according to the project waste management plan. Contaminated disposable clothing will also be packaged in a marked plastic bag and disposed of according to the project waste management plan. The SHSO, at the direction of the Y-12 Plant ER Project Manager, will ensure that waste minimization efforts are employed to keep contaminated and noncontaminated wastes segregated.

The Y-12 Plant Health Physics Department will survey all subcontractor field equipment before it leaves the Y-12 Plant area. All radioactive contamination will be less than the Green Tag limits as determined by Y-12 Health Physics when equipment is scheduled to be removed from the site. A property removal request will be initiated through the Field Operations Manager so that Y-12 Plant Health Physics personnel can conduct required radiation surveys.

The equipment decontamination station will be enclosed to prevent the spread of contamination. Enclosure requirements depend upon the degree of contamination and will be evaluated on a case-by-case basis. The equipment decontamination station will be constructed so that liquids generated during decontamination and any rainwater that falls in the decontamination station will be contained.

Sampling and related equipment will be decontaminated to a level sufficient to prevent cross-contamination of subsequent samples. This stringent requirement ensures that decontaminated sampling equipment is sufficiently clean from a personnel contact perspective. Larger pieces of equipment, such as drill rigs, will be decontaminated with pressurized hot water/steam and will be surveyed for radioactive contamination prior to leaving the site. The following description of the sampling equipment decontamination process is intended to provide only a general overview.

Steps will be taken to ensure that the transporting of sampling equipment does not spread contamination to previously uncontaminated areas. Sampling and related equipment will be screened for radiological and chemical contamination prior to being transported to the decontamination station. Any equipment that is judged by site Health Physics or the SHSO to be heavily contaminated will be decontaminated in the immediate area of the sample collection or will be wrapped in plastic during transit.

This procedure applies to all equipment that comes in contact with surface and subsurface sample material (i.e., water dippers, sample mixing pans, scoops and trowels, continuous split-barrels, and hand augers). If sampling equipment is muddy, it will be rinsed with high-pressure hot water/steam prior to washing. High-pressure hot water/steam will also be used to decontaminate the drill rig. The high pressure hot water/steam wash will occur on the decontamination pad. The spray will be directed toward the back (lower end) of the enclosure so that all runoff and overspray will be collected by the roof, walls, and floor and will enter the sump. All wash and rinse solutions are transferred to containers for testing and

proper disposal. Alcohol and aqueous rinsing will be performed in dedicated containment reservoirs to segregate those solutions for waste minimization purposes.

The following sequence represents the sampling equipment decontamination process:

1. Health Physics survey (for projects involving radioactivity).
2. Wash and scrub equipment with laboratory-grade detergent and potable water.
3. Rinse with potable or deionized water.
4. Rinse with deionized water.
5. Move equipment to isopropyl rinsing container.
6. Rinse with ultrapure isopropyl alcohol at ~70% concentration.
7. Rinse with deionized water.
8. Drain or capture all drilling spoils and associated solutions.
9. Move equipment to drying area/table and air dry.
10. Wrap in aluminum foil if not immediately used.

9.2.6 Personal Protective Equipment

The SAIC Health and Safety Officer will be responsible for selecting initial personal protective equipment (PPE). The selection will be based on the potential hazards posed by site tasks, contaminants, and tools. Factors considered include heat stress, environments with unknown exposure hazards, low-temperature environments, and differences in work activities within the same contaminated work zone. For example, protective clothing for site operations in high-temperature environments should have the lowest practical thermal insulation properties to allow body cooling. Insulating layers of clothing should be worn under protective clothing to protect against low-temperature environments. The minimum protective clothing requirements include hard hats for areas with overhead hazards, steel-toed boots, work clothing, and safety glasses or goggles. Protective clothing requirements will be upgraded or downgraded according to the actual known or suspected exposure hazards.

