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Oakland Operations Office, Oakland, California

WORK PLAN FOR THE ABSORPTION OF RADIUM/STRONTIUM TREATMENT SYSTEMS AREA II LIQUID WASTE AND DECONTAMINATION WATER

at the

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy, National Nuclear Security Administration
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

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Emeryville, California 94608-1827

October 17, 2002
Rev. 1

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental Science, Engineering and Management

Approvals Page

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ACRONYMS

AHA	Activity Hazard Analysis
ALARA	As-Low-As-Reasonably-Achievable
CA	Contamination Area
CFR	Code of Federal Regulations
Co-60	cobalt-60
CPGERP	Contingency Plan and General Emergency Response Procedures
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
gal.	gallon(s)
HSP	health and safety procedure
HWP	Hazardous Work Permit
lb.	pound(s)
LEHR	Laboratory for Energy-Related Health Research
LSDDP	Large-Scale Demonstration and Deployment Program
MEMP	Miamisburg Environmental Management Project
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
ORP	Occurrence Reporting Plan
OST	Office of Science and Technology
PHSM	Project Health and Safety Manager
PHSP	Project Health and Safety Plan
PM	Project Manager
PQAM	Project Quality Assurance Manager
PPE	personal protective equipment
PTL	Project Task Leader
QAPP	Quality Assurance Project Plan

RA	removal action
Ra/Sr	Radium/Strontium
RCM	Radiological Control Manager
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RPP	Radiological Protection Program
RSO	Radiation Safety Officer
RWMP	Radioactive Waste Management Plan
SC	Site Coordinator
SHSO	Site Health and Safety Officer
SOP	standard operating procedure
SQP	standard quality procedure
Sr-90	strontium-90
SRA	Site Records Administrator
WA	Weiss Associates
WAC	waste acceptance criteria
WC	Waste Coordinator
WMTS	Waste and Material Tracking System
WPO	Waste Packaging Observer
WS	Waste Specialist

1. INTRODUCTION

This work plan presents absorption procedures for approximately 4,000 gallons (gal.) of low-level radioactive waste water and decontamination/rain water generated during the Radium/Strontium Treatment Systems Area II removal action (Ra/Sr Treatment Systems Area II RA) at the Laboratory for Energy-Related Health Research (LEHR), University of California, Davis (Figures 1-1 and 1-2).

1.1 Objective

The objective of this work plan is to provide procedures for the safe absorption of free liquids in waste scheduled for land disposal at Envirocare of Utah (Envirocare), a low-level radioactive waste repository. The approach presented in this plan was verbally approved by Bret Rogers, Envirocare Director of Technical Services, during the Envirocare Government Users Conference of 2002. The work plan is designed to obtain necessary data to satisfy the Envirocare waste acceptance criteria (WAC) (Envirocare, 2001). This work plan was prepared according to the LEHR Quality Assurance Project Plan (QAPP) (WA, 2000a) and contains the following elements:

- Waste descriptions;
- Bench test results;
- Large-scale demonstration results;
- Post-absorption laboratory verification results (vibration and paint filter tests);
- Determination of required absorbent-to-waste ratios;
- Absorption and absorption verification procedures;
- Health and safety considerations;
- Waste management considerations;
- Environmental protection considerations;
- Quality assurance considerations; and,
- Supporting data and documents.

1.2 Background

The following sections describe the waste generation process, selection of absorbent materials, bench test, large-scale demonstration and post-absorption verification study (vibration test).

1.2.1 Waste Generation and Characterization

Prior to the demolition of Imhoff tanks during the Ra/Sr Area II RA, approximately 3,000 gal. of waste water were transferred into lined, 55-gal. drums and placed in a secondary containment cell in the former Cobalt-60 (Co-60) Field waste storage area (Figure 1-1). A water level indicator was used to fill the drums to approximately 76% capacity (325 pounds [lb.] of waste water).

Following completion of the Ra/Sr Area II RA, 1,000 gal. of decontamination/rain water were transferred into lined, 55-gal. drums, and placed on secondary containment pallets in the Geriatrics-1 waste storage area. The decontamination/rain water drums were filled to approximately 80% capacity (45 gal., 380 lb. of water). The decontamination/rain water was generated during equipment decontamination operations and as a result of rainfall accumulation in the decontamination pad during Ra/Sr Area II operations. The decontamination/rain water was partially absorbed using five lb. of WaterWorks of America SP-400® Crystals (SP-400 Crystals) per drum prior to placement in storage. An inventory of the waste packages is included in Attachment A.

Composite waste characterization samples of Imhoff Tank waste water were collected *in situ* prior to removal activities. The contamination concentrations in the decontamination/rain water area were assumed to be consistent with the Imhoff tank because the decontamination/rain water was generated while cleaning the equipment used to demolish the Imhoff tanks. The waste water and decontamination/rain water were designated as low-level radioactive waste with no chemical constituents above California or Resource Conservation and Recovery Act (RCRA) hazardous waste thresholds. The maximum detected strontium-90 (Sr-90) activity in the waste water is 20,900 picoCuries per liter. The waste characterization data are summarized in Table 1-1.

1.2.2 Absorption Bench Test

During the Ra/Sr Area II RA, Earthline Technologies of Ashtabula, Ohio and Weiss Associates (WA) conducted a bench-scale test to evaluate the use of SP-400 Crystals to eliminate free liquids in RA waste (Attachment B). The SP-400 Crystals are a super-polymer that bind free liquids in a gel-like matrix. The test was funded by the United States Department of Energy, National Nuclear Security Administration's (DOE/NNSA's) Office of Science and Technology (OST, EM-50) in conjunction with the DOE/NNSA Large-Scale Demonstration and Deployment Program (LSDDP) at the DOE/NNSA-Miamisburg Environmental Management Project (MEMP).

This bench-scale test was conducted on August 8, 2000, in the Geriatrics-1 waste storage building and facilitated by Scott Altmayer of Earthline Technologies. Four tests were performed on 500-gram waste water samples. Absorbent was added to waste water in 1% (5 grams of absorbent added to 500 grams of waste water), 2%, 3%, and 4% proportions. These percentages are the weight of absorbent as a percentage of total weight of waste water. The paint filter test (United States Environmental Protection Agency [EPA] Method 9095, included in Attachment C) was conducted

for each sample to determine if free liquids were sufficiently bound in the absorbent matrix. The 2%, 3%, and 4% mixtures passed the paint filter test, but the 1% mixture did not.

1.2.3 Large Scale Absorption Demonstration

Earthline Technologies returned to the site on March 22, 2001 for a large-scale absorption demonstration (Attachment D). The test was funded by the OST in conjunction with the LSDDP at the MEMP.

Four lined 55-gal. drums of waste water and one partially absorbed, lined 55-gal. drum of decontamination/rain water were selected for this demonstration. The generation process for the waste water and decontamination/rain water is described in Section 1.2.1. Results of the bench-scale test were used to develop the large-scale demonstration to determine the optimal ratio of absorbent to water. Absorbent-to-waste ratios of 2%, 4%, 6%, and 8% were evaluated. A 2% absorbent-to-waste ratio was evaluated for the partially absorbed drum of decontamination/rain water. All tests passed the paint filter test. Detailed test results are presented in Attachment C.

1.2.4 Post-Absorption Verification Study

Following the large-scale demonstration, a sample of the waste water with 2% absorbent was collected for a vibration test (modified American Society for Testing and Materials Test D999-96, Attachment E). The vibration test was designed and implemented by Earthline Technologies to simulate conditions normal and incidental to truck transportation to the disposal facility. The drum with 2% absorbent was selected for further evaluation because it was the most economical alternative, since it required the least amount of absorbent to absorb free liquids and pass the paint filter test. Results of this test conducted on May 14, 2001 show that the sample passed the standard paint filter test following the vibration test; no free-liquids were released during a five-minute evaluation.

1.2.5 Selection of Absorbent-to-Waste Ratio

The bench, large-scale demonstration and vibration tests determined that a 2% by weight absorbent-to-water ratio was sufficient to absorb LEHR waste water and decontamination/rain water. Because the Envirocare WAC requires a quantity of absorbent sufficient to absorb twice the volume of liquids expected, a 4% absorbent-to-water ratio was selected. Waste water packages will receive 13 lbs. of absorbent (325 lbs. of water). Decontamination/rain water waste packages will receive an additional 10 lbs. of absorbent because they already contain 5 lbs. of absorbent. The 15 lbs. of absorbent is two times the required quantity of absorbent required to absorb 380 lbs. of water.

In addition, one lb. of absorbent will be added to the void space between the drum wall and liner to absorb any condensation or free liquids that may be present.

1.3 Schedule

The waste water solidification described in this work plan is scheduled for November 2002. Shipment and disposal of this waste is scheduled for completion by December 31, 2002.

This task will require approximately five working days. Preparatory activities include conducting a pre-phase inspection, completing a hazardous work permit (HWP), establishing the work areas, procuring absorbent and staging waste and materials.

Table 1-1. Characterization Result Summary for Waste Water

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	GEN	Corrosivity	7.74	0.01	SU
CWRSI001	GEN	Flashpoint-200	200	200	Fahrenheit
CWRSI001	GEN	Formaldehyde	ND	0.048	mg/l
CWRSI001	GEN	Hexavalent Chromium	0.005	0.002	mg/l
CWRSI001	GEN	Nitrate	190	0.5	mg/l
CWRSI001	GEN	Reactive Releasable Cyanide	ND	13.8	µg/l
CWRSI001	GEN	Reactive Releasable Sulfide	ND	0.09	mg/l
CWRSI001	GEN	Total Plate Count	2,120	10	CFU/ml
CWRSI001	HERB	2,4,5-T	ND	0.5	µg/l
CWRSI001	HERB	2,4,5-TP	ND	0.5	µg/l
CWRSI001	HERB	2,4-D	ND	0.5	µg/l
CWRSI001	METAL	Aluminum	949	12.2	µg/l
CWRSI001	METAL	Antimony	1.99	1.61	µg/l
CWRSI001	METAL	Arsenic	5.69	2.92	µg/l
CWRSI001	METAL	Barium	112	0.457	µg/l
CWRSI001	METAL	Beryllium	ND	0.456	µg/l
CWRSI001	METAL	Cadmium	3.31	0.686	µg/l
CWRSI001	METAL	Calcium	341,000	8.32	µg/l
CWRSI001	METAL	Chromium	11.8	0.871	µg/l
CWRSI001	METAL	Cobalt	24.5	0.914	µg/l
CWRSI001	METAL	Copper	1,130	1.63	µg/l
CWRSI001	METAL	Iron	8,790	8.6	µg/l
CWRSI001	METAL	Lead	201	1.38	µg/l
CWRSI001	METAL	Magnesium	79,100	30	µg/l
CWRSI001	METAL	Manganese	376	0.937	µg/l
CWRSI001	METAL	Mercury	ND	0.043	µg/l
CWRSI001	METAL	Molybdenum	21.9	1.46	µg/l
CWRSI001	METAL	Nickel	850	1.29	µg/l
CWRSI001	METAL	Potassium	39,600	21.5	µg/l
CWRSI001	METAL	Selenium	7.57	2.14	µg/l

Table 1-1. Characterization Result Summary for Waste Water (continued)

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	METAL	Silver	2.77	0.935	µg/l
CWRSI001	METAL	Sodium	237,000	61	µg/l
CWRSI001	METAL	Thallium	9.29	2.11	µg/l
CWRSI001	METAL	Vanadium	12.9	1.42	µg/l
CWRSI001	METAL	Zinc	237	2.19	µg/l
CWRSI001	PES	4,4'-DDD	ND	0.038	µg/l
CWRSI001	PES	4,4'-DDE	ND	0.038	µg/l
CWRSI001	PES	4,4'-DDT	ND	0.038	µg/l
CWRSI001	PES	Aldrin	ND	0.019	µg/l
CWRSI001	PES	alpha-Chlordane	0.019	0.019	µg/l
CWRSI001	PES	Aroclor-1016	ND	0.48	µg/l
CWRSI001	PES	Aroclor-1221	ND	0.48	µg/l
CWRSI001	PES	Aroclor-1232	ND	0.48	µg/l
CWRSI001	PES	Aroclor-1242	ND	0.48	µg/l
CWRSI001	PES	Aroclor-1248	ND	0.48	µg/l
CWRSI001	PES	Aroclor-1254	ND	0.48	µg/l
CWRSI001	PES	Aroclor-1260	ND	0.48	µg/l
CWRSI001	PES	Chlordane (tech.)	ND	0.24	µg/l
CWRSI001	PES	delta-BHC	ND	0.019	µg/l
CWRSI001	PES	Dieldrin	ND	0.038	µg/l
CWRSI001	PES	Endosulfan I	ND	0.019	µg/l
CWRSI001	PES	Endosulfan II	ND	0.038	µg/l
CWRSI001	PES	Endosulfan sulfate	ND	0.038	µg/l
CWRSI001	PES	Endrin	ND	0.038	µg/l
CWRSI001	PES	Endrin aldehyde	ND	0.038	µg/l
CWRSI001	PES	Endrin ketone	ND	0.038	µg/l
CWRSI001	PES	gamma-BHC (Lindane)	ND	0.019	µg/l
CWRSI001	PES	gamma-Chlordane	0.023	0.019	µg/l
CWRSI001	PES	Heptachlor	ND	0.019	µg/l
CWRSI001	PES	Heptachlor epoxide	ND	0.019	µg/l

Table 1-1. Characterization Result Summary for Waste Water (continued)

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	PES	Methoxychlor	ND	0.19	µg/l
CWRSI001	PES	Toxaphene	ND	0.96	µg/l
CWRSI001	RAD	Actinium-228	ND	8.27	pCi/l
CWRSI001	RAD	Americium-241	ND	0.256	pCi/l
CWRSI001	RAD	Bismuth-212	ND	16.4	pCi/l
CWRSI001	RAD	Bismuth-214	ND	4.92	pCi/l
CWRSI001	RAD	Carbon-14	ND	10.1	pCi/l
CWRSI001	RAD	Cesium-137	ND	1.9	pCi/l
CWRSI001	RAD	Cobalt-60	ND	1.93	pCi/l
CWRSI001	RAD	Gross Alpha	332	129	pCi/l
CWRSI001	RAD	Gross Beta	57,300	182	pCi/l
CWRSI001	RAD	Lead-210	ND	589	pCi/l
CWRSI001	RAD	Lead-212	ND	5.06	pCi/l
CWRSI001	RAD	Lead-214	ND	5.45	pCi/l
CWRSI001	RAD	Plutonium-241	ND	10.5	pCi/l
CWRSI001	RAD	Potassium-40	ND	17.4	pCi/l
CWRSI001	RAD	Radium-226	ND	0.863	pCi/l
CWRSI001	RAD	Sodium-22	ND	2.06	pCi/l
CWRSI001	RAD	Strontium-90	20,900	1.54	pCi/l
CWRSI001	RAD	Thallium-208	ND	2.41	pCi/l
CWRSI001	RAD	Thorium-228	ND	0.624	pCi/l
CWRSI001	RAD	Thorium-230	ND	0.322	pCi/l
CWRSI001	RAD	Thorium-232	ND	0.238	pCi/l
CWRSI001	RAD	Thorium-234	ND	202	pCi/l
CWRSI001	RAD	Tritium	3.15	0.18	pCi/ml
CWRSI001	RAD	Uranium-233/234	ND	0.162	pCi/l
CWRSI001	RAD	Uranium-235	ND	24.4	pCi/l
CWRSI001	RAD	Uranium-235/236	ND	0.192	pCi/l
CWRSI001	RAD	Uranium-238	ND	187	pCi/l
CWRSI001	RAD	Uranium-238	ND	0.232	pCi/l

Table 1-1. Characterization Result Summary for Waste Water (continued)

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	SVOC	1,2,4-Trichlorobenzene	ND	9.6	µg/l
CWRSI001	SVOC	1,2-Dichlorobenzene	ND	9.6	µg/l
CWRSI001	SVOC	1,3-Dichlorobenzene	ND	9.6	µg/l
CWRSI001	SVOC	1,4-Dichlorobenzene	ND	9.6	µg/l
CWRSI001	SVOC	2,4,5-Trichlorophenol	ND	9.6	µg/l
CWRSI001	SVOC	2,4,6-Trichlorophenol	ND	9.6	µg/l
CWRSI001	SVOC	2,4-Dichlorophenol	ND	9.6	µg/l
CWRSI001	SVOC	2,4-Dimethylphenol	ND	9.6	µg/l
CWRSI001	SVOC	2,4-Dinitrophenol	ND	19.2	µg/l
CWRSI001	SVOC	2,4-Dinitrotoluene	ND	9.6	µg/l
CWRSI001	SVOC	2,6-Dinitrotoluene	ND	9.6	µg/l
CWRSI001	SVOC	2-Chloronaphthalene	ND	0.96	µg/l
CWRSI001	SVOC	2-Chlorophenol	ND	9.6	µg/l
CWRSI001	SVOC	2-Methyl-4,6-dinitrophenol	ND	9.6	µg/l
CWRSI001	SVOC	2-Methylnaphthalene	ND	0.96	µg/l
CWRSI001	SVOC	2-Nitrophenol	ND	9.6	µg/l
CWRSI001	SVOC	3,3'-Dichlorobenzidine	ND	9.6	µg/l
CWRSI001	SVOC	4-Bromophenylphenylether	ND	9.6	µg/l
CWRSI001	SVOC	4-Chloro-3-methylphenol	ND	9.6	µg/l
CWRSI001	SVOC	4-Chloroaniline	ND	9.6	µg/l
CWRSI001	SVOC	4-Chlorophenylphenylether	ND	9.6	µg/l
CWRSI001	SVOC	4-Nitrophenol	ND	9.6	µg/l
CWRSI001	SVOC	Acenaphthene	ND	0.96	µg/l
CWRSI001	SVOC	Acenaphthylene	ND	0.96	µg/l
CWRSI001	SVOC	Anthracene	ND	0.96	µg/l
CWRSI001	SVOC	Benzo(a)anthracene	ND	0.96	µg/l
CWRSI001	SVOC	Benzo(a)pyrene	ND	0.96	µg/l
CWRSI001	SVOC	Benzo(b)fluoranthene	ND	0.96	µg/l
CWRSI001	SVOC	Benzo(ghi)perylene	ND	0.96	µg/l
CWRSI001	SVOC	Benzo(k)fluoranthene	ND	0.96	µg/l

Table 1-1. Characterization Result Summary for Waste Water (continued)

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	SVOC	bis(2-Chloroethoxy)methane	ND	9.6	µg/l
CWRSI001	SVOC	bis(2-Chloroethyl) ether	ND	9.6	µg/l
CWRSI001	SVOC	bis(2-Chloroisopropyl)ether	ND	9.6	µg/l
CWRSI001	SVOC	bis(2-Ethylhexyl)phthalate	ND	9.6	µg/l
CWRSI001	SVOC	Butylbenzylphthalate	ND	9.6	µg/l
CWRSI001	SVOC	Carbazole	ND	9.6	µg/l
CWRSI001	SVOC	Chrysene	ND	0.96	µg/l
CWRSI001	SVOC	Di-n-butylphthalate	ND	9.6	µg/l
CWRSI001	SVOC	Di-n-octylphthalate	ND	9.6	µg/l
CWRSI001	SVOC	Dibenzo(a,h)anthracene	ND	0.96	µg/l
CWRSI001	SVOC	Dibenzofuran	ND	9.6	µg/l
CWRSI001	SVOC	Diethyl phthalate	ND	9.6	µg/l
CWRSI001	SVOC	Dimethylphthalate	ND	9.6	µg/l
CWRSI001	SVOC	Diphenylamine	ND	9.6	µg/l
CWRSI001	SVOC	Fluoranthene	ND	0.96	µg/l
CWRSI001	SVOC	Fluorene	ND	0.96	µg/l
CWRSI001	SVOC	Hexachlorobenzene	ND	9.6	µg/l
CWRSI001	SVOC	Hexachlorobutadiene	ND	9.6	µg/l
CWRSI001	SVOC	Hexachlorocyclopentadiene	ND	9.6	µg/l
CWRSI001	SVOC	Hexachloroethane	ND	9.6	µg/l
CWRSI001	SVOC	Indeno(1,2,3-cd)pyrene	ND	0.96	µg/l
CWRSI001	SVOC	Isophorone	ND	9.6	µg/l
CWRSI001	SVOC	m,p-Cresols	ND	9.6	µg/l
CWRSI001	SVOC	m-Nitroaniline	ND	9.6	µg/l
CWRSI001	SVOC	N-Nitrosodipropylamine	ND	9.6	µg/l
CWRSI001	SVOC	Naphthalene	ND	0.96	µg/l
CWRSI001	SVOC	Nitrobenzene	ND	9.6	µg/l
CWRSI001	SVOC	o-Cresol	ND	9.6	µg/l
CWRSI001	SVOC	o-Nitroaniline	ND	9.6	µg/l
CWRSI001	SVOC	p-Nitroaniline	ND	9.6	µg/l

Table 1-1. Characterization Result Summary for Waste Water (continued)

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	SVOC	Pentachlorophenol	ND	9.6	µg/l
CWRSI001	SVOC	Phenanthrene	ND	0.96	µg/l
CWRSI001	SVOC	Phenol	ND	9.6	µg/l
CWRSI001	SVOC	Pyrene	ND	0.96	µg/l
CWRSI001	SVOC	Pyridine	ND	9.6	µg/l
CWRSI001	VOC	1,1,1-Trichloroethane	ND	1	µg/l
CWRSI001	VOC	1,1,2,2-Tetrachloroethane	ND	1	µg/l
CWRSI001	VOC	1,1,2-Trichloroethane	ND	1	µg/l
CWRSI001	VOC	1,1-Dichloroethane	ND	1	µg/l
CWRSI001	VOC	1,1-Dichloroethylene	ND	1	µg/l
CWRSI001	VOC	1,2-Dichloroethane	ND	1	µg/l
CWRSI001	VOC	1,2-Dichloroethylene (total)	ND	2	µg/l
CWRSI001	VOC	1,2-Dichloropropane	ND	1	µg/l
CWRSI001	VOC	2-Butanone	ND	5	µg/l
CWRSI001	VOC	2-Hexanone	ND	5	µg/l
CWRSI001	VOC	4-Methyl-2-pentanone	ND	5	µg/l
CWRSI001	VOC	Acetone	6	5	µg/l
CWRSI001	VOC	Benzene	ND	1	µg/l
CWRSI001	VOC	Bromodichloromethane	ND	1	µg/l
CWRSI001	VOC	Bromoform	ND	1	µg/l
CWRSI001	VOC	Bromomethane	ND	1	µg/l
CWRSI001	VOC	Carbon disulfide	ND	5	µg/l
CWRSI001	VOC	Carbon tetrachloride	ND	1	µg/l
CWRSI001	VOC	Chlorobenzene	ND	1	µg/l
CWRSI001	VOC	Chloroethane	ND	1	µg/l
CWRSI001	VOC	Chloroform	ND	1	µg/l
CWRSI001	VOC	Chloromethane	ND	1	µg/l
CWRSI001	VOC	cis-1,3-Dichloropropylene	ND	1	µg/l
CWRSI001	VOC	Dibromochloromethane	ND	1	µg/l
CWRSI001	VOC	Ethylbenzene	ND	1	µg/l

Table 1-1. Characterization Result Summary for Waste Water (continued)

Sample ID	PCLASS	Laboratory Chemical	Concentration	Detection Limit	Units
CWRSI001	VOC	Methylene chloride	ND	5	µg/l
CWRSI001	VOC	Styrene	ND	1	µg/l
CWRSI001	VOC	Tetrachloroethylene	ND	1	µg/l
CWRSI001	VOC	Toluene	ND	1	µg/l
CWRSI001	VOC	trans-1,3-Dichloropropylene	ND	1	µg/l
CWRSI001	VOC	Trichloroethylene	ND	1	µg/l
CWRSI001	VOC	Vinyl chloride	ND	1	µg/l
CWRSI001	VOC	Xylenes (total)	ND	3	µg/l

Abbreviations

CFU	colony-forming units
DDD	dichlordiphenyl dichlor
DDE	dichlordiphenyl dichloroethylene
DDT	dichlordiphenyl trichlor
GED	general chemistry
HERB	herbicides
mg/l	milligrams per liter
ND	none detect
pCi/l	picoCuries per liter
pCi/ml	picoCuries per milliliter
PCLASS	physical class
PES	pesticide
RAD	radionuclide
SVOC	semi-volatile organic compound
VOC	volatile organic compound
µg/l	micrograms per liter

