DOE/MC/31388 -- 5252
(DE96011311)

Environmental Management Technology Demonstration and Commercialization

Semi-Annual Report
April - October 1995

November 1995

Work Performed Under Contract No.: DE-FC21-94MC31388

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
University of North Dakota
Energy and Environmental Research Center
P.O. Box 9018
Grand Forks, North Dakota 58202-9018

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TASK 2 – EXTRACTION AND ANALYSIS OF POLLUTANT ORGANICS FROM CONTAMINATED SOLIDS USING OFF-LINE SUPERCRITICAL FLUID EXTRACTION (SFE) AND ON-LINE SFE–INFRARED SPECTROSCOPY

Semiannual Report

for the period April 1, 1995, to October 31, 1995

Prepared for:

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UND EERC/DOE Environmental Management
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November 1995

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TASK 2 - EXTRACTION AND ANALYSIS OF POLLUTANT ORGANICS FROM CONTAMINATED SOLIDS USING OFF-LINE SUPERCRITICAL FLUID EXTRACTION (SFE) AND ON-LINE SFE–IFRARED SPECTROSCOPY

1.0 INTRODUCTION/BACKGROUND

Several field-portable (e.g., gas chromatography [GC], gas chromatography–mass spectrometry [GC–MS]) instruments are available for the measurement of organic pollutants. However, solid samples such as soils, sludges, and sediments must first be extracted before analysis can be performed. Conventional extraction methods based on liquid solvent (e.g., Soxhlet extraction) are not practical in the field because of the large volumes of solvents required as well as clumsy apparatus and glassware. However, supercritical fluid extraction (SFE) has been demonstrated in several studies by the Energy & Environmental Research Center (EERC) to extract a broad range of organic pollutants from soils and sediments successfully. Of the approximately 100 major organic pollutants identified as problems for the U.S. Department of Energy (DOE) sites, our SFE laboratory has demonstrated efficient SFE recoveries for about half, and published literature has addressed an additional 40%. SFE in the "off-line" mode (i.e., collection of extracted organics in a small volume of liquid solvent) has also been demonstrated to be easily performed in the field with only generator electrical power for support. Recent advances in flow restrictor design have virtually eliminated the mechanical problems previously associated with the performance of SFE in the field.

2.0 OBJECTIVES

The specific objectives of this task are to demonstrate, develop, and evaluate the use of SFE to extract organic contaminants rapidly and efficiently for analysis at DOE and related sites. This objective is divided into the following two areas:

- To perform and evaluate off-line SFE on-site using conventional portable instrumentation (i.e., a portable GC) for analysis of the extracts, and to compare the results with conventional laboratory methods.

- To evaluate the use of on-line SFE with infrared (IR) detection (based on a fiber optic interface recently built at the University of North Dakota [UND] Chemistry Department in collaboration with the EERC) for an inexpensive (less than $20,000) and simple-to-operate field instrument. This will include determining the ability of this SFE-IR instrument to perform screening surveys at relevant (e.g., parts per million [ppm] to parts per billion [ppb]) detection levels.

3.0 ACCOMPLISHMENTS/WORK PERFORMED

3.1 Selection of Field Sites

Several local sites contaminated with polycyclic aromatic hydrocarbons (PAHs) and fuel spills (total petroleum hydrocarbons [TPHs]) have been surveyed and will be used for the local field demonstrations. Unfortunately, field sites for polychlorinated biphenyl (PCB) contamination have been difficult to find, since U.S. companies that have been contacted are not willing to allow us to demonstrate the SFE technique on their sites. Fortunately, a field site for PCBs was found at Manitoba Hydro (Winnipeg, Canada). Sites for PAHs were found locally (abandoned and current railroad beds) and at Grand Forks Air Force Base (railroad beds and pole storage yard).

3.2 Field Demonstrations of Off-Line SFE

3.2.1 PCB-Contaminated Soils at Manitoba Hydro

Initial PAH- and PCB-contaminated soils were extracted in the laboratory to determine optimal SFE conditions for field extractions. For both PAHs and PCBs, extraction with 400 atm of pure CO_2 for 20 minutes yielded good agreement with extractions performed using conventional methods (Soxhlet extraction for 24 hours). Thus, the same SFE conditions could be used for both PAH and PCB extractions.

A field demonstration for the extraction of PCBs was conducted at Manitoba Hydro (an electrical company storage yard) on several soil samples contaminated with PCBs. The only support was a conventional minivan containing no special equipment for laboratory support and a portable electrical generator. The SFE equipment was fully operational about 20 minutes after arrival on- site, and 18 extractions (six soil samples, each extracted in triplicate) were performed in approximately 4 hours. No technical problems with the SFE system were encountered.

All extracts were returned to the laboratory for analysis using gas chromatography with electron capture detection (GC–ECD). Note that there is no technical problem with performing the GC–ECD analysis in the field; however, such determinations were not performed because of the licensing problems involved in moving the ECD detector into Canada because it contains a low-level radioactive source. Replicate soil samples were also returned to the laboratory and extracted using 24-hour Soxhlet extractions with 150 mL of 1:1 acetone:hexane. Table 1 shows the recoveries of PCBs (SFE performed in the field versus 24-hour Soxhlet extractions) when the PCBs were measured as total Aroclor 1260. Note that the agreement between the 24-hour Soxhlet extractions and the 20-minute SFE field extractions was excellent for all of the samples.

The PCB extracts were also analyzed for individual PCB congeners by GC–ECD. The results from representative samples are shown in Tables 2 to 4. Again, the results from the 20-minute SFE extractions performed in the field (using only about 10 mL of acetone as a collection solvent) with the results of 24-hour Soxhlet extractions performed in the lab (using 150 mL of 1:1 acetone:hexane for the extraction solvent) were excellent.

The SFE PCB extracts were also analyzed on-site by a commercial immunoassay kit. Evaluation of immunoassay was not part of the original work plan, but was performed to add additional evaluation of a field-portable technique that is receiving increasing attention. Unfortunately, the immunoassay was not successful in the field, since all standards and samples exceeded the absorbance values in the linear range of the ultraviolet (UV) spectrometer used by the immunoassay method for the quantitative measurements. Additional experiments demonstrated that the immunoassay test was influenced both by the ambient temperature and by ambient sunlight

TABLE 1

Efficiency of Field SFE (20 min) Compared to Soxhlet (24 hr) for PCB-Contaminated Soils

Sample	Soxhlet[a,b] Conc., ppm (% RSD[c])		SFE[a] Conc., ppm (% RSD)		SFE vs. Soxhlet, % recovery
73 E	6.3	(5.4)	5.9	(6.4)	93
74 N	4.5	(5.1)	4.1	(9.9)	93
74 S	18	(12)	16	(11)	87
C324	64	(8)	57	(9)	89
C311	35	(6)	35	(9)	100
235C	5.3	(4.2)	5.2	(0.8)	98

[a] Determination of total PCB compared to Aroclor 1260.
[b] Extraction with 150 mL acetone:*n*-hexane (1:1).
[c] Relative standard deviation.

TABLE 2

Comparison of Field SFE and Lab Soxhlet for PCBs at Manitoba Hydro Site, Sample 1

Sample	Soxhlet[a] Conc., ppb (% RSD)		SFE[b] Conc., ppb (% RSD)		SFE vs. Soxhlet, % recovery
CB-101	132	(7)	125	(7)	95
CB-149	473	(4)	446	(6)	94
CB-118	42.1	(5.1)	39.7	(9.2)	94
CB-153	632	(6)	595	(8)	94
CB-138	499	(5)	472	(8)	95
CB-128	273	(5)	256	(6)	94
CB-156	90.4	4.6	83.5	(6.6)	92
CB-180	746	(5)	667	(8)	89
CB-170	307	(4)	227	(8)	90

[a] Soxhlet extractions were performed for 24 hr using 150 mL of 1:1 acetone:hexane. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.
[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

TABLE 3

Comparison of Field SFE and Lab Soxhlet for PCBs at Manitoba Hydro Site, Sample 2

Sample	Soxhlet[a] Conc., ppb (% RSD)		SFE[b] Conc., ppb (% RSD)		SFE vs. Soxhlet, % recovery
CB-101	109	(21)	104	(6)	96
CB-149	314	(15)	291	(2)	93
CB-118	26.4	(12.4)	24.3	(5)	92
CB-153	406	(9)	365	(3)	90
CB-138	322	(9)	296	(4)	92
CB-128	206	(9)	187	(8)	91
CB-156	63.8	(7.6)	56.6	(9.6)	89
CB-180	533	(10)	455	(14)	85
CB-170	210	(8)	192	(12)	92

[a] Soxhlet extractions were performed for 24 hr using 150 mL of 1:1 acetone:hexane. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.