Varying levels of protective clothing may be selected for workers performing different activities within the same work zone, if their activities involve different exposure hazards. For example, drillers who are frequently in contact with contaminated soil may be required to wear both inner and outer chemical-resistant gloves and polyvinyl chloride (PVC) chemical-resistant protective suits; however, soil samplers and geologists who have limited contact with contaminated soils may be required to wear only inner chemical-resistant gloves and disposable lightweight chemical-resistant suits. Air monitoring will be performed to ensure that the protective ensembles are appropriate for the type and concentration of contaminants.

The SHSO will ensure that all field workers have the following items available for their use:

- gloves: inner (surgical type, disposable) with outer (chemical-protective, neoprene or nitrile) *or* inner (chemical-protective, PVC or nitrile) with outer (heavy-duty work gloves);

- protective clothing: Tyvek (regular or coated, full length with zipper);
- footwear: steel-toed boots;
- ear protection: disposable foam earplugs *or* industrial earmuffs;
- eye protection: safety glasses with side shields *or* safety goggles to fit over prescription glasses (to be worn at all times when sampling);
- head/face protection: hard hats *or* hard hats with face shield attached; and
- respirator: full-face air-purifying respirator equipped with cartridges for protection against organic vapors and acid gases, dusts and mists, and radionuclides.

9.2.6.1 Level D

Level D personal protection provides no respiratory protection; therefore, it will be used only when no potential for overexposure to airborne contaminants exists.

9.2.6.2 Level C

Level C protection will be used when all of the following conditions exist.

- Oxygen concentrations are not <19.5% by volume.
- The concentration(s) of atmospheric contaminants exceeds the action limit for Level D.
- Air concentrations of identified or suspected substances will be reduced by the respirator to below the substance's TLV, and the contaminant concentrations in air do not exceed the maximum protection factor provided by the canister or cartridge.
- Atmospheric contaminant concentrations do not exceed immediately dangerous to life or health (IDLH) levels.

Level C protection includes a half- or full-face, canister- or cartridge-equipped air-purifying respirator (Mine Safety and Health Administration- or National Institute for Occupational Safety and Health-approved).

9.2.6.3 Level B

Level B protection will be used when any of the following conditions exist.

- Airborne contaminant concentrations exceed the action limit for Level C.
- The atmosphere contains <19.5% oxygen.

Level B protection includes a National Institute for Occupational Safety and Health-approved supplied-air respirator. The respirator may be a positive pressure-demand self-contained breathing apparatus or a positive pressure-demand airline respirator (with an escape bottle for IDLH or potentially IDLH atmospheres).

9.2.6.4 Respiratory protection

Respirator users will be covered by a respiratory protection program that meets the requirements of 29 *CFR* 1910.134 and ANSI Z88.2 by incorporating the following elements:

- designating a program administrator,
- instituting standard operating procedures for selecting and using respirators,
- properly selecting respirators based on hazard,
- training personnel in use and limitations of equipment,
- regular cleaning and maintenance of equipment,
- properly storing equipment,
- constant monitoring of work area for adverse conditions and worker stress,
- determining medical fitness of users, and
- using only approved equipment, always after performing proper fit testing.

The following policies will be adhered to in the fitting and use of respirators:

- Facial hair such as beards, sideburns, or certain mustaches that may interfere with the respirator fit are not allowed.
- Persons requiring corrective lenses will be provided with specially mounted lenses inside the full-face mask.
- A person may use only the specific make(s) and model(s) of air-purifying respirators for which he has obtained a satisfactory fit via the quantitative fit-testing procedures.
- Each respirator user will perform a qualitative face seal check (positive and negative pressure test) each time a respirator is donned.
- Respirators required for radiological protection shall be full-face type.

9.2.7 Monitoring Requirements

Assessment of airborne chemical concentrations, airborne radiological concentrations, and surficial radiological contamination levels will be performed, as appropriate, to ensure that exposures do not exceed acceptable levels. Action levels, with appropriate actions, have been established for this monitoring. In addition to the specified monitoring, the SHSO may perform, or require, additional monitoring such as organic vapor monitoring in the equipment decontamination area, personnel exposure sampling for specific chemicals, etc. The deployment of monitoring equipment will depend on the activities being conducted and the potential exposures. Routine real-time and integrated industrial hygiene measurements will be conducted by contractor personnel. Results will be recorded and maintained on site by the contractor SHSO.