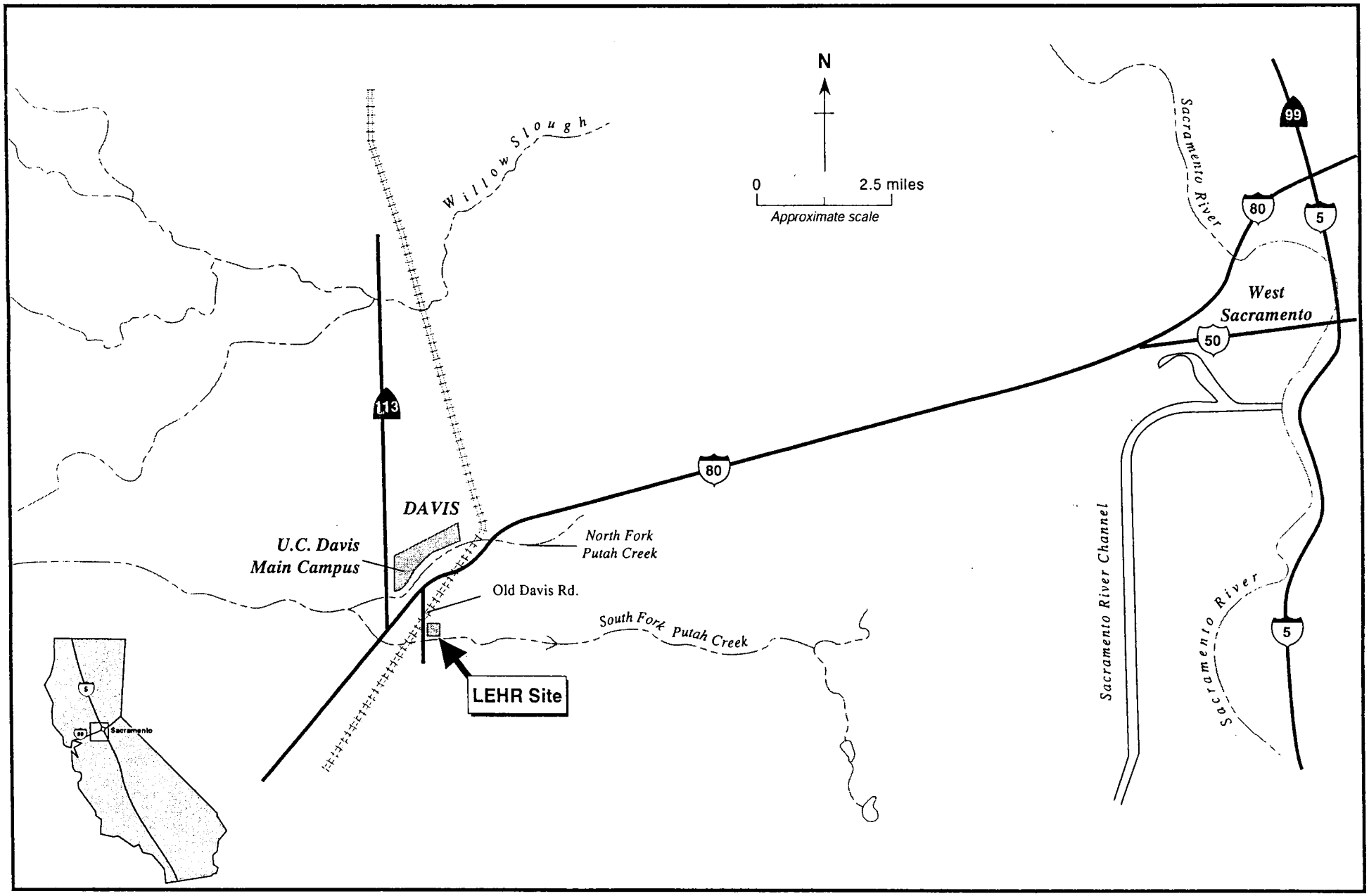

Figure 1-1. LEHR Site Location Map

Weiss Associates

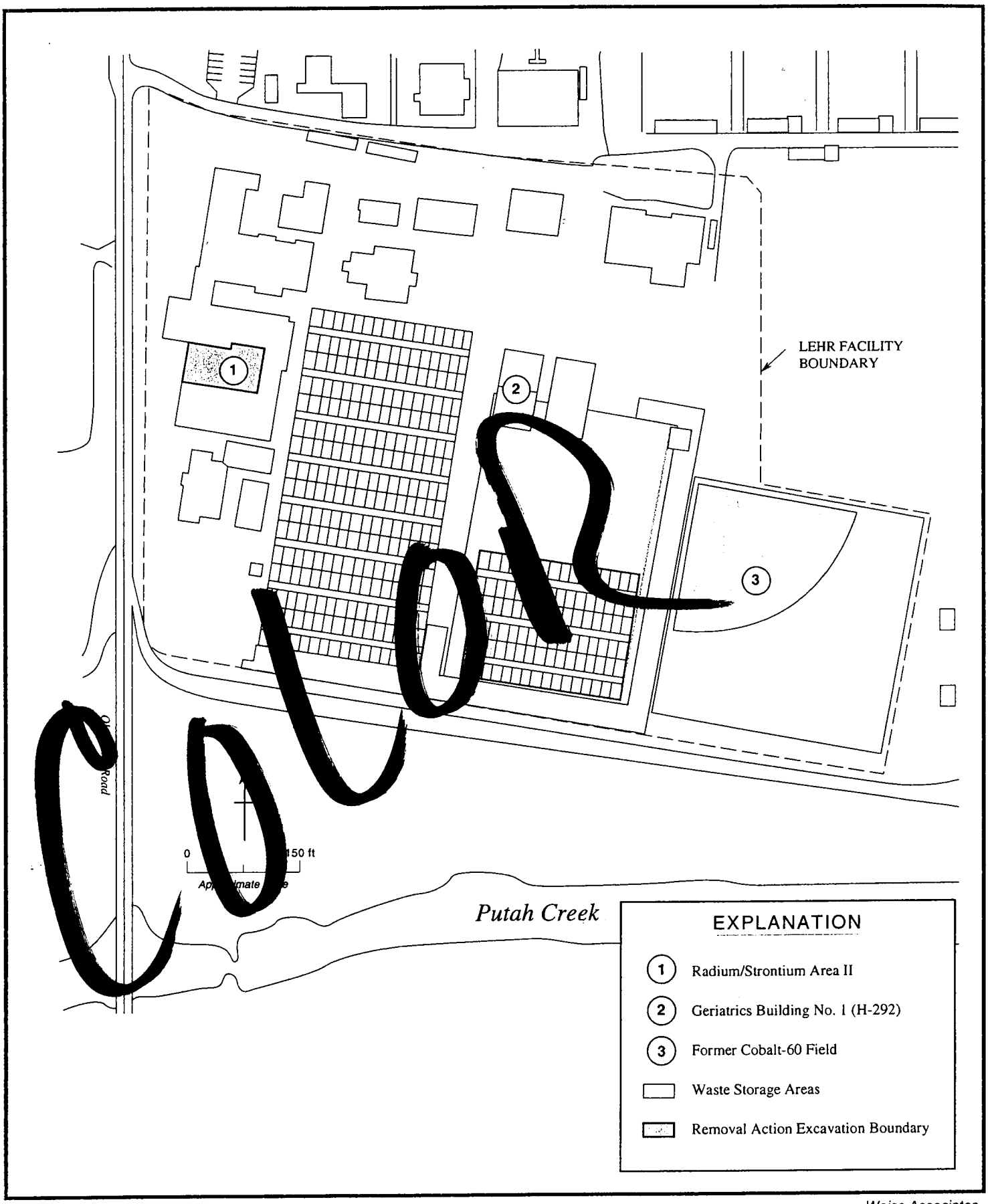

Figure 1-2. LEHR Site Waste Storage Areas and Removal Action Location

Weiss Associates

2. RESPONSIBILITIES

2.1 Corporate Responsibilities

The companies that will implement this work plan are listed below along with their general responsibilities.

- *WA*—Project management and oversight; development of work plan, on-site health and safety oversight; on-site task coordination; waste management; and record keeping.
- *Shaw Environmental and Infrastructure (Shaw E&I)*—On-site radiological support, equipment operation and field labor.
- *Environmental Management Services, Incorporated (EMS)*—Waste profile preparation and consultation during development of this plan to meet the Envirocare WAC and DOE/NNSA waste management requirements.

2.2 Task Staff

The following project personnel will implement this work plan. Project responsibilities are defined in the QAPP, PHSP and the RWMP.

- Project Manager;
- Waste Coordinator;
- Project Quality Assurance Manager;
- Project Health and Safety Manager/Radiological Control Manager;
- Site Health and Safety Officer;
- Radiation Safety Officer;
- Radiological Control Technician; and,
- Site Records Administrator.

Task-specific responsibilities not defined in the QAPP, PHSP and RWMP are described below.

2.2.1 Waste Specialist

The Waste Specialist (WS) will coordinate with Envirocare to fulfill the WAC requirements and provide technical support to implement this work plan, as required.

2.2.2 Waste Packaging Observer

The Waste Packaging Observer (WPO) will observe the absorption process and is responsible for inspection of containers prior to placement into storage. The WPO documents waste package contents and will update the WMTS. The WPO will document completion of the absorption and verification process.

2.2.3 Equipment Operator

The equipment operator will be certified and experienced in the operation of site equipment (i.e., fork truck, lifting tools, etc.), provide logistical support for the absorption activity and be responsible for safely transporting waste on site. The equipment operator will conduct daily safety inspections on all equipment.

2.2.4 Laborers

The laborers are responsible for implementing this work plan and conducting work within the prescribed Contamination Area (CA) including, but not limited to, package handling, addition of absorbents, and sample collection for absorption verification tests.

2.3 Delegation of Authority

Authority and responsibility may be delegated. Persons delegating authority must ensure that the delegate is adequately trained and capable of executing the delegated duties. The delegated duties and responsibilities that are not defined and approved in this plan must be clearly defined in writing.

3. PREPARATORY TASKS

The tasks that will be completed prior to initiating field activities are described below.

3.1 Contracts

The PM will ensure that appropriate contractual mechanisms are in place prior to beginning work. These contractual mechanisms must address contractor compliance with LEHR program requirements, the selected disposal facility (Envirocare), and applicable DOE Orders using the graded approach.

3.2 Materials, Equipment and Tools

Materials, equipment and tools required to complete the waste packaging will, at a minimum, include:

- Hand tools;
- Ground fault current/circuit interrupters;
- Extension cords;
- Absorbent (1,100 lb. of SP-400 Crystals);
- Certified weigh scale;
- Long-handled, drywall mud masher;
- Spill kit(s);
- Spill pallets;
- Spill containment cell;
- Fuel;
- Health physics supplies;
- Radiological instrumentation;
- Health and safety supplies;
- Digital camera;
- Fork truck with lifting attachments;
- Personal protective equipment (PPE); and,
- Personal dosimetry.

The SP-400 Crystals will be purchased from Earthline Technologies. WA will provide all other tools, equipment and materials.

3.3 Personnel Qualifications

The PM/PTL will ensure that all personnel assigned to activities defined in this work plan have the appropriate qualifications and training to perform their duties. The PM or PTL will coordinate with the SHSO and RSO to verify all personnel involved in this task are trained and briefed in accordance with this plan and all applicable project documents prior to commencing work.

3.4 Pre-Phase Planning Guidance

A Pre-Phase-Planning Guidance checklist was completed prior to the initiation of this work plan in accordance with Section 3.3.3 of the QAPP (WA, 2000a).

3.5 Pre-Phase Inspection

As required by the QAPP, appropriate LEHR and contractor staff shall meet prior to implementation of this work plan to verify the availability of all required documents, materials, tools, personnel and other items necessary to complete the activities described herein. Upon completion of this step, the PQAS will authorize this activity to proceed.

4. PROCEDURES

4.1 Absorption Procedures

The absorption procedures detailed in this work plan are based on procedures in the work plan provided by Earthline Technologies that were used for the large-scale demonstration. Work will be completed in the Geriatrics-1 building and the former Co-60 Field waste storage areas where the drums are stored (Figure 1-2).

A slip-resistant, plastic-lined work area will be set up in both storage areas where the absorption of the waste water will occur. SP-400 Crystals will be pre-weighed and packaged in plastic bags and placed on individual drums prior to entry into the CA. Workers will loosen the closure ring and bungs of each drum prior to posting the work area as a CA. Workers will don PPE before entering the CA. SP-400 Crystals will be added to each drum as. Following complete absorption, workers will check visually for free liquid between the drum and the drum liner, and add one lb. of absorbent. Additional absorbent will be added to the annular space as required.

SP-400 Crystals will be added to each drum through the bung opening. The SP-400 Crystal and water reaction does not produce heat or gas and only expands the waste volume by only about 1%. The lid will only be removed once the absorbent has been added to mitigate the splash hazard associated with the liquid waste. Mixing the waste water and absorbent is not required based on the manufacturer's instructions and experimental data from the LEHR bench-test and large-scale demonstration. The reaction of SP-400 Crystals and water lasts approximately 3 hours, with full absorption within 24 hours.

After complete absorption, the workers will remove the lid carefully to avoid dripping any condensate in the work area that may have accumulated on the underside of the lid. A face shield and spill apron will be donned during this step. A long-handled, commercial-grade drywall mud masher will be used to mix absorbent into the partially absorbed drums of decontamination/rain water to ensure uniform distribution of absorbent. The WPO will conduct a visual inspection to determine if the absorption process is complete and that no free liquids are present. No additional vibration or paint filter tests are required based on data from the large-scale demonstration.

Following completion and verification of the absorption process, the RCT will survey the drum for release from the CA and the drum will be weighed.

The WPO will complete a WMTS sheet for each drum, in accordance with SOP 34.5, Waste and Material Tracking System, after each drum has been absorbed and weighed. The WPO will

document the absorption process for each drum, package number, date, time, location, and any additional information.

These procedures are summarized as follows:

1. Stage package in work area using approved lifting device and fork truck.
2. Cover floor/storm drains and utilize secondary containment as a precaution when handling the liquid waste.
3. Measure and individually bag required absorbents (13 lbs. of SP-400 Crystals for each waste water drum and 10 lbs. for each decontamination/rain water drum).
4. Reconcile waste packages in the work area with an inventory of drums provided in this work plan (Attachment A).
5. Set up plastic-lined work areas and support zones in Geriatrics-1 and the former Co-60 Field.
6. Loosen the closure ring and bungs for each drum in the work area.
7. Establish the CA.
8. Don PPE and sign the HWP.
9. Enter the CA.
10. Add absorbent to the appropriate drums through the bung opening.
11. Doff PPE, exit the CA, and sign HWP.
12. Wait for the waste water to solidify (approximately 3 hours with complete absorption within 24 hours). No waiting is required for the partially solidified drums; proceed to step #17.
13. Don PPE and sign HWP.
14. Sign HWP.
15. Enter the CA.
16. Don a face shield and spill apron with assistance from the RCT.
17. Open the drum slowly and check for condensation on the interior of the drum lid.
18. Place the drum lid on top of an adjacent drum, taking care not to spill any condensate.
19. Manually mix the absorbent with a drywall mud masher as required.
20. Check for free liquids between the drum and the drum liner.
21. Verify that there are no free liquids in the waste matrix by plunging a wooden rod into the absorbed drum. Inspect rod and void created in the waste matrix for free liquids.
22. Check visually for free liquid between the drum and the drum liner.
23. Add one lb. of absorbent between the drum liner and the side wall of drum, as required.

24. Conduct visual inspection to determine if the absorption process is complete and no free liquids are present.
25. Conduct a paint filter test on 4 drums (2 each from tank water and decontamination/rain water).
26. Document results of paint filter test.
27. Document the results of the visual inspection on the absorption checklist.
28. Seal the drum.
29. Doff PPE and exit the CA.
30. Sign HWP.
31. Survey and release the drum from the CA.
32. Weigh the drum and record the weight on the package, absorption checklist and WMTS update sheet.
33. Return the absorbed drum to the storage location.
34. Update the WMTS.

5. WASTE MANAGEMENT

The RWMP and associated SOPs (WA, 2001a) define waste management procedures for all waste streams managed at the LEHR site, including the Ra/Sr Area II RA waste discussed in this work plan. Compliance with the RWMP and associated SOPs ensures compliance with DOE Order 435.1, Radioactive Waste Management.

5.1 Waste Minimization

The LEHR Waste Management Program is committed to minimizing waste volumes at the LEHR site by giving preference to source reduction, material substitution, decontamination, and recycling.

To eliminate creating additional waste, care will be exercised during the absorption activities to avoid contamination of any additional materials. Waste expected to be generated during this activity consists of PPE and the material used to protect the floor(s) in the work area(s).

Typically, solidification processes (i.e., concrete solidification) can double waste volumes. However, the SP-400 Crystals expand the waste volume by only about 1%. Therefore, using the SP-400 Crystals will significantly minimize waste volume compared to other approaches.

5.2 Waste Characterization

Composite waste characterization samples of Imhoff tank waste water were collected *in situ* prior to removal activities (Table 1-1). The waste was designated as low-level radioactive waste with no chemical constituents above California or RCRA hazardous waste thresholds. Because the waste contains no chemicals at hazardous waste levels, EPA waste treatment approvals and permits are not required.

5.3 Waste Profile

The WS will ensure that the waste profile generated for the absorbed waste water is reviewed and approved by Envirocare prior to waste shipment in accordance with SOP 35.1, Waste Certification for Off-Site Disposal (WA, 2001a).

5.4 Certification of Compliance with Waste Acceptance Criteria

All waste shipped off site for disposal must be certified as compliant with the disposal facility WAC in accordance with SOP 34.5, Waste Certification for Off-Site Disposal (WA, 2001a).

5.5 Waste and Material Tracking System

WMTS sheets are completed whenever the status of a waste package is modified as described in SOP 34.5, Waste and Material Tracking System (WA, 2001a).

The waste water drums are currently tracked in the WMTS as liquid waste. They will be reclassified as solid waste after the contents of each drum have been absorbed. The WPO will complete WMTS update sheets immediately following the absorption activities to reflect the change from liquid waste to solid waste.

Updated WMTS sheets will be submitted to the SRA for incorporation into the LEHR WMTS database. The WS is responsible for providing WMTS updates to the WC when notification and/or certification of treatment or disposal are provided by the disposal facility. The WC will review these updates and submit them to the SRA for incorporation into the WMTS database.

6. HEALTH AND SAFETY

Health and safety considerations for the activities described in this work plan are addressed in the following documents:

- PHSP (WA, 2001c);
- Health and Safety Procedures (HSPs) (WA, 2001b);
- SOPs (WA, 2001e);
- Contingency Plan and General Emergency Response Procedures (CPGERP) (WA, 2000c);
- Activity Hazard Analysis (AHA);
- As-Low-As-Reasonably-Achievable (ALARA) Program (WA, 1999a); and,
- RPP (WA, 1999b).

The health and safety considerations presented in this section coupled with the foregoing listed documents are the safety and health program required by 29 Code of Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response, and 10 CFR 835, Occupational Radiation Protection, for these work activities.

6.1 Activity Hazard Analysis

An AHA identifies potential safety, health and environmental hazards and defines controls necessary for the protection of personnel and the environment. Hazard analysis helps to ensure that all safety concerns associated with waste handling activities are addressed. An AHA describing hazard analysis and hazard controls for this work plan is included as Attachment E.

During these activities, the SHSO or designee will monitor activities for any changes in conditions that would require modification of controls (e.g., PPE). In the event that changes produce radiological or industrial health and safety conditions that are not covered by this work plan or referenced documents, this work plan and the HWP will be modified in accordance with the procedures contained in Standard Quality Procedure (SQP) 11.1, Field Work Variances/Modification (WA, 2000b).

6.1.1 Radiological Exposure

The Imhoff tank waste water drums contain radioactive constituents. Handling and absorption activities may result in potential exposure to beta radiation. Samples of tank waste water drums contained Sr-90 at 20,900 picoCuries per liter.

6.1.2 Chemical Exposure

No chemical exposures are anticipated or expected based on review of waste characterization data. A Material Safety Data Sheet for the SP-400 Crystals will be reviewed at a safety meeting prior to implementing this work plan.

6.1.3 Heat Stress

The Ra/Sr Area II RA waste water and decontamination/rain water absorption is scheduled to be performed in September when wearing PPE may put workers at risk of heat stress. All workers will have medical clearance prior to working on site and will be required to undergo an acclimation period. Heat stress prevention will include the following mitigation measures:

- Proper rest prior to work,
- Scheduled breaks,
- Appropriate water intake,
- Shaded work/rest areas when feasible, and
- Rotation of heavy work tasks.

A work/rest regime established in accordance with Section 5 of the PHSP will be implemented to prevent heat-related injuries. A Wet Bulb Globe Temperature (WBGT) instrument will be used to monitor weather conditions. Estimated employee work loads for each anticipated RA activity (expressed in calories expended per hour) are provided in Table 5-2 of the PHSP and will be used in conjunction with the WBGT readings to adjust the work/rest cycle as required by the PHSP and HSP 3.1, Working in Hot Environments. Integrated heat stress monitoring will be performed daily and may require modification of this regimen. Body temperature, heart rate and the physical appearance of workers will be monitored as discussed in Section 5 of the PHSP and detailed in HSP 3.1, Working in Hot Environments.

To minimize the effects of heat-related injuries, an area will be established to conduct entrance/exit activities, sample preparation and other support functions. This area will be covered with a portable tarp, when necessary, to provide the workers with shade. During the TSMs, the SHSO will communicate to the workers the signs and symptoms of heat stress, appropriate engineering controls, and the need to replenish body fluids. The buddy system will be used to help monitor heat stress symptoms.

6.2 Hazard Controls

The control measures that will be implemented during execution of this work plan are described below, and will supplement the PHSP and the RPP requirements.

6.2.1 Radiation Exposure Control

Radiation exposure rates and radioactive contamination levels will be monitored by the RCT according to the RPP (WA, 1999b) and the following procedures

- SOP 25.1, Radiological Surveys and Instrumentation (WA, 2001e); and,
- SOP 37.1, Tennelec Series 5 Low Background Counting System (WA, 2001e).

Personnel radiological exposure will be maintained ALARA by employing all appropriate engineering controls and implementing administrative controls such as the HWP. Work will be performed so that no member of the LEHR staff will receive more than 100 millirems of whole body dose. ALARA guidelines for this activity are included as Attachment F.

The following SOPs will be implemented to control radiological exposure and radioactive contamination:

- SOP 24.1, Radiological Areas and Postings (WA, 2001e);
- HSP 17.1, Hazardous Work Permits (WA, 2001b);
- HSP 15.1, External Radiation Exposure Control (WA, 2001b); and,
- SOP 32.1, Contamination Control (WA, 2001e).

6.2.2 Personal Protective Equipment

Employees will wear Modified Level D PPE in accordance with the PPE selection matrix in Section 9 of the PHSP. The task-specific level of protection will be upgraded or downgraded based on real-time field measurements, changes in site conditions, or other findings. Changes in the level of protection require approval by the PHSM.

Modified Level D PPE will consist of the following when no spill hazard exists:

- Steel-toed shoes;
- Tyvek coveralls;
- Nitrile gloves;
- Rubber shoe covers;
- Safety glasses with side shields; and,
- Leather work gloves.

If a spill hazard is identified (e.g., when the drums are opened and samples are collected), Modified Level D PPE will be worn with the following additions:

- Face shield; and,
- Spill apron.

6.2.3 Hazardous Work Permit

An HWP will be used to specify controls for the solidification activities. The HWP will be issued in accordance with the procedures specified in the PHSP. All work will be performed according to this approved HWP, which will, at a minimum, define the following:

- Scope of work to be performed;
- Anticipated radiological, safety, and industrial hygiene conditions;
- PPE requirements;
- Radiological and industrial hygiene monitoring requirements;
- Dosimetry requirements;
- Reference to the work plan and AHA;
- Period for which the HWP is valid; and,
- Additional requirements for entry.

The HWP will be revised if radiological conditions exceed the stated action levels.

6.2.4 Buddy System

The buddy system is a method of organizing employees into work groups and is designed to provide those employees with assistance when needed. Each employee in a work group is designated to be observed by at least one other person. At least two persons will be required to be in the work area when work is conducted. Assignment of designated partners should take place during the daily tailgate safety meeting.

The responsibility of the buddy is to:

- Provide assistance, if needed;
- Maintain line-of-sight and verbal contact with workers;
- Observe for signs of physical trauma or heat stress such as:
  - Changes in complexion and skin discoloration;
  - Changes in coordination or demeanor; or,
  - Changes in speech pattern;
- Periodically verify the integrity of all protective clothing; and,
- Notify the SHSO and WC if emergency help is needed.

6.2.5 Site Emergencies

All site workers will be trained on the procedures outlined in the CPGERP for responding to potential emergency incidents. The SHSO will ensure that all appropriate emergency equipment is available and review evacuation procedures with workers.

6.2.5.1 Emergency Response Equipment

The following equipment will be available in the work area:

- First aid kit;
- Portable eyewash station and hand shower;
- Air horn;
- Portable radio for emergency communications; and,
- Fire extinguisher.

6.2.5.2 Spill Containment

A spill and discharge control plan has been prepared as part of the PHSP and the CPGERP to provide contingency measures for potential spills and discharges of hazardous materials and wastes. Spill control kits are located throughout the Geriatrics-I building in sufficient quantity to mitigate any potential spills of the subject materials. The work in the former Co-60 Field will be conducted in a spill containment cell. In addition, absorbent materials staged in the work area to complete the absorption process can be used in an emergency spill situation.

6.2.5.3 Environmental Occurrence Reporting

The Occurrence Reporting Plan (ORP) (WA, 2000d) covers all operations and activities at LEHR. All incidents requiring emergency response will be reviewed by the Occurrence Reporting Coordinator and handled in accordance with the ORP.

6.3 Training

Per Section 5.1 of the QAPP, only qualified personnel will be allowed to carry out tasks described herein. The PTL will also ensure that all personnel have met the training requirements defined in the QAPP (WA, 2000a), PHSP (WA, 2001c), RPP (WA, 1999b) and associated procedures. Minimum training requirements for personnel entering controlled work areas will be specified in the HWP. Project staff that were qualified to work on the Domestic Septic Systems 3 and 6 RA of 2002 are qualified to complete tasks described in this work plan.

All personnel performing activities associated with this work plan are responsible for understanding the contents of this plan. As specified in the PHSP, daily tailgate safety meetings will be conducted to supplement required training. Prior to commencing work and entering the work area, all workers will review the information provided and sign the tailgate safety meeting form.

7. REGULATORY COMPLIANCE

7.1 National Environmental Policy Act Compliance

The National Environmental Policy Act (NEPA) requires that actions taken by federal agencies include the analysis of potential effects of the proposed actions on the environment. Such environmental evaluation may define mitigation measures to prevent significant environmental impacts or may recommend preparation of an environmental impact report if a significant impact is expected. The NEPA requirement was satisfied through the Comprehensive Environmental Response, Compensation, and Liability Act/NEPA integration process as presented in the Engineering Evaluation/Cost Analysis (WA, 1998).

7.2 Resource Conservation and Recovery Act and California Hazardous Waste Regulations Compliance

The waste water does not contain hazardous constituents per the State of California and/or the RCRA.

8. QUALITY ASSURANCE

This section addresses quality assurance for the scope of work described in this document. This section provides a framework to ensure that quality is integrated in every aspect of the project work.

All quality-affecting records generated as a result of these activities will be managed in accordance with Sections 4 and 8.2 of the QAPP (WA, 2000a); SQP 4.1, Document Control; and SQP 4.2, Records Management (WA, 2000b). Quality-affecting documents include, but are not limited to, personal field logs, calibration records, monitoring data, inspection checklists, sampling documentation, and procurement records.

All records generated by project personnel must be complete, legible and written in blue or black ink. Corrections must be made with a single line, and documented with the initials of the person making the correction and the date the correction was made.

Field documentation will be collected and compiled on a daily basis by the SC or designee. Personal field logs will be submitted on a daily basis by the WC, SHSO and WPO. Completed packages will be submitted to the SRA within three working days for a quality review, copying and filing. If a package is deemed unacceptable by the SRA during the quality review, it will be returned to the SC (or designee) for prompt correction prior to copying and filing. After records have been copied and filed in the project record, the originals will be forwarded to the Project Records Administrator for inclusion in the project file.

Other quality assurance requirements applicable to this work plan are detailed in the QAPP (WA, 2000a).

9. REFERENCES

Envirocare of Utah, Inc. (Envirocare), 2001, Waste Acceptance Guidelines, May, Rev. 3.

Weiss Associates (WA), 1998, Draft Final Engineering Evaluation/Cost Analysis for the Southwest Trenches, Radium-226/Strontium-90 Treatment Systems, and Domestic Septic System Areas for the DOE Areas at the Laboratory for Energy-Related Health Research Site, University of California at Davis, California, January, Rev. E.

WA, 1999a, Final As-Low-As-Reasonably-Achievable Program for the Laboratory for Energy-Related Health Research, University of California, Davis, July, Rev. 3.

WA, 1999b, Final Radiological Protection Program for the Laboratory for Energy-Related Health Research, University of California, Davis, November, Rev. 3.

WA, 2000a, Quality Assurance Project Plan for Environmental Restoration/Waste Management at the Laboratory for Energy-Related Health Research, University of California, Davis, June, Rev. 3.

WA, 2000b, Standard Quality Procedures for Environmental Restoration/Waste Management at the Laboratory for Energy-Related Health Research, University of California, Davis, June.