[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

TABLE 4

Comparison of Field SFE and Lab Soxhlet for PCBs at Manitoba Hydro Site, Sample 3

Sample	Soxhlet[a] Conc., ppb (% RSD)		SFE[b] Conc., ppb (% RSD)		SFE vs. Soxhlet, % recovery
CB-101	321	(11)	283	(8)	88
CB-149	1180	(11)	1025	(8)	87
CB-118	122	(9)	111	(9)	91
CB-153	1756	(11)	1520	(11)	87
CB-138	1271	(11)	1145	(10)	90
CB-128	679	(11)	590	(10)	87
CB-156	240	(11)	212	(10)	88
CB-180	2028	(12)	1708	(12)	84
CB-170	817	(12)	705	(11)	86

[a] Soxhlet extractions were performed for 24 hr using 150 mL of 1:1 acetone:hexane. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.

[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

(i.e., UV light). The same extracts were later successfully analyzed in the lab using the same immunoassay kits, and the quantitative results were sufficiently valid for semiquantitative determinations, as shown in Table 5. Note also that the immunoassay test yields only an estimate of total PCB concentrations and gives no information on the individual PCB congeners present in the sample. While the immunoassay test yielded reasonable semiquantitative results under laboratory conditions, the failure of immunoassay under field conditions demonstrated that immunoassay tests for PCBs (at least this particular kit) should not be used in the field.

3.2.2 PAH-Contaminated Soils at Railroad Beds and at Grand Forks Air Force Base

Field demonstrations of SFE for PAH-contaminated soils were conducted under conditions identical to those for the PCB-contaminated soils described above (using only a portable generator and a standard minivan as support), except that the demonstrations were performed at local railroad beds and at the Grand Forks Air Force Base. As for the PCBs, the time between arrival at the site and beginning the SFE extractions was only 15 to 30 minutes. More than 20 soil samples were extracted in triplicate at seven different sites using 20-minute SFE with collection of the extracts in 10 mL of acetone. Since the SFE instrument could accommodate two samples at one time, sample throughput was four to six extractions per hour.

For several representative sites, replicate soil samples were returned to the laboratory and extracted for 24 hours using a Soxhlet apparatus and 150 mL of methylene chloride. All extracts were analyzed by GC with flame ionization detection (GC–FID) with verification by GC–MS. As shown in Tables 6 to 9, the 20-minute SFE extractions performed in the field gave excellent agreement with the conventional 24-hour Soxhlet extractions performed in the laboratory.

It is important to note that for both PAH- and PCB-contaminated soils, SFE yielded extracts that were immediately ready for analysis by capillary gas chromatography without the further cleanup steps normally required for liquid solvent extracts. This is a great advantage for field determinations since the cleanup steps require column chromatography and hazardous organic solvents, as well as being difficult to perform under field conditions. Also note that the same SFE conditions can be used for both the PAH and PCB extractions. Therefore, one extract can be used for quantitative determination of both PAHs and PCBs, as well as for several other compound classes of semivolatile pollutants. The results of the field demonstrations for PAH- and PCB-contaminated soils clearly demonstrate that SFE is a viable extraction method to use for quantitative extractions of semivolatile pollutants under field conditions.

3.3 Development of SFE–IR Interfaces

Prototype SFE-IR and SFE–FT-IR (Fourier transform infrared) instruments have been constructed and tested based on a simple fiber optic approach as described in earlier reports. Both the SFE-IR and SFE–FT-IR approaches are suitable for field use; however, conversations with several potential users have convinced us to focus on SFE–FT-IR for superior detection limits and better spectral resolution. In addition, the recent availability of field-rugged FT-IR instruments at reasonable prices (< $30K) makes field SFE–FT-IR particularly attractive.

A prototype universal adapter that allows simple installation of the interface into most commercial FT-IR instruments has been constructed and is expected to be further developed into a commercial product during the next year, as discussed below. This interface has been

TABLE 5

Analysis of SFE Extracts for Total PCBs (as Aroclor 1260) with GC-ECD and Immunoassay (IA)

Sample	Mean GC, ppm[a]		Mean IA, ppm[a]	
1	5.9	(6)	6.0	(14)
2	9.1	(17)	7.3	(10)
3	0.74	(9)	0.37	(30)
4	4.1	(10)	6.1	(54)
5	16	(11)	7.7	(36)
6	5.5	(6)	4.38	(29)

[a] RSDs (given in parentheses) are based on triplicate extractions and determinations.

TABLE 6

PAHs from Soil at a Pole Storage Yard

	Soxhlet[a] Conc., ppm (% RSD)		SFE[b] Conc., ppm (% RSD)		SFE vs. Soxhlet, % recovery
Acenaphthylene	0.41	(4)	0.34	(5)	82.9
Acenaphthene	3.66	(12)	3.55	(21)	97.0
Fluorene	4.29	(23)	4.36	(19)	101.6
Phenanthrene	23.41	(28)	25.32	(15)	108.1
Anthracene	10.45	(12)	12.63	(18)	120.8
Fluoranthene	45.65	(10)	45.95	(10)	100.6
Pyrene	37.55	(10)	39.23	(7)	104.5
Benz[*a*]anthracene	12.44	(7)	13.30	(6)	106.9
Chrysene	19.19	(7)	21.47	(15)	111.9
Benzo[*b*+*k*]fluoranthene[c]	6.04	(13)	5.99	(16)	99.1
Benzo[*a*]pyrene	5.72	(27)	5.32	(21)	93.0
Perylene	1.57	(23)	1.35	(15)	86.2
Indeno[*1,2,3-cd*]pyrene	2.00	(34)	1.77	(20)	88.3
Benzo[*ghi*]peryl ene	1.22	(8)	0.78	(2)	64.4
Dibenzothiophene	2.1	(25)	2.24	(17)	107.0

[a] Soxhlet extractions were performed for 24 hr using 150 mL of methylene chloride. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.

[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

[c] The sum of benzo[*b*]- and benzo[*k*]fluoranthene is reported because they were not adequately resolved by the chromatographic conditions used.

TABLE 7

PAHs from Soil at an Abandoned Railroad Bed

	Soxhlet[a] Conc., ppm (% RSD)	SFE[b] Conc., ppm (% RSD)	SFE vs. Soxhlet, % recovery
Acenaphthylene	0.26 (10)	0.22 (8)	85.7
Acenaphthene	0.13 (5)	0.13 (4)	105.3
Fluorene	0.19 (28)	0.24 (6)	126.8
Phenanthrene	3.48 (8)	3.55 (5)	102.0
Anthracene	0.81 (5)	1.00 (9)	123.6
Fluoranthene	11.48 (4)	8.96 (2)	78.0
Pyrene	7.50 (5)	6.30 (2)	84.0
Benz[*a*]anthracene	1.73 (11)	1.38 (1)	80.1
Chrysene	5.79 (2)	5.44 (6)	94.0
Benzo[*b*+*k*]fluoranthene[c]	3.02 (4)	2.57 (2)	85.2
Benzo[*a*]pyrene	1.92 (3)	1.51 (7)	78.5
Perylene	0.40 (16)	0.21 (5)	52.5
Indeno[*1,2,3-cd*]pyrene	0.49 (12)	0.41 (10)	83.8
Benzo[*ghi*]perylene	0.43 (25)	0.31 (18)	71.8
Dibenzothiophene	0.16 (13)	0.19 (5)	116.3
Carbazole	0.97 (6)	1.31 (5)	135.1

[a] Soxhlet extractions were performed for 24 hr using 150 mL of methylene chloride. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.

