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Rev. 00

Soil Washing Field Test Procedure for the 100-DR-1 Operable Unit

Environmental Excellence
HANFORD

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

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Soil Washing Field Test Procedure for the 100-DR-1 Operable Unit

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ACRONYMS

BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
EPA	U.S. Environmental Protection Agency
FY	fiscal year
PNL	Pacific Northwest Laboratory
SAP	Sampling and Analysis Plan
TCLP	toxicity characteristic leaching procedure
TPG	test performance goals
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*

Metric Conversion Chart

The following conversion chart is provided to the reader as a tool to aid in conversion.

Into Metric Units

If You Know	*Multiply By*	*To Get*
Length		
inches	25.4	millimeters
inches	2.54	centimeters
feet	0.305	meters
yards	0.914	meters
miles	1.609	kilometers
Area		
sq. inches	6.452	sq. centimeters
sq. feet	0.093	sq. meters
sq. yards	.0836	sq. meters
sq. miles	2.6	sq. kilometers
acres	0.405	hectares
Mass (weight)		
ounces	28.35	grams
pounds	0.454	kilograms
ton	0.907	metric ton
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.028	cubic meters
cubic yards	0.765	cubic meters
Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius

Out of Metric Units

If You Know	*Multiply By*	*To Get*
Length		
millimeters	0.039	inches
centimeters	0.394	inches
meters	3.281	feet
meters	1.094	yards
kilometers	0.621	miles
Area		
sq. centimeters	0.155	sq. inches
sq. meters	10.76	sq. feet
sq. meters	1.196	sq. yards
sq. kilometers	0.4	sq. miles
hectares	2.47	acres
Mass (weight)		
grams	0.035	ounces
kilograms	2.205	pounds
metric ton	1.102	ton
Volume		
milliliters	0.033	fluid ounces
liters	2.1	pints
liters	1.057	quarts
liters	0.264	gallons
cubic meters	35.315	cubic feet
cubic meters	1.308	cubic yards
Temperature		
Celsius	multiply by 9/5, then add 32	Fahrenheit

1.0 INTRODUCTION

This document will be the controlling document for the pilot plant testing of the soil washing process designed to reduce the volume of contaminated soil in the 100 Area trenches. The testing is designed to fulfill requirements of Milestone M-15-07B of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989). The discussion and procedures in this document are in accordance with the *100 Area Soil Washing Treatability Test Plan* (DOE-RL 1992c). The procedures contain all of the elements required for a Description of Work. Also, it is important to note that the field tests described in this document will not impact groundwater at the Hanford Site.

The soil washing equipment to be used in the Pilot Plant Test is shown on the process flow diagram (see Figure 1-1) and the general arrangement drawing (see Figure 1-2). Tables 1-1 and 1-2 list typical stream mass balance flow rates for the wet sieve-water process and the attrition scrubber process. These mass balance values, equipment types, and process arrangements have been selected to meet the requirements and scope described in Section 1.1 and the objectives and measurements described in Section 1.2.

1.1 REQUIREMENTS AND SCOPE

The requirements and scope for the pilot plant tests of soil washing equipment are described in Sections 1.1.1, 2.2 through 1.1.8.

1.1.1 Shakedown Test

The shakedown test will include setting up the equipment, obtaining operating experience, and selecting operating parameters for the field test. The shakedown test is described in detail in Section 1.1.1, 2.2.

1.1.2 Field Test

The purpose of the field test is to process contaminated soils to determine the effectiveness of wet sieving and attrition scrubbing with water as a means of reducing the volume of contaminated soils. The test will be divided into two parts: (1) wet sieving with water, followed by (2) attrition scrubbing with water. The equipment used will include screens, attrition scrubbers, dewatering screen, clarifiers, pumps, and conveyors. The field test is described in detail in Chapter 3.0.

1.1.3 Field Test Conditions

The field test will process soil particles <150 mm in diameter at the rate of 10 tons/hr. Adjustments to the time and rate of processing will be determined by the field engineer. Operation times will be during normal working hours. Bechtel Hanford, Inc. (BHI) estimates that 100 tons of soil will be processed during field testing to meet test objectives. An undetermined quantity of soil will be processed in the field shakedown test. After the M-15-07B milestone commitment is met, additional material from the 100-DR-1 operable unit or other sites may be processed depending on funding and resources.

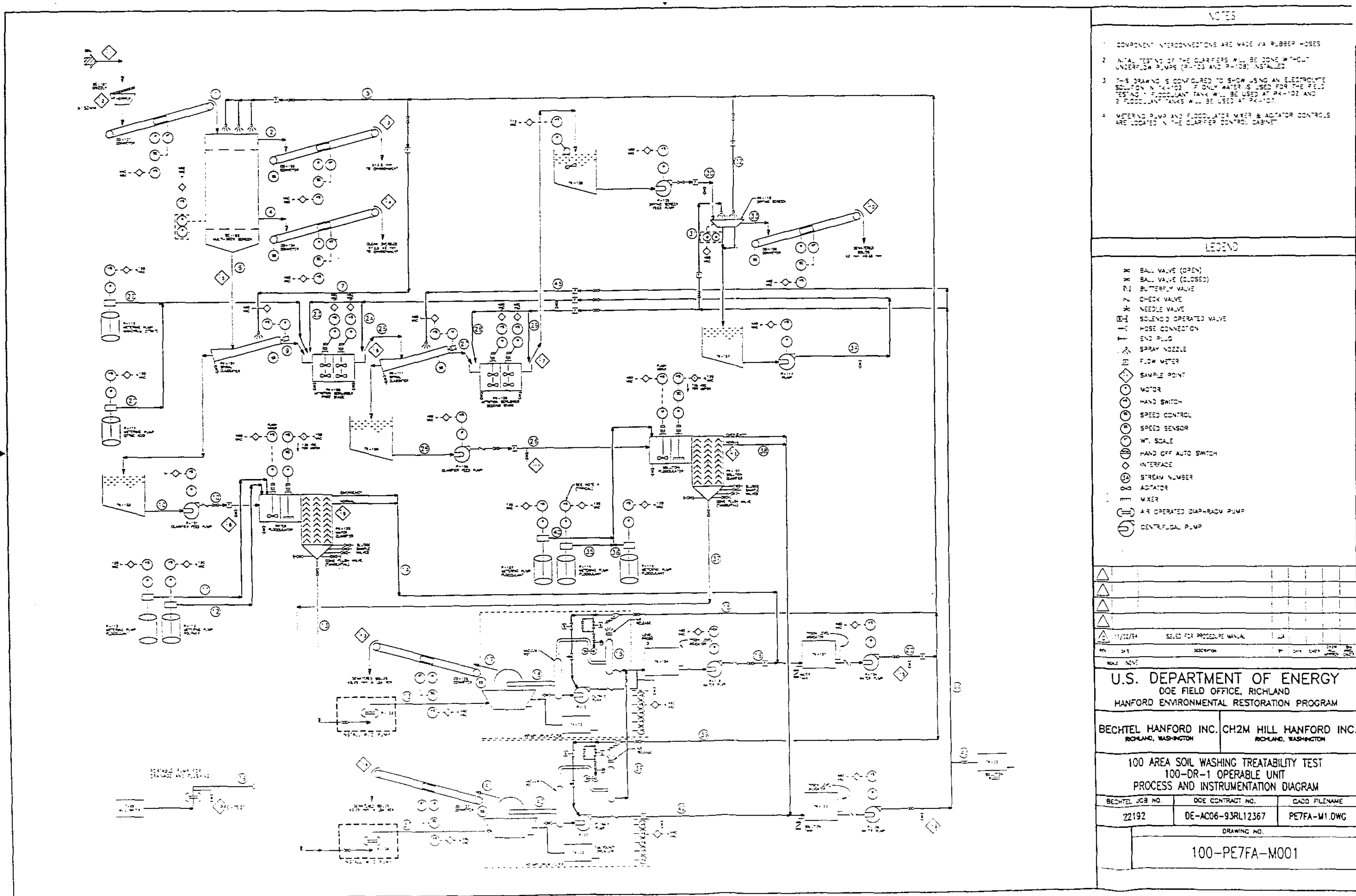

Figure 1-1. 100 Area Soil Washing Treatability Test 100-DR-1 Operable Unit Process Instrumentation Diagram.

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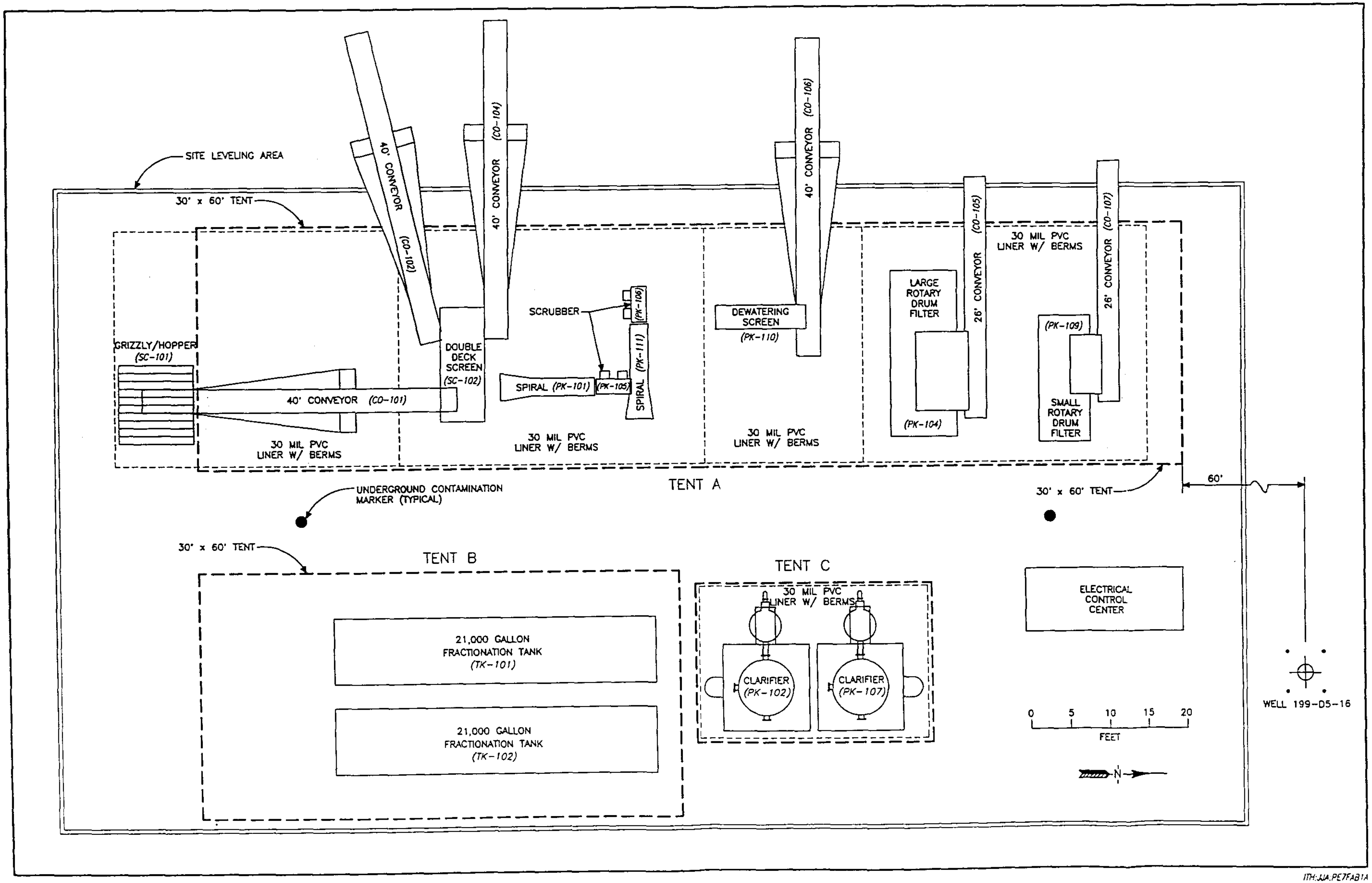

Figure 1-2. 100 Area Soil Washing Treatability Test General Arrangement.

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Table 1-1. Wet Sieving Circuit Mass Balance. (2 Sheets)

Stream Number	Solids Split (%)	Soil Feed From Grizzly 1	Screen Oversize to Environment 2	Screen Undersize to Environment 4	Recycle Water to Screen 5	Underflow to Spiral Classifier 6	Spray to Spiral Classifier 7	Spiral Classifier Sands 9	Attrition Scrubber Solids Split (%)	9A	Fines to #1 Clarifier 10
+ 13.5 mm, lb/hr	33.70	6,740	6,740								
-13.5 + 9.5 mm, lb/hr	7.90	1,580		1,580							
-9.5 + 2 mm, lb/hr	5.30	1,060		1,060							
-2 + 0.25 mm, lb/hr	40.70	8,140				8,140		8,140	90	7,326	
-0.25 + 0.074 mm, lb/hr	4.80	960				960			3.87	315	960
-0.074 + 0.028 mm, lb/hr	7.40	1,480				1,480			5.97	486	1,480
-0.028 mm, lb/hr	0.20	40				40			0.16	13	40
TOTAL SOLIDS, lb/hr		20,000	6,740	2,640		10,620		8,140		8,140	2,480
WATER, lb/hr		3,256	355	293	46,537	49,145	13,511	2,035		2,035	60,621
CAT FLOC L, ppm (mg/L)				77.743	0.490		0.490				0.109
AQUAFLOC 456-C, ppm (mg/L)											
AQUAFLOC 460, ppm (mg/L)											
CAT FLOC L, mg/hr				10,354	10.354		3.006				3,006
AQUAFLOC 456-C, mg/hr											
AQUAFLOC 460, mg/hr											
TOTAL, lb/hr		23,256	7,095	2,933	46,537	59,765	13,511	10,175		10,175	63,101
SOLIDS WEIGHT %		86.00%	95.00%	90.00%		17.77%		80.00%		80.00%	3.93%
TOTAL FLOW, gal/min					93.00	105.53	27.00				122.85
TOTAL VOLUME, ft³/min		2.78	0.77	0.34	12.43	14.11		1.29		1.29	
AVERAGE SPECIFIC GRAVITY		2.23	2.46	2.28	1.00	1.13	1.00	2.10		2.10	1.03
LIQUID SPECIFIC GRAVITY		1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00
SOLIDS SPECIFIC GRAVITY		2.79	2.66	1.00		2.90		2.90		2.90	2.90

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Table 1-1. Wet Sieving Circuit Mass Balance. (2 Sheets)

Stream Number	#1 Clarifier Flocculent 11	#1 Clarifier PK-102	#1 Clarifier Underflow 13	#1 Clarifier Effluent 14	Large Vacuum Pump Water 15	Vacuum Pumps Water 16	Large Filter Solids 17	Large Filter Filtrate 18	TK-101 Water Loss 19	Recycle Water 20
+ 13.5 mm, lb/hr										
- 13.5 + 9.5 mm, lb/hr										
- 9.5 + 2 mm, lb/hr										
- 2 + 0.25 mm, lb/hr										
- 0.25 + 0.074 mm, lb/hr		960	960				960			
- 0.074 + 0.028 mm, lb/hr		1,480	1,480				1,480			
-0.028 mm, lb/hr		40	40				40			
TOTAL SOLIDS, lb/hr		2,480	2,480				2,480			
WATER, lb/hr		60,621	14,054	46,567	12,010	18,515	621	13,433	1,849	80,364
CAT FLOC L, ppm (mg/L)		10,000	40.978	0.651	0.490	0.490	928.004			0.490
AQUAFLOC 456-C, ppm (mg/L)										
AQUAFLOC 460, ppm (mg/L)										
CAT FLOC L, mg/hr	272,212	275,218	261,457	13,761	2,672	4,119	261,457			17,880
AQUAFLOC 456-C, mg/hr										
AQUAFLOC 460, mg/hr										
TOTAL, lb/hr	1	63,101	16,534	46,567	12,010	18,515	3,101	13,433	1,849	80,364
SOLIDS WEIGHT %			15.00%				80.00%			
TOTAL FLOW, gal/min		126.10	29.79	93.06	24.00	37.00		26.85	3.70	160.60
TOTAL VOLUME, ft^3/min							0.39			
AVERAGE SPECIFIC GRAVITY	1.00	1.00	1.11	1.00	1.00	1.00	2.10	1.00	1.00	1.00
LIQUID SPECIFIC GRAVITY	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SOLIDS SPECIFIC GRAVITY			2.90				2.90			

Table 1-2. Attrition Scrubbing Circuit Mass Balance. (3 Sheets)

Stream Number	Slurry Dilution 23	PK-105	Transport Slurry Dilution 24	Slurry from Stage 1 25	Fines to #2 Clarifier 26	Sand to Stage 2 27	Attrition Scrubber Solids Split (%)	27A
+ 13.5 mm, lb/hr								
- 13.5 + 9.5 mm, lb/hr								
- 9.5 + 2 mm, lb/hr								
- 2 + 0.25 mm, lb/hr		7,326		7,326		7,326	97.00	7,106
- 0.25 + 0.074 mm, lb/hr	0	315	88	403	403		1.16	85
- 0.074 + 0.028 mm, lb/hr	0	486	135	621	621		1.79	131
-0.028 mm, lb/hr	0	13	4	17	17		0.05	4
TOTAL SOLIDS, lb/hr	-20	8,127	1,442	629,223	621,555	7,947		7,326
WATER, lb/hr	0	2,714	44,697	47,411	51,084	1,832		1,832
Ammonium Citrate, M	0.290	0.500	0.290	0.302	0.302	0.302		0.302
Citric Acid, M	7.06E-04	1.22E-03	7.06-E-04	7.36E-04	7.36E-04	7.36E-04		7.36E-04
CAT FLOC L, ppm (mg/L)								
AQUAFLOC 456-C, ppm (mg/L)								
AQUAFLOC 460, ppm (mg/L)								
CAT FLOC L, mg/hr	0	(0)	(0)	(0)		(0)		(0)
AQUAFLOC 456-C, mg/hr								
AQUAFLOC 460, mg/hr								
TOTAL, lb/hr		10,841	46,139	676,634	672,639	9,779		9,158
SOLIDS WEIGHT %	0.50%	74.99%	0.50%	15.00%	2.00%	80.00%		
TOTAL FLOW, gal/min	0.00	11.03	89.32	100.51	102.80			
TOTAL VOLUME, ft^3/min						2.32		2.32
AVERAGE SPECIFIC GRAVITY	1.00	1.97	1.00	1.11	1.01	2.10		2.10
LIQUID SPECIFIC GRAVITY	1.00	1.00	1.00	1.00	1.00	1.00		1.00
SOLIDS SPECIFIC GRAVITY	2.90	2.90		2.90	2.90	2.90		2.90

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Table 1-2. Attrition Scrubbing Circuit Mass Balance. (3 Sheets)