The SHSO will ensure that all necessary monitoring equipment is provided, functioning properly, and currently calibrated before starting the investigation. Instrumentation will be used only by the SHSO or qualified personnel who have had prior experience or training in

instrument calibration, operation, and care. Each real-time monitoring instrument will be calibrated (or calibration checked) each day of use and this calibration will be documented.

To assist in evaluating potential site hazards, the SHSO will use one or more of the following (or an equivalent):

- Foxboro-Century OVA Model 128 Flame Ionization Detector and/or HNu Model PI101 Photoionization Detector;
- Ludlum Model 3 portable radiation survey meter with a Ludlum Model 44-9 pancake probe to detect beta and gamma radiation;
- Ludlum Model 12 portable radiation survey meter with a scintillation counter probe to detect alpha radiation;
- Portable explosimeter or Foxboro-Century OVA Model 108 to determine flammable/explosive gases or vapors;
- Portable pH/conductivity meter to monitor drilling fluids and groundwater that may contact the skin; and/or
- Jerome mercury vapor analyzer.

Air monitoring for volatile organic compounds will be conducted using an HNu or Organic Vapor Analyzer. Although not all volatile organic chemicals can be detected in this fashion, many of the site contaminants can be detected and will serve as indicators of contamination. The action levels for organic vapor measurements have been set conservatively to compensate for the instrument's inability to detect some of the site contaminants. Because these action levels are based on the potential to exceed time weighted average exposure limits, their use requires the application of professional judgment on the part of the SHSO.

For example, a breathing zone measurement of 5 ppm for 1 to 2 min that does not recur will not be sufficient reason to require the use of respiratory protection. If breathing zone concentrations remain at 5 ppm, the activity will be stopped and the SHSO will notify Y-12 Plant ER, Y-12 Plant Internal Health, and the SAIC Health and Safety Manager. Following assessment of the situation, appropriate actions will be taken. These may include identifying the airborne contaminant(s), using air purifying respirators, using supplied air respirators, taking measures to reduce airborne concentrations, etc. If breathing zone readings decrease to less than the action level, the activity will be resumed.

TLD badges, which must be worn by all personnel working at the Y-12 Plant site, provide Health Physics Department personnel with radiological exposure data. Abnormally high exposure information will be reported to the SHSO, and appropriate investigations will be conducted by Y-12 Plant personnel as necessary.

All personnel will monitor or be monitored for radioactive contamination prior to entering the support zone from the contamination reduction zone if radiological contamination is known or suspected.

Because the disposal sites received a wide array of wastes, it is not possible to monitor for all the potential exposures. The monitoring strategy is based on using several devices to detect marker compounds and applying conservative action limits. Total organic vapors will

be monitored and will serve as an indicator of exposure to specific compounds. If organic vapor measurements exceed the action limits, additional monitoring will be conducted to exclude the possibility of benzene exposure.

9.2.8 Emergency Preparedness

Emergency actions are tailored according to whether investigative activities are being conducted on sites in noncontaminated areas, on sites that have been designated as radiologically contaminated, or on sites that have been surveyed and may contain hazardous substances.

9.2.8.1 Emergency actions for noncontaminated areas

In the event of an accident involving actual or suspected personal injury, the Field Operations Manager will perform the following steps in the order shown here:

- Initiate emergency first aid, if necessary.
- Contact the Y-12 Plant Shift Superintendent.
- Obtain transportation for injured personnel (e.g., driller's service truck, SHSO vehicle, escort vehicle, ambulance), if required. A medical exam will be required after each accident that potentially exposes personnel to hazardous substances above the allowable limits or that results in injuries, other than minor first aid injuries, that might result in lost work days or reassignment of the injured worker.
- Initiate necessary corrective measures to abate any unsafe conditions.
- Withdraw uninjured site personnel to a safe distance from the accident scene until the SHSO determines that it is safe for work to resume.
- Contact the Y-12 Plant ER Project Manager.