[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

[c] The sum of benzo[*b*]- and benzo[*k*]fluoranthene is reported because they were not adequately resolved by the chromatographic conditions used.

demonstrated to yield good sensitivities and general performance under field conditions (operating from a portable generator). Note that the SFE–FT-IR approach is particularly well-suited to field determinations at hazardous sites, since the method requires no organic solvent and generates no waste. In addition, the instrument can easily be configured to collect the extracts from "positive" samples for additional characterization by GC–MS (or other suitable analytical techniques).

Examples of quantitative determinations performed using SFE–FT-IR are shown in Table 10 for the on-line extraction and analysis of total petroleum hydrocarbons (TPH) from soil. As shown in Table 10, the on-line SFE–FT-IR results give excellent agreement with both the conventional extraction method (4 hours of Soxhlet extraction with 150 mL of Freon-113) and with the off-line SFE method recently accepted as a standard method to determine TPH by the U.S. Environmental Protection Agency (EPA). Note, however, that our on-line SFE–FT-IR method is the only approach that generates no solvent waste.

TABLE 8

PAHs from Soil by a Treated Wood Bridge

	Soxhlet[a] Conc., ppm (% RSD)		SFE[b] Conc., ppm (% RSD)		SFE vs. Soxhlet, % recovery
Phenanthrene	0.92	(17)	0.81	(9)	88.4
Anthracene	0.64	(9)	0.67	(19)	104.7
Fluoranthene	3.17	(8)	2.33	(4)	73.5
Pyrene	2.31	(7)	1.59	(6)	69.0
Benz[*a*]anthracene	1.07	(3)	0.69	(1)	64.5
Chrysene	2.22	(6)	1.69	(15)	75.9
Benzo[*b*+*k*]fluoranthene[c]	1.78	(6)	1.11	(12)	62.1
Benzo[*a*]pyrene	0.84	(16)	0.54	(16)	64.7
Perylene	1.01	(3)	0.86	(27)	84.9
Benzo[*ghi*]perylene	0.20	(13)	0.17	(13)	84.8
Carbazole	0.57	(9)	0.69	(5)	121.8

[a] Soxhlet extractions were performed for 24 hr using 150 mL of methylene chloride. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.

[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

[c] The sum of benzo[*b*]- and benzo[*k*]fluoranthene is reported because they were not adequately resolved by the chromatographic conditions used.

Both SFE-IR (at selected wavelengths) and SFE–FT-IR (yielding full spectral information) have been tested using real environmental samples including soils contaminated with fuel hydrocarbons, PAHs, PCBs, and chlorinated solvents. The prototype SFE–FT-IR interface has recently been optimized so that detection limits (based on contaminant concentration in the soil sample) are typically in the low to mid ppb range.

4.0 FUTURE PLAN - COMMERCIAL DEVELOPMENT

An agreement has been reached with Suprex Corporation, Pittsburgh, Pennsylvania, to commercialize the SFE–FT-IR interface. Suprex is one of the three leading SFE instrument suppliers and has established a worldwide market for its SFE instrumentation. A prototype commercial SFE–FT-IR interface will be produced in the first year. Beta site testing, final development and production of the commercial version, and demonstrations will be performed in the second year.

TABLE 9

PAHs from Soil by Railroad Tracks

	Soxhlet[a] Conc., ppm (% RSD)	SFE[b] Conc., ppm (% RSD)	SFE vs. Soxhlet, % recovery
Phenanthrene	0.17 (7)	0.22 (11)	128.8
Anthracene	1.32 (7)	1.15 (11)	87.1
Fluoranthene	0.73 (18)	1.02 (18)	139.7
Pyrene	0.77 (20)	1.04 (16)	134.5
Benz[*a*]anthracene	0.22 (10)	0.32 (10)	146.2
Chrysene	0.27 (12)	0.35 (12)	130.0
Benzo[*b*+*k*]fluoranthene[c]	0.91 (4)	0.96 (16)	105.5
Benzo[*a*]pyrene	2.09 (3)	2.37 (7)	113.4
Perylene	0.42 (22)	0.49 (3)	118.4
Indeno[*1,2,3-cd*]pyrene	0.47 (29)	0.49 (21)	105.7
Benzo[*ghi*]perylene	0.41 (26)	0.51 (8)	123.4
Carbazole	0.14 (12)	0.15 (14)	104.8

[a] Soxhlet extractions were performed for 24 hr using 150 mL of methylene chloride. Concentrations and relative standard deviations (RSDs) were based on triplicate Soxhlet extractions.

[b] SFE extractions were performed in the field with pure CO_2 at 150°C and 400 atm for 20 minutes.

[c] The sum of benzo[*b*]- and benzo[*k*]fluoranthene is reported because they were not adequately resolved by the chromatographic conditions used.

TABLE 10

Determination of TPH on Contaminated Soil Using On-Line SFE–FT-IR, the New EPA SFE Method, and Conventional Soxhlet Extraction.

	TPH Concentration (ppm) (% RSD)[a]		
Contaminant	4-hr Soxhlet	EPA SFE	On-line SFE–FT-IR
Diesel	38400 (11)	31000 (3)	38000 (24)
Gasoline	5800 (3)	6200 (5)	6500 (17)
Gasoline/Diesel	3200 (7)	ND[b]	3500 (7)
Diesel	17200 (7)	ND	18400 (7)
Diesel	240 (18)	ND	260 (10)

[a] All relative standard deviations (RSDs) were based on triplicate extractions by each method.

[b] Not determined.

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 2 - Extraction and Analysis of Pollutant Organics	7/1/95 through 9/30/95

4. Name and Address
Energy & Environmental Research Center
University of North Dakota
PO Box 9018, Grand Forks, ND 58202-9018 (701) 777-5000

5. Program/Project Start Date: 9/30/94

6. Completion Date: 9/29/99

7. FY: 95/96

8. Months or Quarters: Quarters

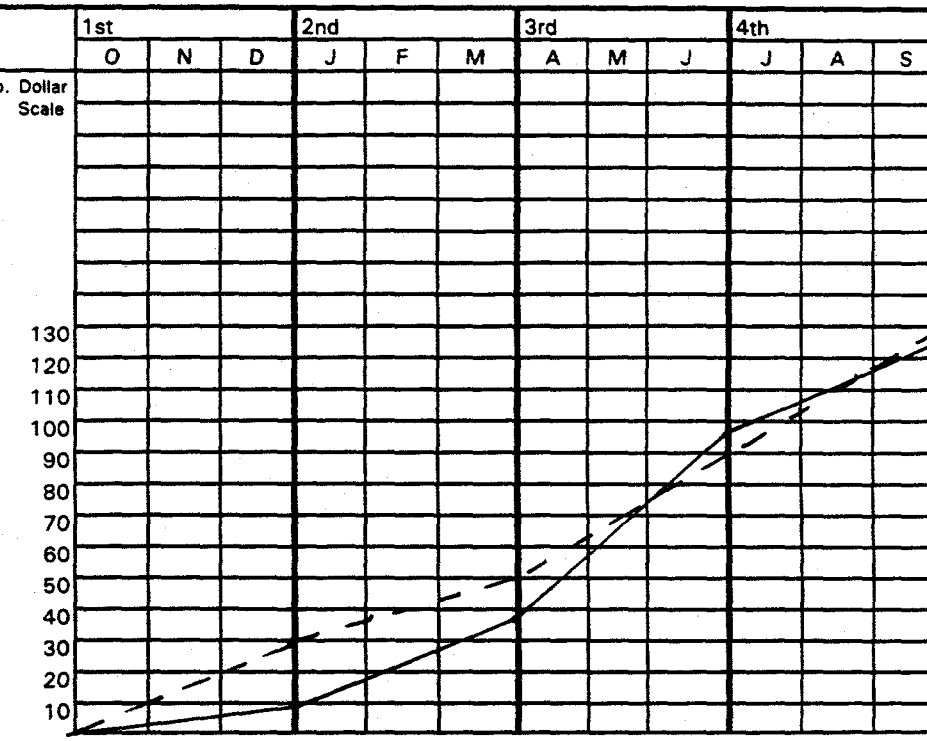
9. Cost Status — a. Dollars Expressed In Thousands — b. Dollar Scale