Stream Number	Recycle Dilution 28	PK-106	Recycle Transport 29	Slurry from Stage 2 30	Recycle Rinse (TK-103) 31	Recycle Rinse (TK-101) 32	Dewatered Sands 33	Screen Underflow 34	#2 Clarifier Flocculent 35	#2 Clarifier Flocculent 36
+ 13.5 mm, lb/hr										
- 13.5 + 9.5 mm, lb/hr										
- 9.5 + 2 mm, lb/hr										
- 2 + 0.25 mm, lb/hr		7,106		7,106			7,106			
- 0.25 + 0.074 mm, lb/hr		85		85				85		
- 0.074 + 0.028 mm, lb/hr		131		131				131		
-0.028 mm, lb/hr		4		4				4		
TOTAL SOLIDS, lb/hr		7,326		7,326			7,106	220		
WATER, lb/hr	0	1,832	39,682	41,514	1,801	1,801	1,777	43,340		
Ammonium Citrate, M	0.302	0.302	0.302	0.302	0.302		0.290	0.290		
Citric Acid, M	7.36E-04	0.001	7.36E-04	7.36E-04	7.36E-04		7.06E-04	7.06E-04		
CAT FLOC L, ppm (mg/L)										
AQUAFLOC 456-C, ppm (mg/L)										
AQUAFLOC 460, ppm (mg/L)										
CAT FLOC L, mg/hr										
AQUAFLOC 456-C, mg/hr										
AQUAFLOC 460, mg/hr										
TOTAL, lb/hr	0	9,158	39,682	48,840	1,801	1,801	8,883	43,560		
SOLIDS WEIGHT %		80.00%		15.00%			80.00%	0.50%		
TOTAL FLOW, gal/min	0.00	8.71	79.30	88.01	3.60	3.60		86.76	0.00	
TOTAL VOLUME, ft^3/min							2.26			
AVERAGE SPECIFIC GRAVITY	1.00	2.10	1.00	1.11	1.00	1.00	2.10	1.00	1.00	1.00
LIQUID SPECIFIC GRAVITY	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SOLIDS SPECIFIC GRAVITY		2.90		2.90			2.90	2.90		

Table 1-2. Attrition Scrubbing Circuit Mass Balance. (3 Sheets)

Stream Number	#2 Clarifier PK-107	#2 Clarifier Underflow 37	#2 Clarifier Effluent 38	Small Vacuum Pump Water 39	Small Filter Solids 41	Small Filter Filtrate 42	TK-102 Gain 43	Recycle 44	Spray to Spiral Classifier 45
+ 13.5 mm, lb/hr									
- 13.5 + 9.5 mm, lb/hr									
- 9.5 + 2 mm, lb/hr									
- 2 + 0.25 mm, lb/hr									
- 0.25 + 0.074 mm, lb/hr	403	403			403				
- 0.074 + 0.028 mm, lb/hr	621	621			621				
-0.028 mm, lb/hr	17	17			17				
TOTAL SOLIDS, lb/hr	1,041	1,041			1,041				
WATER, lb/hr	51,084	5,899	45,185	6,505	262	5,637	3,834	50,822	5,504
Ammonium Citrate, M	0.302	0.302	0.302		0.302	0.302	0.302	0.302	0.302
Citric Acid, M	7.36E-04	7.36E-04	7.36E-04		7.36E-04	7.36E-04	7.36E-04	7.36E-04	7.36E-04
CAT FLOC L, ppm (mg/L)				0.490					
AQUAFLOC 456-C, ppm (mg/L)									
AQUAFLOC 460, ppm (mg/L)									
CAT FLOC L, mg/hr				1,447					
AQUAFLOC 456-C, mg/hr									
AQUAFLOC 460, mg/hr									
TOTAL, lb/hr	52,125	6,940	45,185	6,505	1,303	5,637	3,834	50,822	5,504
SOLIDS WEIGHT %		15.00%			80.00%				
TOTAL FLOW, gal/min	104.17	12.51	90.30	13.00		11.26	7.66	101.56	11.00
TOTAL VOLUME, ft³/min					0.40				
AVERAGE SPECIFIC GRAVITY	1.00	1.11	1.00	1.00	2.10	1.00	1.00	1.00	1.00
LIQUID SPECIFIC GRAVITY	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SOLIDS SPECIFIC GRAVITY		2.90			2.90				

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1.1.4 Target Performance Levels

Test performance goals (TPGs) for the test will be accessible soil levels for ^{60}Co, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{153}Eu, ^{90}Sr, ^{235}U, ^{238}U, and $^{239/240}Pu$ (see Table 1-3). Reasons for selecting these levels instead of those specified in the test plan are given in DOE-RL (1993c).

The results of the testing will be evaluated over a range of levels including lower levels from the 100 Area soil washing test plan (see Table 1-3).

Table 1-3. Test Performance Goals and Evaluation Levels.

Contaminant	**Test Performance Goal**	**Lower Evaluation Level**
Radionuclides	WHC-CM-7-5[a] (pCi/g)	Test Plan[b] (pCi/g)
^{60}Co	7.1	1
^{90}Sr	2,800	13
^{134}Cs	10	2
^{137}Cs	30	3
^{152}Eu	15	3
^{154}Eu	15	3
^{155}Eu	630	100
^{235}U	170	15
^{238}U	370	50
$^{239/240}Pu$	190	75
Chemicals	Test Plan (ppm)	Test Plan (ppm)
Chromium (total)	1,600	1,600

[a]Accessible soil concentrations (Table 6.2 of WHC-CM-7-5 [WHC 1988]).
[b]Performance levels specified in the *100 Area Soil Washing Treatability Test Plan* (DOE-RL 1992c).

1.1.5 Equipment Sources

The soil washing plant is composed of new equipment purchased specifically for this test. The equipment consists of vibrating screens, conveyors, clarifiers, spiral attrition scrubbers, vacuum filters, dewatering screens, classifiers, and other miscellaneous equipment procured.

1.1.6 Toxicity Characteristic Leaching Procedure Analyses

Offsite laboratories will conduct toxicity characteristic leaching procedure (TCLP) analyses for fine soils <0.25 mm and for soils 2 mm to 0.25 mm. In addition, radiochemical analyses of extracts from the two sediment sample size groups will be performed by offsite laboratories.

1.1.7 Water Treatment Tests

In addition to field tests, water treatment tests will be conducted in the laboratory using available sediment from the Pacific Northwest Laboratory (PNL) bench-scale testing described in DOE-RL (1993c). These water treatment tests will include the following:

- A bench-scale batch processing system to assess field test recycle water systems for contaminant buildup and other process factors. Water treatment will include flocculation and filtration. The assessment of contaminant buildup in recycled water will be done in the laboratory, because continuous operation of the pilot-scale plant to reach "equilibrium" water conditions during this test is not feasible.

- Water treatment tests to treat spent process water from the bench-scale recycle tests. These results may give early indications of potential problems with water treatment before they are encountered in the field.

1.1.8 Contaminated Soil Disposal

Soils <0.25 mm will be placed in appropriate containers and handled in accordance with the Waste Control Plan (Appendix A) and stored in the operable unit for disposal and/or future use in technology evaluations. All other soils, processed and unprocessed, will be returned to the original excavation site after the field test is completed. Spent process water will be treated as needed and then evaporated.

1.2 OBJECTIVES AND MEASUREMENTS

Objectives and measurements for the soil washing treatability tests are listed in Sections 1.2.1 through 1.2.6.

1.2.1 Chemical and Radioactivity Levels

Soil processed during field tests will be analyzed for chemical and radioactivity levels and compared for consistency with results from the PNL bench-scale testing.

1.2.2 Soil Returned to the Site

Field measurements of the mass and percentage of each size fraction of feed and processed soils will be used to verify that the percent reduction (by weight) achieved by field-scale processing is consistent with previous bench-scale test results for 116-D-1B.

1.2.3 Water Treatment

Water treatment requirements and recycling needs will be assessed in the laboratory using available sediment from the PNL bench-scale testing (DOE-RL 1993c). Assessment will be made of contaminant buildup and treatment efficiency in removing contaminants from the recirculating liquids that will become the process effluent. These evaluations will include U.S. Environmental Protection Agency (EPA) Level III analyses of the feed water and system effluent after treatment.

1.2.4 Scale-Up

The performance data of the soil washing equipment used in the field test will be analyzed to determine the requirements for scale-up to a full-scale (e.g., 100 ton/hr) system. By a combination of field and bench-scale tests, the following will be determined:

- Operating utility requirements such as the consumption of chemicals, power, and water
- Settings of equipment controls
- Energy input requirements
- Soil/water feed ratios, chemical ratios, pressures, and flow rates.

1.2.5 Emissions and Safety

Emissions and/or environmental impacts will be assessed and as low as reasonably achievable practices will be followed. Air monitoring results, and exposure levels detected by Health Physics personnel, if any, will be reported.

1.2.6 Real-Time Radiation Monitoring

Sodium iodide detectors will be installed on the feed conveyor and three additional conveyors to provide real-time, quantitative radiation monitoring of processed soils (Appendix B). Data will be used as needed to make field changes required to improve system performance and to assess the viability of using real-time monitors for process control. Samples will be taken from these locations to compare real-time output from the radiation monitors with laboratory analyses.

1.3 116-D-1B SITE CHARACTERIZATION

The 100-DR-1 operable unit is located in the Pasco Basin of the Columbia Plateau. The Hanford formation is the uppermost layer extending from 5 m to over 100 m below the surface. All of the trenches and cribs in the 100-DR-1 operable unit are located within the Hanford formation.

Soils within the Hanford formation consist primarily of poorly sorted, unconsolidated, glaciofluvial material classified as Pasco Gravels. The Pasco Gravels are very coarse textured and typically consist of about 50% gravel, 40% sand, and 10% silt (DOE-RL 1988). These deposits primarily consist of quartz, feldspar, and ferromagnesian material (DOE-RL 1992b).

The primary contaminants in the 100-DR-1 operable unit are fission products, specifically $^{134/137}Cs$, ^{90}Sr, $^{152/154}Eu$, and ^{60}Co. Chromium is the primary metal contaminant of concern. All metals and organic constituents are below potential applicable or relevant and appropriate requirements for the 100-DR-1 operable unit (DOE-RL 1993b). Historical data and data from limited field investigations conducted in fiscal year (FY) 1992 and 1993 are included in DOE-RL (1989) and DOE-RL (1993b).

More detailed characterization of 100-DR-1 soils was performed on samples collected from a test pit excavated in the 116-D-1B Trench (DOE-RL 1993c). Based on studies by Dorian and Richards (1978) this trench was believed to be representative of other cribs and trenches in the 100-DR-1 operable unit both in terms of particle size and types of contaminants. Eleven 5-gal samples were collected from depths of 10 to 30 ft below the ground surface. The samples were used for soil washing bench-scale tests performed in FY 1993 and 1994.

The 116-D-1B Trench was used from 1953 to 1967. It is 100 ft long, 10 ft wide, and 15 ft deep. It was used to dispose of an estimated 110,000 lb of radionuclide-contaminated sludge and effluent from the 118-D-6 fuel storage basin. Other contaminants include 1,540 lb of sodium dichromate, 4,400 lb of sodium formate or oxalate, and 4,400 lbs of sodium sulfamate. After waste discharges were discontinued, the trench was backfilled with clean soil.

After wet sieving, the particle size distribution was as follows:

Gravel (>2 mm)	46.9
Medium Sand (2 mm to 0.25 mm)	42.3
Fine Sand (0.25 mm to 0.075 mm)	3.7
Silt and Clay (<0.075 mm)	7.1

Specific gravity of soil particles ranged from 2.7 to 2.9; total organic carbon was low (600 mg/kg); and the pH of the soil was slightly basic (7.66).

The dominant exchangeable cations were calcium (79%) and magnesium (20%). Other exchangeable ions included barium, strontium, and sodium. The total cation exchange capacity was 8.0 meq/100 g.

Major element concentrations (%) were:

Aluminum	5.67
Calcium	4.10
Iron	6.83
Potassium	1.15
Silicon	22.25
Titanium	1.02

Trace element concentrations (mg/kg) were:

Antimony	<19
Arsenic	<2
Barium	632
Cadmium	<14
Chromium (total)	58
Copper	61

Lead	13
Manganese	1,154
Nickel	124
Rubidium	43
Selenium	<1
Silver	<12
Strontium	377
Uranium	9
Vanadium	295
Zinc	138
Zirconium	205

In TCLP tests extract was well below regulatory levels for all constituents including chromium.

The three primary radionuclides detected in the 116-D-1B samples were ^{137}Cs, ^{152}Eu, and ^{60}Co. Other radionuclides were detected, but at significantly lower concentrations. Radionuclide distribution by particle size is shown in Table 1-4.

Table 1-4. Particle Size and Radionuclide Distribution for 116-D-1B Soils.

Particle Size	Wt %	^{137}Cs (pCi/g)	^{152}Eu (pCi/g)	^{60}Co (pCi/g)
>2 mm	46.9	11	2	<1
2 mm to 0.25 mm	42.3	105	48	3
0.25 mm to 0.075 mm	3.7	325	117	10
<0.075 mm	7.1	590	819	49
Bulk Soil	100.0	103.5	83.7	5.6

1.4 BENCH-SCALE TESTS

Soil washing bench-scale tests were performed in FY 1993 and 1994 to assess the feasibility of soil washing for 100 Area soils and to determine system processes to include in a pilot-scale test. These tests are documented in DOE-RL (1993). The TPG for the primary radionuclides found were 30 pCi/g for ^{137}Cs, 7 pCi/g for ^{60}Co, and 15 pCi/g for ^{152}Eu.

The first step of the tests was characterization of the soils. Some results of this work are shown in Section 1.3. Soil characterization included determining physical, chemical, and mineralogical characteristics of the soils.

Plagioclase feldspar and quartz were the major minerals. Micaceous minerals were present in minor quantities. Optical microscopy showed that many mineral grains had white coatings (0.02 mm to 0.18 mm) of aluminosilicate mineral, kaolinite, and Fe-oxide appearing as reddish-yellow stains.

Physical and chemical tests were conducted to reduce the activities of ^{60}Co, ^{137}Cs, and ^{152}Eu in the soil fractions. Physical tests consisted of attrition scrubbing to treat sand size particles (2 mm to

0.25 mm) and autogenous grinding to treat gravels (>2 mm). Attrition tests identified an optimum pulp density (83%) and energy input (1.4 hp/min/lb) for attrition scrubbing to reduce radionuclide concentrations (pCi/g) by >80% for ^{60}Co, 61% for ^{152}Eu, and 28% for ^{137}Cs. Scrubbing at this intensity resulted in generating an additional 9% of particles <0.25 mm. Doubling the energy input did not result in any noticeable increase in reducing radioactivity.

Using an electrolyte solution (0.5 ammonium citrate with citric acid to adjust pH to 3.0) radionuclide concentrations were reduced by 79% for ^{60}Co, 83% for ^{152}Eu, and 39% for ^{137}Cs. The increased removal of ^{152}Eu and ^{137}Cs radionuclides using the electrolyte appeared to be due to the dissolution of surface coatings and reduced readsorption of contaminants onto freshly scrubbed soil particle surfaces.

Two-stage attrition scrubbing tests were also performed with and without electrolyte. In these tests, generated soil fines were removed between stages. During this process >79%, 94%, and 48% of ^{60}Co, ^{152}Eu, ^{137}Cs was removed, and about 14% by weight soil fines were generated.

The results of autogenous grinding experiments conducted on coarse fractions (>2 mm) showed that 88% of ^{60}Co and 94% of ^{152}Eu could be removed, but <25% of the ^{137}Cs activity was removed.

In preliminary chemical extraction tests, several types of widely used extract compositions were tested. Many of these were effective in removing cobalt and europium by >90%, but they were less effective (30% to 40%) in removing cesium. Two new extracts heated to 96 °C were formulated that removed cobalt and europium with the same efficiency and also removed 85% of the ^{137}Cs from 2-mm to 0.25-mm particles. The new extracts were less effective (40%) in reducing ^{137}Cs activity in gravels >2 mm.

Preliminary flocculation tests were conducted on waste-water streams generated from wet-sieving, two-stage attrition scrubbing with electrolyte, and chemical extraction. These tests showed that it was feasible to flocculate suspended solids using commercially available flocculents (CAT FLOC L and POL-E-Z 692, are registered trademarks of Calgon, Pittsburgh, Pennsylvania). After flocculation, the solution concentrations of ^{60}Co and ^{152}Eu were less than minimum detectable activities of 1.7 and 4.3 pCi/mL, respectively. The maximum solution concentration of ^{137}Cs after flocculation was 6 pCi/mL. The study also indicated that flocculents were less effective in removing radionuclides from the electrolyte solution than from "water only" solutions.

Based on test performance goals, pilot tests were recommended at the 116-D-1B Trench. The following three physical soil-washing options were identified.

- Wet screening only: Soils >2 mm in diameter would be washed and separated and 47% of the soil would be below the TPG.

- Wet screening followed by attrition scrubbing with water: Soil particles between 2 mm and 0.25 mm would be treated using a two-stage attrition scrubbing process. A total of 84% of the soil would be treated to below TPG's for ^{152}Eu and ^{60}Co, but ^{137}Cs average levels may be slightly above TPG (37 pCi/g in laboratory tests).

- Wet screening followed by attrition scrubbing with electrolyte: This process is similar to option #2. Again, 84% of the soil would be treated, but ^{137}Cs levels are expected to just meet the TPG (30 pCi/g in laboratory tests).

While electrolyte and chemical extraction processes were more effective than physical soil washing methods in reducing ^{137}Cs levels in soils, they were not recommended for pilot tests. This was due to the ability of physical treatment processes to meet TPG, higher temperatures required for chemical processes, more complex water treatment that would be required, and higher equipment and operating costs compared to physical soil washing.

2.0 PILOT PLANT TEST DESCRIPTION

The pilot plant tests of soil washing equipment will consist of two parts: the shakedown test and field test. The amount of soil required for the shakedown test will depend on how quickly the system can be fine tuned to meet the requirements for the field test. It is anticipated that approximately 100 tons of soil will be processed in the field test, with 10 hours of actual processing. Several runs are planned to process soil for up to 4 hr/day. Equipment will include screens, conveyors, spiral classifiers, an attrition scrubber, rotary vacuum filters, and a dewatering unit.

Figure 1-1 is a process flow diagram of the testing arrangement to be used for the pilot plant tests with baseline material balance numbers. Figure 1-2 is a general arrangement of the soil washing equipment. The soil washing treatability test will evaluate the ability of physical washing, to separate the contaminated fines fraction from raw soil, thus reducing the overall volume of contaminated material. The process will incorporate a wet sieving circuit that will use a double-deck screen, a spiral classifier, a clarifier, and a rotary vacuum filter to separate the raw soil into five size fractions: >150 mm; 150 mm to 13.5 mm; 13.5 mm to 2 mm; 2 mm to 0.25 mm; and <0.25 mm.

The process will also incorporate an attrition scrubbing circuit that will use a two-stage attrition scrubber, a spiral classifier, a dewatering screen, a clarifier, and a rotary vacuum filter to scrub the 2-mm to 0.25-mm particles.