WA, 2000c, Contingency Plan and General Emergency Response Procedures for the Laboratory for Energy-Related Health Research, University of California at Davis, California, August.

WA, 2000d, Draft Final Occurrence Reporting Plan for the Laboratory for Energy-Related Health Research, University of California Davis, California March, 2000, Rev. C

WA, 2001a, Radioactive Waste Management Plan for the Laboratory for Energy-Related Health Research, University of California, Davis, June.

WA, 2001b, Health and Safety Procedures for the Laboratory for Energy-Related Health Research, University of California, Davis, September.

WA, 2001c, Project Health and Safety Plan for Environmental Restoration/Waste Management for the Laboratory for Energy-Related Health Research, University of California, Davis, September.

WA, 2001e, Standard Operating Procedures for the Laboratory for Energy-Related Health Research, University of California, Davis, November.

ATTACHMENT A

DRUM INVENTORY AND ABSORPTION AND VERIFICATION CHECKLIST

Drum Inventory and Absorption Verification Checklist

Package Number	Storage Location	Waste Description (aqueous or semi-absorbed)	SP-400 Added to Water	SP-400 Added to Void between Liner and Drum	Visual Inspection (pass or fail)	Date	Total Package Weight (lbs./kg)	Comments
LEHR1397	Co-60 Field	aqueous						
LEHR1398	Co-60 Field	aqueous						
LEHR1399	Co-60 Field	aqueous						
LEHR1400	Co-60 Field	aqueous						
LEHR1401	Co-60 Field	aqueous						
LEHR1402	Co-60 Field	aqueous						
LEHR1403	Co-60 Field	aqueous						
LEHR1404	Co-60 Field	aqueous						
LEHR1405	Co-60 Field	aqueous						
LEHR1406	Co-60 Field	aqueous						
LEHR1407	Co-60 Field	aqueous						
LEHR1408	Co-60 Field	aqueous						
LEHR1409	Co-60 Field	aqueous						
LEHR1410	Co-60 Field	aqueous						
LEHR1411	Co-60 Field	aqueous						
LEHR1412	Co-60 Field	aqueous						
LEHR1413	Co-60 Field	aqueous						
LEHR1414	Co-60 Field	aqueous						
LEHR1415	Co-60 Field	aqueous						
LEHR1416	Co-60 Field	aqueous						
LEHR1417	Co-60 Field	aqueous						
LEHR1418	Co-60 Field	aqueous						

Drum Inventory and Absorption Verification Checklist

Package Number	Storage Location	Waste Description (aqueous or semi-absorbed)	SP-400 Added to Water	SP-400 Added to Void between Liner and Drum	Visual Inspection (pass or fail)	Date	Total Package Weight (lbs./kg)	Comments
LEHR1419	Co-60 Field	aqueous						
LEHR1420	Co-60 Field	aqueous						
LEHR1421	Co-60 Field	aqueous						
LEHR1422	Co-60 Field	aqueous						
LEHR1423	Co-60 Field	aqueous						
LEHR1424	Co-60 Field	aqueous						
LEHR1425	Co-60 Field	aqueous						
LEHR1426	Co-60 Field	aqueous						
LEHR1427	Co-60 Field	aqueous						
LEHR1428	Co-60 Field	aqueous						
LEHR1429	Co-60 Field	aqueous						
LEHR1430	Co-60 Field	aqueous						
LEHR1431	Co-60 Field	aqueous						
LEHR1432	Co-60 Field	aqueous						
LEHR1433	Co-60 Field	aqueous						
LEHR1434	Co-60 Field	aqueous						
LEHR1435	Co-60 Field	aqueous						
LEHR1436	Co-60 Field	aqueous						
LEHR1437	Co-60 Field	aqueous						
LEHR1438	Co-60 Field	aqueous						
LEHR1439	Co-60 Field	aqueous						
LEHR1440	Co-60 Field	aqueous						

Drum Inventory and Absorption Verification Checklist

Package Number	Storage Location	Waste Description (aqueous or semi-absorbed)	SP-400 Added to Water	SP-400 Added to Void between Liner and Drum	Visual Inspection (pass or fail)	Date	Total Package Weight (lbs./kg)	Comments
LEHR1441	Co-60 Field	aqueous						
LEHR1442	Co-60 Field	aqueous						
LEHR1443	Co-60 Field	aqueous						
LEHR1444	Co-60 Field	aqueous						
LEHR1445	Co-60 Field	aqueous						
LEHR1446	Co-60 Field	aqueous						
LEHR1447	Co-60 Field	aqueous						
LEHR1448	Co-60 Field	aqueous						
LEHR1449	Co-60 Field	aqueous						
LEHR1450	Co-60 Field	aqueous						
LEHR1451	Co-60 Field	aqueous						
LEHR1452	Geri-1	semi-absorbed						
LEHR1550	Geri-1	semi-absorbed						
LEHR1551	Geri-1	semi-absorbed						
LEHR1552	Geri-1	semi-absorbed						
LEHR1553	Geri-1	semi-absorbed						
LEHR1554	Geri-1	semi-absorbed						
LEHR1555	Geri-1	semi-absorbed						
LEHR1560	Geri-1	semi-absorbed						
LEHR1561	Geri-1	semi-absorbed						
LEHR1562	Geri-1	semi-absorbed						
LEHR1563	Geri-1	semi-absorbed						

Drum Inventory and Absorption Verification Checklist

Package Number	Storage Location	Waste Description (aqueous or semi-absorbed)	SP-400 Added to Water	SP-400 Added to Void between Liner and Drum	Visual Inspection (pass or fail)	Date	Total Package Weight (lbs./kg)	Comments
LEHR1564	Geri-1	semi-absorbed						
LEHR1565	Geri-1	semi-absorbed						
LEHR1566	Geri-1	semi-absorbed						
LEHR1567	Geri-1	semi-absorbed						
LEHR1568	Geri-1	semi-absorbed						
LEHR1569	Geri-1	semi-absorbed						
LEHR1570	Geri-1	semi-absorbed						
LEHR1571	Geri-1	semi-absorbed						
LEHR1572	Geri-1	semi-absorbed						
LEHR1573	Geri-1	semi-absorbed						
LEHR1574	Geri-1	semi-absorbed						
LEHR1575	Geri-1	semi-absorbed						
LEHR1576	Geri-1	semi-absorbed						
LEHR1577	Geri-1	semi-absorbed						
LEHR1578	Geri-1	semi-absorbed						
LEHR1579	Geri-1	semi-absorbed						
LEHR1580	Geri-1	semi-absorbed						
LEHR1581	Geri-1	semi-absorbed						
LEHR1582	Geri-1	semi-absorbed						
LEHR1583	Geri-1	semi-absorbed						
LEHR1584	Geri-1	semi-absorbed						
LEHR1585	Geri-1	semi-absorbed						

Drum Inventory and Absorption Verification Checklist

Abbreviations

Co-60	Cobalt-60
Geri-I	Geriatrics-I Building
lbs./kg	pounds per kilogram
SP-400	SP-400 Crystals

ATTACHMENT B

SP-400 CRYSTALS BENCH TEST RESULTS

RECORD COPY
PROJECT: 17623
T3.3.3
waste char.
4794

Project Report

WaterWorks Crystals®
Solidification Technology Deployment
on
Aqueous Low-Level Waste Sludges
at the
DOE LEHR Site

Sponsored By:
DOE Large Scale Demonstration and Deployment Program (LSDDP)
at the
DOE Miamisburg Environmental Management Project (DOE-MEMP)

September 15, 2000

Scott Altmayer
Earthline Technologies

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1.0 Introduction

The Large Scale Demonstration and Deployment Program (LSDDP) is coordinated and funded through DOE's Office of Science and Technology (OST, EM-50). In 1999, successful demonstrations using the SP-400 WaterWorks Crystals® (SP-400 Crystals) aqueous superabsorbent polymer solidifier were completed at the DOE Miamisburg Environmental Management Project (MEMP) to cost-effectively and safely solidify tritium-contaminated wastewater and sludge. Based on these successes and a review of probable waste forms that are emerging during DOE demolition and remediation tasks, the LSDDP is performing follow-on deployments for other interested contractors/DOE sites having appropriate DOE waste forms.

DOE's Laboratory for Energy-related Health Research (LEHR) site is located on the University of California – Davis Campus at the operational Institute of Toxicology and Environmental Health. Historically, DOE supported animal research at the laboratory which has been completed. However, a legacy of radioactive water and soil from daily maintenance of the research kennels has resided in several rectangular underground concrete holding tanks for many years. Parts of the facility are presently undergoing a CERCLA closure action. Selected tank sections (A – H) are scheduled for remediation and demolition in fall 2000.

Recent tank inspections and characterization indicate some additional scope challenges. There are several sections to some tanks, multiphasic aqueous sludge, potential water in-leakage, and a wider range of contamination than originally planned. Appendix 1 is the LEHR request to participate in the LSDDP program. Appendix 2 is the LEHR Site Project Plan. Appendix 3 is an executed copy of the LEHR site-specific "LEHR Field Procedure" which describes the project and governs safe field operations to support solidification tests and processes.

2.0 Background

For several years the waste management group at the LEHR Site has been involved with expedited disposition of numerous waste streams. Two years ago the site participated in a DOE-sponsored Pollution Prevention Opportunity Assessment (PPOA) that identified potential methods to optimize several remediation and waste management tasks. Since then, the site has continued such improvements. For example, they switched from using solely metal waste containers (i.e. B25's), to using supersacks, and have recently added the patented Lift-Liner® system.

Due to site-specific limitations regarding accessibility, waste treatment, and schedule for the tank sludges, the ability for LEHR Site to participate in the LSDDP provided a potentially safer, faster, and more cost-effective solution to properly disposition this waste to meet site milestones.

3.0 Technical Approach

The basic approach was to survey/review screening data for the candidate waste form, characterize the probable success of solidification with SP-400 Crystals, set operational goals for the test project, and solidify actual wastes.

The key waste acceptance test selected was the USEPA's Paint Filter Test (SW-846, Method 9095) because it is the fundamental requirement for receipt of the waste both at Envirocare and Hanford which are the proposed disposal sites. There was interest in additional site-specific testing protocols (i.e. USEPA 9096, ANS/ANSI 55.1, ASTM D4359-90, vibration tests) and/or optimization testing; however, these were beyond the scope of the LSDDP. The LEHR Site contractor, Weiss Associates, may continue additional testing at their discretion.

The key objective at LEHR Site was to determine a formula and mixing technique using small benchtests in a representative fashion so that an actual full-scale solidification project could be completed immediately. Bench-scale tests were performed on nominal 500 ml. samples, as specified, to confirm acceptability, proper ratios, and blending techniques prior to solidifying a larger quantity of waste for a selected waste form.

4.0 Waste Characterization

Process knowledge, visual inspections, and analytic data indicated the tanks had multiphasic aqueous sludges: gray water, slurry/sludge, and dark water. There was no information on the total suspended or dissolved solids content. Analytic results for the tank sludges are as follows:

LEHR Site: Tank Sludge Analytic Data

Waste Name/ Description	Waste Form	Waste Vol.	RAD Data (max)	RCRA Data (max)	Comments
Tank A Septic/Storage Sludge and "Dark-Water"	Thick, compost-like sludge	1000 gallons	Sr-90 < 18,600 pCi/g (Incidental H-3, Th-232, Cs-137)	Detectable < RCRA LDR's	Depth of 2' – 4' of original sludge. Dry on top and slurriable on bottom. More than expected due to potential tank in-leakage. Use of biocides, lime, and pH are unknown.
Tanks B thru H Septic/Storage "Gray-Water"	1" – 6" liquid and (w/ underlying fine silt layer)	1000 gallons	Sr-90 < 18,600 pCi/g (Incidental H-3, Th-232, Cs-137)	Detectable < RCRA LDR's	Tanks had been originally cleaned out. More water than expected due to potential tank in-leakage. Use of biocides, lime, and pH are unknown.

This analytic data, verbal process knowledge, and technical attachments to the project plan (Appendix 2) were key characterization inputs used to evaluate applicability of SP-400 Crystals to solidify this waste form.

5.0 Test Acceptance Criteria

The LEHR Site requirements were to solidify a bucket of tank sludge (and up to 1000 gallons of tank sludge) in a container. The objective was to pass the USEPA Paint Filter Test (PFT). Method 9095 both at the time of offsite shipping and while being received at the disposal site.

The typical "2x" safety margin requirement to use sufficient absorbent to handle twice the free-liquid was also invoked as a typical LEHR Site requirement and incorporated as part of this test.

6.0 Test Performance

All solidification tests were scheduled for August 30/31, 2000 at LEHR Site. Preparations and setup were completed successfully on August 30 and successful solidification of a bucket of sludge was completed by 4:00 PM on August 31, 2000. Due to site-specific schedule and technical limitations, the full-scale solidification test on a large container of sludge was delayed and will be performed in the future, as applicable.

The Project Supervisor coordinated site training, work permit approval, facility walkthrough, tank sludge drawing technical overview, and test area set-up. Tank A had never been cleaned and was contained "original" sludge of various consistencies that was relatively high in rad content. Alternately, Tanks B – F had been cleaned and contained different amounts of gray-water suspected to be essentially clean groundwater or rainwater in-leakage. The field procedure was modified to accommodate specific testing objectives and additional testing materials were procured. At 8:30 AM on August 31, the day began with final review of the procedure and final set-up of the test area (Photo 1). Minor delays occurred due to other work on asbestos-containing materials in the tank area. By late morning, various sludge and water samples had been removed from Tanks A and B, respectively. The team took an early lunch and reconvened for a prejob safety and operational briefing which began at 12:30 PM to overview the field operations steps (Appendix 3). It was well attended and went smoothly. It was very hot and due to the PPE in use and the waste operator was limited to a 45 minute work duration with a 15 minute rest break

At 1:00 PM, Tank B gray-water was transferred into jars. Radioactivity levels were essentially non-detect. Several samples were solidified (Photos 2, 3) prior to the first break and passed the filter test. At 2:00 PM the Tank A sludge sample was opened. It was very moist, with a peat-like texture, and read 300,000 dpm on contact (Photos 4, 5). A sample was placed into a paint filter and passed. The Project Supervisor requested that a sludge-slurry be "manufactured" and tested to replicate the slurry waste form known to exist at the bottom of the Tank A (Photo 6). This test inferred two key physical parameters: 1) the "peat-like" sludge contained over 20 wt% water, 2) the sludge particles were denser than water as evidenced by immediate settling when slurried with water. By 3:30 PM the test on a two-gallon bucket of slurry-sludge was successfully completed (Photo 7, 8).

Key success factors were the interfaces and preparatory work completed by the waste management and safety staff personnel. Staging of this test project in an open area with easy ingress/egress control points allowed the LSDDP project to stay clean, orderly, and progress smoothly.

7.0 Test Results

The results of the LSDDP test at LEHR Site were successful and are detailed in the executed copy of the field procedure (Attachment 9.3) as well as photographs taken by the LEHR Project Supervisor (Attachment 9.4). In summary, a bucket of slurry/sludge solidified immediately upon addition of the SP-400 Crystals. No additional blending was required. The result was a spongy waste form that readily passed the PFT (Photos 7, 8).

There were seven benchscale tests performed ranging from 1.0 wt% - 4.0 wt% of SP-400 Crystals. During benchscale solidification tests, passive blending techniques were preferred where the SP-400 Crystals were placed into the waste and minimal agitation or mixing was used. The goal was to observe the limiting capability of the SP-400 Crystals to move and expand throughout the waste volume. Six tests passed and one test failed, as outlined below:

LEHR Site:
SP-400 WaterWorks Crystals© Solidification Tests on Tank Sludge/Water

Waste Stream	Test Number	Waste Weight	SP-400 wt% (Waste: SP-400)	SP-400 Added	Paint Filter Test (PFT)
Tank B "Gray-water"	B1	500 grams	1 wt% (100:1)	5 gm	Fail
	B2	500 grams	2 wt% (50:1)	10 gm	PASS
	B3	500 grams	3 wt% (33:1)	15 gm	PASS
	B4	500 grams	4 wt% (25:1)	20 gm	PASS
Tank A Sludge and "Dark-water"	A2 (dark-water)	500 grams	4 wt% (25:1)	20 gm	PASS
	A3 (pre-test)	410 grams	none	none	PASS
	A4 (sludge/water blend)	1980 grams	4 wt% (25:1)	80 gm	PASS

Using higher ratios of SP-400 Crystals to pass the PFT test indicates there may be potentially higher dissolved mineral content or high/low pH in the waste. This was qualitatively confirmed based on recent analytic data that is still out for verification.

The full-scale test could not be run due to site-specific technical and schedule conditions. The LEHR Site personnel intend to perform this test in the future with guidance from the LSDDP after additional analytic data are gathered and additional testing requirements are identified. The issue here deals more with options regarding handling, moisture capacity, sorting/separation, and/or commingling of the higher-rad moist sludge and the lower-rad gray-water. These issues will be discussed and evaluated throughout September 2000.

8.0 Conclusions

LEHR Site waste management personnel coordinated a short closeout meeting to summarize the success of the LSDDP test/validation and thank key managers for their support. We acknowledged that the LSDDP could support the full-scale test on sludge later in September, if needed.

The LSDDP results also provided qualitative insight into the variable densities, moisture capacities, and contaminants in the sludge. This information may be used to develop plans for alternate handling and removal plans. The LEHR Site has already started additional tank sampling to quantify this information.

The success of this test at LEHR confirmed the potential use of SP-400 Crystals to safely and cost-effectively bind water and eliminate free-liquids during tank sludge removal, handling, and/or shipping.

9.0 Appendices

Appendix 1 LEHR Site "Request to Participate" in LSDDP

Appendix 2 LEHR Site Project Plan

Appendix 3 Executed Copy of LEHR Site Field Procedure, August 31, 2000

Appendix 4 Solidification Photos

Appendix 1

LEHR Site "Request to Participate" in LSDDP
(see attached e-mail, 8/25/00)

Author: Scott Altmayer at RMIES
Date: 8/25/00 10:00 AM
Priority: Normal
TO: kraudr@doe-md.gov at INTERNET-MAIL, rgovers@compuserve.com at INTERNET-MAIL
CC: Jeff Kulpa
Subject: Re: DOE-Mound Large Scale Demo
---------- Message Contents ----------

Here is the LEHR site's response/request to participate in the LSDDP. We talked about details by phone. He called yesterday and wants us there next Wed/Thurs for demo...lots more watery sludge when they breached the UST's. I'm going out. He's revising a filed procedure for my review.

---------- Forward Header ----------

Subject: Re: DOE-Mound Large Scale Demo
Author: "John Wolf" <JW@weiss.com> at INTERNET-MAIL
Date: 6/12/00 9:46 AM

Hi Scott, received your information. I am attempting to gain access to the tanks and sludge in advance. We are going to have to sample the tanks b/f the start of work to determine if we have mixed waste issues. Because we are popping the tanks for characterization purposes, we will be able to collect a sludge sample as well. I will contact you with additional details as they become available.
-JW

John Wolf, R.E.A.
Project Environmental Scientist

Weiss Associates
5801 Christie Ave, Suite 600
Emeryville CA 94608
510-450-6112

>>> <scott_altmayer@rmies.com> 06/08/00 05:38AM >>>

Thanks for taking my call last week. As discussed, attached is detailed information (i.e. fact sheet, report) on the WATERWORKS CRYSTALS solidification technology which is presently being sponsored through EM-50 and the DOE-Mound Large Scale Demo and Deployment (LSDD) Project. They are also sponsoring oil solidification with NOCHAR.

We are actively seeking other deployment sites with appropriate aqueous sludge/wastewater streams for demonstration. The demonstrations have been successful at all previous sites.

Appendix 2

LEHR Site Project Plan

DOE LEHR Site Demonstration and Deployment of the SP-400 WaterWorks Crystals© Aqueous Waste Liquid/Sludge Solidification Technology

(Supporting the DOE-Mound Large Scale Demonstration and Deployment Project – LSDDP)
(draft, 8/29/00)

1.0 Introduction

The LSDDP is coordinated and funded through DOE's Office of Science and Technology (OST, EM-50). In 1999, successful benchscale and full-scale solidification demonstrations using WaterWorks Crystals© (WWC) aqueous superabsorbent polymer were completed at the DOE Miamisburg Environmental Management Project (MEMP). They showed a cost-effective and safe solidification of tritium-contaminated wastewater and sludge to meet the waste acceptance criteria at the final disposal facilities.

Based on these successes, the LSDDP is performing follow-on voluntary deployments at other sites nationwide that have similar waste forms. The intent is to accomplish additional deployments at DOE sites that have immediate need for solidification treatment, shipping, and/or disposal of applicable aqueous wastes.

2.0 LSDDP Organization

Position	*Name*	*Tasks*
Project Manager (PM)	Don Krause	overall project management, contracting
PM Tech Support	Dick Govers	overall project management
LSDD Project Team	Assigned by PM	review waste characteristics for technology application
Technical Representative	Scott Altmayer	provide solidifying agent, work on-site with receiving site to accomplish training and deployment of the technology, write a summary report
Receiving Site	John Wolf	provide waste characterization information, obtain samples, prepare facilities, safety evaluations and procedures, conduct deployment in conjunction with the technical representative, evaluate/test results, provide summary of conclusions

3.0 Waste Description

The LEHR site is remediating a portion of the grounds that contained an underground leach field and underground septic storage tanks that held wash water from animal cages. Wastes had been processed to render them non-biological. The tank residues/sludges are considered low-level waste. Recently, tank in-leakage has increased the sludge and water loading in the tanks. The following table summarizes candidate wastestreams that were selected based on project schedule, wasteform, contaminants, and waste accessibility:

Waste Name	*Waste Type (MW, LLW)*	*Waste Form*	*Volume/ Net Wt.*	*RAD Data (max)*	*RCRA Data (max)*	*Comments*
Storage Tank Sludge	LLW	"Gray water", and thick sludge	1000 gallons	Sr-90 = < 18,600 pCi/g	Detected but Non-RCRA	Cleanup residue, solidify for transportation to TSDF

4.0 LSDDP Objectives

1. Assist the LEHR project to solidify a volume of aqueous waste sludge to meet site-specific technical specifications for disposal at DOE Hanford or Envirocare. Perform demonstration in a representative fashion so that full-scale solidification operations can be directly implemented, as appropriate. Bench-scale tests will be performed, as specified, to confirm proper ratios and blending techniques prior to solidifying a larger quantity of waste.

2. Perform a field verification test on the final wasteform(s) using the general guidance from the USEPA Paint Filter Test (SW-846, Method 9095).

3. Develop final report and conclusions for.

5.0 Technical Specifications

The LEHR project has identified DOE-Hanford as a probable disposal location. Review of the Hanford website confirms that SP-400 WaterWorks Crystals© are an appropriate and approved solidifier. This includes items such as, but not limited to, treatment, storage, disposal (TSD) facility waste acceptance criteria (WAC), transportation requirements and mode (i.e. drum, box, supersack, bulk container), final waste form testing (see Attachment A), sampling plans, or data quality objectives (DQO's). They may also prescribe best management practices for the given wasteform. In any case, the LSDDP testing is limited to a Paint Filter Test of the benchscale and full-scale wasteforms (typically within one hour of solidification).

6.0 Scope/Schedule/Funding

The scope of the LSDDP at the LEHR project will screen candidate wastes, review characterization information, develop a draft operating field document, train personnel, test the final wasteform, supply solidification media for a single container of waste, and send a final report. The LSDDP provides funding and resources for these tasks direct to Earthline Technologies.

The LEHR project "host" site provides the following: infrastructure support, if needed (training, regulatory permits, etc.), procedure authorization (work request, radiation work permit, safety permit), test area setup (containers, mixers, transfer equipment), and management of job control waste and final wasteform. The site provides funding and resources for these tasks which are estimated to cost between $5,000 and $50,000 depending on the site-specific controls, readiness evaluations, and integrated safety management protocol required.

The schedule for deployment of the LSDDP at the LEHR project includes no pre-job visits, several telecons, and a two-day site visit by September 1, 2000.

7.0 Reporting Requirements

A draft report will be issued within two weeks of project completion.

8.0 References

1. Sludge Initiative Approach by LSDDP/DOE Ohio, 2/29/00
2. WaterWorks Crystals© Application Charts (attached, for reference only)

9.0 Attachments

Attachment A: Example Technical References on LLW/MW Wasteform Durability

Attachment B: SP-400 WaterWorks Crystals® Typical Application Methods

Attachment C: SP-400 WaterWorks Crystals® Typical Application Rates to Pass USEPA Paint Filter Test

Attachment D: SP-400 WaterWorks Crystals© Solidification of "Brackish Gray-Water"

Attachment A

Example Technical References on LLW/MW Wasteform Durability

(for reference only)

REGULATIONS	*SOIL TESTS*
10 CFR 61 49 CFR 173 DOE Order 435.1 ANS/ANSI N16.1, Leaching ANS/ANSI N55.1, LLW Process	ASTM D698-91, Proctor Density ASTM D2850-95, Compression ASTM D2166-91, Compression ASTM D4253-93(96), Vibration Density
MOISTURE	*FREEZE-THAW RESISTANCE*
ASTM D2216-92 ASTM D2974-87(95)	ASTM D590-96, Soil/Cement Resistance ASTM D4842-90, Resistance ASTM D590-96, Waste Freeze/Thaw EDF WGS-005 (INEEL-specific)
FREE-LIQUIDS	*INCINERATION*
EPA Method 9095, PFT (@ 0 psig) EPA Method 9096, LRT (@ 50 psig) ASTM D4359-90, Liquid/Solid Pourability EPA Series 600, Method 160.3	ASTM D240, BTU ASTM D482, Ash Content
VIBRATIONS	*BIODEGRADEABILITY*
ASTM D999-96, Shipping ASTM D4728-95, Random Burrell Wrist-Shaker @ 3cps	40 CFR 264.314(e) (non-biodegradable) ASTM G21-70, Fungi ASTM G22-76, Bacteria

Attachment B

SP-400 WaterWorks Crystals®
Typical Application Methods
(for reference only)

Wasteform	*Relative Water (%)*	*Absorbent Placement*	*Absorbent Mixing/Blending*
Contaminated Water	High (>95%)	Bulk Additive	None (mixing optional)
Slurry/Sludge	High (>60%)	Layered	Vertical and horizontal probe, or Pugmill/paddle mixer
Wet Debris, Bagged Asbestos	Average (>20%)	Layered, Top and Bottom of Waste	Broadcast
Damp Soil (near optimum moisture)	Low (<20%)	Layered, Top and Bottom of Waste	Broadcast
Condensation (all wastes)	Low (<1%)	Top, bottom, and perimeter of waste container and liner	Broadcast

Attachment C

SP-400 WaterWorks Crystals®
Typical Application Rates to Pass USEPA Paint Filter Test
(for reference only)

Container Type	*Typical Max "Soil" Weight (lbs.)*	*Maximum Volume*	*SP-400 Crystals Needed (lbs.)*	
			** Soil w/ 10% extra water*	*** Watery Sludge*
Drum	800 lb	7.3 cf	1	9
Supersack	3,000 lb	27 cf	3	33
B12 Box	4,000 lb	44 cf	4	55
B25 Box	8,000 lb	90 cf	8	113
Liftliner-tm	24,000 lb	260 cf	24	322
Intermodal	42,000 lb	675 cf (= 25 cy)	42	844
Gondola	200,000 lb	1,890 cf (= 70 cy)	200	2,344

Notes:

* *Soil water (pH = 7) @ 100:1 ratio (2/3 design capacity)*

** *Typical D&D Contaminated Water (pH = 7) @ 50:1 ratio (1/3 design capacity)*

Attachment D

SP-400 WaterWorks Crystals© Solidification of "Brackish Gray-Water"

(for reference only)

Total "Mineral Salts" Concentration	Contaminated Aqueous Liquid (lbs.)	SP-400 Crystals Absorbent (lbs.)
2,000 ppm (= 0.2 wt%)	90	1
10,000 ppm (= 1.0 wt%)	50	1
15,000 ppm (= 1.5 wt%)	30	1
30,000 ppm (= 3.0 wt%)	20	1
65,000 ppm (= 6.5 wt%)	10	1

Notes:

1. Approximate minimum application ratios to pass USEPA Paint Filter Test. Use of additional absorbent will increase the safety margin by making a firmer final wasteform.