10. Cost Chart

Fund Source		Quarter 1st	2nd	3rd	4th	Cum. to Date	Tot. Plan
DOE	P	30	20	40	40	130	130
	A	9	28	59	30	126	
	P						
	A						
	P						
	A						
	P						
	A						
Total P		30	20	40	40	130	130
Total A		9	28	59	30	126	
Variance		21	(8)	(19)	10	4	

P = Planned A = Actual

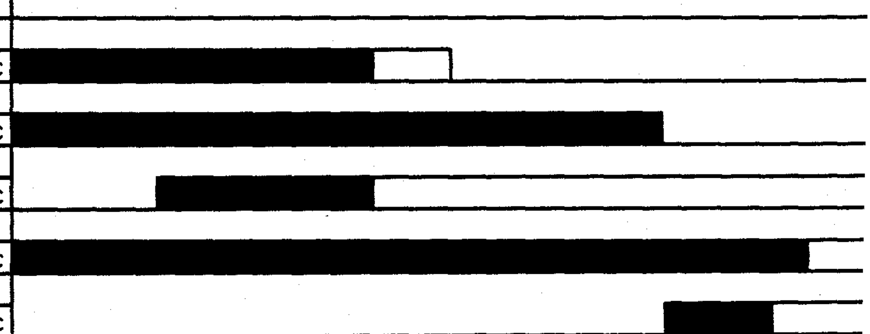
Total Planned Costs for Program/Project: $130



c. Cumulative Accrued Costs

	O	N	D	J	F	M	A	M	J	J	A	S
Planned			30			50			90			130
Actual			9			37			96			126
Variance			21			13			(6)			4

11. Major Milestone Status	Units Planned / Units Complete
2.1 Selection of Field Sites	P / C
2.2 Testing of Field-Portable Off-Line SFE and GC Instrumentation	P / C
2.3 Analysis of Off-Line SFE with Portable GC	P / C
2.4 Conversion of SFE-IR Laboratory Apparatus to Field Apparatus	P / C
2.5 Testing of Prototype On-Line SFE-IR	P / C
	P / C
	P / C
	P / C
	P / C



12. Remarks

13. Signature of Recipient and Date: [signature] 11/6/95

14. Signature of DOE Reviewing Representative and Date

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Energy & Environmental Research Center

TASK 4

STABILIZATION OF VITRIFIED WASTES

Final Report

for the period October 1994 through September 1995

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TASK 4 – STABILIZATION OF VITRIFIED WASTES

EXECUTIVE SUMMARY

The goal of this task was to work with private industry to refine existing vitrification processes to produce a more stable vitrified product. The initial objectives were to 1) demonstrate a waste vitrification procedure for enhanced stabilization of waste materials and 2) develop a testing protocol to understand the long-term leaching behavior of the stabilized waste form. The testing protocol was expected to be based on a leaching procedure called the synthetic groundwater leaching procedure (SGLP) developed at the Energy & Environmental Research Center (EERC). This task will contribute to the U.S. Department of Energy's (DOE's) identified technical needs in waste characterization, low-level mixed-waste processing, disposition technology, and improved waste forms.

The proposed work was to proceed over 4 years in the following steps: literature surveys to aid in the selection and characterization of test mixtures for vitrification, characterization of optimized vitrified test wastes using advanced leaching protocols, and refinement and demonstration of vitrification methods leading to commercialization. For this year, literature surveys were completed, and computer modeling was performed to determine the feasibility of removing heavy metals from a waste during vitrification, thereby reducing the hazardous nature of the vitrified material and possibly producing a commercial metal concentrate.

Subtask 1 Survey of Vitrification Technologies

The literature review provides an overview of low- and high-level nuclear waste immobilization. Emphasis is on vitrification technologies based on borosilicate glass, since this glass will be used in the United States and Europe to immobilize radioactive high-level liquid waste (HLLW) for ultimate geological disposal.

Vitrification of aqueous radioactive wastes will achieve volume reductions of 86–97 vol% and will ensure their stabilization. Borosilicate waste glasses are the most studied and probably best understood waste form that has been developed. The application of synrocs, cements, and bentonites for radionuclide immobilization is also discussed.

This survey indicates that crystallization of vitrified waste typically makes toxic elements more easily leached by groundwater. It also indicates a lack of information exists in the following areas:

- Vaporization of heavy or radioactive metals from the melts and whether vaporization behavior could be controlled by modifying the heating environment in order to separate the hazardous materials from the bulk waste.
- Avoiding the formation molten sodium sulfate on the cold cap.
- Catalytic activity of radionuclides at the surface of the glass and glass corrosion in water.

- The effect of the glass cooling rate on the generation of residual stresses below the temperature of glass transformation and its effect on the leachability of nuclear waste glass.

- The effect of foaming of the melt on the homogenization of nuclear waste during vitrification using plasma technology.

- Immobilization of scrubber-condensed volatilized hazardous components such as strontium, cesium, lead, cadmium, and others in inorganic materials with low melting temperatures not related to silicate glasses.

Subtask 2 Survey of Cleanup Sites

The magnitude and variety of contaminants at the numerous DOE Environmental Management program waste sites are difficult to summarize. Overviews of waste types and combinations and site-specific information are available, but complete information required to make good decisions regarding the applicability of an innovative technology is not readily available or cross-referenced in the DOE documents that were reviewed for this report. Based on the review performed, it can be concluded that small businesses and others trying to determine whether or not a specific technology has a role in the DOE Environmental Management program will find the necessary information difficult to obtain. If DOE is to take advantage of small business innovation, the information must be more readily available.

Review of DOE and Environmental Protection Agency (EPA) documents resulted in the development of preliminary selection criteria to focus the EERC's waste site selection. Using these preliminary selection criteria, several waste sites were identified as examples of the type of waste sites that would provide the opportunity to investigate innovative technologies that would be broadly applicable to numerous DOE sites as well as industrial sites and processes. Each of the identified waste sites requires environmental restoration and is scheduled for remediation. Specific technologies that fit most readily include solidification, fixation, and encapsulation (SFE) techniques. SFE would be most applicable to hazardous solid wastes, but may also have extensive application to mixed wastes. Hazardous trace elements, including heavy metals, were identified as the mixed-waste constituents that EERC efforts should focus on for further work, including their removal during vitrification by enhancing their vaporization.

Subtask 3 Selection and Characterization of Test Mixtures for Vitrification and Crystallization

Based on the findings of the two literature surveys, it was decided that inducing crystallization in vitrified wastes would not be the most efficient way to stabilize them. Instead, it was decided to pursue the idea of removing certain heavy metals from the waste during vitrification through enhanced vaporization.

Subtask 4 Selection of Crystallization Methods Based on Thermochemistry Modeling

As a result of the survey of vitrification technologies, it was decided to modify the original scope of work to delete crystallization of vitrified waste as a stabilization technique. Instead, the idea of removing some toxic elements from a waste during vitrification by enhancing the vaporization of the elements would be investigated.

Common oxides such as silica, alumina, calcium, and boron are durable under the extreme conditions of vitrification in an oxidizing atmosphere, but the stability of other oxides such as mercury, lead, and even plutonium is questionable in silicate melts. Vaporization of the elements may present a way to remove them from the melt and reclaim them, leaving the vitrified product much easier to dispose. The radionuclides commonly found in waste forms are tritium, uranium, strontium, plutonium, and cesium. The nonradioactive trace metals most commonly noted are lead, chromium, arsenic, zinc, copper, mercury, and cadmium. Because of the difficulties associated with performing tests on mixtures containing radioactive elements, the EERC focused primarily on the heavy trace metals for modeling.

Thermochemical equilibrium calculations of the stable phases of the elements over a range of temperatures were performed with a computer code obtained from a Canadian–Swedish team at the École Polytechnique de Montréal in Canada. Tailored for the treatment of about five thousand species, it is known as the Facility for the Analysis of Chemical Thermodynamics (FACT) code. We employed the code to calculate the vaporization temperatures of the heavy elements and their oxides from borosilicate melt/glass in the temperature range of 600° to 2000°C at three different oxygen pressures: 1, 0.001, and 0.000001 atm. The lower pressures simulate reducing atmospheres. For some temperatures and mainly lower oxygen pressures, the FACT code was unable to calculate the vapor concentration since the code was not able to calculate a solution for the equilibrium composition.