The wet sieving circuit will use recirculated process water for washing and slurry transport. The attrition scrubbing circuit will also use recirculated process water.

Process water will be treated as needed and then disposed in accordance with the Waste Control Plan (Appendix A). Treatment of the wastewater is expected to consist of removing suspended solids from solution by flocculation, and clarification. Contaminated soils <0.25 mm will be stored in approved containers and stored in the operable unit for disposal and/or possible future use in technology evaluations. All other soil, processed and unprocessed, will be returned to the excavation after the field test is completed.

2.1 SOIL WASHING EQUIPMENT

The baseline features for the soil washing equipment to be used during testing are described in the following sections. The operating parameters described here may be altered during operation by the process described in Section 2.3.1. Any changes will be detailed in the final test report.

The equipment will be installed and maintained in accordance with individual installation, operating, and maintenance procedures detailed in separate documentation. Similar information for procured equipment will be supplied by the sellers.

2.1.1 Grizzly

In the wet sieving circuit, raw feed soil will be fed to a 150-mm grizzly. The oversize material (>150 mm) will exit the system, while undersize material (<150 mm) will travel up a conveyor belt and fall onto the double-deck screen.

2.1.2 Primary Screen

The primary screen will separate the soil into three sizes: 150 mm to 13.5 mm, 13.5 mm to 2 mm, and <2 mm. The soils will pass under recirculated water sprays to separate the oversize from the fines. The oversize then exits the system by conveyor belts to a low specific activity storage box. The water and fines slurry resulting from the spray step will be collected and gravity fed to the spiral classifier for further processing. The double-deck screen features are listed below:

- Screen dimensions: 4 x 12 ft
- Screen opening size: 13.5 mm and 2 mm slotted
- Slope: 0 degrees
- Soil flow rate and underflow percent solids: See Figure 1-1 and Table 1-1
- Nozzle pressure and flow rate: 40 lb/in^2 and 10 gal/min.

2.1.3 Spiral Classifier

The oversize particles (between 2 mm and 0.25 mm) will discharge by gravity from the upper end of the wet (i.e., the first) sieving spiral classifier to the first-stage scrubber. The undersize particles (<0.25 mm) will overflow from the pool as a slurry and be pumped to the clarifier. In the scrubber (i.e., the second) spiral classifier, the oversize particles will discharge by gravity from the upper end of the spiral to the second-stage scrubber. The undersize particles will overflow from the pool as a slurry and will be pumped to the clarifier. The spiral classifier features are listed below:

- Slope: 16.2 degrees
- Rotation speed: 15 rpm
- Soil flow rate and underflow percent solids: See Figure 1-1 and Tables 1-1 and 1-2
- Volume: 50 gal
- Pool area: 5.1 to 8.1 ft^2.

2.1.4 Attrition Scrubbers

In the first-stage scrubber of the attrition scrubbing circuit, a pair of impellers rotating in each of two tanks will produce surface erosion on the oversize particles (between 2 mm and 0.25 mm) from the wet sieving spiral classifier. The solids concentration in these tanks will be controlled by addition of water. The first-stage scrubber discharge will be diluted, and the slurry will be pumped to the scrubber spiral classifier for fines removal before entering the second-stage scrubber. On the basis of the PNL bench-scale tests (DOE-RL 1993c), 10% of the first stage feed and 3% of the second stage feed will become fines of <0.25 mm. The discharge from the second stage scrubber will be diluted and pumped as a slurry to the dewatering screen. The attrition scrubber features are listed below:

- Volume, each of four cells: 10 ft^3
- Power input to each of four cells: 15 hp
- Rotation speed of each 2-bladed, 18-in.-diameter impeller: 288 rpm
- Soil flow rate: See Figure 1-1 and Table 1-2
- Retention time each cell: 16 minutes.

2.1.5 Dewatering Screen

The dewatering screen will receive the discharge from the second-stage scrubber through the dewatering screen pump. Oversize particles (between 2 mm and 0.25 mm) will be rinsed by water sprays, dewatered, and discharged onto a conveyor belt. Undersize particles (<0.25 mm) will pass through the screen and be pumped as a slurry to the first-stage attrition scrubber. The dewatering screen features are listed below:

Screen dimensions: 2 x 10 ft
Screen opening size: 0.25 mm
Slope: 5 degrees
Soil flow rate and underflow percent solids: See Figure 1-1 and Table 1-2
Water nozzle supply pressure: 40 lb/in^2.

2.1.6 Clarifiers

Process water will flow through flash mix and flocculation tanks integral with both clarifiers. Polymer and flocculent will be added to these tanks as required to assist in adequate clarification of the overflow streams. The two underflow streams containing the settled solids will be pumped to the rotary vacuum filters. The clarified water will be combined with the filtrate and be recirculated through recycle tanks. The clarifier features are listed below:

- Projected plate area: 584 ft^2
- Plate loading rate: 0.17 gal/min/ft^2
- Soil flow rate, overflow, and underflow solids concentration: See Figure 1-1 and Tables 1-1 and 1-2
- Chemical feed rate to the flash mixing and flocculation tanks: See Figure 1-1 and Tables 1-1 and 1-2
- Volume of the flash mix/flocculator tank: 423 gal
- Volume of the settling tank: 3,500 gal.

2.1.7 Rotary Vacuum Filters

In each rotary vacuum filter, the contaminated fines (<0.25 mm) will be discharged to a belt conveyor and transferred to approved containers. The filtrates will be combined with the overflows from the clarifiers and be recirculated through separate recycle tanks. The rotary vacuum filter features are listed below:

- Large
  - Filtration area: 132 ft^2
  - Rotation speed: 0.5 - 5.0 rpm
  - Soil flow rate, and filter cake solids concentration: See Figure 1-1 and Table 1-1
  - Vacuum pressure and flow rate: 20 in. Hg at 740 ft^3/min
  - Filtrate pressure and flow rate: 30 lb/in^2

- Small
  - Filtration area: 56 ft^2
  - Rotation speed: 0.25 - 1.5 rpm
  - Soil flow rate, and filter cake solids concentration: See Figure 1-1 and Table 1-2
  - Vacuum pressure and flow rate: 20 in. Hg at 488 ft^3/min
  - Filtrate pressure and flow rate: 20 lb/in^2

2.2 SHAKEDOWN TEST

The goal of the shakedown test is to ensure that the soil washing system and equipment are functioning properly so that the requirements and objectives for the treatability field test can be met. Any necessary equipment modification or process reconfiguration will be made during this test. Data for scale-up equipment will be gathered, where practical. Operation during the shakedown test will also allow the operators to become familiar with the equipment. There is no set tonnage of soil required to perform the shakedown test. The actual tonnage processed will depend on the time required to get the system functioning properly and for operators to become familiar with its operation.

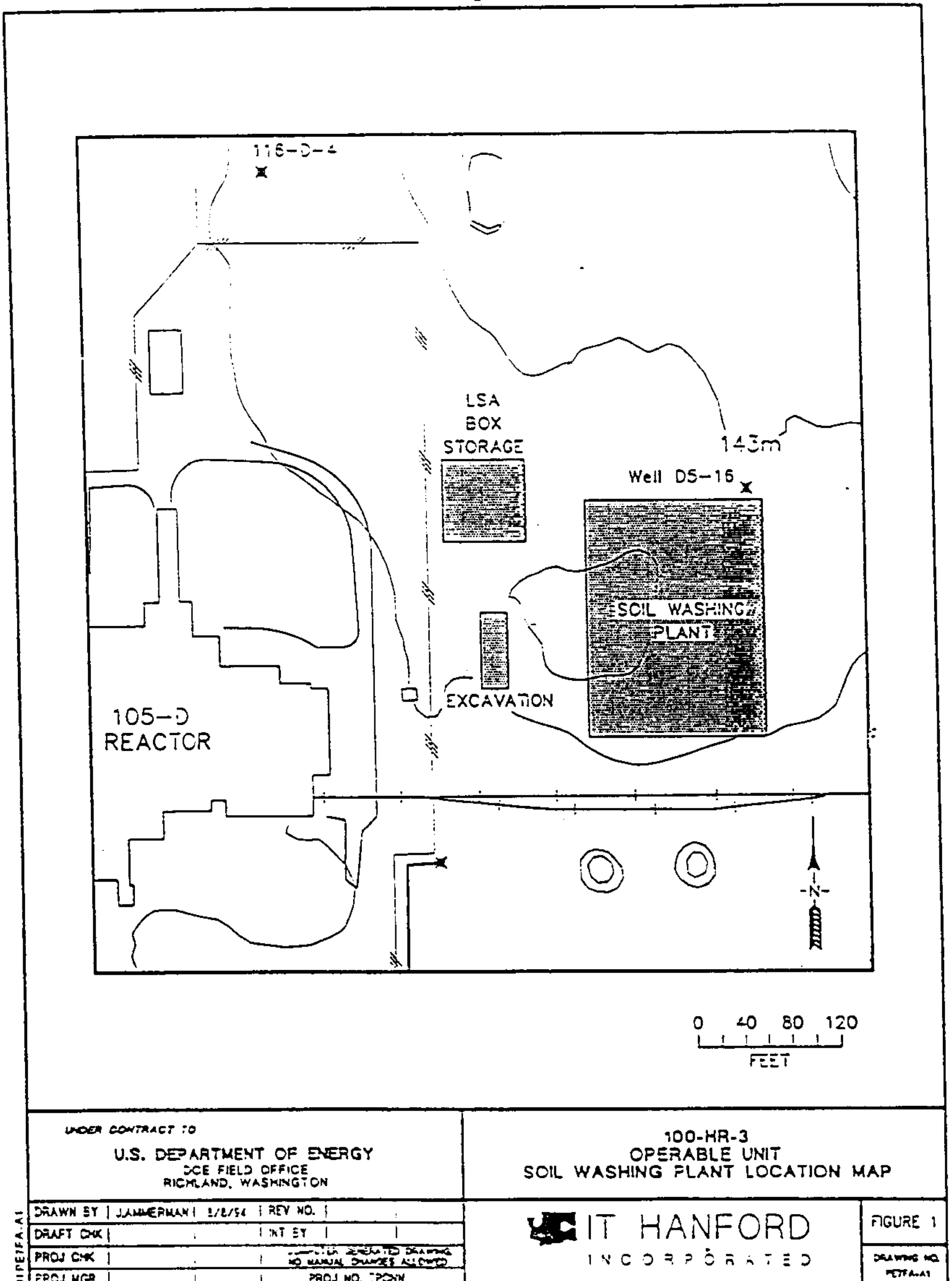
2.2.1 Test Site Location

The pilot plant will be set up in an area located adjacent to the 116-D-1B Trench just outside the east fence at the northeast corner of the 100-D Area in the 100-DR-1 operable unit (DOE-RL 1992a) as shown in Figure 2-1. The projected equipment arrangement is shown in Figure 1-2.

2.2.2 Process Description

Soils for the shakedown test and field test will be excavated from the 116-D-1B Trench and stockpiled prior to actual processing. The estimated excavation dimensions are approximately 10 ft wide, 25 ft deep, and 25 ft long. This will result in 50 to 100 tons of uncontaminated soils and 150 to 200 tons of contaminated soils. Both uncontaminated and contaminated piles will be covered with tarps to control dust.

Figure 2-1. Soil Washing Test Site Location.



Based on test pits excavated for bench-scale tests, it is expected that the first 5 to 10 ft excavated will be clean backfill material. This clean material will be laid down as a base for soil stockpiles and will be the material stockpiled for shakedown tests. The base will serve as a liner and is expected to minimize contamination of clean surface soils.

Soils will be segregated into two piles: uncontaminated and contaminated. Uncontaminated soils will be any soils with no radiation readings above background levels measured in the field using a Geiger-Mueller handheld detector. The uncontaminated soils overlaying the contaminated soils will be removed first. Once these soils are removed and stockpiled, the contaminated soils will be removed and stockpiled. The overall excavation and excavation sequence are illustrated in Figures 2-2 and 2-3, respectively. Upon completion of the material removal process, the excavation will be enclosed with safety netting for security purposes. It will also be covered with tarp for dust-control purposes. No dust suppressants other than water spray will be used for these tests. See Appendix C, Chapter 5.0, "Dust Suppressants."

As shown in Figure 1-1, with flow rates listed in Table 1-1 for the wet sieve circuit and Table 1-2 for the attrition scrubber circuit, the process will discharge soil that has been washed and classified by size. Soil weight flow rates will be monitored on each of the conveyors. When contaminated soils are processed, radiation levels will also be monitored. Fines from the vacuum filters will be stored in appropriate containment. Processing soil through the system will create eight different clean soil or liquid streams. These streams are shown in Figure 1-1 and listed below. All soil streams have associated moisture.

- >150-mm material from the soil feed grizzly
- 150-mm to 13.5-mm material from the double-deck screen, stream 2
- 13.5-mm to 2-mm material from the double-deck, stream 4
- 2-mm to 0.25-mm material from the dewatering screen, stream 33
- <0.25-mm fines from the large rotary vacuum filter, stream 17
- Wet sieving water in tank TK-101, stream 20
- <0.25-mm fines from the small rotary vacuum filter, stream 41
- Attrition scrubbing water in tank TK-102, stream 44

The shakedown test will assess the performance of individual pieces of equipment and may be interrupted at times to permit adjustments, refinements, and modifications. Retention time and power input will be increased in the attrition scrubbers by reducing the soil feed rate to the grizzly. Minor adjustments in solids concentration in the attrition scrubbers will be obtained by adjustments of spiral classifier retention time (pool area) and water flow rates. Chemical feed rates to the flash mixing and flocculation tanks of both clarifiers will be adjusted.

2.2.3 Sampling Strategy

The purpose of the shakedown test is to get the equipment functioning properly and to obtain operational experience. Baseline samples will be designated for laboratory chemical/radiochemical analyses. Random samples will be taken as deemed necessary by the operating personnel in the field. These samples will allow field measurements or observations of physical properties such as flow rates, percent solids, percent moisture, degree of separation, and consumption of power and chemicals. Results of these measurements will be recorded in the field logbook.

Figure 2-2. Overall Excavation Plan for the Soil Washing Field Test.

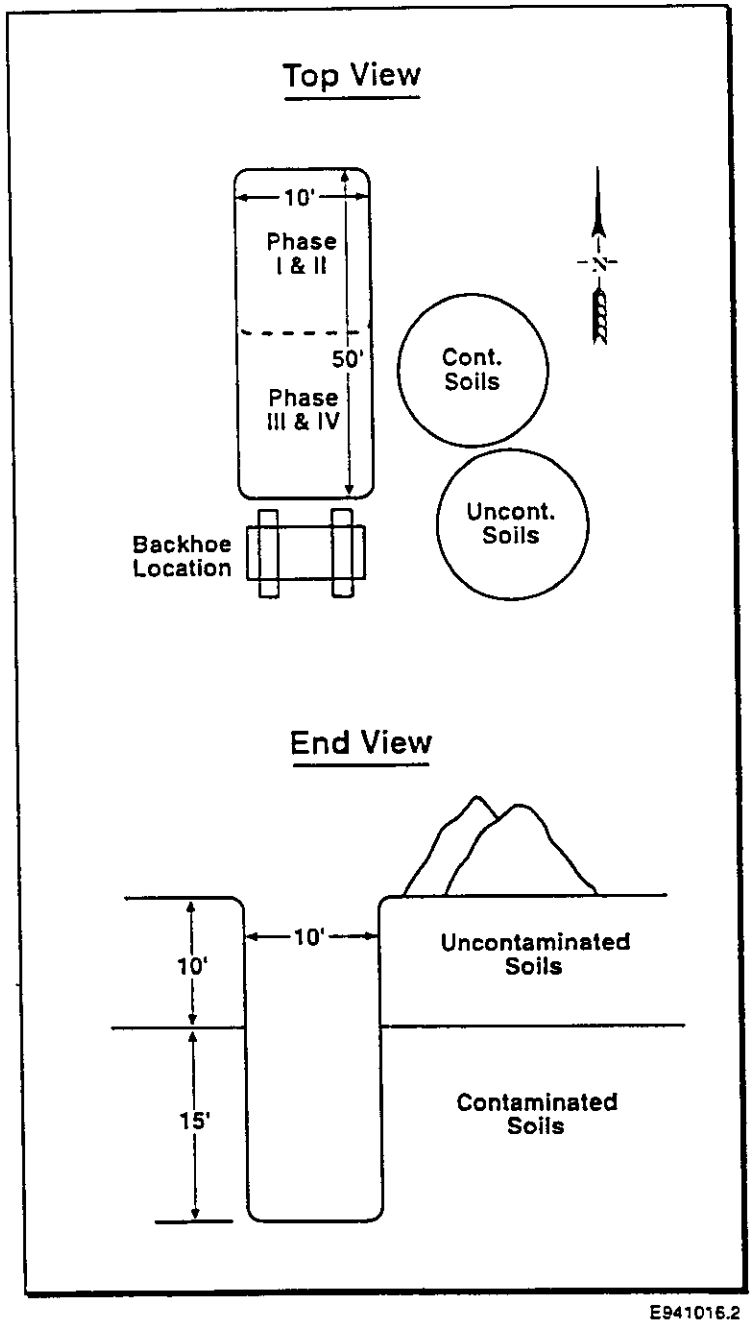
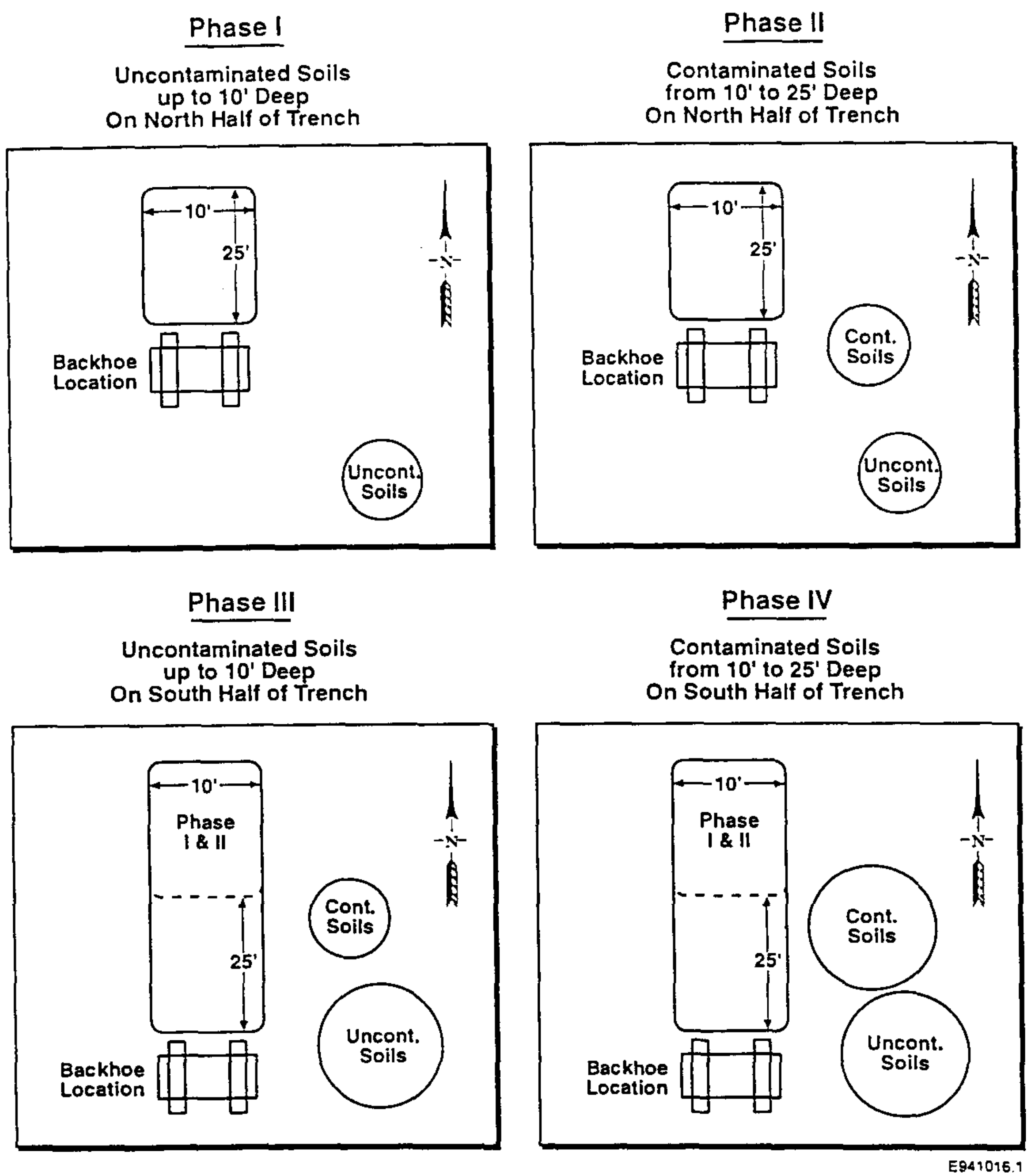


Figure 2-3. Excavation Sequence for the Soil Washing Field Test.