2. Brackish inland coastal waterways and the Great Salt Lake are approximately 6% Total Dissolved Solids (TDS) as "salts" based on empirical evaporation tests. Since results will vary based on actual type of salt and wasteform, a simple treatability study is always required to confirm waste-specific performance.

Appendix 3

Executed Copy of LEHR Site Field Procedure, August 31, 2000
(attached)

LEHR Field Deployment Procedure

(Final Draft, 8/30/00)

Low-Level Waste (LLW) Aqueous Septic Sludge Solidification at the LEHR Project

(Supporting the DOE-Mound Large Scale Demonstration and Deployment Project - LSDDP)

1.0 Introduction/Background

The DOE-Mound Large Scale Demonstration and Deployment Project (LSDDP) is coordinated and funded through DOE's Office of Science and Technology (OST, EM-50). In 1999, successful demonstrations using the SP-400 WaterWorks Crystals© (SP-400 Crystals) aqueous superabsorbent polymer solidifier were completed at the DOE Miamisburg Environmental Management Project (MEMP) to cost-effectively and safely solidify tritium contaminated wastewater, and sludge.

Based on these successes, the LSDDP is performing follow-on deployments at other sites nationwide and with other waste forms.

2.0 Deployment Team

The following personnel are the proposed contacts who will be involved with staging and performance of the deployment at AEMP:

Title	Name	Company
Project Supervisor	John Wolf	Weiss Associates
LSDDP Test Engineer	Scott Altmayer	Earthline Technologies

3.0 Objectives

1. The objective of deployment at LEHR is to solidify a volume of aqueous waste and sludge that is representative of actual full-scale solidification operations for low-level waste liquids. Bench-scale tests will be performed, as specified, to confirm proper ratios and blending techniques prior to solidifying larger quantities of waste.

2. Perform a field verification of the final waste form(s) using the general guidance from the USEPA Paint Filter Test (SW-846, Method 9095) (Attachment B). *(Note: This is not required to be a certified EPA test.)*

3. Develop feedback and lessons-learned that will aid the LSDDP in future deployments, and in meeting the LEHR project waste disposal milestones in a cost-effective fashion.

4.0 Screening/Selection

The LEHR waste inventory includes tank sludges and water contaminated with Sr-90 to approximately 20,000 pCi/g as outlined below:

Waste Name/ Description	Waste Form	Size/ Net Wt.	**RAD Data (max)	RCRA Data (max)	Comments
Tank A Septic/Storage Sludge and "Dark-Water"	Thick compost-like sludge	1000 gallons	Sr-90 < 18,600 pCi/g	Detectable < RCRA limits	More sludge than expected due to potential in-leakage. Use of biocides or lime and pH value are unknown.
Tank B Septic/Storage "Gray-Water"	"Gray water"	1000 gallons	Sr-90 < 18,600 pCi/g	Detectable < RCRA limits	More sludge than expected due to potential in-leakage. Use of biocides or lime and pH value are unknown.

As summarized by the Project Supervisor, based on appropriate wasteform consistency and successful results of this demonstration, the LEHR project may be able to consider directly solidifying the 1' – 3' layer of sludge in-situ for removal as a solid low-level waste debris during tank demolition; in addition to the baseline technology of sludge pumping/dewatering.

5.0 Characterization/Analysis

The data and analysis has been reviewed by the site as accurately describing these liquid wastes. Quantitative measurements on rad and RCRA content are available. Information on total dissolved solids, pH, total suspended solids, moisture content, and/or viscosity is not available. Typical application of SP-400 Crystals at other sites are consistent with its use at LEHR.

6.0 Operations

6.1 Prerequisites

Perform a pre-job briefing for the team to clarify LSDDP and LEHR objectives and discuss the following:

- facility location
- Review field documents and permits
- potential hazards of wastes (i.e. physical, rad, chemical)
- Review MSDS's for SP-400 WaterWorks Crystals©
- equipment and tools (i.e. scale, colliwasa, test beakers, spill pads)
- residue/waste management, storage, and disposal
- spill control and emergency response actions
- Stop Work issues
- Questions and answers

6.2 Equipment/Supplies

The following equipment needs to be prepared and staged in the work area(s):

By: LSDDP Test Engineer	By: LEHR Project Supervisor
WaterWorks Crystals© SP-400 (2 ea., 55 lb. bag) Paint Filters (Mesh #60, 423 micron, fine-mesh)	Facilities (with ventilation hoods, as needed) Facility MSDS Approvals Camera (by engineering) PID/HNU Volatiles Detector (as needed) Flat Surface/Table (for bench tests) Power Cords (optional) Mixer/Blender (optional) Paper Towels Disposable gloves/PPE Lab Scale (5 kg ± 5 grams) Drum scale (500 lb. ± 1 lb.) Plastic cups > 500 ml. Sample Jars w/lids (5 ea.) Containers: 2 gal., 5 gal. (2 ea.) Litmus/pH paper (optional) Colliwasa (optional) Transfer Ladel (optional) Hand/air oil transfer pump (optional) Empty Containers (bucket, bag, drum, box) Plastic liners (optional) Wrench (for lid and bung removal) Forklift (w/ drum rotator)

6.3 Solidification Sequence

Note: Solidification here means to process the water/sludge to pass the Paint Filter Test.

1. Verify/Transfer buckets/drum(s) of sludge and water to work area.

2. Verify/Transfer empty containers and/or liner to work area.

BENCH SCALE DEMONSTRATION

Note: The LSDDP Test Engineer may select or modify appropriate test ratios from Attachment A-1 to meet field conditions.

3. Use a ladle, scoop, pump, or colliwasa to fill several jars each with approximately 500 gm. of selected waste per Attachment A-1.

4. Record % moisture, TSS, pH, and/or bulk density for a representative sample of waste and SP-400 Crystals, as applicable. *(Note: For test on sludge, perform initial Paint Filter Test (Att. B), as needed, to assist in determining density and/or fraction of releasable water).*

5. Weigh/measure SP-400 Crystals and place into separate containers (i.e. plastic cups, small beakers). Record actual weight.

6. Blend/add SP-400 Crystals to waste per Attachment A-1. Mix or layer per waste form consistency. *(Note: For thicker sludgse use the "layering technique": layer ¼ of sorbent on bottom, add first ½ of waste, layer ½ of sorbent, add second ½ of waste, layer ¼ of sorbent. For very thick sludge minor mixing/stirring is appropriate to optimize absorbtion and speed reaction).*

7. Record observations for at least fifteen minutes (photos, PID/HNU, as needed).

8. Perform a visual check to see that waste appears solidified with no free-liquids. If so, perform an informational Paint Filter Test (ref. Att. B) on a nominal 100 – 200 gram sample and record results.

9. After completion of final test, decon tools and place all job control waste in proper receptacles per direction of Project Supervisor.

LARGE SCALE DEMONSTRATION

****

Based on results of benchscale tests, and input from LEHR personnel, a recommended ratio/mixture will be selected for use on one or more containers of waste. Perform solidification test in a controlled area to prevent spilling and as directed by Project Supervisor. Record results in table.

****

10. Use the plant scale to measure gross, tare, and net weight of waste.

11. Identify the solidification container (i.e. drum, supersack-inside-lined B12V box) and weigh-out the appropriate amount of SP-400 Crystals, as needed.

12. Blend/transfer the SP-400 Crystals and waste slowly into a container as directed by safety, operations, and Technical Representative.

13. Record observations for at least fifteen minutes (photos, HNU, as needed).

14. Perform informational Paint Filter Test (ref. Att. B) on a nominal 100 – 200 gram grab sample.

Wasteform	Sludge (thick)	Water (liquid)
Gross Wt.		
Tare Wt.		
Net Wt.		
HNU/PID and/or pH Readings (before solidification)		
SP-400 Ratio (wt %) (waste : SP-400 polymer)		
SP-400 weight		
Blending Comments (layered, blend)	Layered	Blend
HNU/PID and/or pH Readings (after solidification)		
Informational PFT (Pass/Fail)		
Other Inspections or Observations		

RESIDUE MANAGEMENT

15. After completion of fullscale tests, decon tools and place all job control waste (i.e. decon, rags, pads, containers) in proper receptacles per direction of Project Supervisor.

16. Use SP-400 Crystals, or equivalent, to complete solidification on any wastes that were not completely solidified during these demonstrations, as requested by Project Supervisor.

17. Place all demonstration samples (benchscale, fullscale) in a segregated area per direction of the Project Supervisor for ongoing inspection/evaluation, as required. *(Note: Verify samples are properly labeled.)*

18. Project Supervisor will perform a waste evaluation on the demonstration samples (benchscale, full-scale) before final disposition, processing, and disposal.

7.0 References

none

8.0 Attachments

Attachment A-1 – Bench Scale Test Plan Outline

Attachment A-2 – Bench Scale Test Data Sheet

Attachment B – Paint Filter Test

Attachment A-1
Bench Scale Test Plan Outline

Waste Description	Test Number	Notes	Waste Weight	Absorbent (wt%, weight) (Waste : SP-400 Ratio)
Tank A Sludge and "Dark-Water"	A1 Dark Water	Blend (add sorbent to water)	500 gm	2 wt%, 10 gm. (50:1) N/A
	A2 Dark Water made	Blend (add sorbent to water)	500 gm	4 wt%, 20 gm. (25:1) PASS
	A3 Sludge	Layered (SP-400 Crystals on bottom)	500 gm	2 wt%, 10 gm (50:1) (assumes 100% moisture) DAG/ST PASS
	A4 Sludge	Layered (SP-400 Crystals on bottom)	2 gal. ~~(20 lbs.)~~ 1/2 full (1980 gms)	~~2 wt%~~, 0.4 lb. ~~5.4 oz (153 gm)~~ (50:1) 4 wt% 25:1 (assumes 100% moisture) PASS
	A5 Sludge	Layered (SP-400 Crystals: ¼ bottom, 91 gm ½ middle, 182 gm ¼ top) 91 gm	2 gal. (20 lbs.)	4 wt%, 0.8 lb. 12.8 oz (364 gm) (25:1) (assumes 100% moisture) N/A

Waste Description	Test Number	Notes	Waste Weight	Absorbent (wt%, weight) (Waste : SP-400 Ratio)
Tank B "Gray-Water"	B1	Blend (add sorbent to water)	500 gm.	1 wt%, 5 gm. (100:1) FAIL
	B2	Blend (add sorbent to water)	500 gm.	2 wt%, 10 gm. (50:1) PASS
	B3	Blend (add sorbent to water)	500 gm.	3 wt%, 15 gm. (33:1) PASS
	B4	Blend (add sorbent to water)	500 gm.	4 wt%, 20 gm. (25:1) PASS

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: _____ Date Test Started: ____/____/____

Tank Number: _____ Waste Description: _____

Test Personnel: _____

****

Initial PID/HNU: _____ppm pH: _____

Waste Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	
SP-400 Ratio (wt%)	
Actual SP-400 Crystals Weight	

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
(attach additional sheets as needed)				

Attachment B

USEPA Paint Filter Test (Method 9095)

Attachment B

METHOD 9095

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter: Mesh number 60 (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden for an approximate cost of $0.07 each.

4.2 Glass funnel: If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel is to be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker: 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected according to the directions in Chapter Nine of this manual.

6.2 A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter.

7.3 Allow sample to drain for 5 min into the graduated cylinder.

7.4 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None required.

LEAR Site
LSDDP Deployment

Sequence of Events

Date	Notes
8/30 (Thurs) 2:30	Arrived at site. Met w/ John Wolff from Weiss Assoc. (WA). Introduced to site Mgr. Kim Worsen (WA) and RSO Dave? (UT). Looked at dug of Tanks A-G. Worton A, B.
8/30 3:00	Processed verbally thru NGET training. Isotopes are Sr-90, Ra-226, H-3, Cs-137. Discussed issues w/ RSO wrt Fenwald Box and vibes rctrs.
8/30 4:00	Walkdown of facility and location + procedures for testing. Also checked for and staged buckets, SP-400, hood/table, etc. Made list of items needed to buy (cups, scale, scoop, etc). Followed up on site "permit" (work order) to allow work to [illegible]
8/30 4:30	Drafted/updated field procedure based on desire to test sludge/water in both Tank A (sludge) + Tank B (water). Project desire may be to solidify in tank and remove as solid vs. pump w/ supersacks truck. Waste form and texture still unknown. Seems [illegible] layer of compost on top and wet soup [illegible]

Sequence of Events

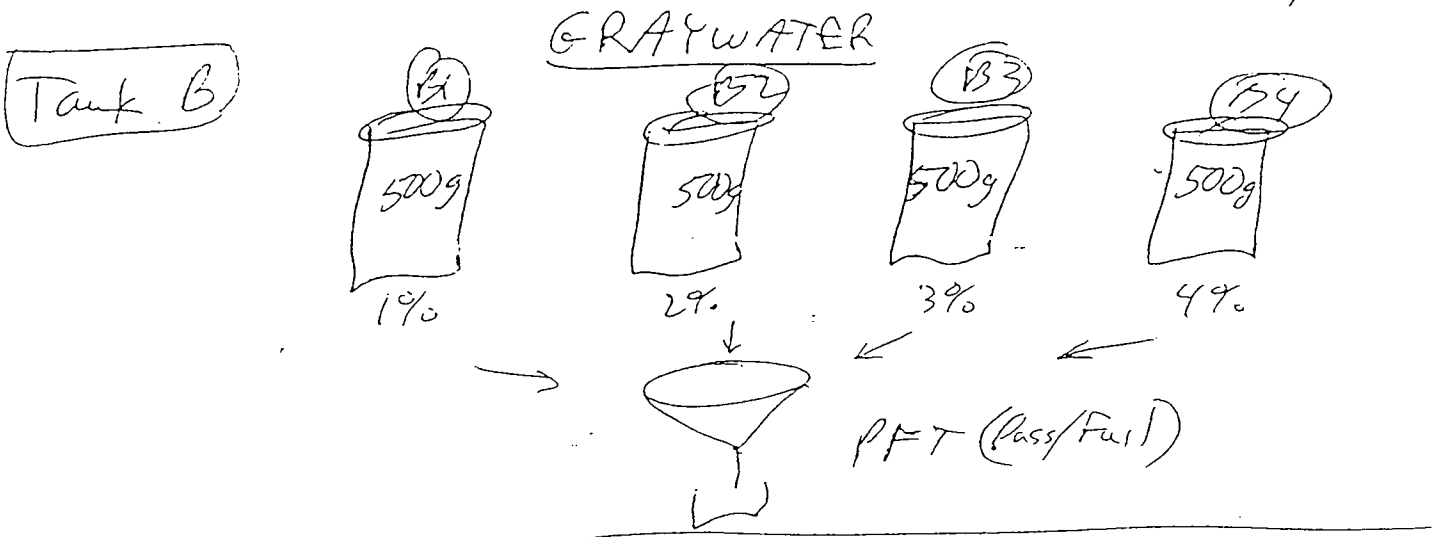
Date	Time	Notes
8/31	8:30	Arrived on site to setup equipment and permits. Note: Add procedure steps to 1) Use 500g or 1000g of water (vs. 400) 2) Perform initial PFT on sludge to dewater/reduce inadvertent water release
	9:00	Minor delays due to other priority asbestos work and sampling of sludge.
	9:45	Start project setup in field. Hazardous work permit #004-800, 8/31/00.
	10:45	Setup SP-400 samples + work area. Waiting for prejob brief + release of samples from site to work area. Plan early lunch + tests @ 12:30. Tare weights: Pyrex Cup: 490 gm. Jar/Lid: 485 gm. (15 gm lid)
	12:30	Prejob briefing RSO, HP, Ops (Ed), PM. No back water. Pretty "dry" sludge.

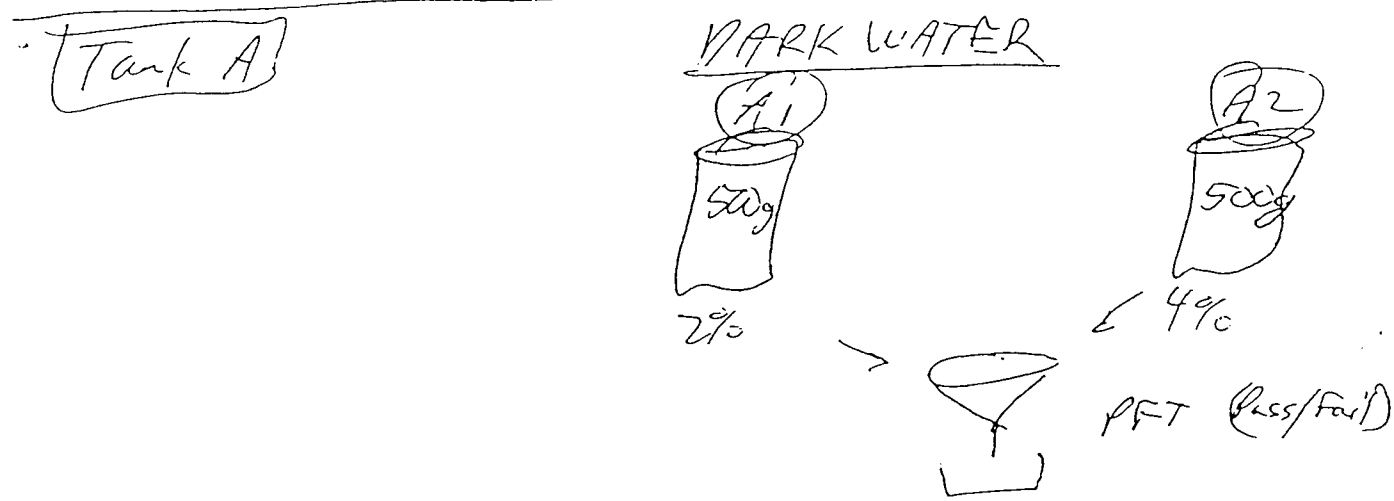
Sequence of Events

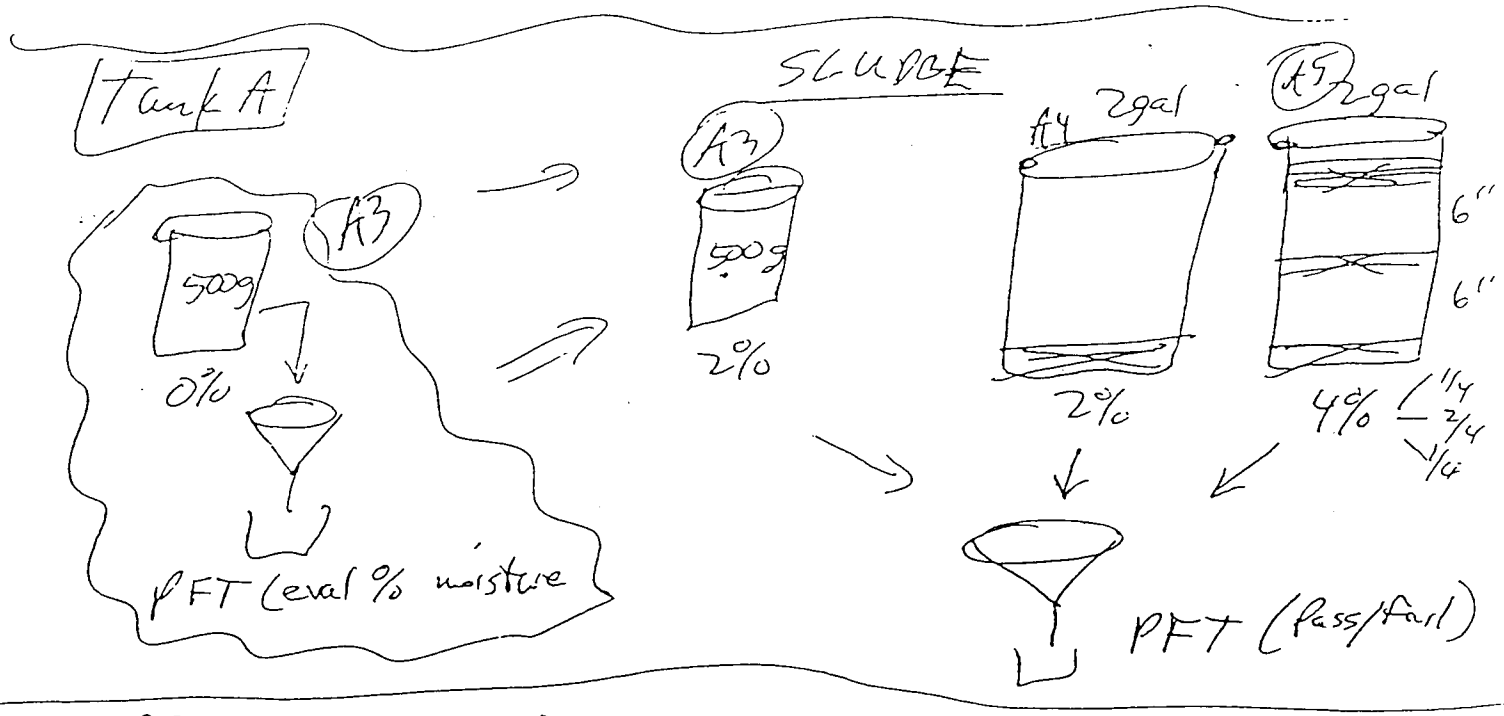
Date	Time	Notes
8/31	1:10 P	Ed started water xfer for Tank B samples.
	1:20 P	4 Samples charged + waiting on Earthfax.
	1:40	Start PFT's.
	1:47	Need to prep for rest break (Temperature) @ 1:55
	1:50	Opening Sludge bucket 5 gal. 300,000 dpm
	2:30	Restart w/ A3 test on soil. Test for liquid. If none, mix 50/50 weight of water + compost. Determine moisture holding - (See attached) Bucket Tare = 400g. Lid Tare = 95 Soil: 410g. +
	3:00	Do A2 test w/ made sludge
	3:10	Heat Break
	3:30	Restart
	4:00	Closeout + Demob

LEHR LSDDP Overview

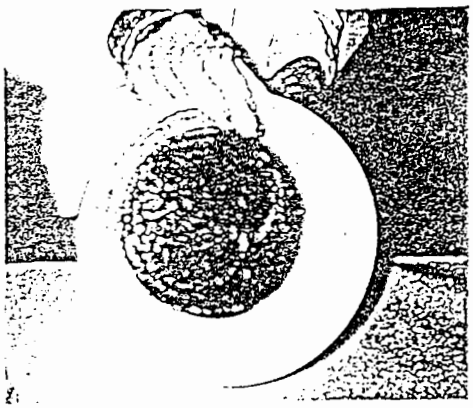
8/31/00





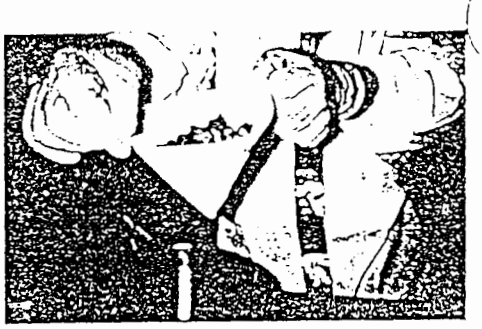


RESIDUE MGMT All into 5 gallon bucket



CERSLDG

LERA2PFT

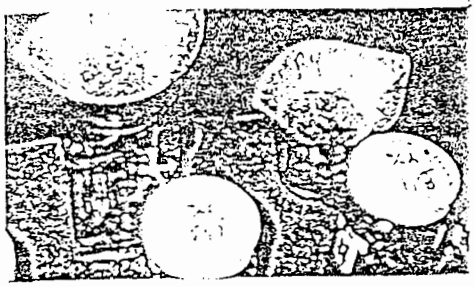


LERA3PFT

LERA4

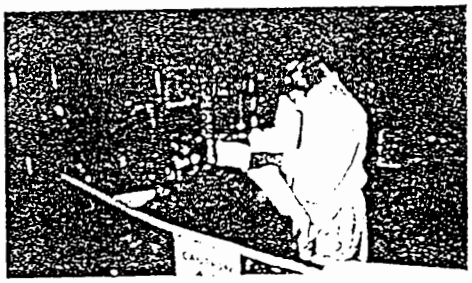
LERA4PFT

LERB2



LERB4

LERPEAT



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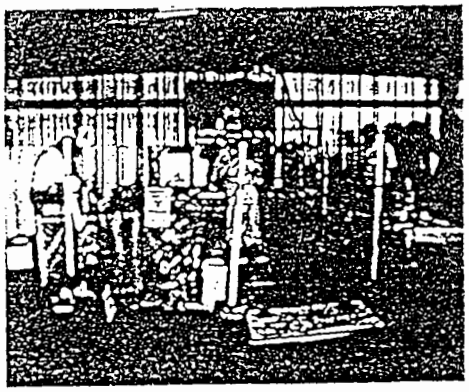
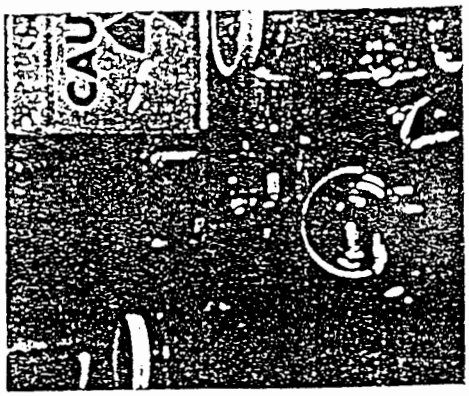


PIC00016

PIC00017



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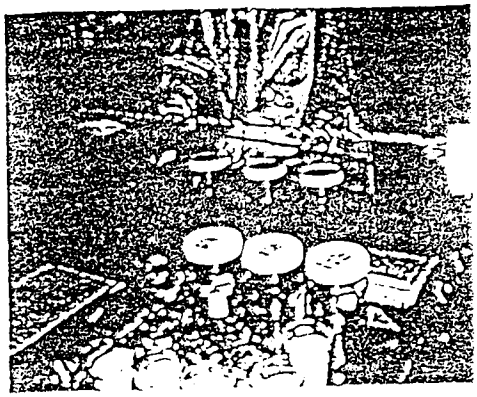

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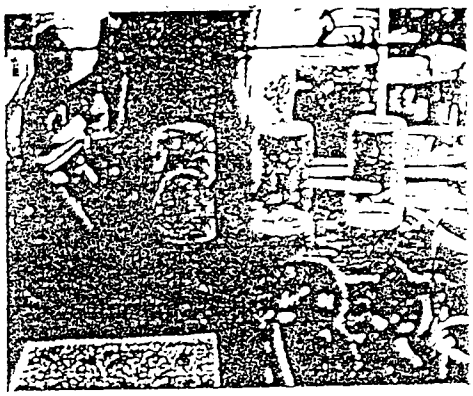


PIC00020

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: B1 Date Test Started: 8/31/00

~~Drum~~ Tank Number: B Waste Description: Gray Water

Test Personnel: Scott Altmayer, John Wolf, Ed Chun

****

Initial ~~Drum~~ HNU: NA <0.3 ppm pH: _____

Waste Bulk Specific Gravity: (970 - 485 gm) / (500 cc) = 0.97 g/cc
Tare Jar + Lid: 485gm Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = 100 %, TSS = NA %

SP-400 Bulk Specific Gravity: (890 - 490) (490+ 345 gm) / (500 cc) = .69 g/cc
Glass Cup Tare: 490gm Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	500g
SP-400 Ratio (wt%)	1%
Actual SP-400 Crystals Weight	5g

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
8/31	1:10	SAA	Slow expansion	Yes
	1:25	SAA	7" liquid still	Yes
	1:30	SAA	0" liquid, still flowable	
	1:40	SAA	Grainy surface	FALL
(attach additional sheets as needed)				

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: B2 Date Test Started: 8/31/00

~~Drum~~ Tank Number: B Waste Description: Gray Water

Test Personnel: (Same)

****

Initial Drum HNU: 0.3 ppm pH: N/A

See B1

Waste Bulk Specific Gravity: (_____gm) / (_____cc) = _____g/cc
Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	500g
SP-400 Ratio (wt%)	2%
Actual SP-400 Crystals Weight	10g

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
9/31	1:15	SAA	expand	Yes
	1:25	SAA	upside down / falls	Yes
	1:30	SAA	Start Test 1:32 / End 1:37	PFT - PASS
(attach additional sheets as needed)				

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: B3 Date Test Started: 8/31/00

~~Drum~~ Tank Number: B Waste Description: Gray Water

Test Personnel: (Same)

****

Initial Drum HNU: _____ppm pH: _____

See B1

Waste Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	500g
SP-400 Ratio (wt%)	3%
Actual SP-400 Crystals Weight	15g

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
8/31	1:20	SAA	expand	Yes
	1:25	SAA	Solid/upside down	Yes
	1:40	SAA	Start PFT 1:40/End 1:45	Yes, PFT-Pass
(attach additional sheets as needed)				

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: B4 Date Test Started: 8/31/00

~~Drum~~ Tank Number: B Waste Description: Gray Water

Test Personnel: (Sane)

****

Initial Drum HNU: _____ppm pH: _____

Waste Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

See B1

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	500g
SP-400 Ratio (wt%)	4%
Actual SP-400 Crystals Weight	~~2000~~ 20g.