Generally, there is a characteristic temperature (T_{cr}) at which the elements and their oxides vaporize, and this depends on the oxygen pressure over the melt/glass. Usually, T_{cr} decreases with oxygen pressure and is very well defined below 1 atm. The following table lists these temperatures for the seven elements and their oxides released from borosilicate melt/glass at 1 atm oxygen pressure.

It is found that lead may vaporize from borosilicate melts above 1530°C; cadmium, zinc, arsenium, chromium, and copper may vaporize at temperatures between 1230° and 1430°C; and mercury may vaporize above 530°C. Also, it is found that, for the range studied, the concentration of the elements in the melt does not significantly affect the vaporization temperatures.

Phase Transformation of Metallics and Their Oxides

Vapor-Phase Component	Solid → Liquid K	Solid → Gas K	Liquid → Gas K
PbO	1159	---	---
Pb	600	---	---
Pb_2	Gas	Gas	Gas
HgO	---	811.6	---
Hg	---	---	630.5
Hg_2	Gas	Gas	Gas
As_4O_6	Gas	Gas	---
As	---	2290	---
As_2	Gas	Gas	---
As_3	Gas	Gas	---
CrO_3	470	---	---
CrO_2	---	---	---
CrO	---	---	3687
Cr	2179	---	---
CuO	---	---	---
Cu	1358	---	---
Cu_2	Gas	Gas	---
Cd	594	---	---
Zn	692	---	---

FUTURE WORK

The ability to enhance the vaporization of heavy trace metals during vitrification will take significant development, including more detailed computer modeling as well as laboratory- and bench-scale testing before field testing can commence. Therefore, the work does not meet the EERC's brokering criteria of an identified industrial partner and a high probability of near-term commercialization, so it was not proposed for continuation in 1996. In addition to the vaporization work, another area for EERC focus is waste cleanup and site remediation. This area will allow small businesses to benefit the most from EERC staff expertise and facilities. Specific technologies that fit most readily include SFE techniques. SFE would be most applicable to hazardous solid wastes, but may also have extensive application to mixed wastes. The EERC could participate in materials characterization, mix design, and solidified waste form evaluation for both physical integrity and mobility of constituents. Opportunities exist to work with commercial partners in all of these areas, and new tasks will be proposed when defined activities meeting the commercialization criteria are met.

TASK 4 - STABILIZATION OF VITRIFIED WASTES

1.0 INTRODUCTION/OBJECTIVES

Simply vitrifying a material into a glassy slag does not necessarily produce an environmentally stable product. To make a waste material stable for disposal, the chemistry of the materials will need to be assessed and, possibly, modified. An assurance that toxic metals and radionuclides have been incorporated into stabilized phases will also need to be determined.

The ability of a vitrification process to produce an environmentally stable product from a hazardous material is largely dependent upon the chemical composition of the material as well as the conditions of the process. The goal of this task is to work with private industry to refine existing vitrification processes to produce a more stable vitrified product. The initial objectives of this multiyear task were to 1) demonstrate a waste vitrification procedure for enhanced stabilization of waste materials and 2) develop a testing protocol to understand the long-term leaching behavior of the stabilized waste form. The testing protocol was expected to be based on a leaching procedure developed at the Energy & Environmental Research Center (EERC), called the synthetic groundwater leaching procedure (SGLP). This task will contribute to the U.S. Department of Energy's (DOE's) identified technical needs in waste characterization, low-level mixed-waste processing, disposition technology, and improved waste forms.

The proposed work was to proceed over 4 years in the following steps: perform literature surveys to aid in the selection and characterization of test mixtures for vitrification, fabrication and characterization of optimized vitrified test wastes using advanced leaching protocols and refinement and demonstration of vitrification methods leading to commercialization. For this year, literature surveys were completed and computer modeling was performed to determine the feasibility of one method of improving the environmental stability of vitrified waste.

2.0 ACCOMPLISHMENTS/WORK PERFORMED

2.1 Subtask 1 Survey of Vitrification Technologies

2.1.1 Introduction

A literature review has been completed that provides an overview of low- and high-level nuclear waste immobilization. The objective of the survey was to make a concise summary of glass properties with nuclear wastes and/or hazardous elements for their effective immobilization, and to specify directions of further tests to produce durable and highly stable glasses. Emphasis is on technologies based on borosilicate glasses since this glass will be used in the United States and in Europe to immobilize radioactive high-level liquid wastes (HLLW) for ultimate geological disposal.

Radioactive wastes are produced at all stages in nuclear fuel cycles over the world. In the United States, they are stored at three DOE sites: the Hanford reservation in Richland, Washington, the Savannah River Site in South Carolina, and Idaho Chemical Processing Plant in

Idaho Falls. The Hanford site was the world's first to concentrate plutonium used for atomic weapons. It holds from 3×10^7 to 6.5×10^7 gal of HLLW. To store the waste, DOE is considering enhanced waste form options for numerous sites, because the immobilization of radionuclides requires materials with long-term chemical durability, preferably more than 10^4–10^6 years (1). Therefore, vitrification of nuclear wastes is considered the best alternative for radionuclide immobilization and has been a subject of interest for almost four decades (2).

Generally, the stability of any material can be characterized by its thermodynamic equilibrium with its surroundings and by the rate of structural and/or chemical changes to reach this equilibrium. As an example, glasses with their disordered structures are less stable than their crystalline forms under normal environmental conditions, so the glasses are somewhat less durable than crystalline forms. However, sufficient knowledge exists today to develop selection criteria for glass compositions based on long-term rather than short-term behavior.

The durability of glass in contact with groundwater and its ability to retain nuclear waste within its structure depends on bulk glass properties, hydrodynamic constraints, the groundwater composition, and the solubility and complexation behavior of nuclear wastes (3–5). The presence of low-level impurities such as iron may enhance the solubility of the glass (6). All these factors may cause the same material fabricated in two different laboratories to have different chemical durabilities. However, two major factors contribute to the suitability of immobilizing high-level nuclear wastes into glass matrices: technical performance—such as chemical durability, the ability to incorporate waste streams having small amounts of flux components, and limited requirements for purchased additives—and ease of fabrication (7, 8).

Research programs on HLLW immobilization using vitrification technologies have been mostly concentrated on either borosilicate glass or Synroc ceramic made from a reactive mixture of Al, Ba, Ca, Ti, and Zr oxides. In borosilicate glasses, hazardous elements can be immobilized by dissolving them in the glass, forming Si–O–M–O chemical bonds, and by encapsulation where bonds are not formed (9).

2.1.2 Characterization of Nuclear Waste Streams

Generally, radioactive wastes are separated into two groups: 1) high-level waste (HLW), which includes transuranic constituents (elements with atomic numbers greater than uranium) generated from reprocessing spent fuel and making plutonium, that have more than 100 nanoCuries (nCi) per gram (g) as well as having half-lives greater than 20 years, and 2) low-level waste (LLW), which include medical materials and protective casings and tools used around radioactive materials that have a total specific activity below 100 nCi/g. Many DOE sites have large-volume waste streams that contain a significant amount of high-level nuclear waste both from military programs and from defense reactors; these are rich in plutonium and uranium along with a large variety of other contaminants, often highly heterogenous. They may contain complex hazardous organic compounds with low, medium, and high heating values and inorganic materials such as heterogenous debris and pieces of metals.

An example of a site where high-level waste is stored is the three silos at the Fernald Environmental Management Project in Fernald, Ohio, which contain residues from the processing of pitchblende ores. Silos 1 and 2, designated collectively as K-65, contain the depleted ore, while

Silo 3 contains calcined residue from processing solutions. Silos 1 and 2 also contain a bentonite clay cap that was added to the silos to reduce random emanation from the waste. The K-65 residue totals 8.6 million kg (9500 tons). It is a siliceous material containing uranium, uranium-derived products, and thorium, with high levels of radium and lead; Silo 3 residue is lower in silica and consists largely of metal oxides and sulfates, phosphates, nitrates, carbonates along with uranium and thorium (10). The gamma radiation from the residue is sufficient to result in an average dose of about 200 mr/hr outside the silo dome. The radon concentration of the silo headspace is around 30 million pCi/L.