There will be an initial checkout of the soil radiation monitors on the feed conveyor and the three clean soil conveyors. Operator training will be performed as required for safe and efficient operation. Field supervisors will ensure that the system works properly and that all operators are qualified.

2.2.4 Fugitive Dust Control

Control of fugitive dust from the action of dumping feed material onto the grizzly will be addressed during the field pre-test. The effect of dust control water on the amount of fines that adhere to the >150-mm material will be evaluated. As the amount of water used for dust control increases and the amount of fugitive dust decreases, the amount of fines in the >150-mm clean pile is expected to also increase. With less water used, the potential for fugitive dust is higher, but the amount of fines in the >150-mm pile may decrease (DOE-RL 1993a). The flow rate and total quantity of fugitive dust-control water applied will be varied to examine its effect. The technique used to dump the feed material into the hopper will be observed and adjusted to determine what is an appropriate compromise between adequate dust control and minimum fines in the >150-mm material.

2.2.5 Process Water

Process operators will use a tank truck or fire hydrant to transport fresh water to the water recycle tank and to the solution recycle tank. From these tanks, the water will be pumped into their respective process circuits and eventually reach the clarifiers and filters.

The anticipated process water consumption for this test is unknown. Water use will be dependent on the processing time required to achieve the goals of the shakedown test and the success achieved in reducing the amount of water used in the system by evaporation, solids moisture, and dust sprays. Any water remaining in these tanks (TK-101 and TK-102) at the end of the shakedown test will be available for use in the field test.

2.2.6 Processed Material Disposal

On completion of the shakedown test, processed and unprocessed material from the excavation will be piled to one side for backfill after completion of the field test. After soil replacement in the excavation, the surface will be contoured as required to approximate its original profile.

2.3 FIELD TEST

The field test will be conducted using water in both the wet sieving and attrition scrubbing circuits. It will be at the same location as the shakedown test described in Section 1.1.1, 2.2. It is not expected to require any additional equipment mobilization or demobilization is not expected. Figure 1-2 shows the general arrangement of the equipment and its approximate layout adjacent to the 116-D-1B trench.

The purpose of the field test is to process contaminated soils to determine the effectiveness of wet sieving and attrition scrubbing with water as a means of reducing the volume of contaminated soils. The goal of this test is to reproduce, at pilot scale, the same processes used in bench-scale test results (DOE-RL 1993c) where the volume of the contaminated soils was reduced by up to 88% by weight.

Soil particles <0.25 mm contain most of the contamination. Wet sieving is designed to wash and remove soil >2 mm and thus reduce the total amount of contaminated soil 47% by weight. Attrition scrubbers are designed to treat soil between 2 mm and 0.25 mm and thus reduce the total amount of contaminated soil an additional 41% by weight. A total of approximately 100 tons of soil will be processed at a rate of approximately 10 tons/hr.

Following processing, composite soils will be wet sieved and radionuclide concentrations will be measured for each size fraction. Weighted average radioactivity concentrations will be determined for soil particles >13.5 mm, >2 mm, >1 mm, >0.425 mm, >0.25 mm, >0.15 mm, <0.075 mm, and >0.075 mm. From this information, graphs will be developed to show the percent by weight of soils that could be cleaned if cleanup levels for gamma-emitting radionuclides were 200%, 100%, 50%, or 10% of TPGs.

The operating variable expected to have the most affect on soil radionuclide concentrations is retention time in the attrition scrubbers. If necessary to obtain extra retention time, with a resulting lower radionuclide concentration in the oversize off the dewatering screen and a higher ratio of power input to soil weight, the soil feed rate to the grizzly will be reduced. Solids concentration in the attrition scrubbers will be adjusted as described in Section 2.2.2 to obtain maximum soil quantities with the radionuclide concentrations below TPG.

2.3.1 Process Description

Feed material will be retrieved from the contaminated soil stockpile described in Section 2.2.2. The material will be fed from the stockpile to the main grizzly by a front end loader in the manner determined during the field pre-test. Water for dust control will be applied as determined by the shakedown test and adjusted as necessary.

As soil is processed through the system, six different soil streams will be created. These streams are shown in Figure 1-1 and listed below.

<u>Potentially Clean Streams</u>

- >150-mm material from the soil feed grizzly
- 150-mm to 13.5-mm material from the double-deck screen, stream 2
- 13.5-mm to 2-mm material from the double-deck, stream 4
- 2-mm to 0.25-mm material from the dewatering screen, stream 33

<u>Contaminated Streams</u>

- <0.25-mm fines from the large rotary vacuum filter, stream 17
- <0.25-mm fines from the small rotary vacuum filter, stream 41

In the field test, the system will process material for a maximum of 4 hr/day, which will amount to about 40 tons of feed material per day. The system will be closely monitored and adjustments will be made as required to balance flows and keep operations running smoothly. Belt scales will be used to measure and record the weight of material transported on the system conveyor belts. Also, real-time radiation monitors will be used to monitor material on four of the conveyor belts (i.e., the soil feed, 150 mm to 13.5 mm, 13.5 mm to 2 mm, and 2 mm to 0.25 mm). These data will be used to guide adjustments to process parameters, if necessary. Because the filter solids (streams 17 and 41) are expected to be contaminated above the proposed TPGs, they will not require routine monitoring at their points of discharge from the filter solids discharge conveyors. Rather, they will be monitored after they are transferred to approved containment.

2.3.2 Sampling Strategy

To determine performance, samples will be taken before, during, and after the processing period, in accordance with the Sampling and Analysis Plan (SAP) described in Appendix E. The data from this sampling and analysis will be evaluated and presented in the final report for the soil washing treatability test.

2.3.3 Process Water

The process water will be supplied in the same manner as described above for the shakedown test. Clean water will be hauled to the site, where it will be pumped into two tanks that will feed the system through the recycle pumps, shown as streams 20 and 44 in Figure 1-1. After the water flows through the system, it will recycle to these same two tanks for reuse. Residual contaminated water will be treated (see Chapter 4.0) prior to evaporation (see Appendix A).

2.3.4 Containment Measures

Polyvinyl chloride liners with berms will be placed under all of the pieces of equipment to prevent losses to the environment from any spills or leaks.

At the point of exit for each stream, consideration has been given to the need for some type of containment to minimize water losses. All soils exiting the system will be contained in approved containers before being returned to the excavation or stored for future disposal. The fines <0.25 mm from the rotary vacuum filters (streams 17 and 41) are the only streams expected to be contaminated. These fines will also be collected and stored for future disposal in accordance with the Waste Control Plan (Appendix A).

Although not shown in Figures 1-1 or 1-2, a third tank, equal to or greater in size than the two recycle tanks will serve as secondary containment during field test. After the field test is completed, any water in the secondary containment tank will be managed in accordance with the Waste Control Plan (Appendix A). Minor losses that might occur will be monitored to ensure that no danger to worker safety, public health, or to the environment arises.

3.0 SAMPLING AND ANALYSIS

The SAP (Appendix E) applies to the field test. It details sample sizes and locations. Quality assurance/quality control procedures, and analytical methods for water and soil samples are detailed in the Quality Assurance Project Plan in Appendix F.

4.0 WATER TREATMENT AND RESIDUALS MANAGEMENT

The wet sieve and attrition scrubbing processes will include independent equipment to provide suspended solids clarification and filtration before recirculation of the water within the separate circuits. Flocculent and polymer will be pumped at metered rates into the flash mixing and flocculating tanks preceding the settling tank of each clarifier as needed to produce acceptable clarifier performance. Initially, the rates will be in accordance with the recommendations determined by the PNL bench-scale testing (WHC 1994b). These rates are interpreted as listed in Tables 1-1 and 1-2 (streams 11, 35, and 36). CAT FLOC L will be used as the flocculent in the wash water clarifier. AQUAFLOC 460 and 456-C (registered trademarks of Grace Dearborn) will be used as the flocculents in the attrition water clarifier. Process water will be handled in accordance with the Waste Control Plan (Appendix A).

As mentioned in Section 1.1.7, bench-scale laboratory tests will be conducted on a recycle system including flocculation, clarification, and filtration. The test will use available sediment from previous bench-scale testing (DOE-RL 1993c).

Solids removed from the water in the field test will be disposed in accordance with the Waste Control Plan (Appendix A). Laboratory test waste will be managed by the laboratories in accordance with laboratory procedures.

5.0 DATA EVALUATION

Ten percent of samples receiving EPA Level III chemical analysis and EPA Level V radiochemical analysis will be validated using Contract Laboratory Program-like data validation procedures.

6.0 PROCEDURES

Activities for this project will be controlled and performed in accordance with *Soil Physical Separations Treatability Safety Assessment for 100 and 300 Areas* (WHC 1994a) and *Environmental Investigations Procedures* (BHI 1994). The applicable procedure subjects are listed below.

SUBJECT	**BHI-EE-01, Vol. 1 PROCEDURE(S)**
	EII-
Sampling Procedures	5.2, 5.8
Sample Handling	5.2, 5.11
Field Documentation and Logbooks	1.5, 5.1, 5.10
Equipment Decontamination	5.4, 5.5
Waste Handling and Disposal	4.2

Control of *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and Other Past-Practice Investigation Derived Waste, Rev. 2	4.3
Site Entry Requirements	1.1
Deviation From Procedures	1.4
Personnel Requirements	1.1, 1.7, 3.2
Health and Safety Requirements	1.1, 1.7, 2.1, 2.2, 2.3, 3.2
Data Management	14.1

7.0 PROGRAM ORGANIZATION

Figure 7-1 shows the organization for performing all phases of the 100-DR-1 soil washing treatability test.

8.0 SCHEDULE

Figure 8-1 shows the schedule for planning and performing the soil washing treatability tests and issuing a test report. The planned start of the test is mid-July 1994. This schedule is contingent on acquiring process equipment and obtaining regulatory approval of the Waste Control Plan (Appendix A).

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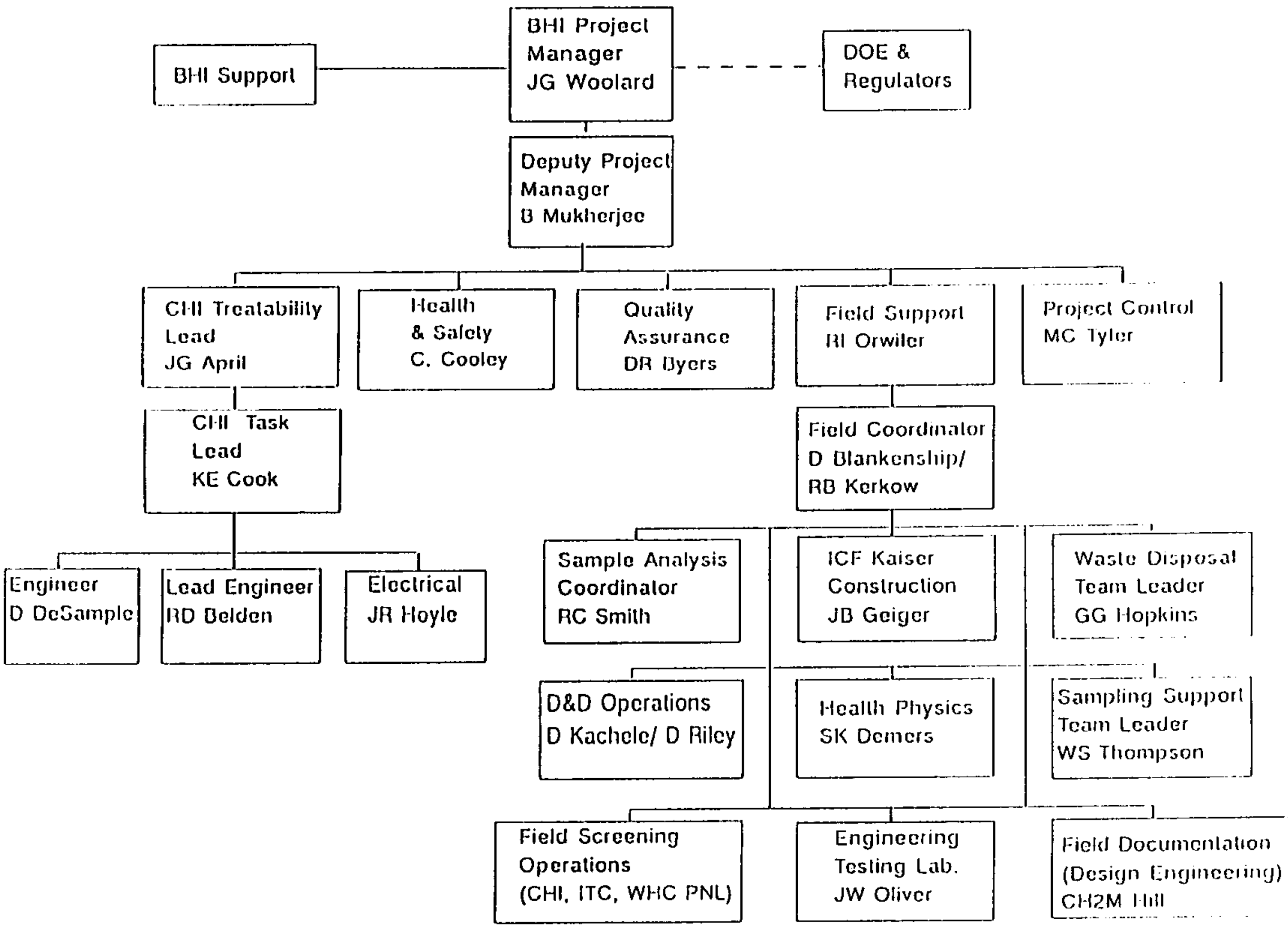

Figure 7-1. 100 Area Soil Washing Treatability Test Organization.

Figure 8-1. 100-DR-1 Soil Washing Schedule. (November 1994)

TASK	DATE START	DATE FINISH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
LAB WATER RECYCLE TESTS		11/30												
PILOT TEST														
PROCUREMENT		11/22												
PLANS/NOTIFICATION/PROCEDURES		11/18												
EQUIPMENT SETUP/INSTALL		11/22												
EARTH MOVEMENT	11/28	to 12/5												
SHAKEDOWN TEST	12/5	to 1/6												
FIELD TEST	1/9	to 2/15												
SAMPLE ANALYSIS	2/16	to 4/7												
DATA VALIDATION	4/7	to 5/12												
PREPARE DRAFT REPORT	4/10	to 6/2												
BHI REVIEW	6/5	to 6/30												
RL REVIEW	7/3	to 7/28												
RESOLVE COMMENTS/ISSUE DOCUMENT	8/5	to 8/25												
DRAFT TO ECOLOGY/EPA		8/31												

Assumptions:
45 day turn around on sample analysis
31 day turn around on validation

9.0 REFERENCES

BHI, 1994, *Environmental Investigations Procedures*, BHI-EE-01, Vol. 1, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 1988, *Final Status Post-Closure Permit Application: 183-H Solar Evaporation Basins*, DOE/RL-88-09, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1989, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL-89-09, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992a, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit, Hanford Site,* Richland Washington, DOE/RL-89-09, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992b, *Hanford Site Soil Background*, DOE/RL-92-24, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992c, *100 Area Soil Washing Treatability Test Plan*, DOE/RL-92-51, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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DOE-RL, 1993b, *Limited Field Investigation Report for the 100-DR-1 Operable Unit*, DOE/RL-93-29, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993c, *100 Area Soil Washing Bench-Scale Tests*, DOE/RL-93-107, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Dorian, J.J. and V. R. Richards, 1978, *Radiological Characterization of the Retired 100 Areas*, UNI-946, United Nuclear Industries, Inc., Richland, Washington.

Ecology, EPA, and DOE, 1989, et seq, *Hanford Federal Facility Agreement and Consent Order*, 2 Vols., State of Washington Department of Ecology, U.S. Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1987, *Data Quality Objectives for Remedial Response Activities*, Appendix A. Historical Precision and Accuracy Data Classified by Media by Analytical Level, EPA/540 G-87/004, OWSER Directive 9335.3-01, U.S. Environmental Protection Agency, Office of Emergency Response and Office of Waste Programs Enforcement, Washington, D.C.

EPA, 1990, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*, EPA Publication SW-846, 3rd edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

WHC, 1988, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Sample Management and Administration Manual*, WHC-CM-5-3, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities*, WHC-SD-EN-QAPP-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994a, *Soil Physical Separations Treatability Safety Assessment for 100 and 300 Areas*, WHC-SD-EN-SAD-005, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994b, *100 Area Soil Washing Bench-Scale Tests*, WHC-SD-EN-TI-268, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

WASTE CONTROL PLAN

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WASTE CONTROL PLAN

Page 1 of 2

Work Scope Description: 100 Area Soil Washing Treatability Test. Testing to be conducted within the 100-DR-1 Operable Unit using soils from the 116-D-1 site. See Attachment I for specific wastes covered by this plan.