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
8/31	1:25	Staff	Immediate Solidify	Yes
	1:25	Staff	Solid / Upside Down	Yes
	1:43	Staff	Start PFT 1:43 / End PFT 1:48	PFT - Pass
(attach additional sheets as needed)				

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: A1 Date Test Started: 8/31/00

~~Drum~~ Tank Number: A Waste Description: Sludge Dark Water

Test Personnel: Scott Altmayer, John Wolf

****

Initial ~~Drum~~ HNU: _____ ppm pH: _____

Waste Bulk Specific Gravity: (_____ gm) / (_____ cc) = _____ g/cc
Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____ gm) / (_____ cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	
SP-400 Ratio (wt%)	
Actual SP-400 Crystals Weight	

Not Available Made

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
(attach additional sheets as needed)				

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: A2 Date Test Started: 3/31/00

~~Drum~~ Tank Number: A Waste Description: ~~Sludge~~ Pickle water

Test Personnel: (Same)

****

Initial ~~Drum~~ HNU: _____ ppm pH: _____

Waste Bulk Specific Gravity: (975-490 gm) / (500 cc) = 0.97 g/cc Same
Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	500g
SP-400 Ratio (wt%)	4%
Actual SP-400 Crystals Weight	20g.

Made Sludge (decant water)

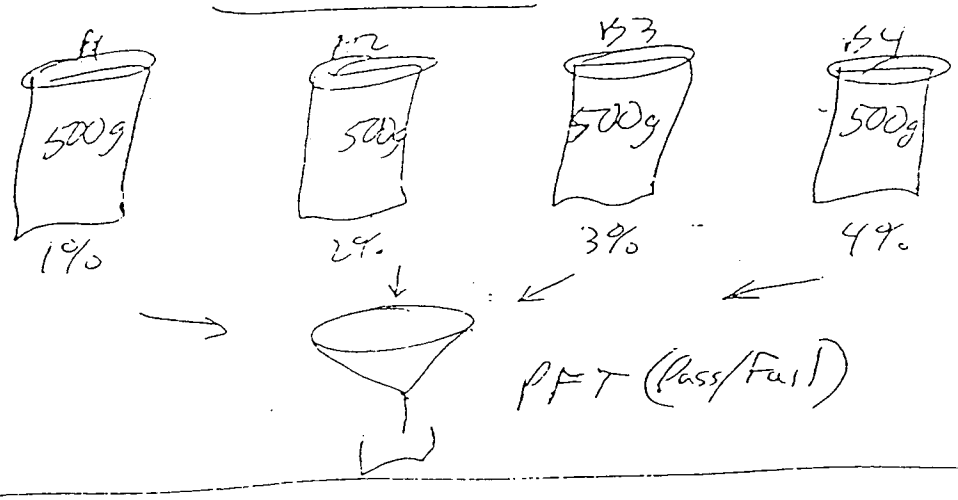
INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
8/31	3:00	SAA	Sorbent Added, ~~Slowly~~	—
			Absorbing Slowly	
	3:10	SAA	Still absorbing, Cracks	Photo
	3:30	SAA	Start PFT 3:35 Forming	
			/ End 3:40	PFT-Pass
(attach additional sheets as needed)				

LEHR LSWF Overview

8/31/00

GRAYWATER

Tank B

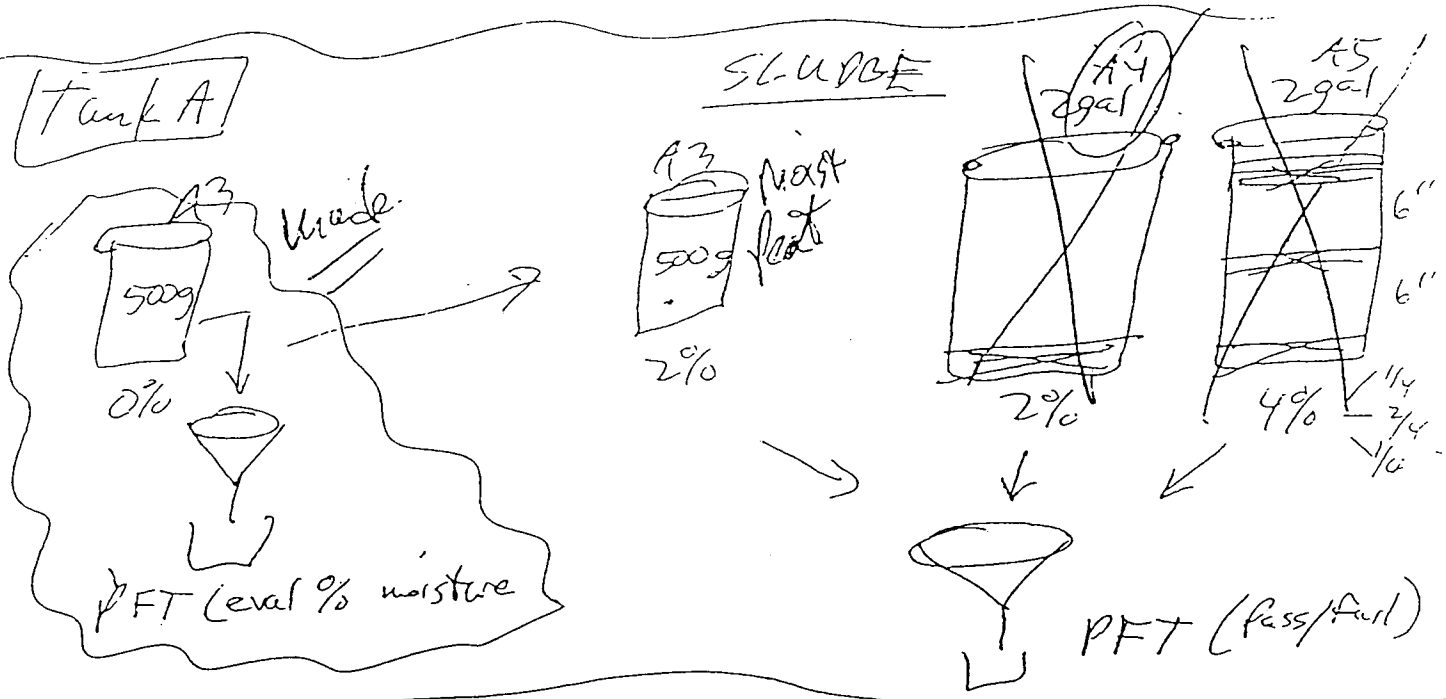


DARK WATER

Tank A

SLUDGE

Tank A



RESIDUE MGMT All into 5 gallon bucket

Attachment

A2 Formulation

Add water to compost/peat sludge.
Solidify
Perform PFT

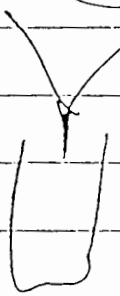
Solid (Sludge #1 900 - 490 = 410 gm
#2 865 - 490 = 375 gm
#3 870 - 490 = 380 gm
1165 gm

Liquid (Water 1165 gm

2335 gm

In 2 gallon Bucket
Blend w/ spoon (Noted that Solids settle out)

500 cc Input Liquid (Slurried)



Before: 515 gm
-460
= 55 gm

→ Solid 900 - 490
Wet 320 cc
= 460 gm / 320 = 1.4
(*)

∴ Liquid: 55 gm

(*) Notice Density doubled from Dry Peat

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: A3 Date Test Started: 8/31/00

~~Drum~~ Tank Number: Tank A Waste Description: Sludge Tank A

Test Personnel: (Same)

****

Initial ~~Drum~~ HNU: _____ ppm pH: _____

Initial PFT results: Start weight ____ End weight ____ ; Water Released _____

Waste Bulk Specific Gravity: (410 gm) / (500 cc) = 0.82 g/cc (1)
(400 - 490)
Mass (gm) Volume (cc)

see above N/A

Waste "% moisture" or "Total Suspended Solids": % moisture = ____ %, TSS = ____ %

SP-400 Bulk Specific Gravity: (_____ gm) / (_____ cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	410
SP-400 Ratio (wt%)	NA
Actual SP-400 Crystals Weight	NA

~~Dry~~ MOIST SLUDGE (= PEAT)

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
8/31	2:30	SAA	Sludge is a peat like material	Photo
	2:30	SAA	Initial PFT passing, no	PFT PASS
			moisture + no liquid	no moisture
	~~3:00~~	~~SAA~~	~~Liquid from separation test~~	work on
				filter
(attach additional sheets as needed)				

(1) When moistened/supersaturated, density goes to 1.44 (extra liquid still exists)

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: A4 Date Test Started: 8/31/00

Drum Number: A Waste Description: Sludge (waste)

Test Personnel: (same)

****

Initial Drum HNU: _____ppm pH: _____

See above

Waste Bulk Specific Gravity: (_____gm) / (_____cc) = _____g/cc
Mass (gm) Volume (cc)

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight (2475 - 495g)	1980 gm
SP-400 Ratio (wt%)	4%
Actual SP-400 Crystals Weight	79 gm

INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
8/31	3:20	SAA	50/50 Sludge separates easily	
			(Run test @ 4% as w/ A2 testing)	
	3:40	SAA	Add sorbent to waste	
	3:45	SAA	~~Start PFT~~ / Solidified	Photo
	3:50	SAA	Start PFT / 3:55 End	PFT - Pass
(attach additional sheets as needed)				

Attachment A-2
(suggested format)

Bench Scale Test Data Sheet

Test #: A5 Date Test Started: 8/31/00

~~Drum~~ Tank Number: A Waste Description: Sludge

Test Personnel: (same)

****

Initial ~~Drum~~ HNU: _____ppm pH: _____

Waste Bulk Specific Gravity: (_____gm) / (_____cc) = _____g/cc
Mass (gm) Volume (cc)

See above

Waste "% moisture" or "Total Suspended Solids": % moisture = _____%, TSS = _____%

SP-400 Bulk Specific Gravity: (_____gm) / (_____cc) = _____ g/cc
Mass (gm) Volume (cc)

Sample Blending:

CONTAINER	VALUE
Actual Waste Weight	
SP-400 Ratio (wt%)	
Actual SP-400 Crystals Weight	

NONE

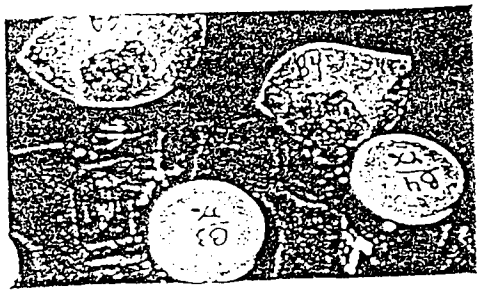
INSPECTION LOG				
Date	Time	Name	Observations	PFT or Photos
(attach additional sheets as needed)				

SAMP ID	LAB CHEM	TCLP ug/L (Preliminary)		Regulatory Level ug/L				
		DL FLAG	CONC	CONC				
CWRSC084	ALUMINIUM							
CWRSC084	ANTIMONY							
CWRSC084	ARSENIC		11.8	5000				
CWRSC084	BARIUM		61.3	100000				
CWRSC084	BERYLLIUM							
CWRSC084	CADMIUM		6.14	1000				
CWRSC084	CALCIUM							
CWRSC084	CHROMIUM	<		5000				
CWRSC084	COBALT							
CWRSC084	COPPER							
CWRSC084	IRON							
CWRSC084	LEAD		2.23	5000				
CWRSC084	MAGNESIUM							
CWRSC084	MANGANESE							
CWRSC084	MERCURY	<		200				
CWRSC084	MOLYBDENUM							
CWRSC084	NICKEL							
CWRSC084	POTASSIUM							
CWRSC084	SELENIUM		4.94	1000				
CWRSC084	SILVER		1.4	5000				
CWRSC084	SODIUM							
CWRSC084	THALLIUM							
CWRSC084	VANADIUM							
CWRSC084	ZINC							
CWRSC085	ALUMINIUM							
CWRSC085	ANTIMONY							
CWRSC085	ARSENIC		14.1	5000				
CWRSC085	BARIUM		57.8	100000				
CWRSC085	BERYLLIUM							
CWRSC085	CADMIUM		6.85	1000				
CWRSC085	CALCIUM							
CWRSC085	CHROMIUM	<		5000				

CWRSC085	COBALT							
CWRSC085	COPPER							
CWRSC085	IRON							
CWRSC085	LEAD		1.6	5000				
CWRSC085	MAGNESIUM							
CWRSC085	MANGANESE							
CWRSC085	MERCURY	<		200				
CWRSC085	MOLYBDENUM							
CWRSC085	NICKEL							
CWRSC085	POTASSIUM							
CWRSC085	SELENIUM		4.92	1000				
CWRSC085	SILVER		1.5	5000				
CWRSC085	SODIUM							
CWRSC085	THALLIUM							
CWRSC085	VANADIUM							
CWRSC085	ZINC							
CWRSC086	ALUMINIUM							
CWRSC086	ANTIMONY							
CWRSC086	ARSENIC		42.2	5000				
CWRSC086	BARIUM		66.7	100000				
CWRSC086	BERYLLIUM							
CWRSC086	CADMIUM		0.11	1000				
CWRSC086	CALCIUM							
CWRSC086	CHROMIUM	<		5000				
CWRSC086	COBALT							
CWRSC086	COPPER							
CWRSC086	IRON							
CWRSC086	LEAD		38.1	5000				
CWRSC086	MAGNESIUM							
CWRSC086	MANGANESE							
CWRSC086	MERCURY	<		200				
CWRSC086	MOLYBDENUM							
CWRSC086	NICKEL							
CWRSC086	POTASSIUM							

CWRSC086	SELENIUM		0.44	1000
CWRSC086	SILVER		3.49	5000
CWRSC086	SODIUM			
CWRSC086	THALLIUM			
CWRSC086	VANADIUM			
CWRSC086	ZINC			
CWRSC087	ALUMINIUM			
CWRSC087	ANTIMONY			
CWRSC087	ARSENIC		2.32	5000
CWRSC087	BARIUM		82.7	100000
CWRSC087	BERYLLIUM			
CWRSC087	CADMIUM		1.37	1000
CWRSC087	CALCIUM			
CWRSC087	CHROMIUM	<		5000
CWRSC087	COBALT			
CWRSC087	COPPER			
CWRSC087	IRON			
CWRSC087	LEAD		32.6	5000
CWRSC087	MAGNESIUM			
CWRSC087	MANGANESE			
CWRSC087	MERCURY	<		200
CWRSC087	MOLYBDENUM			
CWRSC087	NICKEL			
CWRSC087	POTASSIUM			
CWRSC087	SELENIUM		7.38	1000
CWRSC087	SILVER		1.9	5000
CWRSC087	SODIUM			
CWRSC087	THALLIUM			
CWRSC087	VANADIUM			
CWRSC087	ZINC			

3/3



LERB4

(3)

LERPEAT

(4)

LERSET2

(1)

Appendix 4

Benchscale Solidification Photos for LEHR Tank Sludge/Water

Photo Number	*Photo Description**	*Photo File Location*
1	Test Area Setup	LERSET1
2	Tank B Gray-Water Benchtest	LERB2
3	Tank B Gray-Water Benchtest Passing PFT	LERB4
4	Tank A "Peat" Sludge	LERPEAT
5	Tank A "Peat" Sludge Passing PFT	LERA3PFT
6	Tank A Dark-Water Passing PFT	LERA2PFT
7	Tank A Wet-Sludge	LERA4
8	Tank A Wet-Sludge Passing PFT	LERA4PFT

* PFT = USEPA Paint Filter Test

Photo 1

Test Area Setup

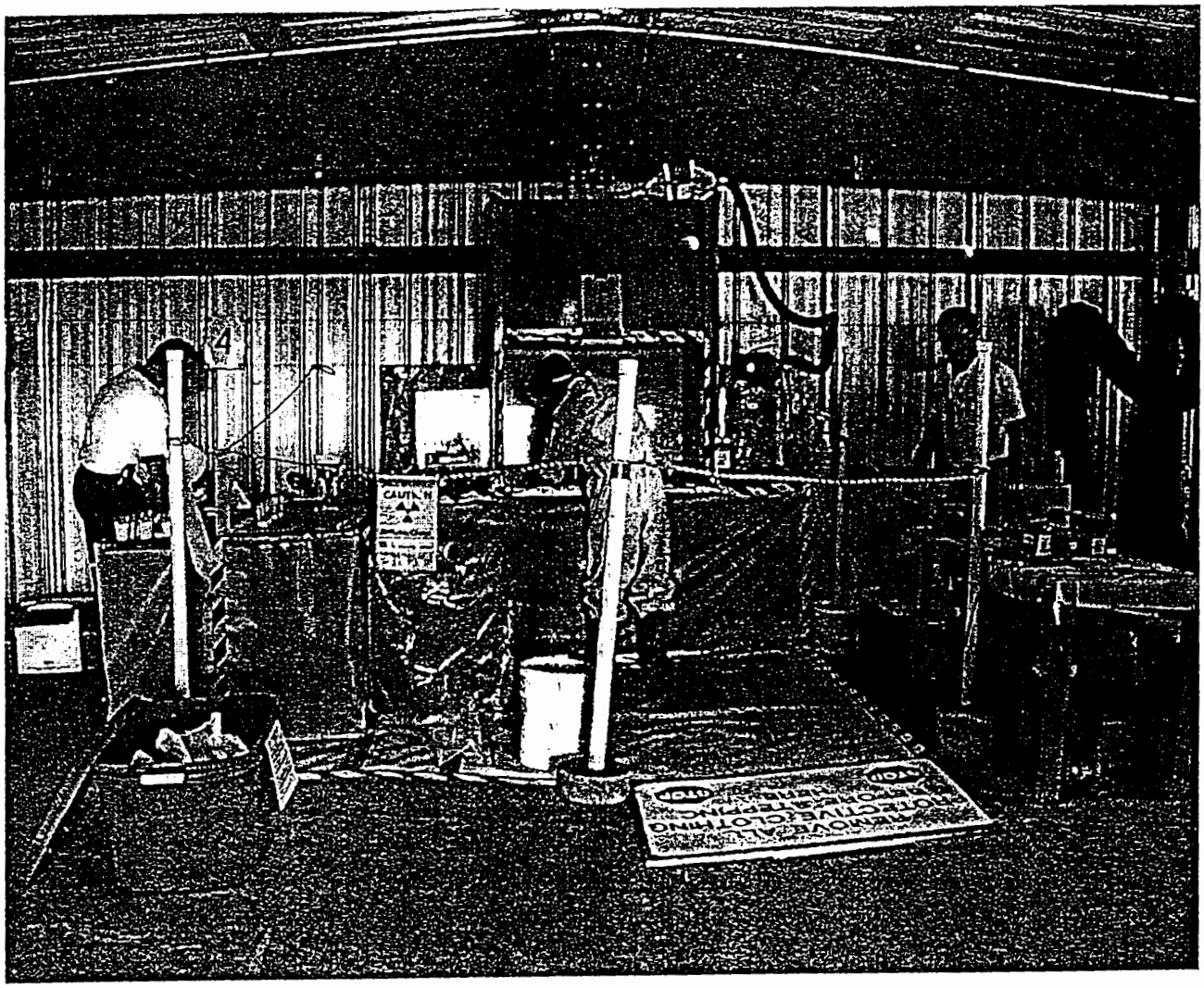


Photo 2

Tank B Gray-Water Benchtest

Photo 3

Tank B Gray-Water Benchtest Passing PFT

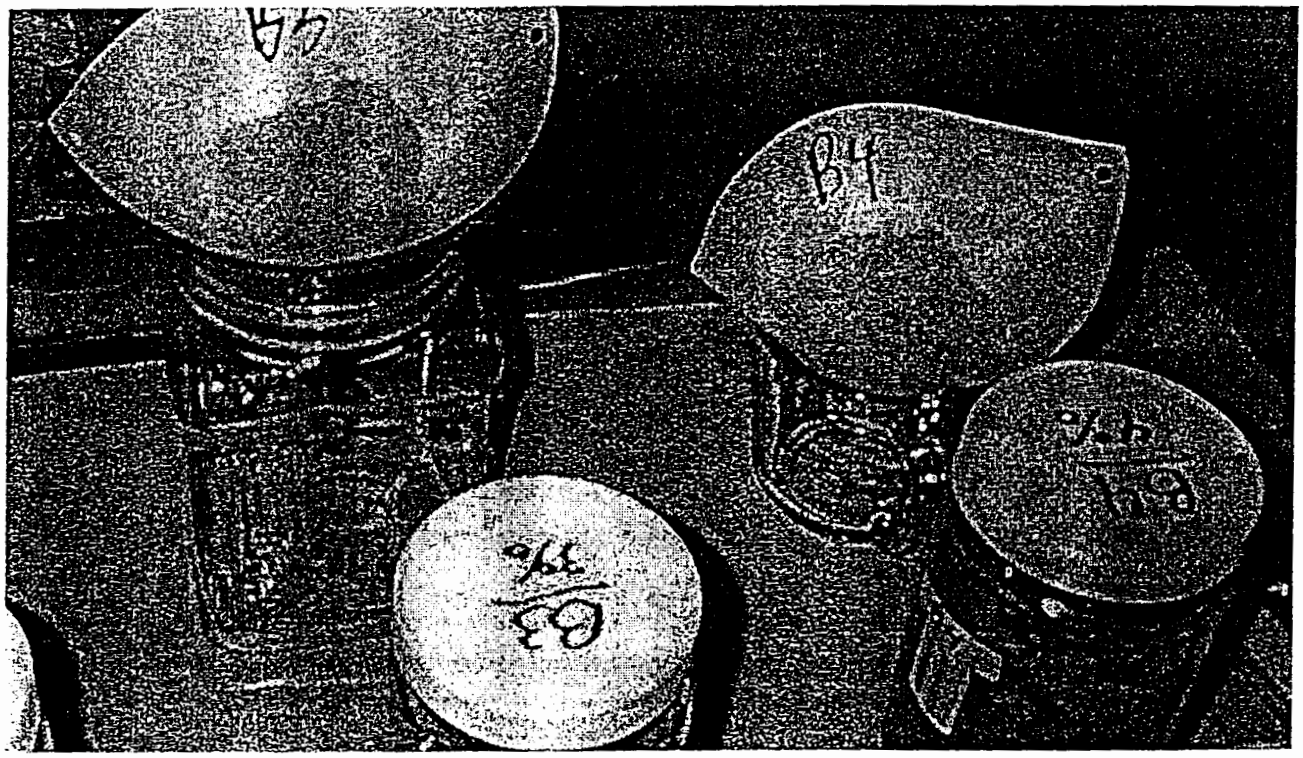


Photo 4

Tank A "Peat" Sludge

Photo 5

Tank A "Peat" Sludge Passing PFT

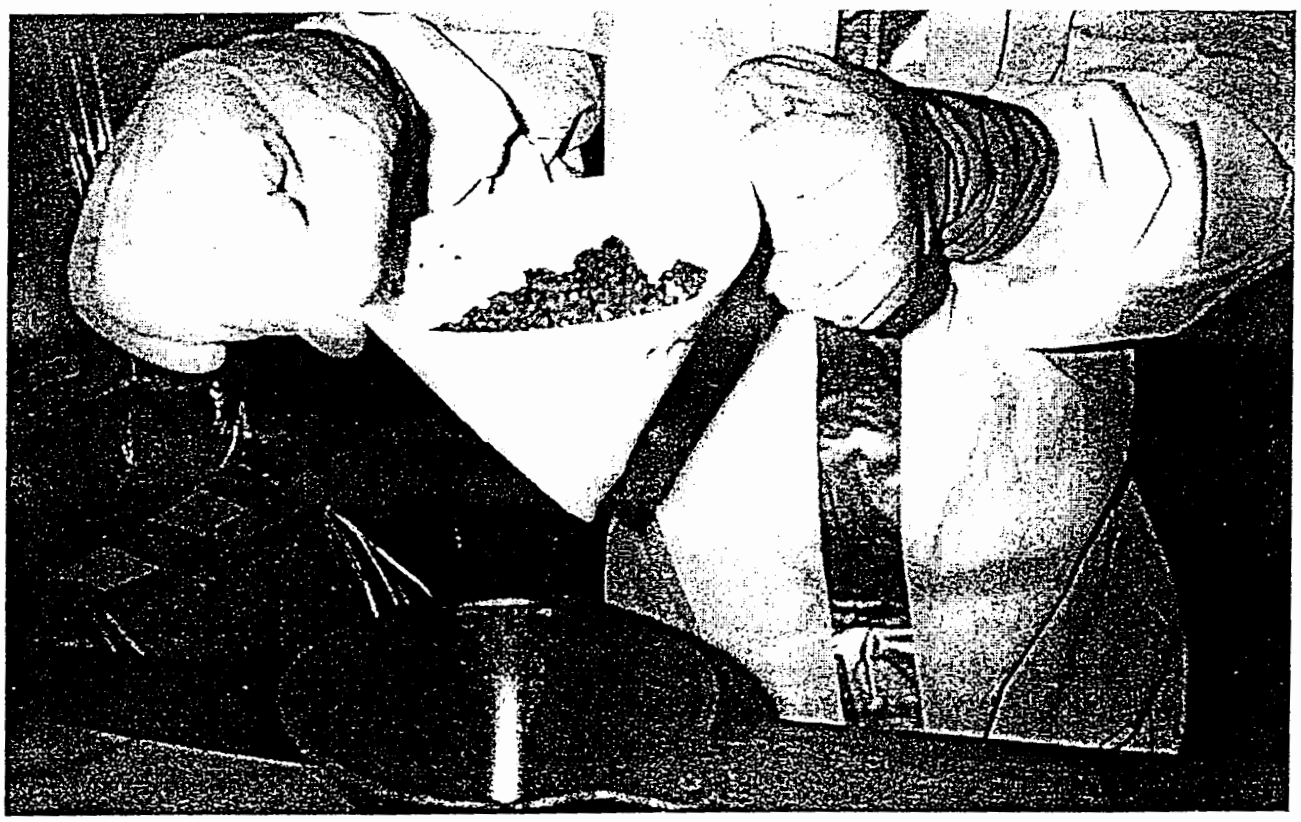


Photo 6

Tank A Dark-Water Passing PFT

Photo 7

Tank A Wet-Sludge

Photo 8

Tank A Wet-Sludge Passing PFT

ATTACHMENT C

SP-400 CRYSTALS LARGE-SCALE DEMONSTRATION RESULTS

WOLF

Project Report

WaterWorks Crystals® Waste Solidification Technology Deployment on Drummed Aqueous Low-Level Waste Water at the DOE LEHR Site

Sponsored By:
DOE Large Scale Demonstration and Deployment Program (LSDDP)
At the
DOE Miamisburg Environmental Management Project (DOE-MEMP)

June 30, 2001

Scott Altmayer
Earthline Technologies

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1.0 Introduction

2.0 Background

3.0 Technical Approach

4.0 Waste Characterization

5.0 Test Acceptance Criteria

6.0 Test Performance

7.0 Test Results

8.0 Conclusions

9.0 Appendices

1.0 Introduction

The Large Scale Demonstration and Deployment Program (LSDDP) is coordinated and funded through DOE's Office of Science and Technology (OST, EM-50). Throughout 2000, successful demonstrations were conducted on various using the SP-400 WaterWorks Crystals® (SP-400 Crystals) validate safe, cost-effective solidification processes for radioactively-contaminated wastewaters and sludge.