Personnel should not enter an area to attempt a rescue if their own lives would also be threatened because of inadequate personal protection (e.g., clothing, self-contained breathing apparatus). The SHSO will ensure that all employees can be rescued from any area of the site that they are allowed to enter and is responsible for developing any special decontamination procedures for injured personnel if necessary.

Emergency planning will include establishing a procedure for evacuation from the site in case of a natural or man-made catastrophe. For work sites inside the Y-12 Plant, contractor and subcontractor personnel will assemble at the designated assembly point or where instructed by the Plant Shift Superintendent in the event of a plant emergency.

9.2.8.2 Emergency actions within contaminated areas

If personal injury or exposure of personnel to radiological contamination, suspected hazardous chemicals, vapors, or particulates occurs within a contaminated site, the following emergency procedures will be applied.

Personnel injury in the exclusion zone. All site personnel will assemble at the decontamination line. The rescue team will enter the exclusion zone (if required) to remove the injured person to the boundary.

- The SHSO or other qualified person will evaluate the nature of the injury. If the injury is determined not to be an immediate threat to life, the injured person will be decontaminated to the extent possible before being moved to the support zone. If the injury is determined to be an immediate threat to life, decontamination procedures will be postponed until the injured person stabilizes.
- The Y-12 Plant Shift Superintendent will be contacted for an ambulance, and the designated medical facility will be notified (if required). No person will re-enter the exclusion zone until the cause of the injury or symptoms is determined.

PPE failure. If any site worker experiences a failure or alteration of PPE that affects the protection factor, that person and his/her buddy will immediately leave the work area for a safe location. Re-entry will not be permitted until the equipment has been repaired or replaced. Rescue operations from toxic atmospheres will be conducted by persons wearing either self-contained breathing apparatus or suitable air-line respirators with escape bottles.

First Aid. At least one person on site will be certified in first aid and cardiopulmonary resuscitation (CPR). Workers trained and certified in first aid and CPR will render first aid and will attempt to stabilize any ill or injured worker needing assistance. Life support techniques such as CPR and treatment of life-threatening problems such as bleeding, airway obstruction, and shock will be given top priority. All on-site emergency assistance, including medical assistance, will be obtained as rapidly as possible by calling 911 or the Plant Shift Superintendent at 574-7172.

Spill Response. Site personnel will respond and contain any nonemergency spill such as hydraulic fluid or small quantities of decontamination fluid. Site personnel will not perform emergency response to significant spills such as large quantities of fuels. The PSS will be contacted for emergency response and site personnel will withdraw from the area.

9.2.8.3 On-site communications

On-site communication is required. For emergency communication, the SHSO will use one of the following communication methods:

- mobile radio,
- mobile telephone,
- nearest plant or guard house telephone, or
- fire pull-station.

APPROVALS
ADDENDUM TO THE REMEDIAL INVESTIGATION
WORK PLAN FOR BEAR CREEK VALLEY OPERABLE UNIT 1
(DOE/OR/01-1161/V1&D2/A1)
WASTE MANAGEMENT PLAN
AUGUST 1994

J. E. H. J. 8/23/94
Technical Support Contractor Program Manager Date

M. K. K. 8/10/94
Technical Support Contractor QA/QC Officer Date

Sherry L. Lankford 9/8/94
DOE-ER Site Program Manager Date

Atterton for J.T. Grunski 8/24/94
Energy Systems ER Site Program Manager Date

Judy A. Hodgins 8/10/94
Energy Systems ER Site Project Manager Date

M. Smith 8/10/94
Plant ER Waste Management Coordinator Date

10. WASTE MANAGEMENT PLAN

10.1 SCOPE

The objectives of this Waste Management Plan for the BCV OU 1 RI are to specify requirements for managing wastes generated as a result of investigation activities and to estimate the volume of waste that will be generated.