List Constituents of Concern: ^{60}Co, ^{137}Cs, ^{152}Eu, ^{90}Sr, $^{239/240}Pu$, Cr

Site Description: The 116-D-1 Trench (Received cooling and other effluent from 100-D-1 Operable Unit, Hanford Site, Richland, WA.

References: DOE/RL 93-107 Rev. Draft A Date Approved 5/94
WHC-SD-EN-TI-255 Rev. 0 5/94

K.E. Cook [signature] Date 11/7/94
Preparer/Project RI Coord. Print/Sign Name

Safety Class: 3
Impact Level: EQS

Field Team Leader/Cognizant Engineer: R.B. Kerkow
IDW Coordinator: G.G. Hopkins

Planned Start and Finish Dates: From November 1994 To May 1995

Waste Storage Facility ID Number(s):

Field Screening Methods

Method	Frequency	Reference	Detection Range	Analyst
GM	Per RWP	-RSCM-1	0-100,000 CPM	HPT
PAM	Per RWP	-RSCM-1	0-100,000 CPM	HPT

Laboratory Methods (constituents of concern)

Method	Frequency	Reference	Minimum Detection Limit	Analyst
See Attachment II	WHC-SD-EN-TI-255 Section 3.0	See Attachment III		Quanterra and PNL

APPROVALS (Print/Sign Name and Date)

L.A. Mihalik [signature] 11/9/94
Regulatory Support

J.G. Woolard [signature] 11/9/94
Project/RI Coordinator

R.B. Kerkow [signature]
Field Team Leader/Cognizant Engineer

G.G. Hopkins [signature] 11/7/94
IDW Coordinator

C.L. Cooley [signature] 11-7-94
Safety Function (if required)

C.R. Evers [signature] 11/9/94
Quality Assurance (if required)

WASTE CONTROL PLAN

Sample Site Coordinate Location: Excavation area shown on Attachment III

Waste Container Storage Area(s) Coordinate Location(s): LSA Box storage area shown on Attachment III

Requirements for Soil Pile Sampling (if any): Per WHC-SD-EN-TI-255, Section 3.0, "Sampling and Analysis"

Nonregulated Material Disposal Location(s): Hanford Site Central Landfill

Sketch of Work Site

See Attachment III

APPROVALS (Print/Sign Name and Date)

Phil Staats [signature] 11/10/94
Lead Regulatory Agengy Representative

N.A. Werdel [signature] 11/9/94
DOE/RL

J.G. Woolard [signature] 11/9/94
Project/RI Coordinator

Attachment 1

100 AREA SOIL WASHING TREATABILITY TEST
WASTE CONTROL PLAN

This Waste Control plan (Plan) governs management of the waste generated as a result of the 100 Area Soil Washing Treatability Test (Test). waste generated from this Test will be subject to the management directives of EII 4.3, "Control of CERCLA and Other Past Practice Investigation Derived Waste" and this Plan.

The Test is to be conducted at the 116-D-1 Site, located within the 100-DR-1 Operable Unit. Soils from the 116-D-1 Trench will be excavated and processed through the soil wash apparatus. Large quantities of soils, some contaminated with various radionuclides or heavy metals, will be generated as a result of the Test. Following processing and dewatering, soils will be stored in large metal boxes. Soils > 0.25 mm in diameter will be returned to the excavation site. Soils < 0.25 mm in diameter will be stored in the metal boxes, within the boundary of the 100-DR-1 Operable Unit, until such time as a suitable disposition is identified (ie. ERDF, vitrification, etc.).

During the Test, process water will be stored in tanks located at the site. Process water will be treated using a clarifier and flocculent to remove suspended solids. The treated process water will then be recycled through the system in order to minimize process liquid waste. Any spillage or precipitation collected in the containment areas will be returned to the process for treatment.

After the Test is completed, the treated process water will be evaporated by solar means. The Department of Health has been notified of this and has concurred the DOH ARARS will be met. Meeting minutes and support information is included in Attachment IV.

Treated process water will be analyzed for the constituents of concern for this Test (heavy metals and radionuclides) prior to final dispositioning. Additional process effluent treatment methodologies may be enlisted if deemed appropriate, and agreed to by the cognizant technical project leads and Unit Managers.

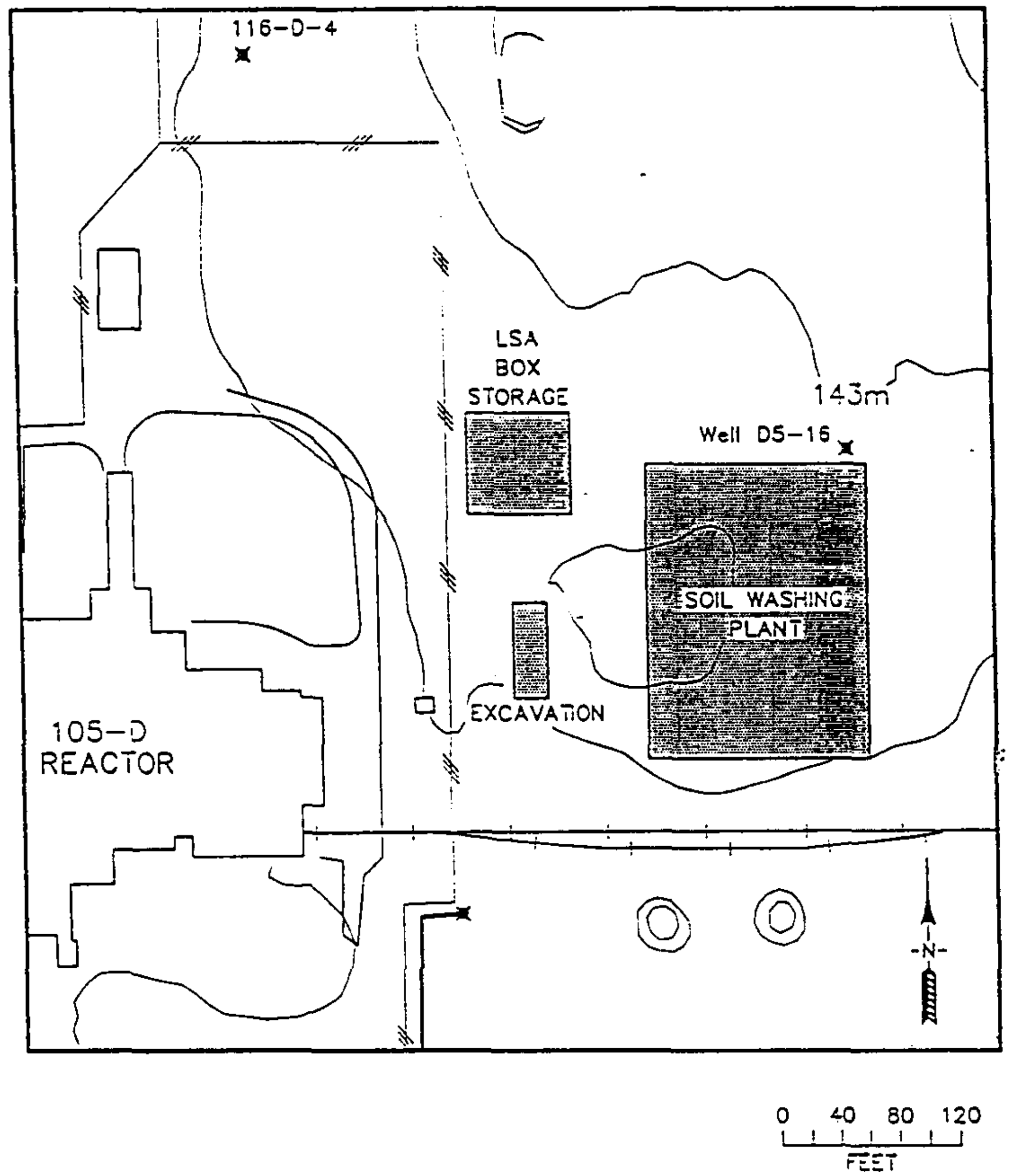
Other waste generated during the test (disposable PPE, tape, wipes, rags, etc.) will be segregated by waste classification, and will be disposed of at an appropriately permitted facility or held as Investigation Derived Waste (IDW)". Equipment, including tenting, piping and containment materials will either be decontaminated, surveyed and released or be held for future use as controlled materials. Decon water will be contained in appropriate containers (depending on volume), sampled and disposed of as negotiated with Regulators.

Attachment II

Test Analytes, Methods, Detection Levels, and Expected Levels.

Category	Analyte	Analytical Method	Soil MDC[a] pCi/g Onsite	Soil MDC[a] pCi/g Offsite	Soil 116-D-1B Average[b] pCi/g	Water and Solution MDC[a] pCi/L Onsite	Water and Solution MDC[a] pCi/L Offsite
Radionuclides: EPA Analytical Level V	Cesium-137	Gamma Spec.	0.1	0.05	205	100	15
	Cobalt-60	Gamma Spec.	0.1	0.1	15	100	25
	Europium-152	Gamm Spec.	0.2	0.1	177	200	50
	Europium-154	Gamma Spec.	0.2	0.1	17	150	50
	Plutonium-239,240	Alpha Spec.		1.0	2.74	10	1
	Strontium-90	Low Beta		1.0	12.5	50	2
			PQL (mg/kg)		mg/kg	PQL (ug/L)	
Metals: EPA Analytical Level III[c]	Aluminum	SW-846-6010		20	56,700		200
	Antimony	SW-846-6010		10	<19		100
	Beryllium	SW-846-6010		0.7	NA		7
	Cadmium	SW-846-6010		2.0	<14		20
	Chromium	SW-846-6010		2.0	58		20
	Copper	SW-846-6010		2.5	61		25
	Iron	SW-846-6010		10	68,300		100
	Manganese	SW-846-6010		1.5	1,154		15
	Nickel	SW-846-6010		4	24		40
	Silver	SW-846-6010		20	<12		200
	Zinc	SW-846-6010		2	138		20

a. MDC refers to the Minimum Detectable Concentration for radionuclides and PQL refers to Practical Quantitative Limits. For all analyses the required precision is 20 Relative Percent Difference (RPD); Accuracy is 75 to 125 percent recovery.
b. Trench 116-D-1B averages are stated in DOE-RL 1993.



UNDER CONTRACT TO
U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE
RICHLAND, WASHINGTON

100-HR-3
OPERABLE UNIT
SOIL WASHING PLANT LOCATION MAP

DRAWN BY	J.AMMERMAN	5/8/94	REV NO.
DRAFT CHK			INT BY
PROJ CHK			COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED
PROJ MGR			PROJ NO. TPCNN

IT HANFORD
INCORPORATED

FIGURE 1

DRAWING NO. PETFA-A1

MEETING MINUTES

Subject: ROUTINE TECHNICAL REVIEW MEETING -- DOH/RL/WHC/BHI/PNL				
TO: Distribution		BUILDING: TCPC, Conf. Rm. 501		
FROM: J. A. Bates H6-22 J. M. Nickels H4-80		CHAIRMAN: S. D. Stites A5-15		
Dept-Operation-Component	Area	Shift	Meeting Date	Number Attending
DOE,RL - Regulatory Permits Branch	700	Day	September 14, 1994	33

The meeting was held as one of the routine technical review meetings which have been established for enhanced communication regarding evolving regulations, current compliance activities, and sharing of technical information relative to environmental regulation of radioactive air emissions.

Mr. Al Conklin, Head of the Washington State Department of Health (DOH), Air Emissions and Defense Waste Section, was in attendance. The U.S. Department of Energy, Richland Operations Office (RL), Westinghouse Hanford (WHC), Bechtel Hanford Incorporated (BHI) and Battelle, Pacific Northwest Laboratory (PNL) were represented at the meeting. Key items of discussion are summarized below, under the main agenda headings.

Opening Remarks; Old Business; New Business

Mr. Steve Stites (RL, Regulatory Permits) directed the opening remarks for the meeting. At Mr. Stites' request, all persons in attendance introduced themselves.

Regarding old business, Mr. John Bates (WHC, Environmental Policy) stated that the meeting minutes for the previous routine meeting (July 20, 1994) would be distributed for draft review within the next two weeks. Some portions of those meeting minutes have already received concurrence signatures as will be noted in the overall minutes.

Regarding new business, Mr. Conklin stated that to cover the increased demand for discussion of items in the routine technical review meetings, he would not support development of any separately arranged routine meetings. Instead, he proposed more frequent routine technical review meetings, say on a once per month basis rather the 6 week frequency averaged earlier. Mr. Stites concurred with the idea of more frequent meetings. Tentatively, the routine technical review meetings will now be scheduled for the morning of the second Wednesday of each month. The next meeting is thus slated for Wednesday, October 12 from 8 am to 12 pm.

Status of Increased Estimates of Inventory Within the 232-Z Facility

Mr. Lee Ebbeson (WHC, Plutonium Finishing Plant) provided a handout for discussion (Attachment 1). Mr. Ebbeson was responding to Mr. Conklin's earlier request for recent information about an Unusual Occurrence Report concerning a potential finding that more residual plutonium inventory remains within the 232-Z building than was originally estimated. Mr. Conklin stated that it was his concern that the actual inventory of plutonium within the 232-Z might significantly exceed the estimate of plutonium inventory which formed the basis for the formerly approved NOC for cleanup of 232-Z.

Courtesy Information Regarding Contamination Incident at AW Valve Pit

Acting for Mr. Steve Lijek (MACTC, supporting RL/TOP), Mr. Stites provided information to Mr. Conklin regarding a recent incident at the 241-AW Tank Farm resulting from work in a valve pit. The information included survey results showing that although the job was halted due to wind conditions and possible windborne contamination spread, there was no indication of loss of contamination control beyond the valve pit.

118-B-1 Burial Ground Treatability Test

Ms. Coenenberg introduced Ms. Linda Bergmann (CH2M HILL Hanford) who provided a brief status on the treatability test activities to be performed at the 118-B-1 Burial Ground. Ms. Bergmann stated that a milestone of August 31, 1994, established under the Tri-Party Agreement, which requires work to be started was met. Currently, activities being conducted are site setup, and performing "cold" mockups. Ms. Bergmann stated that work has not begun on contaminated soils. Mr. Conklin stated that a member on his staff received an anonymous phone call of concern on the site condition. Mr. Conklin stated that it was not clear as to what exactly were the concerns other than a request was made by the caller to investigate the site. Ms. Bergmann continued by stating that a "hot" spot area of contamination was found on an asphalt road, parallel to the test site, measuring off scale on a GM counter and was later removed appropriately. The cause of the contamination is unknown. Ms. Bergmann stated that air sampling was set up on August 15 with weekly sample collection for analyses. No analytical data is available at this time. Ms. Coenenberg concluded by extending an offer to Mr. Conklin and his staff to visit and tour the site anytime during the testing program.

100-DR-1 Soil Washing Field Test

Ms. Coenenberg introduced Mr. Ron Belden (CH2M HILL) who provided a handout (Attachment 10) to Mr. Conklin on the soil washing field test to be performed under CERCLA as a TPA Milestone M-15-07B. Mr. Belden provided a general project description, history of the 116-D1-B Trench, physical and process description, primary contaminants, potential airborne emissions, emission controls, monitoring, and overall map of the site plan. Mr. Conklin asked how clean the material would be following the soil washing. Mr. Belden responded by stating that the initial bench test indicated the limits for acceptable onsite soil in the WHC Environmental Compliance Manual (WHC-CM-7-5) were achieved. However, Mr. Belden stated that radioactive cesium, the primary contaminant of concern, has a limit of 30 picocuries per gram of sample and that cleanup levels have not been established yet. Mr. Belden continued with a discussion on the controls to be used during this test. Mr. Conklin asked for clarification on the source term as to whether the source will be dry or wet and how the HEPA filtration will be utilized. Mr. Belden stated that the soil washing test will involve a wet source term. Additionally, based on the results of a current study to determine the concentrations of the exhaust from the vacuum filters, the exhaust will be either discharged or will be recycled back to the rotary drum vacuum filters or be run through HEPA filters before exhausting. Mr. Conklin concurred by stating based on the source term described, the controls for the project as described met the applicable ARARs. However, Mr. Conklin stated that if, for any reason, the source term changes or unexpected contamination levels are found during the test, DOH shall be notified of the changes.

POTENTIAL AIR EMISSIONS:

- Windblown dust- the table below shows the calculation for the unabated loss of the entire 300 tons.

Contaminant	Concentration (pCi/g)	Total Tons	Total Curies	Offsite Dose Factor	Offsite Dose (mrem/yr)
^{60}Co	15	300	0.0041	0.143	0.0006
^{137}Cs	205	300	0.0558	0.148	0.0083
^{152}Eu	177	300	0.0482	0.205	0.0099
^{154}Eu	17	300	0.0046	0.165	0.0008
$^{239/240}Pu$	2.74	300	0.0007	12.3	0.0086
				Total	0.0282

- Vacuum Filters Exhausts (attached plant layout and process flow diagram show locations of vacuum filters)
    - A study is currently underway to determine the concentrations of the exhaust from the vacuum filters.
        - Study is based on samples taken during 1993 excavation and the results of bench scale soil washing tests (DOE/RL-93-107).
        - If necessary exhaust will be recycled back to the filters or exhausted through a HEPA filter.

- Solar evaporation of Process Effluent
    - Bench scale test so far indicate the effluent should meet and exceed purge water acceptance criteria and possibly even drinking water standards.

CONTROLS AND MONITORING

- Water will be added as needed and a "wet process" will be used to keep soils moist and minimize potential exposure to windblown dust.
- Work activities will stop if the sustained wind speed is ≥ 15 mph.
- Air samplers will be used to monitor for radioactive air-borne particulates.
- Routine HPT surveys will be conducted.
- Plant will be set on bermed liners to contain spills
- Plant will be contained within a tent to protect the water from freezing during winter weather.
- Soil stockpiles will be covered with tarps when not in use.
- The excavation pit will be covered when not in use.
- Vacuum filters may be recycled or vented through HEPA filters.
- Processed soils will be discharged to LSA boxes with lids.
- The amount of liquid effluent generated will be minimized by treating and recycling effluent.
- Process effluent will be treated using the vacuum filters and clarifiers with flocculants to remove suspended solids prior to evaporation.

  (Note: based on bench scale tests, it is expected that treated water will meet or exceed purgewater acceptance criteria.)

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APPENDIX B

100 AREA SOIL WASHING REAL-TIME RADIATION MONITORING SUPPORT

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APPENDIX B

100 AREA SOIL WASHING REAL-TIME RADIATION MONITORING SUPPORT

1.0 SCOPE

Real-time radiation monitoring support will be provided by Pacific Northwest Laboratory (PNL) during the 100-DR-1 soil washing treatability test. The field test is to be completed by August 31, 1994 in fulfillment of Tri-Party Agreement Milestone M-15-07B.