DOE's Laboratory for Energy-related Health Research (LEHR) site is located on the University of California – Davis Campus at the operational Institute of Toxicology and Environmental Health. Historically, DOE supported animal research at the laboratory which has been completed. However, a legacy of radioactive water and sludge from daily maintenance of the research kennels has resided in several rectangular underground concrete holding tanks for many years. In late 200 these tanks were emptied and demolished. The residues require some type of dewatering, solidification, blending. or thermal treatment prior to ultimate disposal.

This report summarizes the results of the full-scale solidification deployment on four drums of aqueous waste sludge that have been stored in drums since the underground concrete tanks were emptied in fall 2000. Appendix 1 is a series of field photographs during deployment. Appendix 2 is an executed copy of the field procedure used.

2.0 Background

Based on successful benchscale testing with WaterWorks Crystals® solidification of tank sludges and wastewater, the LEHR site has endorsed validation and deployment of full-scale solidification for several drums of waste. The full-scale solidification processes and recipes are based on successful completion of these benchscale tests.

In addition, this demonstration aided LEHR to perform an additional waste form evaluation and solidification validation test on a drum of partially-solidified decontamination waste water that represents 90 drums of decon water and/or higher-mineral $CaCO_2$ waste water that was generated during tank demolition in fall 2000. Preliminary information indicates that inadequate quantities of absorbent were used during a rain storm event.

Finally, LEHR may also perform independent durability and vibratory testing of selected samples from this full-scale demonstration to validate the safety margins for these waste forms in storage and/or transit.

3.0 Technical Approach

LEHR personnel provided input to the field procedure (Appendix 2) based on site-specific needs. The basic approach was to select up to four drums of waste and solidify them for disposal (or follow-on durability testing, as required). The goal was to validate different blending techniques and variable ratios of WaterWorks Crystals® under actual field conditions that would be controlled by Integrated Safety Management System (ISMS) guidelines applied at the LEHR site.

4.0 Waste Characterization

Process knowledge, visual inspections, and analytic data from the tanks were used to infer drum contents. The drums contained a brownish water with less than 5 vol% solids at the bottom. Analytic results for the tank sludges are as follows:

LEHR Site: Tank Sludge Analytic Data					
Waste Name/ Description	**Waste Form**	**Waste Vol.**	**RAD Data (max)**	**RCRA Data (max)**	**Comments**
Tanks A through H Septic/Storage "Gray-Water"	1" – 6" liquid and underlying fine silt layer)	1000 gallons	Sr-90 < 18,600 pCi/g (Incidental H-3, Th-232, Cs-137)	Detectable < RCRA LDR's	Tanks had been originally cleaned out. More water than expected due to potential tank in-leakage. Use of biocides, lime, and pH are unknown.

5.0 Test Acceptance Criteria

The LEHR Site requirements were to solidify several drums of contaminated water to pass the USEPA Paint Filter Test (PFT), Method 9095. The typical "2x" safety margin requirement to use sufficient absorbent to handle twice the free-liquid was also invoked as a typical LEHR Site requirement and incorporated as part of this test. The key objective at LEHR Site was to solidify waste so it is acceptable for transport and burial.

Benchtesting showed that for the Tank A –H sludges 2 wt% - 4 wt% WaterWorks Crystals® was required to pass the Paint Filter Test. These higher ratios are indicators

that lime, biocides, or other chemical stressors are present in the watery sludge. The typical "2x" DOT and disposal site safety margin (which can account for transitory vibration or chemical stressors) was not explicitly included in these benchtests. It is included in the full-scale deployment validation. Five drums of wastewater were staged and WaterWorks Crystals® were added in ratios of 2 wt% - 8 wt%.

6.0 Test Performance

The full-scale solidification tests were scheduled and performed on March 22, 2001. The key project personnel were John Wolf (supervisor), Ed Chun (field engineer), Steve Sorrell (field support), and Kimberly Warren (safety oversight). The Project Supervisor coordinated site training, work permit approval, and a facility walkthrough in compliance with the ISMS requirements at the site. The test engineer (Scoitt Altmayer) identified the key potential hazards per the vendor MSDS as nuisance dust issues and potential slippery areas if absorbent is wetted on a smooth hard surface.

The preparations, tailgate safety meeting, and setup started at 9:30 AM on March 22. Radiological conditions for the waste were as follows: 50 ur/hr beta/gamma, 30 ur/hr beta/gamma at 30 cm, loose contamination at 10,000 dpm/100 cm^2 beta/gamma inside the drums. The outside temperature was moderate so that personnel heat stress issues were unlikely.

At 10:00 AM the workers donned PPE, entered the work zone, and prepared the work area while the absorbent was premeasured in a clean area and containerized. At 11:00 AM the first drum was opened, inspected, photographed. The internal drum lid was covered with condensate droplets (estimated 50 ml.) that condensed and dripped back into the drum. Between 11:00 and 12:00 the four drums were solidified in sequence. Sometimes a rotary paint-stirrer was used to evaluate the potential process risks (i.e. electric exposure, contamination spread, airborne contamination) and improvements.

An unexpected occurrence was that most of the lined drums contained water between the stiff plastic liner and the drum due condensation and/or leakage through liner failures. The liners were pulled back at four radial locations (i.e. 0°, 90°, 180°, 270°) to expose the water at the drum base and approximately one pound of absorbent was placed around the perimeter of the liner to solidify this water or future water that could accumulate.

At 12:20, the partially-solidified drum was evaluated. A preliminary paint filter test failed and indicated that 5 cc of liquid was quickly released. Based on successes in the previous hour, we calculated that at the minimum 2 wt% ratio, approximately 3 lbs. of additional absorbent was needed to pass the paint filter test. This material was added, blended with a stirrer, and a grab sample subsequently passed the paint filter test.

Successful solidification on all five drums of wastewater and a project debriefing were completed by 12:30 PM the same day. The process went smoothly and safely.

7.0 Test Results

The results of the full-scale testing on LEHR waste water were successful and are detailed in the executed copy of the field procedure (Appendix 1) along with photographs taken by the LEHR Project Supervisor (Appendix 2). In summary, all the drums solidified within 15 minutes of adding the WaterWorks Crystals®. Additional blending with a paint blender on a drill helped speed the process. The result was a spongy waste form that readily passed the PFT.

There were five tests performed ranging from 2 wt% - 8 wt% of WaterWorks Crystals®. All five tests passed, as outlined below:

LEHR Site:
SP-400 WaterWorks Crystals® Solidification Tests on Tank Sludge/Water

Test No.	Drum No.	Waste Weight	SP-400 wt% (Waste: SP-400)	SP-400 Added	Key Field Notes	Paint Filter Test (PFT)
1	1452	150 lb.	2 wt% (50:1)	3 lb.	No mix, 3 min. top center solid, 8 min. complete vibe samples: 1 @ 1000 ml.	PASS
2	1451	300 lb.	4 wt% (25:1)	12 lb.	Power mix 30 sec. 2 min. top center solid, 8 min. complete vibe samples: 1 @ 1000 ml.	PASS
3	1450	300 lb.	6 wt% (16:1)	18 lb.	Power mix 10 sec. <1 min. top center solid, 2 min. complete vibe samples: 2 @ 500 ml.	PASS
4	1449	300 lb.	8 wt% (12:1)	24 lb.	Power mix 10 seconds, <30 sec. top center solid, 45 seconds complete vibe samples: 2 @ 500 ml.	PASS
5	1566 (partial solidified)	415 lb.	2 wt% (50:1)	5 lb + 3 lb extra	Power mix for 30 seconds and it solidified to prevent further mixing	PASS

8.0 Conclusions

LEHR Site waste management personnel coordinated a short closeout meeting to summarize the success of the LSDDP full-scale testing. The success of this full-scale test at LEHR confirmed the use of direct solidification using WaterWorks Crystals® as a safe and cost-effective method to directly bind wastewater and eliminate free-liquids during handling, shipping, and disposal.

In summary, wastes from the LEHR tanks (i.e. water or sludge) will require at least 2 wt% WaterWorks Crystals® (or approximately 9 lbs. for each filled 55-gallon drum of waste). Passive solidification will occur with no mixing in less than fifteen minutes. Mixing can speed the solidification/set-up process down to 2 minutes and requires a more personnel exposure.

Many containers have water trapped between the liner and the drum. Care should be taken to manage, transfer, and solidify this residual along with the waste inside the liner. If wastes must be transferred to new shipping/burial containers, consider using larger ones (i.e. B12, B25, or new waterproof Lift-Liner ®).

9.0 Appendices

Appendix 1 Solidification Photos

Appendix 2 LEHR Site Full-Scale Field Deployment Procedure, (executed copy)

Appendix 1

Full-Scale Solidification Photos for LEHR Tank Sludge/Water

Photo Number	*Photo Description*	*Photo File Name*
1	LEHR Test Area Setup with Field Crew	Saa001
2	LEHR Test Area Setup	Saa002
3	Staged Absorbent	Saa003
4	Staged Absorbent (with lot number)	Saa004
5	Drum #1452 - Wastewater	Saa005
6	Drum #1451 - Rotary Stirrer and PPE	Saa006
7	Drum #1451 - **PFT and Jar Sampling	Saa009
8	Drum #1450 - Solidified	Saa008
9	Drum #1450 - Solidified (with scoop stuck vertical)	Saa009
10	Drum #1450 - PFT	Saa010
11	Drum #1450 - PFT and Jar Sampling	Saa011
12	Drum #1566 - Partially-solidified	Saa012
13	Drum #1566 - PFT Failure (> 5 cc liquid)	Saa013
14	Drum #1566 - PFT Failure (running liquid)	Saa014
15	Drum #1566 - Rotary Stirrer	Saa015
16	Drum #1566 – Solidified to Pass	Saa016

**PFT = USEPA Paint Filter Test

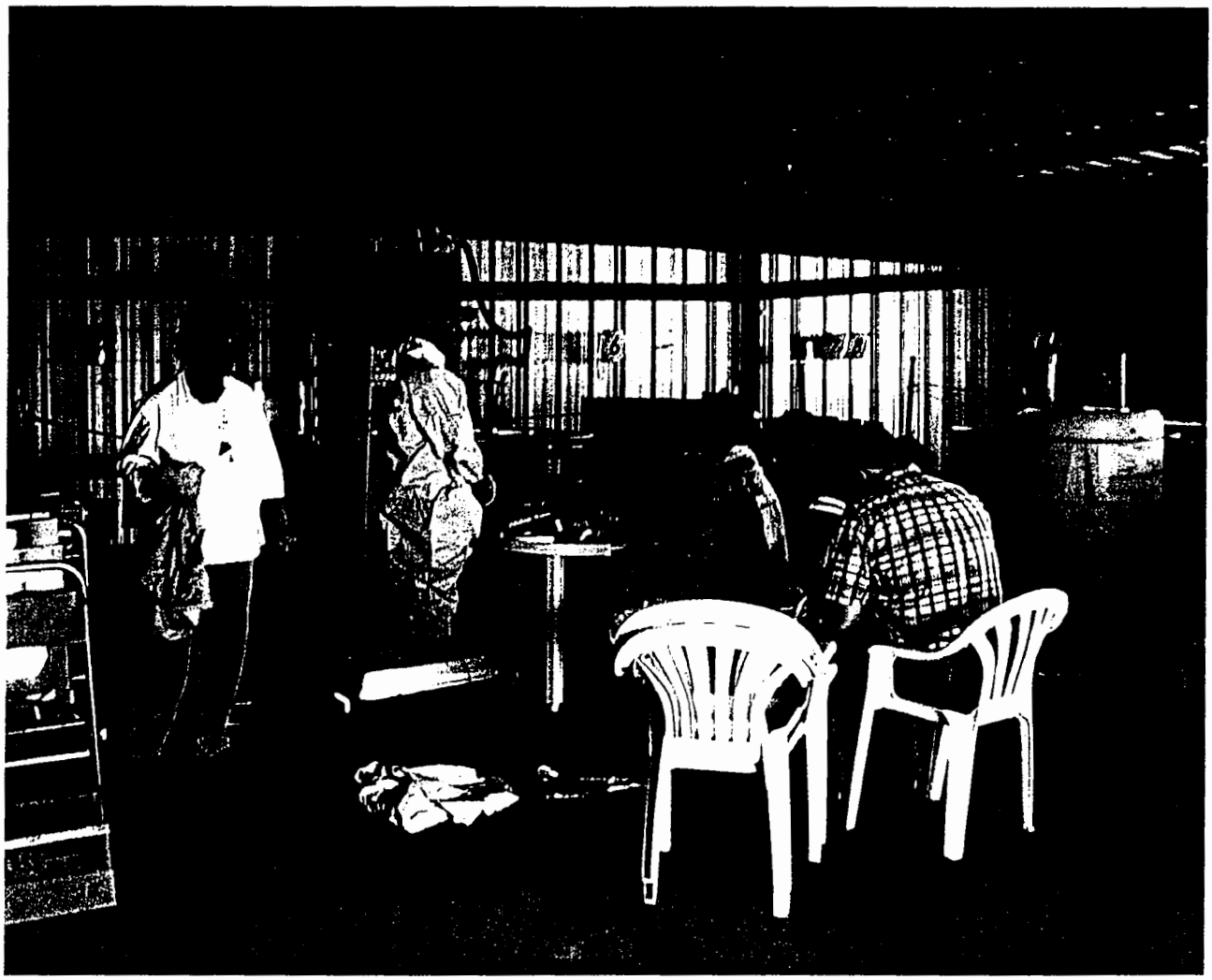


Photo 1

LEHR Test Area Setup with Field Crew

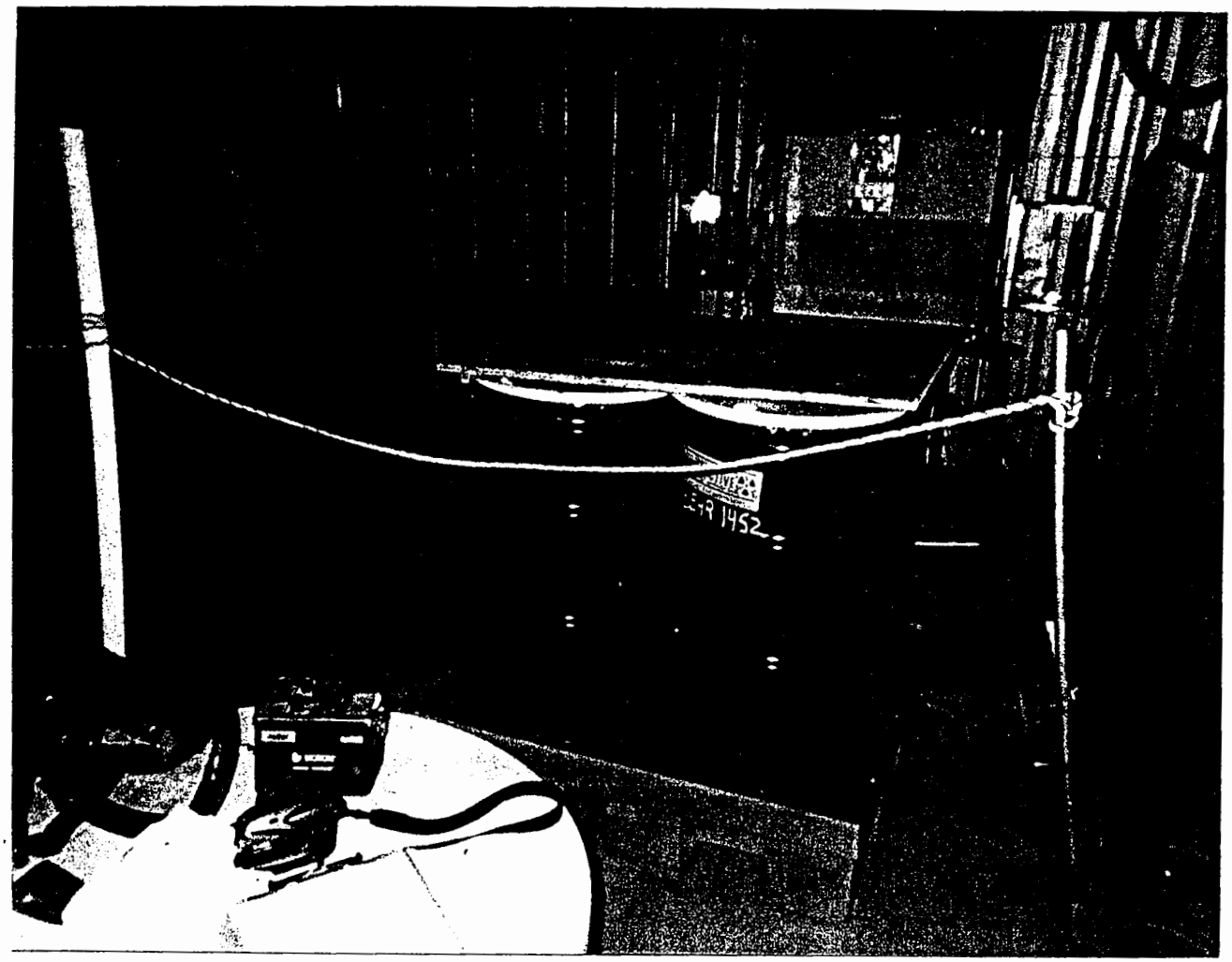


Photo 2

LEHR Test Area Setup

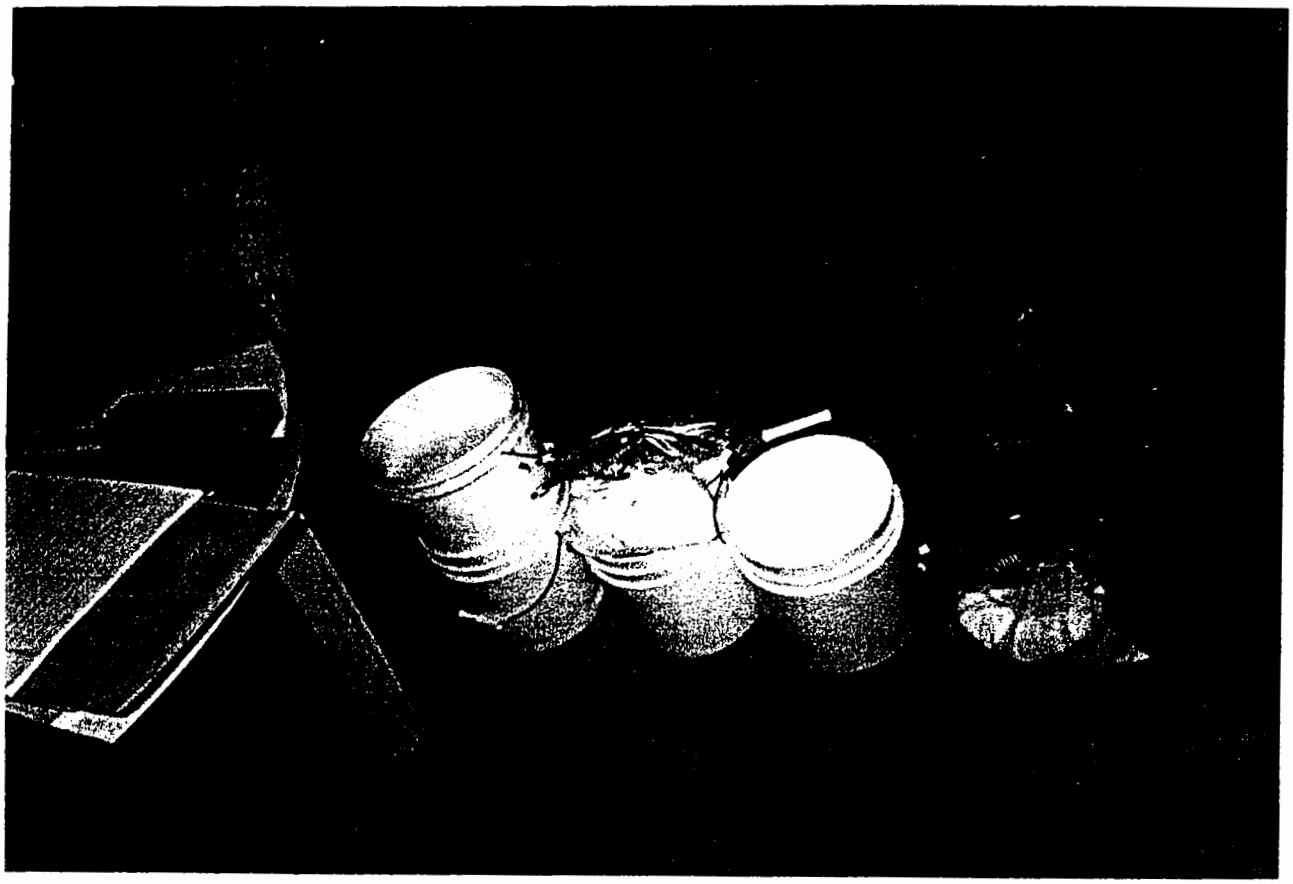


Photo 3

Staged Absorbent

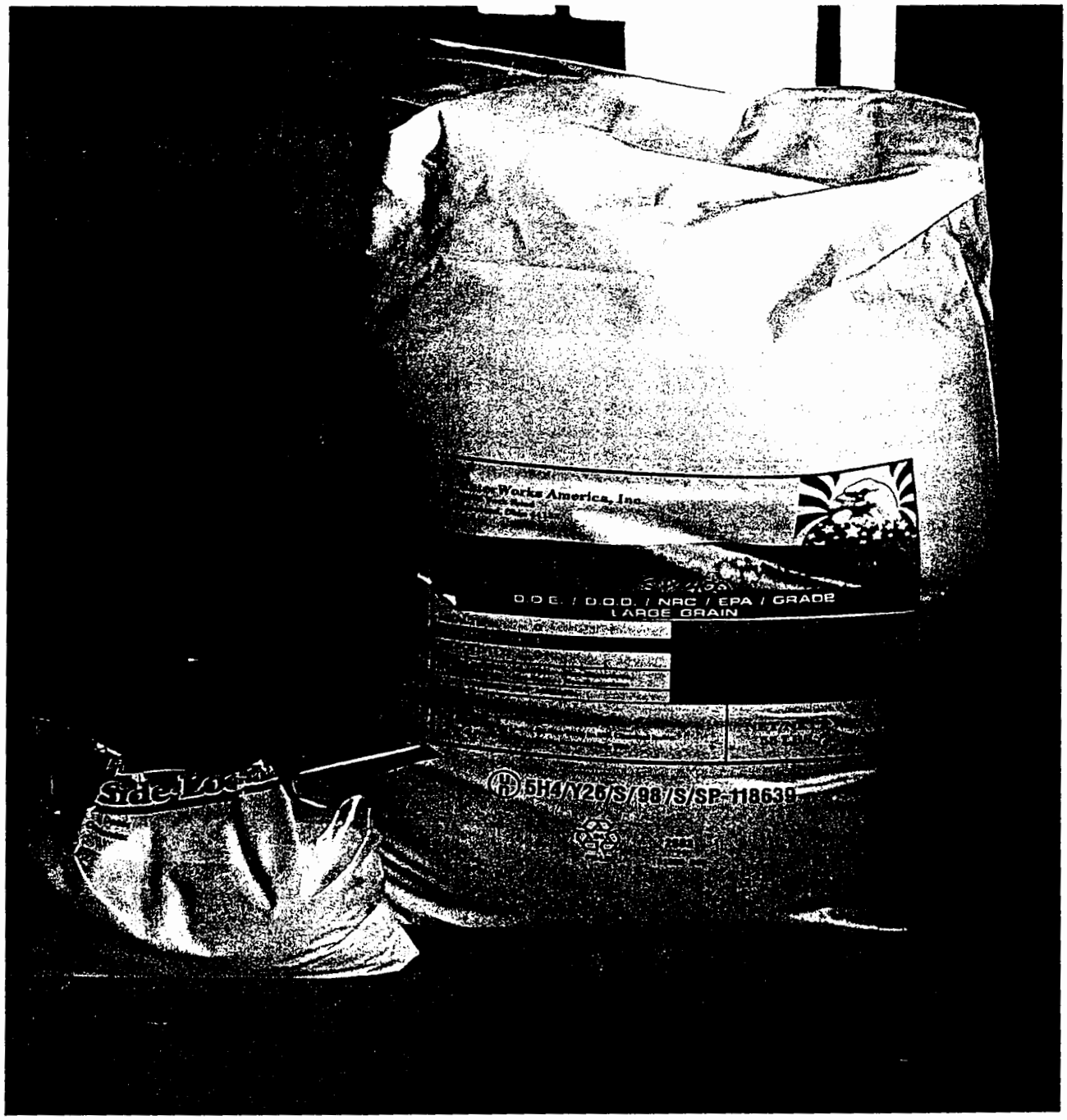


Photo 4

Staged Absorbent (with lot number)