At another site, the Savannah River Site (SRS) in Aiken, South Carolina, HLW is stored as a concentrated liquid radioactive waste by-product of plutonium processing, consisting of a strongly caustic solution of nitrate salts. Insoluble and highly radioactive metal oxide sludge is also present in some of the materials. These waste streams are pumped from the separations facilities to the liquid radioactive waste-handling facilities (called the waste tank farms) located in F-Area and H-Area. The tank farm facilities consist of 51 underground waste tanks with a nominal capacity of 1 million gallons each. The sludge of highly radioactive metal oxide undergoes aging and several chemical processes prior to vitrification in borosilicate glass (11).

Examples of other materials in waste streams are as follows:

- Scrap metals, e.g., 22 wt% of the buried wastes at the Idaho National Engineering Laboratory Radioactive Waste Management Complex

- Metal oxides, e.g., the K-25 pond sludge–soil of over 16 million kg at the DOE Oak Ridge site, which contains 25 wt% iron oxide, 20 wt% aluminum oxide, and 20 wt% calcium oxide (8, 12). Other wastes contain chromium and nickel oxides. Because the maximum solubilities of iron, chromium, and nickel oxides in borosilicate glass are 20, 3, and 3 wt%, respectively, a large amount of glass will be necessary to fix these materials (8).

Analytical results have shown that nuclear wastes may also contain organochloride pesticides, ketones, and other volatile and semivolatile components. As this waste is heated, volatiles are released, and organics are either pyrolyzed in an oxygen-poor atmosphere or oxidized in an oxygen-rich atmosphere. Offgas treatment is required to minimize air emissions (13).

Some DOE sites such as the SRS have contaminated soils resulting from spills over the many years of processing radioactive and hazardous materials that also should be disposed.

2.1.3 Borosilicate Glass Use in the Vitrification of High-Level Nuclear Wastes

Borosilicate glass was selected in 1982 as the reference waste matrix for solidifying high-level radioactive wastes stored in tanks at Savannah River and West Valley. The vitrified waste produced by the Defense Waste Processing Facility (DWPF) at the SRS will be in the form of glass logs contained in 2-ft × 10-ft Type 304L stainless steel canisters. This disposal system is designed to provide safe and permanent storage.

Borosilicate glasses have been shown to be a good solid matrix for immobilization of radioactive wastes. Their success stems from the following:

- Amorphous structure and strong interatomic bonding
- Ability to be processed at lower temperatures than other glasses
- Higher durability than that of other most glasses
- Boron remaining in the residual glass phase upon crystallization of other phases (14)

2.1.4 Glass Structure

Oxides that form glasses when melted and cooled are called glass-forming or network-forming oxides. They include SiO_2, GeO_2, P_2O_5 and As_2O_5 because of the ability of these oxides to build continuous three-dimensional (amorphous) random networks. On the other hand, modifying oxides such as Na_2O, K_2O, CaO, and MgO are incapable of building a continuous network, and the effect of such oxides is usually to weaken the glass network. The addition of the modifiers to the network-forming oxides invariably lowers the viscosity of the glass melt.

The nature of the bonding between the cations and oxygen plays a critical role in the immobilization of nuclear waste. This bonding behavior is described by the model validity constraints. Generally, those oxides with highly covalent bonds to oxygen are more likely to assume the role of network formers than oxides in which the bonding is predominantly ionic. One measure of the power of a cation to attract electrons and, therefore, a description of the covalent or ionic nature of the bonds it will form, is the ionic field strength, given by (15)

$$F = Z/r^2 \qquad \text{[Eq. 1]}$$

where Z is the valency and r the ionic radius. Table 1 lists the ionic radius and the ionic field strength for some cations. The data show that some ions such as U^{4+} and Pu^{4+} may occupy either network-forming positions (because of their high charge) or network-modifying positions (because of their low F values).

Generally, the maximum concentration of either network formers or modifiers in a glass depends on structural limits. In Table 2, the approximate measured solubilities of elements in silicate waste glass are listed.

Since some oxides have limited solubility in glass, it is important to obtain information on the solubility properties from *The Handbook of Glass Manufacture* prior to vitrification (16). An example of target composition determined for the DWPF is shown in Table 3 (17).

The composition of nuclear wastes are often unknown, which makes it difficult to predict glass properties such as liquidus and softening temperatures and even the probable level of radioactivity of the waste. For example, only 1-3 wt% plutonium in a vitrified waste is enough to create a chain reaction which will dramatically increase the radioactivity of the material. The presence of water, which is an excellent neutron moderator, around the glass can substantially

TABLE 1

Ionic Field Strength of Cations Present in Silicate Glasses

Ion	Ionic Radius, Å	Field Strength, Z/r^2	Structural Role in Glass
B^{3+}	0.23	56.7	Network-forming ions
Si^{4+}	0.42	22.6	
As^{5+}	0.46	23.6	
Al^{3+}	0.51	11.5	Intermediate ions
Ti^{4+}	0.68	8.7	
Mg^{2+}	0.66	4.6	Network-modifying ions
Ca^{2+}	0.99	2.04	
Na^{+}	0.97	1.06	
K^{+}	1.33	0.57	
U^{4+}	0.97	4.2	
Pu^{4+}	0.93	4.6	
Cs^{+}	1.67	0.35	
Sr^{2+}	1.12	0.79	

TABLE 2

Approximate Solubilities of Elements in Silicate Glasses[1]

Less than 0.1 wt%	Ag, Au, Br, H, Hg, I, Pd, Pt, Rh, and Ru
Between 1 and 3 wt%	As, C, Cl, Cr, S, Sb, Se, Sn, Tc, and Te
Between 3 and 5 wt%	Bi, Co, Cu, Mn, Mo, Ni, and Ti
Between 5 and 15 wt%	Ca, F, Gd, La, Nd, Pr, Th, B, and Ge
Between 15 and 25 wt%	Al, B, Ba, Ca, Cs, Fe, Fr, K, Li, Mg, Na, Ra, Rb, Sr, U, and Zn
Greater than 25 wt%	P, Pb, and Si

[1] Taken from Reference 13.

TABLE 3

Target Composition Range for DWPF Waste Glass

Component	Minimum Range, wt%	Maximum Range, wt%
SiO_2	44.6	54.4
Al_2O_3	2.9	7.1
B_2O_3	6.9	10.2
CaO	0.8	1.2
MgO	1.3	1.5
Na_2O	8.2	12.1
K_2O	2.1	4.6
Li_2O	3.1	4.6
Fe_2O_3	7.4	12.7
MnO	1.6	3.1
TiO_2	0.6	1.0
U_3O_8	0.5	3.2
ThO_2	0.01	0.8
Group A[1]	0.08	0.2
Group B[2]	0.08	0.9

[1] Isotopes: Tc, Se, Te, Rb, and Mo.
[2] Isotopes: Ag, Cd, Cr, Pd, Ti, La, Ce, Pr, Pm, Nd, Sm, Tb, Sn, Co, Zr, Nb, Eu, Am, and Cm.

increase the probability of a chain reaction (18). In addition, technology constraints related to viscosity of the molten glass can be difficult to predict (19, 20).

2.1.5 Glass Processing

The most important technological property for glass processing is its viscosity. The viscosity determines the working, annealing, and fining (removal of bubbles from the melt) temperatures, upper temperatures of use, and devitrification rate. These properties are often defined in terms of viscosity (η) as follows (21):

- Glass melting temperature: $\log \eta = 2.0$ poise
- Working temperature: $\log \eta = 4.0$ poise
- Flow point: $\log \eta = 5.0$ poise
- Softening point: $\log \eta = 7.6$ poise
- Annealing point (upper annealing temperature): $\log \eta = 13.0$ poise
- Transition temperature (T_g): $\log \eta = 13.3$ poise
- Strain point (lower annealing temperature): $\log \eta = 14.6$ poise

Typical acceptable viscosity values for melt processing should range between 2 and 10 Pa · s (20–100 poise) (22), because these lower viscosities ease homogenization of the constituents. The addition of 14% waste to the melt can lower the viscosity by a factor of two. Depending on the vitrification process, glass-forming constituents should be added as a premelted ground glass frit to the precalcined radioactive waste.