The work will include calibration, software development, and support during installation and field operations for four sets of monitors. One set of monitors will be installed over the feed conveyor and three sets will be installed over the processed soils conveyors. The monitors will be installed by Bechtel Hanford, Inc. (BHI) (with PNL support) over 2-ft-wide conveyors. Nominal conveyor speed will be 100 ft/min. The targeted sensitivity for radionuclides will be <10 pCi/g for ^{137}Cs, ^{60}Co, and ^{154}Eu and <100 pCi/g for ^{90}Sr.

In addition to the real-time monitors, PNL will provide drum-counting services (portable equipment and support) for measurement of radioactivity levels in feed soils and/or processed-rock and soil samples.

This is a test and no higher level of quality assurance (QA) will be required than that of PNL's Good Practices Standard (QA Level III).

At the conclusion of the testing, radiation monitoring equipment will either be returned to PNL or the equipment will be purchased by BHI at a fair market value.

2.0 DELIVERABLES

2.1 DEVELOPING AND INSTALLING MONITORS

Each of the four sets of monitors will utilize 5-in.-diameter sodium iodide (TI) scintillation crystals (each array composed of 14 detectors) to measure the characteristic gamma rays emitted by ^{137}Cs, ^{60}Co, and ^{154}Eu and the bremsstrahlung radiation emitted by ^{90}Sr (^{90}Y). A single array on each conveyor should provide the required sensitivity at the anticipated conveyor speed. Each of the 56 detectors will be tested for operability, the output gain set on each photo multiplier tube, and inoperable detectors replaced.

Electronic hardware components will be assembled and tested to acquire data from each of the 56 detectors. This may include purchasing additional equipment (up to $15,000) to replace missing equipment components. Data will include, at a minimum, a continuous line chart showing radiation levels on each of the conveyors and a light or alarm indicator if the thresholds for radiation levels are exceeded. Depending on the outcome of the system calibration effort, data may include a continuous report of the absolute concentration of each of the isotopes under surveillance.

Software will be written and assembled for data acquisition and reduction to provide real-time quantitative results.

The systems will be calibrated in the laboratory in static and/or dynamic modes to ensure reliable quantitative data in the field. Appropriate quantitative radioisotope sources, traceable to the National Institute of Standards and Technology, will be used for this effort. Calibration checks shall also be performed in the field.

PNL will assemble detectors and electronics in the field in proper configurations, provide support and direction to BHI to mount systems on the conveyors, and arrange for the necessary infrastructure for field operations.

APPENDIX C

SUPPORTING LABORATORY TEST PROCEDURES

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APPENDIX C

SUPPORTING LABORATORY TEST PROCEDURES

1.0 INTRODUCTION

Pacific Northwest Laboratory has developed and will perform four bench-scale laboratory tests to support the 100 Area soil washing treatability test. The following sections describe these tests.

2.0 RECYCLABILITY OF WET-SIEVING PROCESS WATER

The objective of this test will be to examine the recyclability of process water resulting from wet sieving of soils <2 mm from the 116-D-1B trench. The number of times process water can be recycled will depend on two major factors. First, after several wash cycles, the increase in total dissolved solids (TDS) concentration in the wash water may require excessive quantities of flocculent, thus making further recycling less cost-effective. Second, the potential buildup of TDS and radionuclides in the wash water may result in increasing residual radionuclide activities in the washed particles (0.25 mm to 2 mm) that will be treated further in the attrition scrubbing circuit. The proposed test scheme is designed to evaluate these factors and to delineate the limits of recyclability of wash water.

Each wet-sieving cycle will be conducted with 667 g of <2-mm soil from the 116-D-1B trench. Sieving will be conducted using a 0.25-mm sieve and 3,300 mL of water. The fraction retained on the sieve (0.25 mm to 2 mm) will be air dried, counted for radionuclide (^{137}Cs, ^{60}Co, and ^{152}Eu) activity, and stored for use in attrition scrubbing wash water recycling tests. The wash water with <0.25-mm fines will be clarified after addition of a flocculent (CAT FLOC L, is a registered trademark of Calgon, Pittsburgh, Pennsylvania) and the supernatant will be decanted. The floc will be filtered, the filter cake will be analyzed for radionuclide content, and the filtrate will be composited with the decanted supernatant. An aliquot of the supernatant will be analyzed for turbidity, pH, conductivity, alkalinity, radionuclides, cations, and anions. The volume of the supernatant will be adjusted to 3,300 mL with makeup water and reused in the wet-sieving operation.

Approximately 10 cycles of wet sieving will be conducted. Following the final recycling step, toxicity characteristic leaching procedure (TCLP) tests will be conducted on the last batch of 0.25-mm to 2-mm size fraction and <0.25-mm fractions (composited during recycling).

3.0 RECYCLABILITY OF ATTRITION-SCRUBBING WASH WATER

The objective of this test is to determine the recyclability of wash water resulting from two-stage attrition scrubbing of previously wet-sieved fines (0.25 mm to 2 mm) from the 116-D-1B trench. Wash water resulting from two types of attrition scrubbing will be tested for recyclability. In the first set of experiments, the attrition scrubbing will be conducted with water and in the second set, the scrubbing will be conducted with an electrolyte consisting of a mixture of ammonium citrate and citric acid. It is expected that the recyclability of wash water resulting from these two sets of tests will differ because in one case the wash water will contain the electrolyte. The proposed test schemes are designed to evaluate those factors that affect the recyclability of wash water resulting from two different attrition scrubbing processes.

Each attrition scrubbing water recycling test will be conducted with 500 g of 0.25-mm to 2-mm air dried soil derived from the wet-sieving water recycling test (described in Section C.3). The first stage attrition scrubbing will be conducted with water at a pulp density of about 83% for a residence time of 30 minutes at an impeller speed of 900 rpm. Following scrubbing, the fines (<0.25-mm fraction) will be washed out with 1,500 mL of water and collected in a 4-L beaker. In the second stage, the washed coarse fraction (0.25 mm to 2 mm) will be scrubbed again at the same pulp density and residence time as the first stage and washed again with 1,500 mL of water to remove the fines. The wash water and the fines from the second-stage scrubbing will be composited with the wash water and fines from the first-stage scrubbing. The washed coarse fraction (0.25 mm to 2 mm) after the second-stage scrubbing will be dried and counted for radionuclide (^{137}Cs, ^{60}Co, and ^{152}Eu) activity. The composited wash water with <0.25-mm fines will be clarified with a combination of flocculents (CAT FLOC L and POL-E-Z 692, are registered trademarks of Calgon, Pittsburgh, Pennsylvania; and AQUAFLOC, is a registered trademarks of Grace Dearborn), and the supernatant will be decanted. The floc will be filtered, the filter cake will be analyzed for the radionuclide content (^{137}Cs, ^{60}Co, and ^{152}Eu), and the filtrate will be composited with the decanted supernatant. An aliquot of the supernatant will be analyzed for turbidity, pH, conductivity, alkalinity, radionuclides, cations, and anions. The volume of the supernatant will be adjusted to 3,000 mL with makeup water and reused in the wet sieving of attrition-scrubbed soil fraction.

The same sequence of steps will be used in the second set of experiments in which attrition scrubbing will be conducted with an electrolyte rather than with water. However, in the second set of experiments, in addition to the other dissolved constituents, concentrations of both ammonium and citrate in the supernatant will be monitored and part of the supernatant will be used to reconstitute the electrolyte for the next attrition scrubbing cycle.

Approximately five cycles each of attrition scrubbing (with water and with electrolyte) will be conducted. Following the final recycling step, TCLP tests will be conducted on the last batch of attrited 0.25-mm to 2-mm fines and <0.25-mm fines (composited during recycling).

4.0 FINAL WATER TREATMENT

The goal of this test will be to identify the most appropriate method of treating the final effluent to meet the purge water criteria (PWC) established in Table 8.3 of the *Environmental Compliance Manual* (WHC 1993) for radionuclides and other contaminants. The clarified final effluent will be analyzed for radionuclide activities (^{137}Cs, ^{60}Co, and ^{152}Eu) and other inorganic constituents. If any of the regulated constituents exceed the PWC, additional treatment such as precipitation and ion exchange will be tested. Even though the PWC does not include regulatory limits for ^{152}Eu, NH^+_4, and citrate, the efficacy of treatment technologies such as ion exchange (^{152}Eu, NH^+_4, and citrate), break-point chlorination, and air stripping (NH^+_4), will be examined.

5.0 EFFECTS OF DUST SUPPRESSANTS

Soil washing is an exsitu process. Therefore, the soil to be treated has to be excavated and staged before washing. One of the concerns during this staging step is the production of nuisance dust generated during the handling of contaminated soil. Therefore, spraying of dust suppressants has been proposed for significantly reducing the concentrations of airborne particulate generated from staged soils (Sackschewsky 1993; Thompson et al. 1993). Dust suppressants tested by these investigators included solutions of Flambinder (calcium lignosulfates), XDCA (sugar polysaccharides), and pregelled potato starch. Data generated by Sackschewsky (1993) showed that due to their binding action both XDCA and potato starch reduced the quantity of fines in two soils from the Hanford Site (a sandy soil and a silty soil). These data suggested that the use of dust suppressants has the potential to measurably affect the particle size distribution in both coarse and fine-textured Hanford soils. Consequently, these dust suppressants, if used on radionuclide-contaminated soils from the Hanford Site, may affect the wet sievability and the radionuclide distribution in these soil fractions. Therefore, a set of tests has been designed to measure any potential changes in particle-size and radionuclide distribution in 116-D-1B Trench soil if this soil were treated with dust suppressants. The purpose of these tests is to assess the effect of applying dust suppressants for future use. Dust suppressants will not be used during the 100-DR-1 pilot test.

Two dust suppressants (calcium lignosulfate and XDCA) will be tested at two rates of application (2 and 4 L/m^2). Soil samples (<2-mm size fraction) will be treated with each dust suppressant and dried to promote crust formation. The treated samples and a control (untreated) sample will be wet sieved with a set of sieves consisting of 2 mm, 0.425 mm, 0.25 mm, and 0.075 mm. The soil fractions retained on each sieve and the pan will be oven dried at 105 °C and counted for radionuclide (^{137}CS, ^{60}Co, and ^{152}Eu) activity. The effects of the two dust suppressants will be assessed by comparing the particle size and the radionuclide distribution data from the three samples.

6.0 REFERENCES

Sackschewsky, M.R., 1993, *Fixation of Soil Surface Contamination Using Natural Polysaccharides*, WHC-EP-0688, UC-721, Westinghouse Hanford Company, Richland, Washington.

Thompson, D.N., A.L. Freeman, and V.E. Wixom, 1993, *Evaluation of the Contamination Control Unit During Simulated Transuranic Waste Retrieval*, EGG-WTD-10973, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho.

WHC, 1993, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

APPENDIX D

PORTABLE DRUM COUNTER

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APPENDIX D

PORTABLE DRUM COUNTER

1.0 INTRODUCTION

As described in *Calibration and Operation of the PNL Barrel Assayer* (Arthur 1991), Pacific Northwest Laboratory (PNL) operates a mobile apparatus (commonly called a portable drum counter) developed for measuring the radionuclide content of 55-gal drums as well as small containers. Drums containing waste are positioned on a turntable, rotated, and directly measured using both a collimated intrinsic germanium (IG) gamma-ray spectrometer positioned at 11 equally spaced intervals opposite the drum and 62 stationary $^{10}BF_3$ tubes embedded within two hemicycles of polyethylene moderator. Some of the advantages of this type of system are (1) the counting instrumentation can be transported to drum-storage locations, (2) very large sample sizes can be accommodated, (3) individual isotopic analysis and total gamma activity are determined, (4) the relative vertical distribution of activity within a drum may be determined from the scans, (5) sensitivity and counting geometry variability are improved by analyzing the sum of the 11 segmented gamma scans (SGS), and (6) transuranic (TRU) levels can be determined.

2.0 DESIGN AND OPERATION

In the portable drum counter, a lead-collimated, shielded IG detector mounted on a movable platform vertically scans a drum from top to bottom. A magnetic position sensor accurate to 0.001 in. is employed by the software controlling program, "SGS," to locate the detector platform within 0.1 in. of the specific height. A barrel is mounted on a turntable that rotates the drum at approximately 30 rpm during the vertical scanning. The vertical gamma-ray scanning is normally performed in eleven 3 in. segments for 55-gal drums, and the segment counts are summed to provide both total gamma-ray activity and specific activity, as well as individual isotopic activity. This information is useful in the event that some portion of the waste in the drum contains a highly unusual radionuclide composition.

The counting system contains a relatively large IG detector, typically with an efficiency for gamma-ray detection of between 19% and 30% (relative to a 3-in. x 3-in. right-circular sodium-iodide cylindrical detector). The detector is shielded on the side by 1 in. of lead. A 2-in. lead collimator is used on the face of the diode with a slit of height 0.25 in. or 1.0 in. depending on the activity of the waste, exposing the full width of the diode.

The neutron detectors that surround the drum measure neutrons emitted by TRU isotopes within the waste. The detector are embedded in polyethylene moderator to enhance the efficiency of the measurement. Additionally, TRU concentrations for americium, curium, and plutonium can be directly measured with the IG detector if their concentrations exceed about 1 nCi/g and if their gamma-ray emissions are not dominated by fission or activation product radiations.

Gamma-ray spectral data from the IG detector are collected and stored using a commercial software program. The resulting 11 spectra from the analysis of a typical drum are then summed together. The summed data are then reduced and experimentally determined efficiency curves are generated. The contents of a drum are assumed to be packed homogeneously in the first analysis. For barrels with detectable activity, the analyst checks this assumption by observing the count rate for each segment and by looking at the resulting disintegration-per-second (dps) factors on radioisotopes with gamma-rays of several energies, such as ^{134}Cs, ^{60}Co, ^{152}Eu, ^{154}Eu, ^{239}Pu, and ^{125}Sb. If a discrepancy is noted in the dps factor, several methods are available to correct the discrepancy. For example, the segments can be analyzed individually using an appropriate technique to approximate a more accurate attenuation correction.

3.0 REFERENCES

Arthur, R.J., 1991, *Calibration and Operation of the PNL Barrel Assayer*, PNL-7739, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX E

SAMPLING AND ANALYSIS PLAN

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APPENDIX E

SAMPLING AND ANALYSIS PLAN

1.0 INTRODUCTION

This Sampling and Analysis Plan provides details on sizes, locations, schedules, quality assurance/quality control (QA/QC) requirements, and analytical methods for water and soil samples to be taken during 100-DR-1 soil washing treatability tests.

Makeup water, solids, slurry, and liquid samples will be collected from sample points marked in Figure E-1.

Table E-1 shows analytes for the test and corresponding goals and detection levels for onsite and offsite analyses. Onsite laboratory services will be provided by Pacific Northwest Laboratory (PNL). This will include Level V laboratory analyses and particle size analysis. Offsite, U.S. Environmental Protection Agency (EPA) Levels III and V, laboratory services will be provided by Quanterra Laboratories (formerly International Technologies Corporation [IT]).

Analytical methods, required preservatives, holding time, and volumes are specified in Table E-2.

2.0 SHAKEDOWN SAMPLES

During shakedown, water samples will be collected from sample points 15 and 16 (see Figure E-1) and sent offsite to assess baseline operating conditions prior to starting the tests. In addition, soil samples will be collected as needed for field screening analyses, to assess process operations. Field screening methods will include sieving to assess screening efficiencies and turbidity measurements to assess water treatment processes.

3.0 PREPROCESS SAMPLES

Prior to processing for the field test, two clean water samples will be collected and sent offsite for characterization. These samples will be analyzed using inductively coupled plasma (ICP) for metals and gamma-spectrometry (gamma-spec) for radionuclides as specified by the Sample Authorization Form (SAF).

Water samples will also be collected to measure temperature and pH in the field using Level I analytical methods (EPA 1987).

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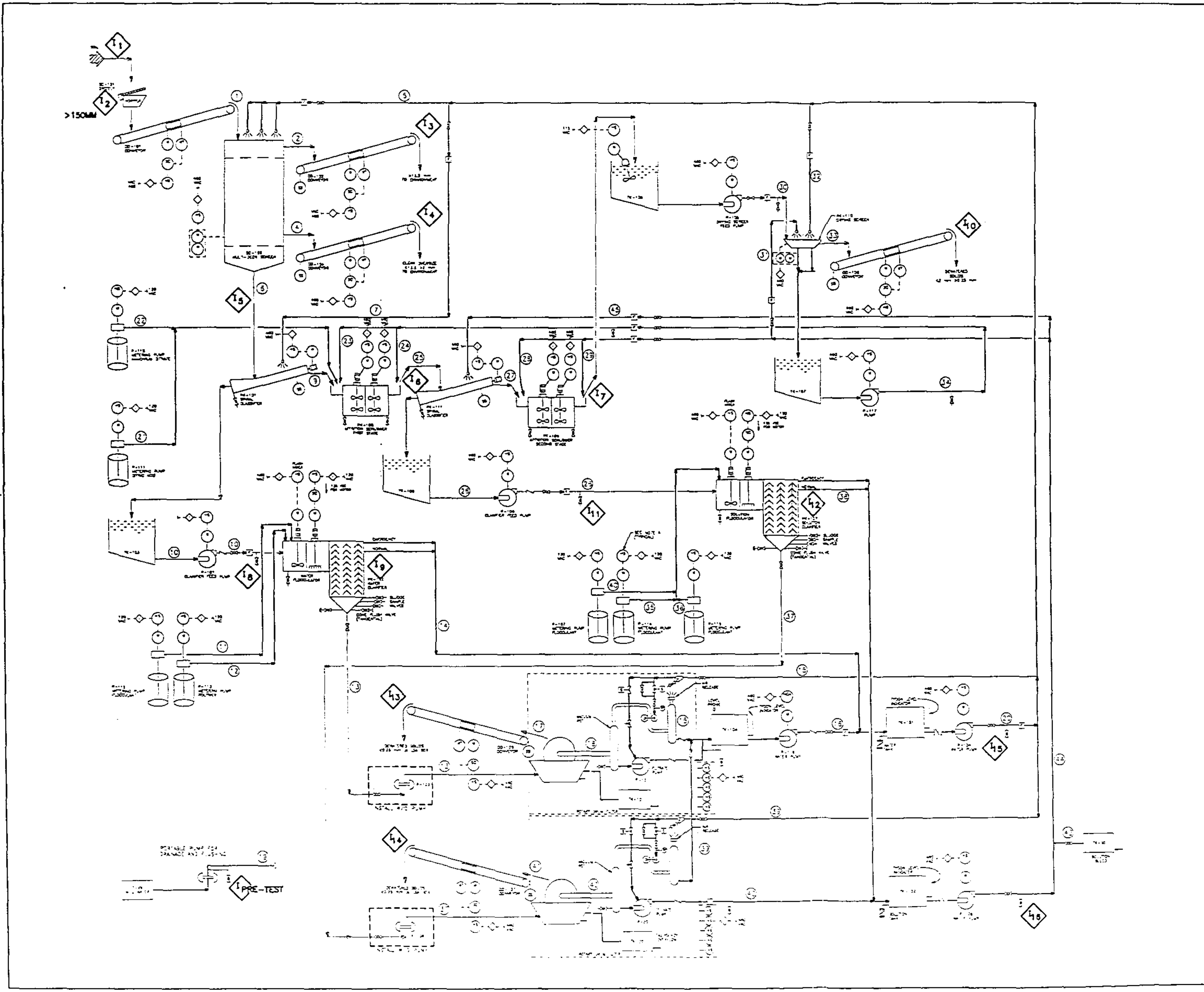

NOTES

1. COMPONENT INTERCONNECTIONS ARE MADE VIA RUBBER HOSES.
2. INITIAL TESTING OF THE CLARIFIERS WILL BE DONE WITHOUT UNDERFLOW PUMPS (PU-103 AND PU-108) INSTALLED.
3. THIS DRAWING IS CONFIGURED TO SHOW USING AN ELECTROLYTE SOLUTION IN TK-102. IF ONLY WATER IS USED FOR THE FIELD TESTING 1 FLOCCULANT TANK WILL BE USED AT PK-102 AND 2 FLOCCULANT TANKS WILL BE USED AT PK-107.
4. METERING PUMP AND FLOCCULATOR MIXER & AGITATOR CONTROLS ARE LOCATED IN THE CLARIFIER CONTROL CABINET.