Photo 5

Drum #1452 - Wastewater

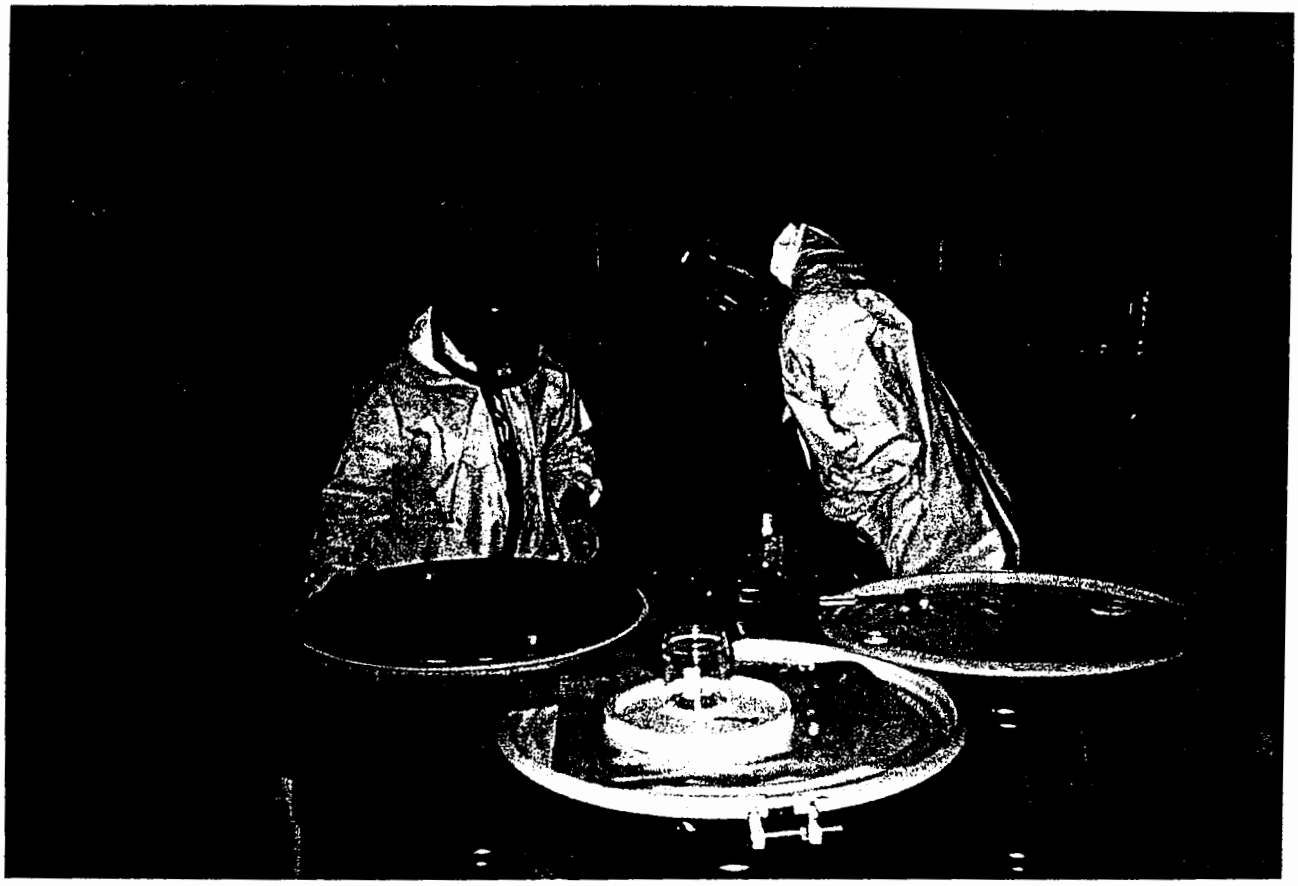


Photo 6

Drum #1451 - Rotary Stirrer and PPE

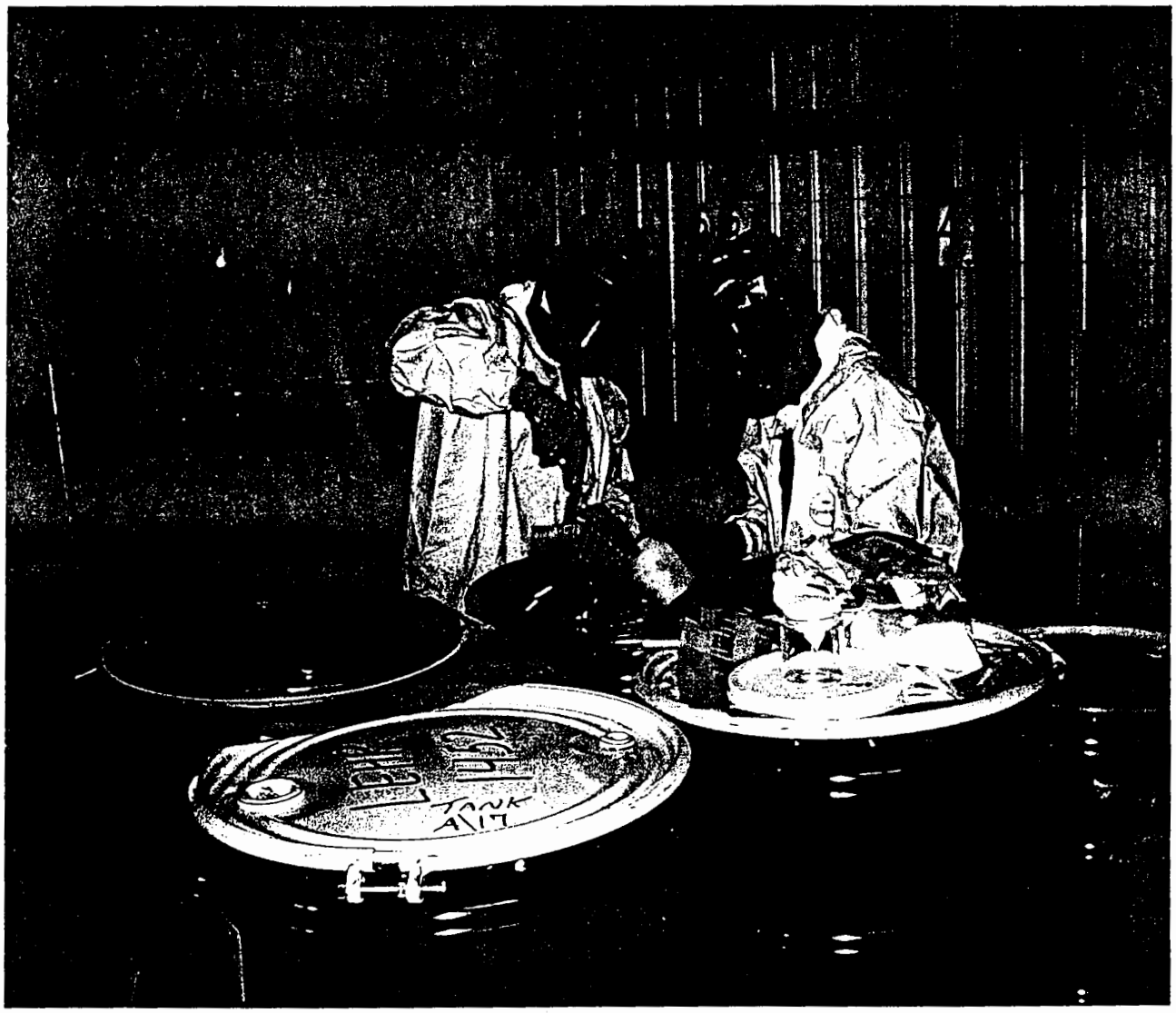


Photo 7

Drum #1451 - PFT and Jar Sampling

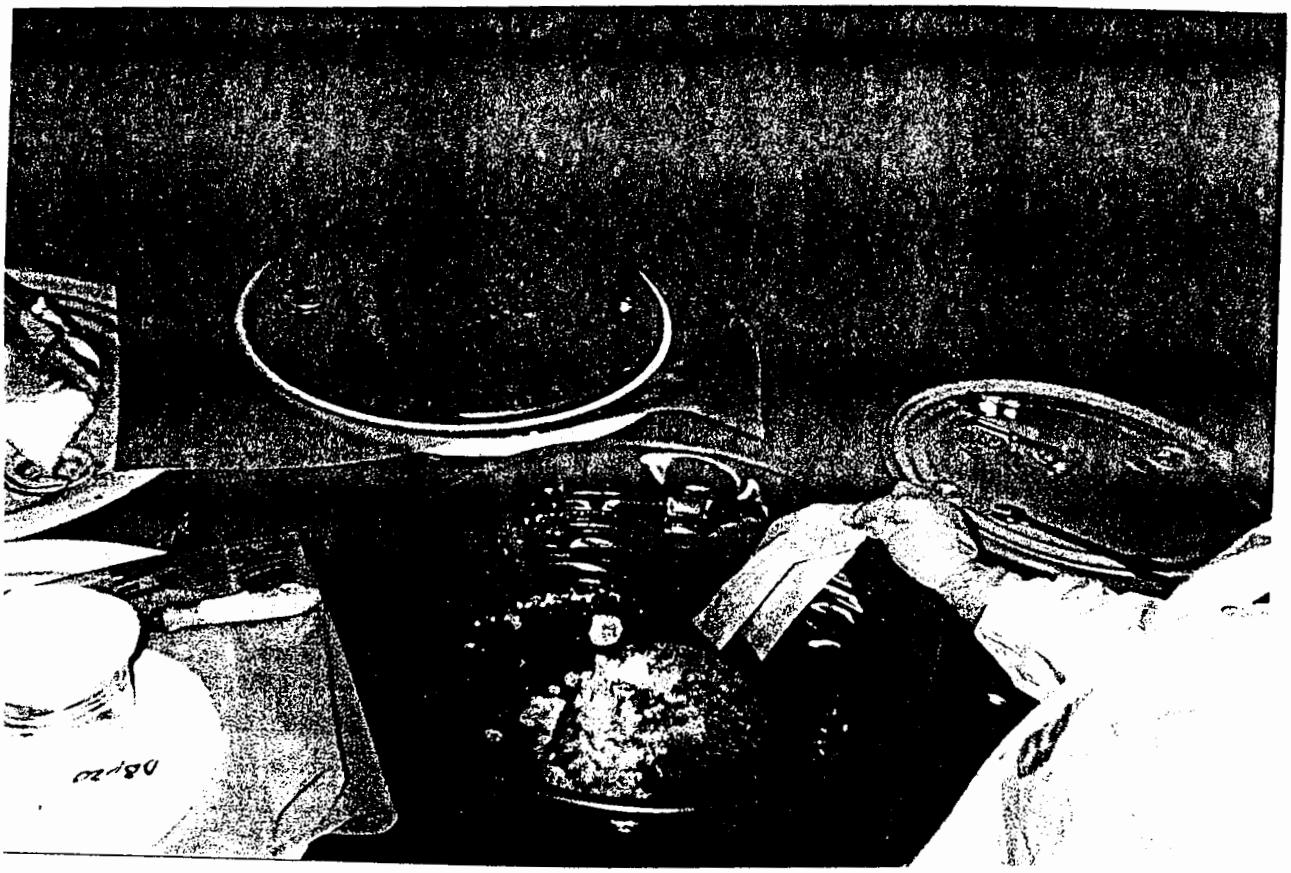


Photo 8

Drum #1450 - Solidified

Photo 9

Drum #1450 - Solidified (with scoop stuck vertical)

Photo 10

Drum #1450 - PFT

Photo 11

Drum #1450 - PFT and Jar Sampling

Photo 12

Drum #1566 - Partially-solidified

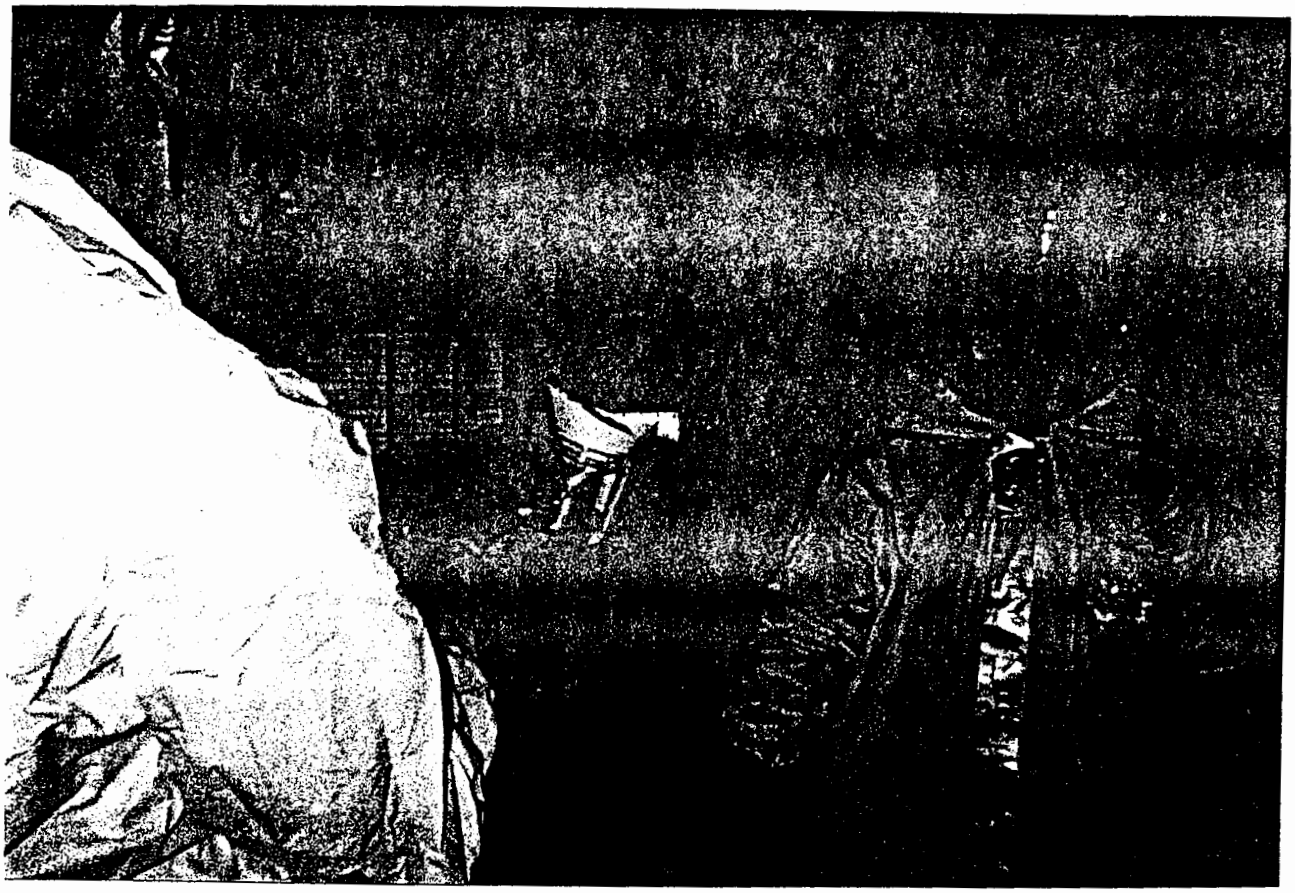


Photo 13

Drum #1566 - PFT Failure (>5 cc liquid)

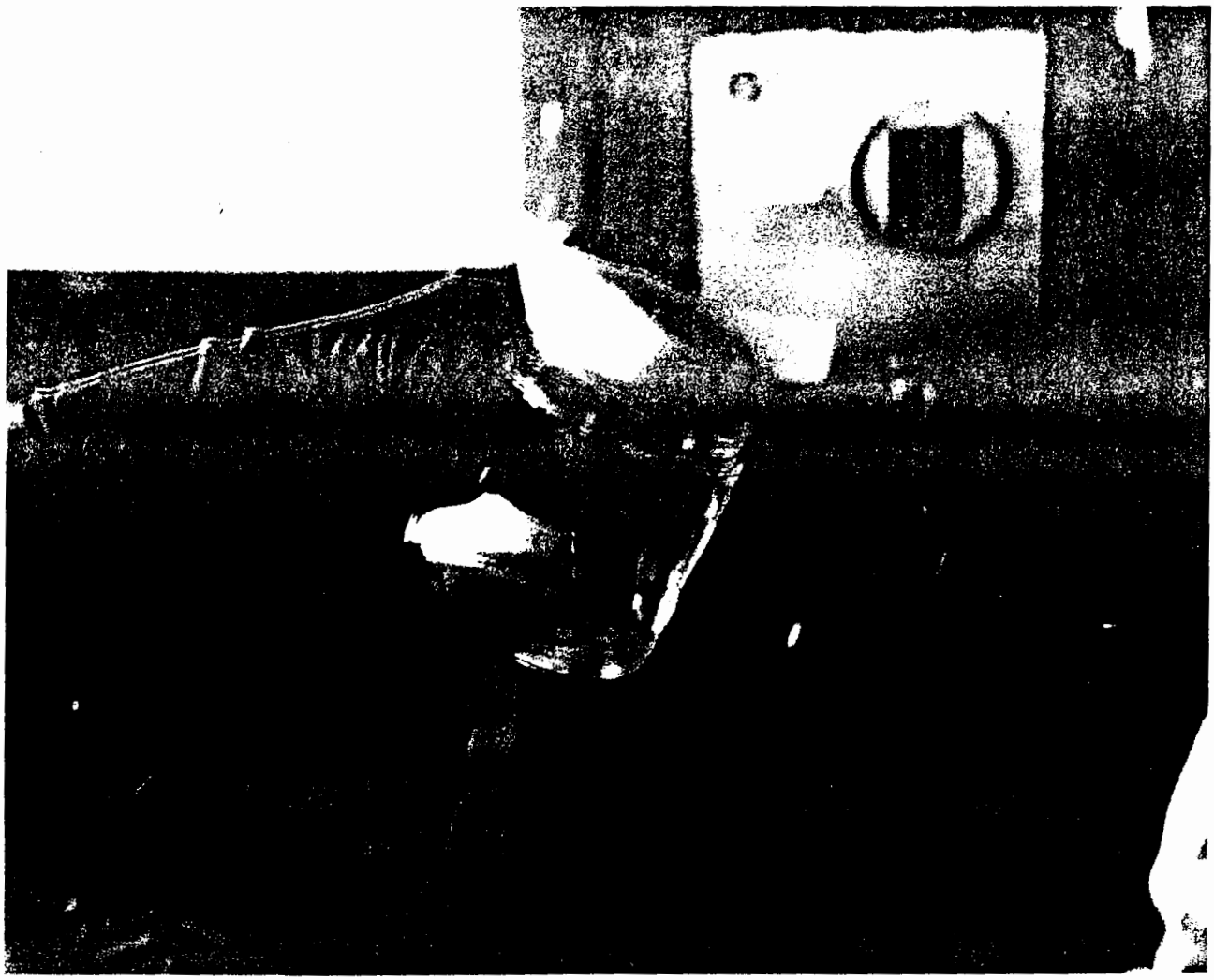


Photo 14

Drum #1566 - PFT Failure (running liquid)

Photo 15

Drum #1566 - Rotary Stirrer

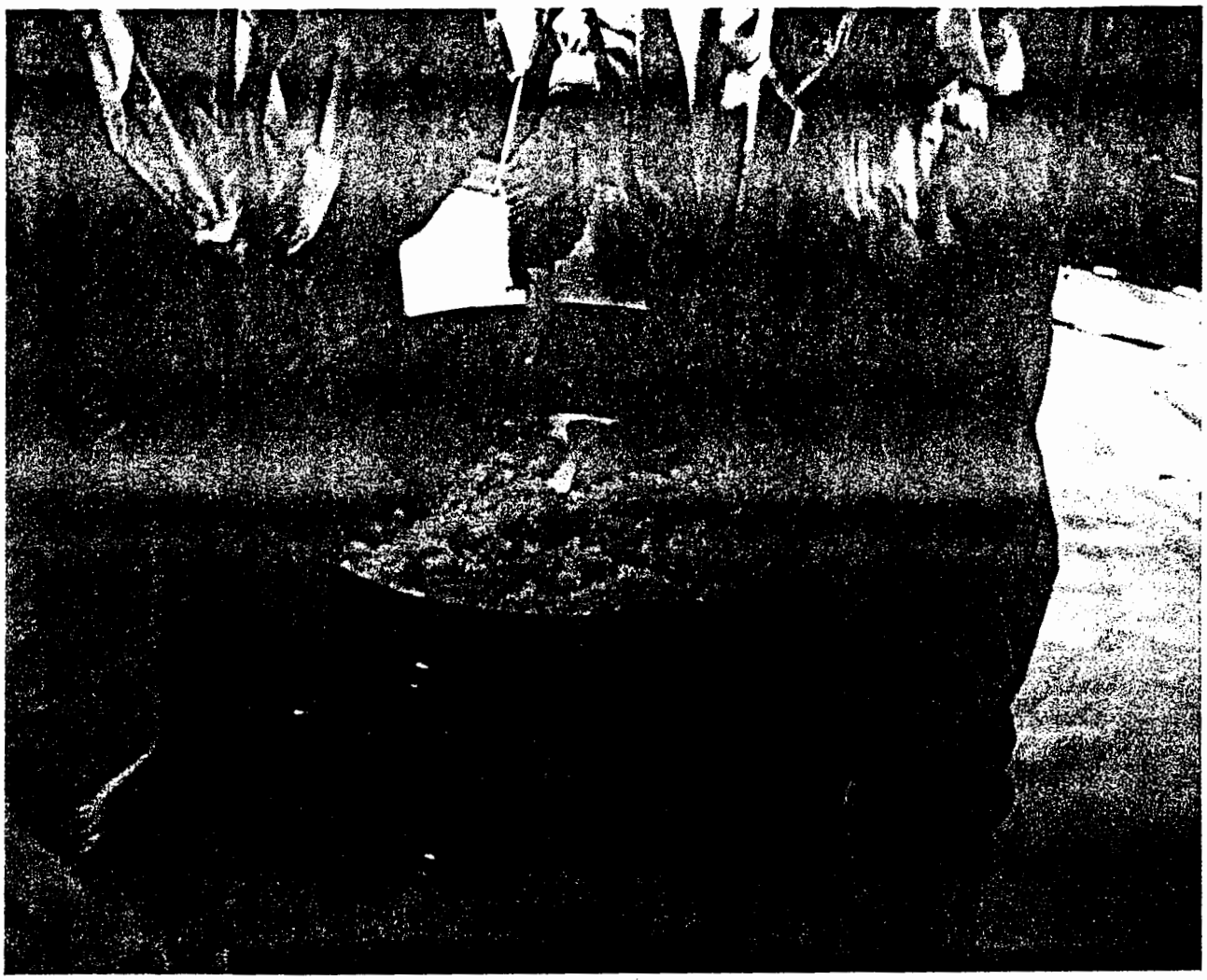


Photo 16

Drum #1566 – Solidified to Pass

Appendix 2

LEHR Site Field Procedure (Executed Copy, March 22, 2001)

(attached)

LEHR Site Full-Scale Field Deployment Procedure

Low-Level Waste (LLW) Aqueous Septic Sludge Solidification at the LEHR Project

(Fianl Draft, 3/14/01)

Executed JAO 3/22/01

1.0 Introduction/Background

The DOE-Mound Large Scale Demonstration and Deployment Project (LSDDP) is coordinated and funded through DOE's Office of Science and Technology (OST, EM-50). In CY 2000, successful benchtop testing was completed at DOE's Laboratory for Energy-related Health Research (LEHR) facility using the SP-400 WaterWorks Crystals© (SP-400 Crystals) aqueous superabsorbent polymer solidifier. The results validated the probable cost-savings and safety improvements that could be realized by directly and safely solidifying contaminated wastewater and sludge for direct disposal. Based on these successes, the LSDDP is performing a full-scale deployment on several drums of waste water at LEHR.

2.0 Deployment Team

The following personnel are the proposed contacts who will be involved with staging and performance of the deployment at LEHR:

Title	Name	Company
Project Supervisor	John Wolf Ed Chun	Weiss Associates
LSDDP Test Engineer	Scott Altmayer	Earthline Technologies

3.0 Objectives

1. The objective of deployment at LEHR is to solidify several drums of aqueous waste at LEHR to determine the appropriate blending techniques, safety margin, and costs associated with different ratios of SP-400 Crystals.

2. Perform a field verification of the final waste form(s) using the general guidance from the USEPA Paint Filter Test (SW-846, Method 9095) (Attachment B). *(Note: This is not required to be a certified EPA test.)*

3. Send verification samples of solidified sludge and solidified waste water to a laboratory to evaluate vibratory release of solidified wastes.

4.0 Screening/Selection

The LEHR waste inventory includes tank sludges and water contaminated with Sr-90 to approximately 20.000 pCi/g as outlined below:

Waste Name/ Description	Waste Form	Size/ Net Wt.	**RAD Data (max)	RCRA Data (max)	Comments
Tank A Septic/Storage Sludge and "Dark-Water"	Thick compost-like sludge	1,000 gallons	Sr-90 < 18,600 pCi/g	Detectable ≤ RCRA limits	More sludge than expected due to potential in-leakage. Use of biocides or lime and pH value are unknown.
Tank B Septic/Storage "Gray-Water"	"Gray water"	3,000 gallons	Sr-90 < 18,600 pCi/g	Detectable < RCRA limits	More water than expected due to potential in-leakage. Use of biocides or lime and pH value are unknown.