In addition to viscosity, the temperature of glass transition, T_g, is a very important glass property. Below it, glass loses its ductility and becomes brittle, and its volume significantly decreases. If a quenched glass is reheated above the T_g, it speeds devitrification. It is desirable, therefore, that a glass containing radioactive material is not subjected to temperatures higher than the T_g so that the radioactive material does not segregate into crystals where the radioactive elements are highly concentrated. Atmosphere also plays an important role in glass processing since reduced glasses tend to be less durable than oxidized glasses (23). However, to avoid precipitation of metals and metal sulfides such as NiS and CaS from the glass-forming solution, processing should occur under reducing conditions in which the Fe^{2+}:Fe^{3+} ratio is higher than 0.5.

In addition to glass properties, several properties of the feed materials will also limit the effectiveness of vitrification, including the following (13):

- Feed moisture content (lower than 20 wt% for many processes)
- Feed material composition
- Feed compatibility (ability of the process to handle all sizes and types of materials)
- Presence of combustible material (organics)
- Presence of process-limiting materials (halogens, reducing agents, and metals)
- Potential volatilization of contaminants and metals with low partial pressures (e.g., Hg, Pb, and Cd)
- Potential shorting of electrodes in Joule heating caused by metals

2.1.6 Devitrification

Devitrification implies the growth of crystalline material in the glass. It can occur as a result of the selection of an unsuitable glass composition or prolonged contact and reaction with the furnace refractories in stagnant regions of the melting furnace. The addition of nucleating agents to the glass may promote devitrification. Usually, the nucleating agents are soluble in the molten glass.

Devitrification of borosilicate glass occurs to a certain extent between 900° and 500°C (24). Usually, the crystalline phase will be a maximum of 3.6 vol% of the canisters filled with glass (25). The size and number of crystalline phases depend on the rate of cooling. Thus, to avoid generation of internal stresses (mainly tensile stresses around the temperature of glass transformation that lead to cracking and void formation), the cooling rate should be carefully controlled. Stresses in glass can be relieved above the glass transition temperature, 430°–450°C, so cracking usually occurs as the temperature drops below 450°C (26). At room temperature, the rate of crystallization of borosilicate glass is very slow and is not expected to occur for 10^6–10^{13} years (27).

Borosilicate glasses are also susceptible to phase separation into two or more noncrystalline phases. If the phase separation takes place in the melt at a temperature above the liquidus temperature, it is described as stable immiscibility, whereas phase separation occurring below the liquidus is described as metastable immiscibility (28). The presence of stable immiscibility is important in glass manufacturing. Two mixed glassy phases often have quite different properties from those of a single phase of the same average composition. Devitrification rates and leachability are higher in phase-separated glasses. Phase separation occurs only if the waste compositions are modified to contain much higher levels of B_2O_3 (29). Generally, there is no evidence of phase separation in properly formulated borosilicate glasses (30–32).

Decay of radionuclides in nuclear waste glasses, self-irradiation, and internal and external stresses generate heat, and the temperature of the material may rise to the glass transition temperature, which can lead to devitrification. The temperature can subsequently increase exponentially with the cumulative irradiation dose (33).

Devitrification of glass may have a number of deleterious effects on the integrity of the glass waste form (14). They include the following:

- Depletion of silica leaves the residual glass phase with a lowered chemical durability.
- Problems with draining of the melt occurs if it crystallizes at the bottom of the drain tube.
- Crystalline materials are more susceptible to radiation damage than glasses, and chemical durability may decrease even more than it does for a glass.

2.1.7 Durability of Nuclear Waste Glass

Long-term glass stability is related to the maintenance of silica saturation in the surrounding environment. Generally, glass dissolution in an aqueous solution is controlled by orthosilicic acid activity in solution (34). Glasses with more alkali than the sum of boron and aluminum tend to yield alkaline leach solutions in which the increase of pH is faster than the accumulation of silica. The exchange of hydronium ions in solution for the alkalis in the glasses is the main rate-determining step, and the rate of the glass reaction depends on the concentration of the hydronium ions (35). The main glass reaction process can be presented as

$$\text{Glass–O}^-\text{R}^+ + \text{H}_3\text{O}^+\text{(solution)} \rightarrow \text{Glass–OH} + \text{R}^+\text{(solution)} + \text{H}_2\text{O} \qquad \text{[Eq. 2]}$$

where R^+ represents an alkali metal.

It has been shown that waste glass durability also depends on 1) the amount of water contacting the glass waste, 2) temperature, 3) the ratio of glass surface area to solution volume, 4) radionuclide decay effects, 5) glass composition, and 6) alteration phases resulting from glass hydration (36). The chemical behavior of individual radionuclides in glass depends on the glass homogeneity of the glass and the reaction conditions, such as pH, temperature, water flow rate, and pressure. Also, glass dissolution is enhanced by the presence of clay (37).

Usually, radiation influences glass stability through the formation of corrosive daughter products and by physically altering the glass structure through atomic displacements. Radioactivity can also make the surrounding aqueous solution more reactive through the ionization of water molecules, mostly from gamma and alpha radiation, which creates highly reactive radicals. Also, nitrogen and carbon dioxide dissolved in the water undergo radiolytic decomposition to form nitric and carboxylic acids, respectively (38, 39). These processes can change the leachate pH and glass dissolution rates. Under batch test conditions, glass corrosion has been shown to increase up to three- to fivefold in irradiated tests relative to nonirradiated tests (40).

Many studies have shown that the Al_2O_3 (alumina) reduces borosilicate glass leachability because of the stronger interconnection of alkali and alkaline-earth elements within the network structure of glass containing alumina (41). There is, however, an anomalous increase of the dissolution rate at 150°C (42).

Some controversial techniques are used in measuring the chemical durability of the glasses, such as the Savannah River product consistency test (PCT) procedure (43). The test uses washed, crushed glass powder (100–200 mesh) and a glass surface-area-to-solution-volume ratio of 2000 m^{-1}. It is performed with deionized water (100 mL) at 90°C. This test provides only information on the maximum solubility of glasses and wastes in deionized water and no real solubility of vitrified nuclear wastes. Also, it was acknowledged in some studies that dissolution is affected by the surface area and the volume of leachate (SA/V) (25, 31). The lack of a standardized test to determine leachability makes the results difficult to compare.

2.1.8 Application of Glass Ceramics for Radionuclide Immobilization

The study of glass ceramics for immobilizing nuclear wastes stems from pioneering work at the Hahn-Meitner Institut in Berlin on the crystallization of borosilicate-based waste glasses to improve the thermal stabilities and mechanical properties of the products. The compositions investigated included those that produced celsian ($BaAl_2Si_2O_8$), perovskite ($CaTiO_3$), diopside ($CaMgSi_2O_6$), or eucryptite ($LiAlSi_2O_6$) and residual glass (44).

Practically any inorganic glass can crystallize above the softening temperature. The crystals may deplete the residual glass of ions, such as Al^{+3}, Zn^{2+}, etc., that confer durability on the glass, such that the vitreous matrix becomes more susceptible to aqueous dissolution than the original glass. However, these glasses have considerably higher mechanical and impact strengths and are more resistant to cracking than their parent glass. Therefore, they may be used for radioactive waste immobilization in a low flow rate environment if crystalline phases are thermodynamically stable (45).

Also, sphene-based glass ceramics have been considered as an alternative for HLLW immobilization in Canada. These materials consist of discrete crystals of the major crystalline phase, sphene ($CaTiSiO_5$), within a matrix of aluminosilicate glass, and the waste ions are either incorporated in the sphene structure as solid solution replacements for Ca and Ti or dissolved in the glass matrix. The aluminosilicate glass matrix that remains after sphene crystallization is a highly durable material for immobilizing those waste ions that do not partition into the sphene phase. Generally, sphene is a common accessory mineral in many types of rocks and is resistant to chemical alteration.

The glass ceramics usually have compositions in the following ranges: Na_2O (5.1–9.0 wt%), Al_2O_3 (5.9–11.5 wt%), CaO (9.2–17.1 wt%), TiO_2 (10.7–26.7 wt%), and SiO_2 (40.1–59.2 wt%) and can include waste oxides of Ce, La, U, Sr, Cs, and U (0–25 wt%). The melting temperature is between 1250° and 1450°C. Crystallization is accomplished by controlled reheating of the glass between 900° and 1050°C and holding for 1-3 hours before cooling to room temperature. Typically, crystalline phases that occur in the glass consist of sphene, pyrochlore, fluorite, wollastonite, anorthite, and other minor phases.