LEGEND

- BALL VALVE (OPEN)
- BALL VALVE (CLOSED)
- BUTTERFLY VALVE
- CHECK VALVE
- NEEDLE VALVE
- SOLENOID OPERATED VALVE
- HOSE CONNECTION
- END PLUG
- SPRAY NOZZLE
- FLOW METER
- SAMPLE POINT
- MOTOR
- HAND SWITCH
- SPEED CONTROL
- SPEED SENSOR
- WT. SCALE
- HAND OFF AUTO SWITCH
- INTERFACE
- STREAM NUMBER
- AGITATOR
- MIXER
- AIR OPERATED DIAPHRAGM PUMP
- CENTRIFUGAL PUMP

ISSUED FOR PROCEDURE MANUAL

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
HANFORD ENVIRONMENTAL RESTORATION PROGRAM

BECHTEL HANFORD INC. RICHLAND, WASHINGTON | CH2M HILL HANFORD INC. RICHLAND, WASHINGTON

100 AREA SOIL WASHING TREATABILITY TEST
100-DR-1 OPERABLE UNIT
PROCESS AND INSTRUMENTATION DIAGRAM

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	PE7FAM1A.DWG

DRAWING NO. 100-PE7FA-M001

Figure E-1. Process Schematic and Sampling Points.

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Table E-1. Test Analytes, Methods, Detection Levels, and Expected Levels.

Category	Analyte	Analytical Method	Soil			Water and Solution	
			MDC (pCi/g)		116-D-1B Average[a] (pCi/g)	MDC (pCi/L)	
			Onsite	Offsite		Onsite	Offsite
Radionuclides: EPA Analytical Level V	Alpha/Beta	Gross Alpha/Beta	6/3	10/15	NA	100/20	3/4
	Cesium-137	Gamma Spec.	0.1	0.05	205	100	15
	Cobalt-60	Gamma Spec.	0.1	0.1	15	100	25
	Europium-152	Gamma Spec.	0.2	0.1	177	200	50
	Europium-154	Gamma Spec.	0.2	0.1	17	150	50
	Plutonium-239/40	Alpha Spec.		1.0	2.74	10	1
	Strontium-90	Low Beta		1.0	12.5	50	2
			PQL (mg/kg)		mg/kg	PQL (μg/L)	
Metal: EPA Analytical Level III[a]	Chromium (Total)	SW-846-6010		2.0	58		20

MDC = minimum detectable concentration for radionuclides
NA = not available
PQL = practical quantitative limits
For all analyses the required precision is 20 relative percent difference (RPD); Accuracy is 75% to 125% recovery.

[a]Trench 116-D-1B averages are stated in DOE-RL 1993.

Table E-2. Analytical Methods, Required Preservatives, Holding Time, and Volumes.

Analyte	Method	Preservative	Holding Time	Volume
Soil Samples				
Alpha/Beta - $^{134/137}Cs$ - ^{60}Co - $^{152/154}Eu$ ^{90}Sr $^{239/240}Pu$	Gross Alpha/Beta Gamma Spec Alpha Spec Low Beta	None	6 months	P/G 1,500 mL
ICP Chromium (Total)	6010	None	6 months	G 50 mL
toxicity characteristic leaching procedure (TCLP) Metals by ICP	1311/6010	None	180 days[a]	G 500 mL
Moisture	160 Series	None	14 days	G 500 mL
Water Samples				
Analyte	**Method**	**Preservative**	**Holding Time**	**Volume**
Alpha/Beta - $^{134/137}Cs$ - ^{60}Co - $^{152/154}Eu$ ^{90}Sr $^{239/240}Pu$	Gross Alpha/Beta Gamma Spec Alpha Spec Low Beta	HNO_3 to pH <2	6 months	P/G 5X1000 mL
ICP Chromium (Total)	6010	HNO_3 to pH <2 Cool to 4° C	6 months	G 500 mL
TCLP Metals by ICP	1311/6010	None	180 days[a]	G 1,000 mL
Total Suspended Solids	160 Series	None	14 days	G 1,000 mL

G = Glass
P = Plastic

[a]TCLP Holding Time - 180 days from time of collection to leachate preparation and 180 days from extraction to analysis.

4.0 IN-PROCESS SAMPLES

For each test, the first sampling event at time 0 hours will occur when the processed material appears at the farthest point in the process (sample point 14). Successive sampling events will occur at 1-hour intervals, with the final event occurring just before completion of the test. Table E-3 is a summary of sample numbers and types to be collected. Table E-4 shows the number and types of samples to be analyzed for each analytical method.

The following types of samples will be taken during processing. Table E-5 provides justification for each sample point.

On the second or third sampling event, on the last day of sampling, duplicate and split samples will be collected at each of these points. The duplicates will be sent to an offsite laboratory for SW-846 and radionuclide analyses.

4.1 FEED SOIL SAMPLES

Two samples of feed material will be taken from alternate buckets (odd number loads) of the front-end loader before it is emptied onto the grizzly screen. Sample volumes will be specified by the SAF. Approximately ten samples are anticipated during operations. In addition, one sample duplicate and one split sample will be collected.

Half of the samples collected from the front-end loader will be crushed to <6 mm, if needed, and shipped offsite to receive SW-846 analysis for chromium and analyses for radionuclides. The other half of the samples will be composited in the field in a 10- to 20-L (2.5- to 5-gal) container and handled as specified in Tables E-3 and E-4.

4.2 LIQUID SAMPLES

Samples will be taken of clarifier streams just before they enter the water tanks (sample points 9 and 12), just after they leave the tanks (sample points 15 and 16), and just before entering the clarifier (sample points 8 and 11). Tank samples (sample points 15 and 16) will be collected at the same frequency as the other water samples, but only the first and last samples will be analyzed. The other samples will be held for possible future analyses if data indicate the need for investigation of tank water variations.

The first sampling event will occur after feed material is observed to reach the farthest point in the process (sample point 14). Subsequent samples will be taken at approximately 1-hour intervals. All liquid samples will be sent to an offsite laboratory for total chromium, solids, and radionuclides analyses.

Table E-3. Number and Types of Samples to be Collected.

Sample Point[a]	Solids	Liquids	Composites	Splits	Duplicates
1. Feed bucket	10[b]		10/1[c]	1	1
2. >150 mm	1[b]		1[c]	1	1
3. 150 to 13.5 mm	10[b]		10/1[c]	1	1
4. 13.5 to 2 mm	10[b]		10/1[c]	1	1
5. Before spiral	10		10/1[c]	1	1
6. After attrition 1	10		10/1[c]	1	1
7. After attrition 2	10		10/1[c]	1	1
8. Clarifier 1 influent		10		1	1
9. Clarifier 1 effluent		10		1	1
10. 2 to 0.25 mm	10		10/1[c]	1	1
11. Clarifier 2 influent		10		1	1
12. Clarifier 2 effluent		10		1	1
13. <0.25 mm	10		10/1[c]	1	1
14. <0.25 mm	10		10/1[c]	1	1
15. Recirculation tank (TK-101)		10/2[d]		1	1
16. Recirculation tank (TK-102)		10/2[d]		1	1
Make-up water (preprocess samples)		2		1	1
Total Samples	91	62	10	17	17

[a]See Figure E-1 for sample points.
[b]Samples are crushed in the field before being sent for analysis
[c]Ten samples in addition to those shown in the solids column are taken at 1-hour intervals. The samples will be composited as they are collected using plastic 5-gal buckets with lids. Half the composite from each sampling point will be sent to PNL for sieving and gamma-spec analysis. The other half will be crushed, if needed, and split again; half will be sent to PNL and half will be sent offsite. All of sample point no. 2 (>150 mm) will be composited into a single sample.
[d]Collect 10 samples. Analyze only the first and last. Hold the rest for possible future analyses.

Table E-4. Number and Types of Analyses.

Sample Point[a]	Offsite Analyses							Onsite Analyses				
	Chromium SW-846[b]	Gamma-Spec[b]	Strontium[b]	Plutonium[b]	Moisture/ TSS[b]	TCLP Metals[d]	Gross (α/β)	Gamma-Spec	Gross (α/β)	Moisture	Sieve	Gamma-Spec by Size
Feed bucket	12	12	12	12	12							
>150 mm		3			3							
150 to 13.5 mm		12	12	12	12							
13.5 to 2 mm	12	12	12	12	12							
Before spiral		12			12							
After attrition 1		12			12							
After attrition 2		12			12							
Clarifier influent (water)					12							
Clarifier effluent (water)		12			12							
2 to 0.25 mm	12	12	12	12	12	2						
Clarifier influent (water)					12							
Clarifier effluent (water)		12			12							
<0.25 mm	12	12	12	12	12	2						
<0.25 mm	12	12	12	12	12	2						
Recirculation tank 1 (water)		4			4							
Recirculation tank 2 (water)		4			4							
Make-up water		4			4							
Equipment/Trip Blanks (water)	5	10	5	5								
Composites[c]		10			10		10	10	10	10	10	72[e]
Total Soil	60	121	72	72	121	6	10	10	10	10	10	72
Total Water	5	46	5	5	60	0	0	0	0	0	0	0
Total Analyses	65	167	77	77	181	6	10	10	10	10	10	72

[a]See Figure E-1 for sample points.
[b]Sample numbers include one split and one duplicate for each sample point except blanks and composites.
[c]Half of the composite from each sample point will be sent to PNL; the sample will be sieved into eight size fractions (>13.5 mm, 13.5 mm to 2 mm, 2 mm to 1 mm, 1 mm to 0.425 mm, 0.425 mm to 0.25 mm, 0.25 mm to 0.15 mm, 0.15 mm to 0.074 mm, <0.074 mm) and receive gamma-spec analyses by size fraction. The other half will be crushed, if needed, and split again. Half of the material will be sent to PNL for moisture, gamma-spec, and gross alpha/beta analyses; the other half will be sent offsite for gamma-spec and gross alpha/beta analyses.
[d]Includes analyses for chromium (total) and radioactivity (gamma-spec and alpha/beta).
[e]Note: Estimated value.

9513339.0639

Table E-5. Justification for Sample Points.

Sample Point	Reason for Sampling
1. Feed bucket	Input to system, characterize feed
2. >150 mm	Confirm data from bench-scale work
3. 150 to 13.5 mm	Confirm data from bench-scale work
4. 13.5 to 2 mm	Confirm data from bench-scale work
5. Before spiral classifier 1	Evaluate spiral classifier efficiency - mass balance data
6. After attrition 1	Evaluate attrition scrubbers - mass balance data
7. After attrition 2	Evaluate attrition scrubber - Mass balance data
8. Clarifier 1 influent	Evaluate spiral classifier and clarifier efficiency - mass balance data
9. Clarifier 1 effluent	Evaluate clarifier efficiency - mass balance data
10. 2 to 0.25 mm	Confirm bench-scale work - mass balance data
11. Clarifier 2 influent	Evaluate spiral classifier and clarifier efficiency - mass balance data
12. Clarifier 2 effluent	Evaluate clarifier efficiency - mass balance data
13. <0.25 mm 1 Vacuum Filter	Confirm bench-scale work - mass balance data
14. <0.25 mm 2 Vacuum Filter	Confirm bench-scale work - mass balance data
15. Recirculation tank T-101	Evaluate buildup of contaminants
16. Recirculation Tank T-102	Evaluate buildup of contaminants
Make-up water (preprocess samples)	Baseline data

4.3 SLURRY SAMPLES

Two samples will be taken of the slurry streams after the double-deck screen, after the first attrition scrubber, and after the second attrition scrubber (sample points 5, 6, and 7). The solids content of streams 6 and 7 is expected to be about 70%. The first sampling event will occur after feed material is observed to reach the farthest point in the process (sample point 14). Subsequent samples will be taken at approximately 1-hour intervals.

Half of the samples collected will be shipped offsite. Samples will receive moisture analyses for reporting on a dry basis. Samples will receive SW-846 analysis for total chromium and analyses for radionuclides. Analyses may be performed on as-received or dried samples as appropriate to the procedures employed, but all results must be reported on a dry basis.

The other half of the samples will be composited in the field and handled as specified in Tables E-3 and E-4.

4.4 SOLIDS SAMPLES

Two sets of solids samples will be collected from the ends of conveyors (sample points 3, 4, 10, 13, and 14). The first sampling event will occur after feed material is observed to reach the farthest point in the process (sample point 14). Subsequent samples will be taken at approximately 1-hour intervals.

Half of the samples will be crushed to <6 mm, if needed, and shipped offsite to receive SW-846 analysis for chromium (total) and analyses for radionuclides. Analyses may be performed on as-received or dried samples as appropriate to the procedures employed, but all results must be reported on a dry-basis.

The other half of the samples will be composited in the field in a 20-L (5-gal) container for each stream (four composite samples) and handled as specified in Tables E-3 and E-4.

These samples will be taken such that, to the extent possible, the material sampled is the same material that is analyzed by on-line radiation monitors.

4.5 TOXIC CHARACTERISTIC LEACH PROCEDURE SAMPLES

Samples of materials discharging from the dewatering screen and the solution rotary vacuum filter (sample points 10, 13, and 14) will be sent offsite for TCLP analysis. Two samples will be taken from each conveyor near the end of the test. The liquids from the TCLP test will be analyzed for total chromium (SW-846) and radionuclides (gamma-spec and gross alpha/beta).

4.6 PORTABLE DRUM COUNTER SAMPLES

In addition to laboratory samples, feed soils, particles >150 mm (if any), particles between 150 mm and 13.5 mm, and particles between 13.5 mm and 2 mm will be analyzed in the field for radionuclide levels using a portable drum counter (see Appendix D of procedures document). For each size fraction, a 55-gal drum of material will be filled (if there is enough material). The number of drums will depend on the amount of time required for each analysis and the amount of material in each size fraction. It is expected that one 55-gal sample per test for each size fraction will be analyzed using the drum counter.

The drum counter will be calibrated before operation and will be operated by trained personnel in accordance with PNL procedures (see Appendix D).

4.7 ON-LINE RADIATION MONITORING

On-line sodium iodide detectors will be mounted on the feed conveyor, and conveyors for the 150-mm to 13.5-mm, 13.5-mm to 2-mm, and 2-mm to 0.25-mm material. The monitors will be connected to a central computer and calibrated and operated by trained personnel in accordance with PNL procedures (to be prepared). A description of the on-line radiation monitors is included in Appendix B of the procedures document.

The purpose of the monitors is to test real-time feedback mechanisms that will potentially be utilized in design of an automated control system for full-scale equipment.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Analytical samples will be subject to in-process QC procedures appropriate for the field and the laboratory (Appendix F of procedures document).

Sample duplicates, splits, and blanks will be analyzed to determine analytical precision and accuracy in accordance with contract laboratory program-like quality laboratory requirements. Representativeness will be achieved by using Bechtel Hanford, Inc. (BHI)-approved sampling procedures, and standard EPA Levels III and V analytical methods. Completeness and comparability of samples and analyses will also be determined. Eighty percent completeness is required. This is the percentage of unflagged data divided by the total number of data. Comparability is facilitated by reporting of results in the correct units (specified in Table E-3), and analysis of duplicate samples.

6.0 SAMPLE HANDLING

Sample handling shall comply with Department of Transportation (DOT), Washington State regulations, and BHI applicable procedures specified in the Quality Assurance Project Plan (QAPjP) (Appendix F of procedures document). Stainless steel decontaminated sampling equipment or disposable containers will be utilized in sample collection. The sampling equipment may include shovels, scoops, spoons, funnels, ladles, and large glass or plastic containers. An onsite jaw crusher will be used to reduce larger pieces to 1/4 in. size. The crusher will only be able to handle 3-in.-diameter material; some manual preprocessing of materials >3 in. using soil sample bags and hammers will be required.

6.1 SAMPLE CONTAINERS

One- or two-liter glass and plastic sample containers will be used for solid and liquid samples (see Table E-2 sample volumes). Composite samples will be placed in 10- to 20-L (2.5- to 5-gal) containers with removable lids. Sample bottles used must show verification of being decontaminated in accordance with EPA methods. The sample containers must be labeled.

6.2 SAMPLE LABELLING

Preprepared labels will be affixed to each sample container. The information on the labels will include:

- Project name
- Collecting date
- Name of the sampler
- Sample tracking number
- Nature of material
- Requested analysis.

6.3 PACKAGING

Sample containers must be closed, sealed with evidence tape, and triple contained. Yellow plastic bags are used for radioactive mixed waste. Radiation from the exterior of the last bag shall meet DOT regulatory requirements.

The Health Physics Technician (HPT) shall screen all samples collected for alpha, beta, and gamma radiation to determine proper handling protocols, in compliance with the Radiation Work Permit for the project. Total activity analysis shall be done for each sample to determine proper laboratories and packaging and shipping requirements. Samples shall be packaged and shipped per Environmental Investigations Instruction (EII) 5.11 (BHI 1994). The HPT will sign an Offsite Property Control form for unconditional release of each bag. For offsite shipment, a group of sample bags will be placed in an approved package.

The following documents must be placed inside the package before it is sealed with evidence tape.

- Chain of Custody/Sample Analysis Request
- Total Activity Analysis.

The package shall be labeled, marked, and released for shipment.

6.4 SHIPPING

Sample shipping will be performed in accordance with EII 5.11.

For onsite shipping, a Radioactive Shipment Record will be completed and sent with samples and a chain of custody to the receiving laboratory.

For shipping to offsite laboratories, BHI-Transportation Log will provide the shipper with the number of bill of lading. This number is entered on the Hazardous Material Shipment Record. When the package is delivered to the shipping authorities, the chain of custody must be signed by the package recipient. The designated laboratories will break the seals. If no tampering has occurred, the samples will be analyzed.