The BCV OU 1 RI Waste Management Plan will include management of soil, protective clothing, well development purge water, and decontamination water wastes. Table 10.1 outlines the ER Waste Management Plan Checklist for BCV OU 1. Investigation-derived waste (IDW), waste types, waste categories, estimated generation volumes, and expected contaminants for each waste stream are provided in Table 10.1.

Decontamination procedures will be established to support equipment decontamination and reduce the potential for cross contamination during sampling activities. All equipment and personnel will be scanned for radioactive contamination before leaving a borehole location. Equipment exhibiting radioactive contamination will be decontaminated at the borehole location where it was used before being moved to another borehole location or returned to the temporary decontamination area. All equipment at each borehole location will be subjected to preliminary cleaning to remove surface dirt or mud that otherwise might be tracked to other areas of the Y-12 Plant.

Soil cuttings will be generated during the installation of boreholes. It is not anticipated that much, if any, soil cuttings will be generated when boreholes are installed using Geoprobe. Soil cuttings, however, will be generated when the auger drilling rig is used to install boreholes. These soil cuttings will be scanned for radiological and volatile organic contamination using field screening instruments. Soil cuttings will be returned to the borehole from which they came in accordance with CERCLA guidance (Guide to Management of Investigation-Derived Waste, EPA Publication 9345-03FS, April 1992).

Boreholes will be abandoned by installing bentonite pellets to 1.0 ft above the water table, filling the borehole with soil cuttings and compacting the cuttings with the drilling rig to within 4.0 ft of ground surface and filling the final 4.0 ft with grout. Excess soil cuttings will be mounded on top of the borehole to alleviate any settling and/or spread around the borehole. Boreholes where the Geoprobe is used will be filled with bentonite pellets since soil cuttings are not expected to be generated.

Protective clothing will be scanned for radioactive contamination as determined by K/HS-410, Radiological Control Manual; if not contaminated, it will be treated as nonhazardous solid waste and will be disposed of in a dumpster provided by the Y-12 ER Program. Any protective clothing that is contaminated will be placed in 209-L (55 gal) drums and disposed of as hazardous waste by the Y-12 Plant.

All decontamination areas will be set up on the AOCs. Decontamination water will be scanned for radiological and volatile organic contamination using field screening instruments. If contaminated, this water will be pumped into 209-L (55-gal) drums with bung hole tops or poly tanks provided by the Y-12 Plant Water Treatment Plant. If not contaminated, this water

Table 10.1. Environmental Restoration Waste Management Project Plan

General project information						
Project name:	Bear Creek Operable Unit 1 Remedial Investigation Project					
Plant:	Y-12 Plant					
Organization:	Environmental Restoration Division/Remedial Investigation Subcontractor					
Responsible project manager:	Judy Hodgins, Y-12 Environmental Restoration Program					
Expected start/completion date:	August 1, 1994/June 29, 1996					
Project description (brief):	Remedial Investigation to collect surface and subsurface samples					
Project participants (for waste management interface only):	Waste generator: RI subcontractor Waste handler: Y-12 ER Division Waste transporter: WTSD Interim waste storage: RI subcontractor Permanent waste storage: WTSD Waste treatment: WTO Waste disposal: Y-12 sanitary landfill and/or WTSD					
Waste stream general information						
Waste stream	Category	Contaminant	Available analysis	Volume (ft or gal)	Packaging	2109#
Waste Stream 1 Unused soil will be returned to the borehole from which it came. The upper 4 ft of each borehole will be grouted. Any remaining soil will be kept on site	LLW	Depleted and enriched uranium, nitrates, metals, acids, bases	None required	1.8 m ³ (60 ft ³)	None	None required
Waste Stream 2 Decontamination water (uncontaminated will be returned to AOC; only contaminated will be contained)	LLW	Depleted and enriched uranium, nitrates, metals, acids, bases	CSTI required field screening for rad	418 L (110 gal)	Poly tanks or drums	Yes
Waste Stream 3 PPE (clothing)	Sanitary (Dumpster)	Same as Waste Stream 1	Field screening for rad	1.35 m ³ (45 ft ³)	None	None required