As summarized by the Project Supervisor, the LEHR project has many drums of watery sludge stored in drums that were pumped from a former septic storage tank. The intent of this LSDDP demonstration is to directly solidify at least two of these drums by direct addition of SP-400 Crystals. The final wasteform should be suitable to allow for either transfer to other larger containers and/or direct follow-on shipment and burial as a solid low-level waste to Envirocare of Utah.

5.0 Characterization/Analysis

The data and analysis has been reviewed by the site as accurately describing these liquid wastes. Quantitative measurements on rad and RCRA content are available. Information on total dissolved solids, pH, total suspended solids, moisture content, and/or viscosity is not available. Typical application of SP-400 Crystals at other sites are consistent with its use at LEHR.

6.0 Operations

6.1 Prerequisites

Perform a pre-job briefing for the team to clarify LSDDP and LEHR objectives and discuss the following:

- hazardous work permit
- facility location
- Review field documents, project HASP, ALARA plan, and applicable SOP's
- potential hazards of wastes (i.e. physical, rad, chemical)
- Review MSDS's for SP-400 WaterWorks Crystals©
- equipment and tools (i.e. scale, colliwasa, test beakers, spill pads)
- residue/waste management, storage, and disposal
- spill control and emergency response actions
- Stop Work issues

— Also covered Int. Safety Mgmt. System (ISMS) - attached

6.2 Equipment/Supplies

The following equipment needs to be prepared and staged in the work area(s):

By: LSDDP Test Engineer	By: LEHR Project Supervisor
WaterWorks Crystals® SP-400 (2 ea., 55 lb. bag)	Facilities (with ventilation hoods, as needed)
Paint Filters (Mesh #60, 423 micron, fine-mesh)	Facility MSDS Approvals
	Camera (by engineering)
	Flat Surface/Table (for bench tests) Power Cords (optional) Mixer/Blender (optional)
	Paper Towels Disposable gloves/PPE
	Lab Scale (5 kg ± 5 grams) NA Drum scale (500 lb. ± 1 lb.) NA Plastic cups NA > 500 ml. Sample Jars w/lids (5 ea.) Plastic Jars Vibes Sample Litmus/pH paper (optional)
	Empty Containers (bucket, bag, drum, box) Plastic liners (optional) Wrench (for lid and bung removal)

6.3 Solidification Sequence

Note: Solidification here means to process the water/sludge to pass the Paint Filter Test.

1. Verify/Transfer drum(s) of watery sludge to work area.

2. Benchtests B2, B3, and B4 showed that 2 wt% - 4 wt% SP-400 Crystals was required to pass the Paint Filter Test. These high ratios are indicators that lime, biocides, or other chemical stressors are present in the watery sludge. The typical "2x" DOT and disposal site safety margin (which can account for transitory vibration or chemical stressors) was not explicitly included in the benchtests. It is included in the full-scale deployment validation.

Scott Attinger 3/24

LARGE SCALE DEMONSTRATION

****

Based on results of benchscale tests, and input from LEHR personnel, a set of recommended ratio/mixture will be selected for use on one or more containers of waste. Perform solidification test in a controlled area to prevent spilling and as directed by Project Supervisor. Record results in table.

****

3. Use the plant scale to measure gross, tare, and net weight of waste. Record below.

4. Identify the solidification container (i.e. drum, supersack-inside-lined B12V box) and weigh-out the appropriate amounts of SP-400 Crystals, as needed.

5. Blend/transfer the SP-400 Crystals and/or waste into each container as directed by safety, operations, and LSDDP Test Engineer.

6. Record observations and wait at least fifteen minutes before performing the Paint Filter Test.

7. Perform informational Paint Filter Test (ref. Att. B) on a nominal 200 gm. grab sample. *(Note: Attempt to get a non-surface "at-depth" sample from the containers.)*

Drum Layout

2	3
4	1

↑ Front

Wasteform / Drum Identification	Drum 1 # 1452	Drum 2 # 1451	Drum 3 # 1450	Drum 4 # 1449	Drum #5 #1564
Start Date 3/22/01	3/22/01	3/22/01	3/22/01	3/22/01	
Gross Wt. (1)	NA	NA	NA	NA	
Tare Wt.	NA	NA	NA	NA	(See Next Page detail)
"Target" Net Wt. (Note 1)	400 lb.	400 lb.	400 lb.	400 lb.	
(1) Actual Net Wt.	150 lb	300 lb	300 lb	300 lb	415 lb
"Target" SP-400 Ratio	2%	4%	6%	8%	2%
Actual SP-400 Ratio	2%	4%	6%	8%	2%
"Target" SP-400 weight	8 lb.	16 lb.	24 lb.	32 lb.	8.3 lb
Actual SP-400 weight	3 lb.	(2 gal bucket) 12 lb.	18 lb.	24 lb.	5+3=8
Time Added (=T_0)	11:17	11:40	11:55	12:07	12:30
Solidification Observations (2)	Clear, 1/3 Clear Back 11:20	Clear, 2/3 Power Mix 30 sec.	Clear, 2/3+ Power Mix 10 sec	Clear, 2/3+ Power Mix 10 sec	Thicker with mixing
Time Started (=T_0 + 15 min.) not hold	11:25	11:42	11:57	12:10	12:30
Informational PFT (5 minute hold: Pass/Fail)	Pass	Pass	Pass	Pass	Pass
Other Inspections or Observations	Fast Solidify	Solidify before mix done	Solidify < 1 min Hard to Shovel	Solidify 45 sec.	none

Note 1: Target values account for "2x" margin that was not explicitly evaluated in benchtests.

(1) Based on 2/3 or 1/3 full to loops.

(2) Minor condensation between liner + drum. Add ≈ 16 oz so-best

Questions and answers

Additional Test

Drum 5

3/22/01

Semi Solidified Drum of Decon Water

LEHR Drum #1566

History: ~5# added to 45-50 gal in Fall 2000 (ongoing rain storm)

.012
415) 500
415
550
= 1.2%

(8.3 / 150 / 400 / 415#

80:1
5) 415
5/415 =

Date: 3/22/01

Initial PFT: Start Time: 12:20

End Time: 12:21

1.2% Results: Fail ("slushy")

≈ 5 cc free liquid

If Addition @ 2 wt%

Use this per John Wolfe.

415 lb x .02 = 8.3 #

8.3# − 5# = 3.3# needed

(→ used 3# ←)

If Addition @ 3 wt%

415 x .03 = 12.5#

12.5# − 5# = 7.5# needed

New PFT: Start Time: 12:30

End Time: 12:35 – mixer bogged down as it thicken

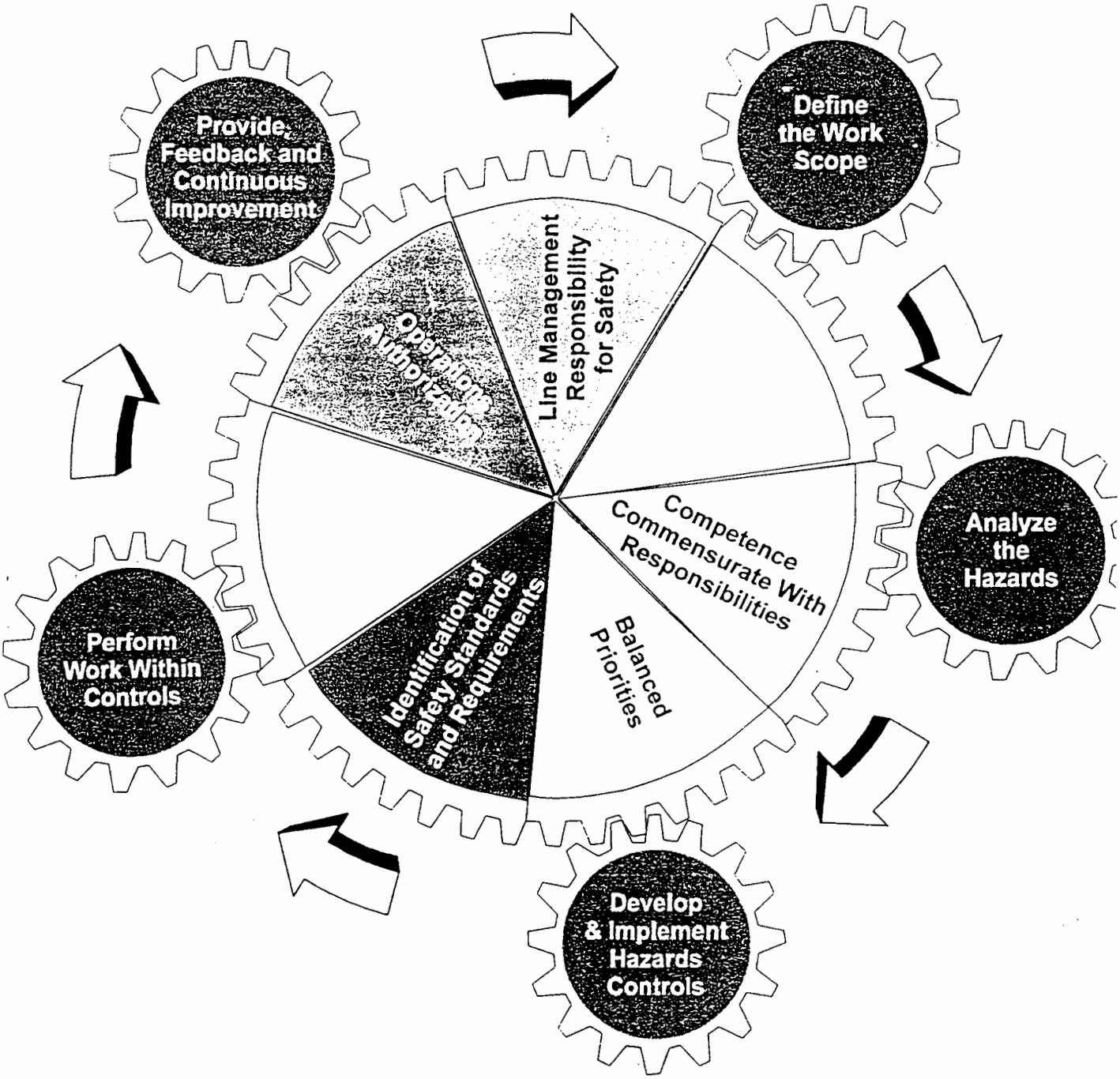
.0192
415) 800
415
3850
3735

2 wt% Results: Pass

1.92

Rcvd 3/22/01

LEHR Integrated Safety Management



ISMS Principles and Functions

RESIDUE MANAGEMENT

8. Collect samples for off-site vibratory analysis. Waste will be returned to drum of origin.

$\bar{X}_{wet} \approx 20{,}000$ pCi/g $X_{min} =$

9. After completion of fullscale tests, decon tools and place all job control waste (i.e. decon, rags, pads, containers) in proper receptacles per direction of Project Supervisor.

10. Use SP-400 Crystals, or equivalent, to complete solidification on any wastes that were not completely solidified during these demonstrations, as requested by Project Supervisor. not needed

11. Place/return all demonstration samples (benchscale, fullscale) in a segregated area per direction of the Project Supervisor for ongoing inspection/evaluation or off-site analysis, as required.

12. Project Supervisor will perform a waste evaluation on the demonstration samples (benchscale, full-scale) before final disposition, processing, and disposal.

7.0 References

Project Report, "WaterWorks Crystals® Solidification Technology Deployment on Aqueous Low-Level Waste Sludges at the DOE LEHR Site", September 15, 2000

8.0 Attachments

Attachment A – [reserved] (not used)

Attachment B – Paint Filter Test

Attachment B

USEPA Paint Filter Test (Method 9095)

Attachment D

METHOD 9095

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter: Mesh number 60 (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden for an approximate cost of $0.07 each.

4.2 Glass funnel: If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel is to be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker: 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected according to the directions in Chapter Nine of this manual.

6.2 A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter.

7.3 Allow sample to drain for 5 min into the graduated cylinder.

7.4 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None required.

Attachment B

USEPA Paint Filter Test (Method 9095)

METHOD 9095

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9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None required.

ATTACHMENT D

VIBRATION TEST RESULTS

EARTHLINE
TECHNOLOGIES
A Division of RMI Titanium Company

P.O. Box 579
Ashtabula, Ohio 44005-0579
(440) 992-7442
Fax (440) 993-1995

July 20, 2001

Mr. John Wolf
Weiss Associates
5421 Christie Ave, Suite 600
Emeryville, CA 94608

SUBJECT: Sample Analysis of Solidified Radioactive Waste

Dear Mr. Wolf

Refer to the attachment please find the final report, which indicate the findings on the water and sludge samples. This completes the work under Contract No. 1284006-01-P-006.

If you have any questions or concerns, please contact me at (440) 993-2082.

Best regards,

Muthana Al-Quraishi
Engineer
Earthline Technologies

C:

John Hughes
Jeff Kulpa
Scott Altmayer

EARTHLINE
TECHNOLOGIES
A Division of RMI Titanium Company

P.O. Box 579
Ashtabula, Ohio 44005-0579
(440) 992-7442
Fax (440) 993-1995

Final Report

The Pourability, Vibration, and Paint Filter Tests have been performed and gathered the following findings:

1. Both the sludge and water samples **FAILED** the ASTM D4359 Pourability test. When the can was inverted onto the ring stand in a vertical position over the tared watchglass, there was an appreciable flow from the can before the 3 minutes were up, immediately stopped the test and placed the can in an upright position (the same scenario in both samples).

2. In the Vibration Test, a custom fabricated horizontal vibration table was used to provide repetitive shocks to the specimen. Placed the test specimen on the test machine platform and started the vibration on the platform, and steadily increased the frequency by increasing the air pressure up to 26 psi (to provide a continuos repetitive shocks), until some portion of the test specimen repeatedly leaved the test surface. To ensure that the test specimen received a continuing series of repetitive shocks, a shim with a 1/16" thickness and a width of 2" was used to determine when the test specimen is leaving the test platform by inserting it under the package, a minimum of 4", and moving it intermittently along one entire length of the package. The test continued at a constant frequency for three hours. A mass of 100 g or 100 ml was needed to perform the test.

100 ml of the water sample has been used for the vibration/Method 9095-paint filter test. After three hours of vibration at 16 psi, provided approximately 100 Hz. Upon the completion of the vibration test, a standard paint filter test has been performed. This water sample PASSED the test after 5 minutes, but **FAILED** after 10 minutes because the sample released 1/2 ml of water in between 5-10 minutes. The sample was allowed to stand in the filter an additional of 15 minutes, one drop was released only. Again, the sample was allowed to stand in the paint filter for another additional 15 minutes, but nothing was released at this time. Free water percentage was 0.55% by volume.

100 g of the sludge sample has been used for the vibration/Method 9095-paint filter test. The sample was vibrated for three hours at 26 psi to provide continuos repetitive shocks. Then the sample placed in the paint filter and **PASSED** the test after 5, 10, and 15 minutes.

ATTACHMENT E

ACTIVITY HAZARD ANALYSIS FOR ABSORBING STRONTIUM TANKS LIQUID

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Absorption of Imhoff wastewater and decontamination/rain water in 55 gal. drums

ANALYZED BY/DATE: John Wolf, August 28,2002
Kim Warren, August 28,2002

REVIEWED BY/DATE: Agata Sulczynski by September 4, 20002

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Removing drums from Co60 secondary containment and transporting drums to designated area.	Damage from ripping secondary containment	Caution will be used to remove drums from secondary containment.
A backhoe or bobcat with drum lifting device will be used to remove the drums from secondary containment.	Overhead obstructions	Spotter and other ground crew will wear hard hats
A forklift will be used to transport drums to designated area.	Crushing	Operators must be trained and experienced in use of forklift operation. Backhoe or bobcat operator must have past experience with heavy equipment operation. Spotter will always be on hand to help direct heavy equipment operator.
	Traffic issues	All vehicle movements shall be monitored for location of obstacles.
	Heavy equipment failure	Daily vehicle safety inspection is required prior to use. All equipment will have seat and seat belts for all riders, and operational back-up alarms. Load ratings will be adhered to for all equipment.
	Pinch points	Spotter shall be aware of possible pinch points associated with the operation of the drum lifting equipment and shall wear work gloves when loading drums on the pallet. Emergency equipment will include portable radio, first aid kit, fire extinguisher and air horn at designated area and Co60.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Absorption of Imhoff wastewater and decontamination/rain water in 55 gal. drums

ANALYZED BY/DATE: John Wolf, August 28,2002
Kim Warren, August 28,2002

REVIEWED BY/DATE: Agata Sulczynski by September 4, 20002

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Drums falling off drum spill-containment pallets or coming loose from lifting device hooks.	Drums to be securely strapped together, to a spill pallet and to the forklift for transportation. Spotter must accompany drum transport at all times Lifting hooks will be securely attached to the drums when lifting individual drums using bobcat or backhoe drum lifting device. Spotter will be on hand to help load the drums onto the spill pallet with a drum lifter. Hard hats, safety vests and steel-toed boots in required in work area. Spotter shall stay clear of working equipment during drum loading.
Absorption and Sampling of Absorbed Waste Water and Decontamination/Rain Water	Spills	Haul route will avoid storm drains. Wastewater absorbent, WaterWorks, Absorbent material (SP-400 Crystals), and MSDS will be staged in the work area for carrying out task. The same absorbent will be used for clean up along with a spill kit to abate potential spills.
	Exposure to Radioactive Contamination	Personnel must be trained in accordance with the LEHR PHSP, RPP, SOPs, HSPs, ALARA program and other supporting documents such as the MSDS for SP-400 Absorbent before conducting activity, and the HWP. Personnel will wear splash apron and a face shield (when splash issues are of concern) to avoid skin contact with any form of contaminant. Absorbent will be added through bung of drum prior to removing the lid closure ring and lid to mitigate splash hazard. Pull dry topside of lid towards you when removing lid from drum to avoid contact with condensation. Place lid dry side down until re attaching to drum. A spill kit will be available at all times.
	Slips, Trips and Falls	Workers will clean up any absorbent that spills in the work area to prevent slippery surfaces to avoid potential slips/falls. Workers will maintain a neat/tidy work area to eliminate any unnecessary tripping hazards

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Absorption of Imhoff wastewater and decontamination/rain water in 55 gal. drums

ANALYZED BY/DATE: John Wolf, August 28,2002
Kim Warren, August 28,2002

REVIEWED BY/DATE: Agata Sulczynski by September 4, 20002

PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Pinch points	Personnel shall be careful when removing and replacing the drum lid and ring while opening and closing the drum. Personnel shall wear work gloves while performing this activity.
	Heat Stress	Personnel shall be properly trained to identify signs and symptoms of heat stress. Drinking water will be available. Work shifts will be designed appropriately for environmental conditions.

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Absorption of Imhoff wastewater and decontamination/rain water in 55 gal. drums

ANALYZED BY/DATE: John Wolf, August 28,2002
Kim Warren, August 28,2002

REVIEWED BY/DATE: Agata Sulczynski by September 4, 20002

EQUIPMENT	INSPECTION	TRAINING
Forklift with drum lifting device	Heavy equipment operator shall complete a heavy equipment safety inspection before each use.	Only a certified forklift operator may operate heavy equipment.
Backhoe or Bobcat with drum lifting device	Heavy equipment operator shall complete an initial onsite heavy equipment safety inspection and a daily inspection there after before each use	Heavy equipment operators must be experienced in operating heavy equipment.

ATTACHMENT F

ALARA GUIDELINES FOR THE ABSORPTION OF AREA II WATER DRUMS

U.S. Department of Energy

Oakland Operations Office, Oakland. California

ALARA GUIDELINES FOR ABSORPTION OF AREA II WATER DRUMS

For the:

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

Weiss Associates
5801 Christie Avenue
Emeryville, California 94608-2411

March 21, 2001
Rev. 1

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental Science, Engineering and Management

ALARA GUIDELINES FOR ABSORPTION OF AREA II WATER DRUMS

For the:

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH UNIVERSITY OF CALIFORNIA, DAVIS

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Issued To: _____ Date: _____

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Approvals Page

ALARA GUIDELINES FOR ABSORPTION OF AREA II WATER DRUMS

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Prepared by:

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5801 Christie Avenue
Emeryville, California 94608-2411

March 21, 2001
Rev. 1

Approved by: for Date: 3/22/01
Jerry McHugh, P.E., C.H.P.
Radiological Control Manager
Weiss Associates

CONTENTS

1. INTRODUCTION 1-1

2. ALARA PROCEDURES 2-1

ABBREVIATIONS AND ACRONYMS

ALARA	As-Low-As-Reasonably-Achievable
CA	Contamination Area
LEHR	Laboratory for Energy-Related Health Research
PPE	personal protective equipment
RCM	Radiological Control Manager
RCT	Radiological Control Technician
RSO	Radiological Safety Officer
SHSO	Site Health and Safety Officer

RECORD OF REVISIONS

Revision Number	Description	Date

1. INTRODUCTION

As-Low-As-Reasonably-Achievable (ALARA) consideration is required for work involving the absorption of the Imhoff Tank Liquid drums and decon and rain water drums collected during Ra/Sr Area II Removal Action. Specifically, these procedures pertain to the test and large scale action of adding SP-400 Absorbent, provided by Earthline, to determine the correct consistency of the waste for disposal off-site. This activity is described in detail in the work plan provided by Earthline. These ALARA procedures may benefit by change (addition, deletion, or revision) as the activity progresses. Any change shall be approved by the Radiological Safety Officer (RSO) or Radiological Control Manager (RCM) and appropriately documented. These procedures are not necessarily inclusive of all procedures required for either worker protection or preservation of the environment.

2. ALARA PROCEDURES

There is no anticipated significant known measurable dose (either external or internal) associated with the tasks required by this Work Plan. Therefore, a graded approach was made to evaluate and implement ALARA procedures. In accordance with the LEHR ALARA Program, every effort should be made to maintain doses at ALARA levels. The following precautionary procedures should be thus implemented. New or revised ALARA procedures should be added to this list as identified throughout the task. Any changes should be discussed during tailgate safety meetings with site workers.

ADMINISTRATIVE CONTROLS

Training:

1. Each worker entering the radiological areas shall be instructed on these ALARA provisions (either as on-the-job training or at a tailgate safety meeting). Tailgate safety meetings will be used to document instructions and topics discussed.

2. Reinforcement of Rad Worker training shall be periodically conducted during tailgate safety meetings and on-the-job instruction to demonstrate how ALARA can be achieved by use of appropriate work procedures and practices.

3. Workers shall be instructed in the proper use of tools and methods that result in the generating as little splash as possible.

4. Workers shall be instructed in methods of keeping personal protective equipment (PPE) intact to reduce personal contamination, including methods to reduce likelihood of cuts, tears, rips, etc. (creating potential route for contamination to reach an unprotected area on a person), from waste (including sharps) and equipment.

5. Personnel shall be instructed on the proper means of egress from contamination areas (CAs) to reduce exposure and possibility of spreading contamination.

6. Workers shall be advised of areas or surfaces that are known to contain appreciable levels of removable surface contamination.

All Personnel:

7. Workers shall follow all applicable project procedures, practices, and work plan instructions as advised by the Radiological Control Technician (RCT), RSO, Site Health and Safety Officer (SHSO), and Supervisory personnel.

8. Workers shall not follow procedures that the RCT, RSO, SHSO, or Supervisory personnel deems non-ALARA.

9. Workers shall optimize all work and operations to maintain dose at ALARA, when and where practical.

10. Workers shall not bring construction materials, tools, and equipment not required for work in the CA into the CA, where practical.

11. Workers or supervisors shall ensure equipment is operational and functional prior to bringing it in to radiation areas or CA.

12. Workers shall maintain a distance between themselves and the work task if their duties do not require their immediate presence at the task site.

13. Workers shall keep the elevation of their head above that elevation where a dust generating activity may be ongoing, when practical.

14. All waste handling shall be done in a safe, expedient and planned manner.

15. Workers shall ensure that they are wearing appropriate PPE and have sufficient skin protection (including face/hands) when handling radioactive sludge or other wet radioactive material that may splash or otherwise come into contact with worker.

Supervisors/Managers:

16. Supervisory personnel shall optimize all work and operations to maintain dose at ALARA, when and where practical.

17. Only workers that have a need to be within the CA (exclusion zone) shall be permitted to enter the CA (exclusion zone).

18. Supervisors shall attempt to eliminate any unnecessary work or rework.

19. Supervisors shall ensure use of a trained work force.

20. Supervisors shall sequence tasks to reduce exposure, schedule work in an efficient manner, and identify/coordinate necessary resource requirements.

21. Supervisor shall control and minimize the number of workers in a radiation area or CA.

22. Any construction materials, tools, or equipment required for work in the CA shall be evaluated by a RCT for ease of decontamination prior to bringing this equipment into the CA. Equipment shall be covered if needed.

23. Equipment shall not be knowingly exposed to contamination that can be avoided.

24. When practical, extension tools shall be used to eliminate or minimize personnel entry into the CA.

25. Supervisors shall ensure equipment is operational and functional prior to bringing it into the radiation area or CA.

26. Workers shall be supervised and monitored to minimize exposure to airborne contamination.

27. Mock up shall be staged for difficult or complicated work to reduce time spent exposed to known sources of ionizing radiation, or where a large amount of contamination is likely.

28. Work shall begin with the least contaminated area and finish with the most contaminated area, when practical.

29. Provisions for dealing with wet or liquid radioactive waste shall be used in accordance with HWP and best management practice.

ENGINEERING CONTROLS

30. Use of portable air conditioning units and/or fans shall be considered for worker cooling, where practical.

31. All work areas, including lay down and waste storage areas, shall be chosen with ALARA considerations in mind.

32. Traffic patterns and pathways shall be chosen to minimize the potential spread of contamination and cross contamination.

33. Precautions shall be taken to prevent and to mitigate any waste spills, especially to drainage pathways, and to prevent the off-site release of airborne contaminants.

34. Direct contact with objects containing known and measurable radiological contamination shall be avoided by placement of barriers, such as plastic, between the workers and these objects, when practical.

35. Precautionary ALARA measures shall be implemented during disconnection and subsequent handling of pipes and structures.

MONITORING

36. Every effort shall be made to keep all doses at ALARA and less than 100 millirems Total Effective Dose Equivalent.

37. Monitoring shall be conducted and consideration of measured levels shall be utilized in ALARA procedures review and revision. Waste containers shall be surveyed prior to removal from the CA.

38. RCTs shall incorporate radiological hold points into monitoring and evaluation.

39. Waste containers shall be swipe sampled and analyzed, when directed by the RSO, prior to CA removal or excessive handling.

40. Unknown waste materials shall not initially be approached by anyone other than an RCT.

3. REFERENCES

Weiss Associates (WA), 2000, Removal Action Work Plan for the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic System Area for the Laboratory for Energy-Related Health Research, University of California, Davis, July, Rev. 0.

IT Corporation (IT Corp.), 2000, Assessment of the RPP for Historical and Continuing Activities at the LEHR Site, Letter from Rick Greene, CHP, to Jerry McHugh dated March 6, 2000.