6.5 CHAIN OF CUSTODY

A chain-of-custody form shall be completed as specified by EII 5.1. The information in the chain of custody includes:

- Date
- Sample tracking number
- Nature of sample such as solid or liquid
- Requested analysis
- Name or chemical formula of analytes
- Sample holding time
- Signature of custodian
- Signature of recipient when custodianship is transferred.

7.0 SAMPLE ANALYSIS

Analytical methods and requirements are summarized in Table E-1. Analyses will be performed in accordance with the QAPjP (Appendix F of procedures document). Analytical levels will be in accordance with EPA guidance for data quality objectives (EPA 1987).

The laboratory analytical work will be done in accordance with Tables E-3 and E-4 and BHI analytical requirements. Soils and water samples will be analyzed for metals (including chromium) and radionuclides using EPA Levels III and V methods (EPA 1990) as specified in Tables E-3 and E-4.

7.1 SAMPLE ANALYSIS REPORT

After sampling is completed, offsite laboratories will submit a sample analysis report to the project manager (this is not the final test report to be completed by BHI). The report will include (1) statistical analyses of laboratory results, (2) validation of 10% of the laboratory data, (3) QA documentation, and (4) a hardcopy and disk copy of results. This report is a QA document and will reside in the retired project file.

8.0 REFERENCES

BHI, 1994, *Environmental Investigations Procedures*, BHI-EE-01, Vol. 1, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 1993, *100 Area Soil Washing Bench-Scale Tests*, DOE/RL-93-107, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1987, *Data Quality Objectives for Remedial Response Activities*, Appendix A, Historical Precision and Accuracy Data Classified by Media by Analytical Level, EPA/540 G-87/004, OWSER Directive 9335.3-01, U.S. Environmental Protection Agency, Office of Emergency Response and Office of Waste Programs Enforcement, Washington, D.C.

EPA, 1990, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*, EPA Publication SW-846, 3rd edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

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APPENDIX F

QUALITY ASSURANCE PROJECT PLAN

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APPENDIX F

QUALITY ASSURANCE PROJECT PLAN

1.0 INTRODUCTION

The Quality Assurance Project Plan (QAPjP) describes the quality assurance (QA) requirements that support the 100-DR-1 soil washing field test and supporting laboratory activities. This QAPjP presents the objectives, organizations, functional activities, procedures, and specific QA and quality control (QC) protocols associated with these activities.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The QAPjP responsibilities of key personnel and organizations are as follows:

- **Field Coordinator (Bechtel Hanford, Inc. [BHI])**: Responsible for onsite direction of all field activities in compliance with the requirements of this QAPjP, the sampling plan, and all implementing Environmental Investigations Instructions (EII).

- **Cognizant Quality Assurance Engineer (BHI)**: The QA person is responsible for performing formal audits/surveillances to ensure compliance with QAPjP requirements (BHI 1994b).

- **Other Support Contractors**: The project manager will prepare a task assignment for project services and responsibilities by other companies, including Westinghouse Hanford Company (WHC) and Pacific Northwest Laboratory (PNL). Such services shall be in compliance with standard BHI and/or WHC procurement procedures as discussed in Section 5.0. All work shall comply with BHI approved QA plans and/or procedures.

- **Sample Management**: Is responsible for coordinating qualified and approved laboratory support for all project analyses concerns, assisting in sample shipment tracking, resolving chain-of-custody issues, and when requested validating all related data.

- **Qualified Offsite Analytical Laboratories:** Soil samples shall be sent to an approved contractor, participant subcontractor, or subcontractor laboratory. They shall be responsible for performing the analyses identified in this plan in compliance with work order, contractual requirements, and approved procedures (see Section 5.0). Each laboratory shall have and comply with a written approved laboratory QA plan. All analytical laboratory work shall be subject to the surveillance controls invoked by QI 7.3, "Source Surveillance and Inspection" (BHI 1994b). This plan shall meet the appropriate requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989). Sample Management shall retain prime responsibility for ensuring acceptability of offsite laboratory activities.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

The QAPjP's principal objective is to maintain the quality of field activities, sample handling, and laboratory analysis by specifying quality affecting requirements for the project.

Specific test objectives and measurements are stated in the test procedures.

4.0 PROCEDURES

Activities shall be performed as specified in the test procedures, facility operation and maintenance procedures, and current EIIs (BHI 1994a), including:

SUBJECT	**BHI-EE-01, Vol. 1 PROCEDURE(S)**
	EII-
Sampling Procedures	5.2, 5.8
Sample Handling	5.2, 5.11
Field Documentation and Logbooks	1.5, 5.1, 5.10
Equipment Decontamination	5.4, 5.5
Waste Handling and Disposal	4.2
Control of *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and Other Past-Practice Investigation Derived Waste, Rev. 2	4.3
Site Entry Requirements	1.1
Deviation From Procedures	1.4
Personnel Requirements	1.1, 1.7, 3.2
Health and Safety Requirements	1.1, 1.7, 2.1, 2.2, 2.3, 3.2
Data Management	14.1

Contractor and/or subcontractor services shall be subject to the following (BHI 1994b):

- QI 4.0, "Procurement Document Control"
- QI 4.1, "Procurement Document Control"
- QI 4.2, "External Services Control"
- QI 7.0, "Control of Purchased Items and Services"
- QI 7.1, "Procurement Planning and Control"
- QI 7.2, "Supplier Evaluation"

- QI 7.3, "Source Surveillance and Inspection"
- QI 17.0, "Quality Assurance Records"
- QI 17.1, "Quality Assurance Records Control"
- EII 1.6, "QA Records Processing" (BHI 1994a).

Contract documents shall specify that the contractor submit for BHI review and approval prior to use all analytical procedures and its QA/QC program. Participant contractor or subcontractor procedures, plans, and/or manuals shall be retained as project quality records.

5.0 SAMPLE CUSTODY

Project samples shall be controlled per EII 5.1, "Chain of Custody," from the point of origin to the analytical laboratory. Laboratory chain-of-custody procedures shall be reviewed and approved as required by procurement control procedures as noted in Chapter 4. The contractor shall ensure the maintenance of sample integrity and identification throughout the analytical process. Offsite sample tracking shall be performed by Sample Management in accordance with applicable BHI procedures.

Results of analyses shall be traceable to original samples through a unique code or identifier. BHI shall assign the samples Hanford Environmental Information System sample numbers. All results of analyses shall be controlled as permanent project quality records.

6.0 CALIBRATION PROCEDURES

Calibration of critical measuring and test equipment, whether in existing inventory or newly purchased, shall be controlled as required by:

- QR 12.0, "Control of Measuring and Test Equipment" (BHI 1994b)

- QI 12.1, "Acquisition and Calibration of Portable Measuring and Test Equipment" (BHI 1994b)

- QI 12.2, "Measuring and Test Equipment Calibration by User" (BHI 1994b)

- EII 3.1, "User Calibration of Health and Safety Measuring and Test Equipment" (BHI 1994a).

Routine field equipment operational checks shall be per applicable EIIs or procedures. Similar information shall be provided in approved participant contractor or subcontractor procedures.

Participant contractor or subcontractor laboratory analytical equipment calibrations shall be per applicable standard analytical methods. These shall be subject to review and approval.

7.0 ANALYTICAL PROCEDURES

Analytical methods and requirements shall be as specified in the test procedures, and the Sampling and Analysis Plan (Appendix E of Procedures) Onsite (laboratory screening performed by PNL) and offsite (U.S. Environmental Protection Agency [EPA] Level III) analytical methods are specified in Table F-1.

The PNL analytical work will be conducted in accordance with PNL best management practices.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION AND DATA PACKAGE PREPARATION

Onsite laboratory screening analyses and reports will be as specified in contract documents and in accordance with soil washing test procedures (WHC 1994) and bench-scale test procedures (Freeman et al. 1993).

Offsite analytical laboratories shall be responsible for preparing a report summarizing the analysis results and a detailed data package. This includes all information necessary to perform data validation. Data shall be reported on a dry-weight basis. The data summary report format and data package content shall be defined in procurement documentation subject to review and approval as noted in Section 4.0. As a minimum, offsite laboratory data packages shall include the following:

- Sample receipt and tracking documentation, including identification of the organization and individuals performing the analysis; the names and signatures of the responsible analysts; sample holding time requirements; references to applicable chain-of-custody procedures; and the dates of sample receipt, extraction, and analysis

- Instrument calibration documentation, including equipment type, model, initial and continuing calibration data, method of detection limits, and calibration procedure used

- Additional QC data, as appropriate for the methods used including matrix spikes, duplicates, recovery percentages, precision data, laboratory blank data, and identification of any nonconformance that may have affected the laboratory's measurement system during the analysis time period

- The analytical results or data deliverables, including reduced data, reduction formulas or algorithms, unique laboratory identifiers, and description of deficiencies

- Other supporting information, such as reconstructed ion chromatographs, spectrograms, traffic reports, and raw data.

Table F-1. Test Analytes, Methods, Detection Levels, and Expected Levels.

Category	Analyte	Analytical Method	Soil			Water and Solution	
			MDC (pCi/g)		116-D-1B Average[a] (pCi/g)	MDC (pCi/L)	
			Onsite	Offsite		Onsite	Offsite
Radionuclides: EPA Analytical Level V	Alpha/Beta	Gross Alpha/Beta	6/3	10/15	NA	100/20	3/4
	Cesium-137	Gamma Spec.	0.1	0.05	205	100	15
	Cobalt-60	Gamma Spec.	0.1	0.1	15	100	25
	Europium-152	Gamma Spec.	0.2	0.1	177	200	50
	Europium-154	Gamma Spec.	0.2	0.1	17	150	50
	Plutonium-239/40	Alpha Spec.		1.0	2.74	10	1
	Strontium-90	Low Beta		1.0	12.5	50	2
			PQL (mg/kg)		mg/kg	PQL (μg/L)	
Metal: EPA Analytical Level III[a]	Chromium (Total)	SW-846-6010		2.0	58		20

MDC = minimum detectable concentration for radionuclides
NA = not available
PQL = practical quantitative limits
For all analyses the required precision is 20 relative percent difference (RPD); Accuracy is 75% to 125% recovery.

[a]Trench 116-D-1B averages are stated in DOE-RL 1993.

Onsite and offsite sample data shall be retained by the analytical laboratory and made available for systems or program audit purposes upon request by BHI; the U.S. Department of Energy, Richland Operations Office; or regulatory agency representatives. Such data shall be retained by the analytical laboratory through the duration of their contractual statement of work, at which point, it shall be turned over to BHI for archiving.

8.2 FINAL REVIEW AND RECORDS MANAGEMENT CONSIDERATIONS

Ten percent of the offsite sample analyses will be validated using current EPA Level III, contract laboratory program-like data validation procedures. Validation reports and supporting analytical data packages shall be subjected to a final technical review by qualified reviewers at the direction of the BHI project engineer. This will be done before data submittal to regulatory agencies or inclusion in reports or technical memoranda. All validation reports, data packages, and review comments shall be retained as permanent project quality records in compliance with EII 1.6, "Records Management" (BHI 1994a). The project manager will have the primary responsibility for dispositioning project-related records and data.

9.0 INTERNAL QUALITY CONTROL

Sampling plan activities may be evaluated as part of the project's QC effort. All analytical samples shall be subject to in-process quality measures from the field to the laboratory and during laboratory processing. Laboratory analyses performance audits are implemented through the use of quality samples sent to multiple laboratories. The data quality generated in this project will be operationally defined by the following.

- Split samples shall be collected and submitted to separate laboratories for a measurement precision assessment. At least 1 split sample will be taken for every 10 samples.

- Duplicate samples shall be collected and submitted to measure intralaboratory precision. One (1) duplicate sample will be taken for every 10 samples.

- Equipment blanks (matrix-silica sand) shall be prepared and submitted to assess sampling equipment cleanliness. Equipment blanks will be performed for 1 out of 20 sampling events.

- Offsite laboratory internal QC checks performed per applicable protocol for the analysis. This must include data demonstrating achieved accuracy, precision, system calibration, and performance. Reportables will include:

  -- Preparation and calibration blanks
  -- Calibration verification standards
  -- Matrix spikes
  -- Duplicates
  -- Control samples
  -- Other supporting documentation.

10.0 PERFORMANCE AND SYSTEMS OVERVIEW

Program activities are subject to oversight by QA personnel. Quality-affecting activities that may be reviewed include, but are not limited to, measurement system accuracy; intramural and extramural analytical laboratory services; field activities; and data collection, processing, validation, reporting, and management. The QA overview shall be performed under the standard operating procedure requirements of BHI.

System overview requirements are implemented in accordance with QI 10.4, "Surveillance," or other procedures. All quality-affecting activities are subject to surveillance. The project engineer shall interface with both the Environmental Field Services quality coordinator and the QA officer. QA is responsible for providing surveillances, assessments, and audits to identify conditions adverse to quality.

11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratory that directly affects analytical data quality shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime. Field equipment maintenance instructions shall be as defined by the approved procedures governing their use. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment; maintenance requirements, spare parts lists, and instructions shall be included in individual methods or in laboratory QA plans, subject to review and approval. When samples are analyzed using EPA reference methods, the preventive maintenance requirements for laboratory analytical equipment are as defined in the procured laboratory's QA plan(s).

12.0 DATA QUALITY INDICATORS

12.1 DATA ASSESSMENTS BY ANALYTICAL FACILITY

Adherence to approved procedures will be sufficient for the majority of data reports. To the extent possible, performance-based standards will be the preferred method of assessment for precision and accuracy measurements. A familiar example is the use of control charts. Values exceeding a 3-sigma limit on well-established and appropriate control chart should be flagged when reported. Samples in the analytical batch should be rerun if possible, and those results also reported.

When appropriate performance-based standards are not available and referenced procedures do not specify, the following two rules may be used.

- **Precision**: The difference between laboratory duplicates will be subject to a control limit of 150% of the requested limit whenever both sample values exceed the estimated method detection limit (MDL). If the estimated MDL exceeds the requested limit, the higher value may be used to calculate the control limit. When either or both duplicates are below the estimated method detection limit, laboratory precision may be assessed by comparing identically spiked samples. Samples exceeding five times the control limit can be subject to a 20% relative percent difference (RPD) limit, where:

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

S = Sample concentration
D = Duplicate sample concentration.

Failure to meet a precision limit will require evaluation and corrective action as appropriate.

- **Accuracy**: Defined by percent recovery data, where:

$$\% \ Recovery = \frac{(Spiked \ Sample \ Result \ - \ Sample \ Result)}{Spike \ Added} \times 100$$

When the sample result (SR) is less than the MDL, use SR=0 for the purpose of calculating the percent recovery. Spiked samples having concentrations two to five times greater of the requested detection limit or MDL will have recovery control limits of 50% to 150%. Spiked samples exceeding five times the estimated MDL will have recovery control limits of 75% to 125%. Failure to meet the control limit will require evaluation and corrective action as appropriate. Applicable samples not meeting the limit should be rerun using a post-digestion spike if possible. Post-digestion spikes should be made at two times the indigenous level or lower reporting limit, whichever is greater.

- **Representativeness**: Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Representativeness will be addressed primarily in the sample design, through the selection of sampling sites and procedures. Representativeness also will be ensured by the proper handling and storage of samples. Representativeness of data will be discussed, when appropriate, in deliverable reports.

- **Completeness**: Measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

$$\% C = 100 \times V/n$$

V = Number of valid data points acquired
n = Total number of data points

Completeness objectives for this project are set at 80% of validated data.

- **Comparability**: Expresses the confidence with which one data set can be compared to another. Comparability for this project will not be quantified, but will be addressed through the use of accepted laboratory methods. The use of standard reporting units also will facilitate comparability with other data sets. Comparability of other data will be discussed, when appropriate, in the final report.

12.2 PROJECT LEVEL ASSESSMENTS

Summary statistics for measurement precision and accuracy shall be prepared in conjunction with the data analysis.

Precision evaluation at the project level will address interlaboratory precision. Precision of environmental measurement systems is often a function of concentration. This relationship should be considered before selecting the most appropriate form of summary statistic. Simplistically, this relationship can usually be classified as falling into one of the following three categories:

- Standard deviation (or range) is constant
- Coefficient of variation (or relative range) is constant
- Standard deviation (or range) <u>and</u> coefficient of variation (or relative range) vary with concentration.

The pooled standard deviation or pooled coefficient of variation can be used to summarize data in bullets 1 and 2, respectively. Bullet 3 will require either graphical summary of the data or specialized regression techniques.

Data quality assessments are generally made at concentrations typical of the observed range in routine analyses. In some situations, the typical value measurement will be below an estimated practical method, or instrument detection limit (i.e., an engineering zero). If a standard exists (or is to be set) at some positive finite value, quality assessment summaries may be desired at that level rather than the most representative concentration.

13.0 CORRECTIVE ACTIONS

Corrective action requests required as a result of surveillance reports, nonconformance reports, or audit activity shall be documented. Primary responsibilities for corrective action resolution are assigned to the project manager and the QA officer. Other measurement systems, procedures, or plan corrections that may be required as a result of routine review processes shall be resolved as required by governing procedures or shall be referred to the project engineer for resolution. Copies of all surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project QA records upon completion or closure.

14.0 QUALITY ASSURANCE PROJECT REPORTS

Special QA reports are not planned for this project. Project records will be maintained in conformance with standard operating procedure requirements of BHI (1994a). Project records will be maintained according to EII 1.6, "QA Records Processing," and technical data will be dispositioned according to EII 1.11, "Technical Data Management." Surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project manager on completion or closure of the activity. The final project report prepared by the cognizant engineer or designee shall include an assessment of the overall adequacy of the total measurement system with regard to the data quality objectives of the investigation.

15.0 REFERENCES

BHI, 1994a, *Environmental Investigations Procedures*, BHI-EE-01, Vol. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1994b, *Quality Assurance Manual*, BHI-QA-02, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 1993, *100 Area Soil Washing Bench-Scale Tests*, DOE/RL-93-107, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, et seq., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Freeman, H.D., A. Gerber, S.V. Mattigod, and R.J. Serne, 1993, *100 Area Soil Washing Bench-Scale Test Procedures*, PNL-8520, Pacific Northwest Laboratory, Richland, Washington.

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APPROVAL PAGE

Title of Document: SOIL WASHING FIELD TEST PROCEDURE FOR THE 100-DR-1 OPERABLE UNIT

Author(s): K. E. Cook, CH2M Hill Hanford, Inc.
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J. G. Woolard, Bechtel Hanford, Inc.

Approval: J. G. April, CH2M Hill Hanford, Inc.

Signature — Date 11/28/94

G. R. Eidam, Bechtel Hanford, Inc.

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BHI PROJECT FILE 04 H6-08	Transmittal No. TR-OP-28	Date 12-15-94
	Document No./Title of Manual BHI-OP-00007	

The procedure(s) listed below are being issued by BHI Procedures Coordination as new or revised procedures.

PROCEDURE NO.	REV. NO.	TITLE
BHI-OP-00007	0	Soil Washing Field Test Procedure for the 100-DR-1 Operable Unit

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