Table 10.1 (continued)

Waste Stream 4 Purge water	LLW	Same as Waste Stream 2	Same as Waste Stream 2	(2000 gal)	Poly tanks or drums	Yes
<i>Waste stream handling</i>						
Transport across public access roads Road involved: DOT regulations to be applied: Reportable quantities of anticipated DOE regulated hazardous material (if required):	☐ Yes ☒ No N/A ☐ Yes ☒ No N/A					
Waste storage requirements 90-day storage area (waste handler must obtain 90-day permit from the Environmental Compliance Department) Location: Capacity: Waste acceptance criteria requirements: Responsible organization: Permitted (or interim status) storage Location: Capacity: Waste acceptance criteria requirements:	☐ Yes ☒ No ☐ N/A ☐ Yes ☒ No ☐ N/A					
Identification of potential treatment options Location: Capacity: Responsible organization: Special waste acceptance criteria requirements:						
Identification of potential disposal options Location: Capacity: Responsible organization: Special waste acceptance criteria requirements:	SLF 5 WTSD N/A					

Table 10.1 (continued)

<i>Waste minimization and reduction techniques to be implemented</i>	
Segregation: ✓ Decontamination: Compaction: ✓ Solvent substitution: Sludge dewatering: Section of PPE: ✓ Other:	In field pretreatment: Waste handling: ✓ Material recycling (solvents, containers): Material reuse (solvents, wash waters): Cutting fluids recovery: Section of equipment:
Description of special techniques and expected effectiveness:	
<i>General project information (continued)</i>	
Prepared by:	Science Applications International Corporation
Date:	June 14, 1994
Reviews: ER Waste Management Coordinator: Plant Waste Coordinator: (Certifies Acceptance into Waste Management)	_____ _____ _____

will be pumped back onto the AOC at a rate that does not cause the water to run off the AOC. The isopropyl alcohol used as a rinse during decontamination will be contained separately from the decontamination water and allowed to evaporate.

Well purge water will be scanned for radiological and volatile organic contamination. Well locations in relation to existing wells that require drumming of purge water will also be evaluated. Purge water that shows radiological or volatile organic contamination using field screening instruments or that is in close proximity to an existing well that requires purge water to be drummed will be put into 209-L (55 gal) drums or poly tanks provided by the Y-12 ER Program. Water that is not considered contaminated will be placed on the ground within the AOC. All contained purge water will be disposed of by the Y-12 ER Program.

10.2 LABORATORY ANALYTICAL SAMPLES

The analytical laboratory will be subcontracted directly by Energy Systems through the APO. The disposal of any laboratory-generated waste and excess sample material will be the responsibility of the subcontracted laboratory, and such waste will be disposed of at an approved facility.

DISTRIBUTION

1. D. T. Bell
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4. M. F. P. DeLozier
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40. R. K. White
41. Y-12 Technical Library
- 42-45. ER Document Management Center
46. Y-12 ER Document Center
47. Y-12 Central Files
48. J. A. Archer, Jacobs Engineering, 800 Oak Ridge Turnpike, Oak Ridge, TN 37830
- 49-58. S. L. Lankford, DOE Oak Ridge Operations Office, P.O. Box 2001, Oak Ridge, TN 37831-8541
59. Duncan Moss, Science Applications International Corporation, 800 Oak Ridge Turnpike, Oak Ridge, TN 37831
- 60-61. R. L. Nace, Branch Chief, Nonenrichment Facilities, Oak Ridge Program Division, Office of Eastern Area Programs, Office of Environmental Restoration, EM-423, Trevion 2, U.S. Department of Energy, Washington, DC 20585
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- 63-64. H. M. Thron, Chief, Enrichment Facilities, Oak Ridge Program Division, Office of Eastern Area Programs, Office of Environmental Restoration, EM-423, Trevion 2, U.S. Department of Energy, Washington, DC 20585