2.1.9 Natural Glasses in High-Level Nuclear Waste Immobilization

The common observation of natural glasses persisting in nature for long periods of time provides evidence that natural glasses can be kinetically stable in a variety of environments. Natural glasses are classified according to their silica content from silica-rich rhyolitic glasses and tektites to silica-poor basalt glasses (Table 4) (46). Tektites are glasses of excellent durability with approximately 74 wt% SiO_2. They resist water diffusion similarly to nuclear glasses, which have diffusion coefficients of approximately 2×10^{-24} m^2/s at 25°C (47). The results of a series of experiments with tektite glass in water between 150° and 225°C for up to 400 days show a reaction resulting in the formation of a birefringent hydration layer that increased in thickness up to 4.8 μm as a function of the square root of time.

A series of basalt-based glass ceramics for immobilization of nuclear wastes was developed at Battelle Pacific Northwest Laboratory (44). The suggested composition was given as 52 wt% SiO_2, 1.6 wt% TiO_2, 2.7 wt% Na_2O, 10 wt% CaO, 6.8 wt% MgO, 11.9 wt% Fe_2O_3, 14.1 wt% Al_2O_3, and 0.2 wt% MnO_2. This particular basaltic melt is able to incorporate up to 20 wt% defense and commercial wastes. The melting temperature is 1300°–1400°C with nucleation and crystallization of 670°–700°C for 0.5 hour. The final products are 35–45 vol% crystalline material with major phases of augite (a Ca,Mg,Fe pyroxene), powellite ($[Ca,Sr]MoO_4$), and a $NiFe_2O_3$ spinel.

Iron-enriched basalt glasses were developed at the Idaho National Engineering Laboratory, with melting temperatures of 1400°–1500°C. Devitrification takes place during controlled cooling with an optional holding period of 16–24 hours at 1000°–1100°C. This particular glass may incorporate transuranic defense waste. Leaching resistance, mechanical properties, and degrees of crystallinity depend on the quantity of radionuclides.

Beginning in the late 1950s, an alternative to high-temperature vitrification of soda–alumina–silicate glasses, a sol-gel process producing phosphate glasses, was suggested. The basic building block in phosphate glasses and crystals is the phosphorus–oxygen tetrahedron. However, in contrast to the tetravalent glass formers (such as Si^{4+} in silicates), the pentavalent phosphorus is double-bonded to one of its surrounding oxygen atoms. Apparently this bonding increases the solubility of the phosphate-related glasses, so they cannot be recommended for use in immobilizing HLLW material.

TABLE 4

Typical Compositions (wt%) of Natural Glasses and Representative Waste Glass SRL 165[1]

Oxide	Basalt Glass	Rhyolitic Glass	Roman Bottle Glass	Tiffany Window Glass	SRL 165 Glass
SiO_2	50.7	74.9	68.48	43.3	52.86
Al_2O_3	11.7	14.2	2.61	2.0	4.08
B_2O_3	--	--	--	11.5	6.76
Na_2O	4.5	4.68	19.73	0.2	10.85
K_2O	0.7	4.59	0.77	2.7	0.19
CaO	10.6	0.53	6.74	0.35	1.62
MgO	6.7	0.02	0.68	0.03	0.72
FeO	--	0.49	0.29	0.09	--
Fe_2O_3	13.1	0.29	--	--	11.74
TiO_2	1.9	0.04	--	0.1	0.14
MnO	0.4	0.03	0.65	--	2.79
P_2O_5	--	--	--	0.26	0.02
Li_2O	--	--	--	--	4.18
NiO	--	--	--	--	0.85
ZrO_2	--	--	--	--	0.66
PbO	--	--	--	38.93	--
CuO	--	--	0.06	0.06	--
H_2O	0.1	0.3	--	--	0.1

[1] Compositions are taken from Reference 46.

2.1.10 Application of Synrocs for Radionuclide Immobilization

Synrocs consist of an assemblage of four main titanate minerals: zirconolite ($CaZrTi_2O_7$), hollandite ($Ba_{12}[(Al,Ti]_8O_{16}$), perovskite ($CaTiO_3$), and titanium oxide (Ti_nO_{2n-1}) (48). Synrocs are capable of dissolving the transuranic waste ions such as U^{+4}, $Np^{+3,+4}$, $Pu^{+3,+4}$, $Am^{+3,+4}$, and Cm^{+3} by substituting waste ions for host ions. The creation of synrocs requires temperatures of 1250°-1400°C, and a relatively high pressure of at least 20 MPa. Since HLW contains a wide range of components, some of which are readily reduced to the elemental state and others which are readily oxidized to higher valence states, it is important to provide careful control of the atmosphere.

Zirconolite is considered the most durable of the synrocs and can immobilize waste actinides at levels up to 30 wt% (49). Excess uranium would react with TiO_2 to form very stable $CaUTi_2O_7$ crystalline phase. Cesium would react with trivalent titanium plus additional TiO_2 to form a cesium hollandite component, $CsTi_x^{3+}Ti_{8-x}^{4+}O_{16}$. The primary concern with synroc minerals is their excess porosity. To date, samples have been made by solid-state sintering for extended periods (about 100 hours) at 1450°C, and/or at 1250°C and 20 MPa pressure for 2 hours, and the density of the sintered materials was only about 90% (50, 51). This porosity can increase the leachability of the material.

The leachability rate of synrocs sharply decreases with time. The decrease is attributed to the depletion of monovalent and divalent cations in the surface layer, leaving it enriched in TiO_2 and, to lesser extent, ZrO_2 (Figure 1) (52, 53). The chemical durability of synrocs is higher than that of borosilicate glasses. Also, crystalline phases formed in synrocs such as $Ca_2Nd_8(SiO_4)_6O_2$, $Gd_2Ti_2O_7$, and $CaZrTi_2O_7$, are less leachable than that of borosilicates after irradiating at doses as high as 10^{25} α-decay events/m^3.

2.1.11 Cements and Bentonites

Two other groups of materials capable of immobilizing radioactive wastes include cements and bentonite. Bentonites are weathering products of volcanic ash. Their essential component is the clay mineral montmorillonite, present in proportions of 65%-99%. However, their durability is less than that of borosilicate glasses and synrocs ceramics.

Cement can be used for immobilization of low- and intermediate-level radioactive wastes (48). For use in encapsulation of radioactive wastes, cement blends have to meet a number of requirements: they should make a stable monolith; heat generation must be avoided since temperatures exceeding 100°C will result in steam generation and creation of cracks; and water should not be segregated since this complicates the encapsulation process.

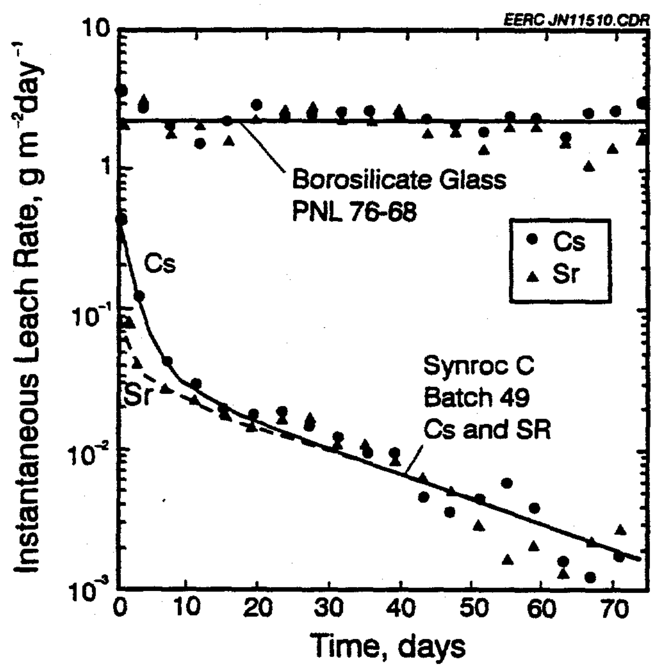


Figure 1. Leach results for cesium and strontium from Synroc-C (10 wt% simulated HLLW) and waste glass (PNL 76–68) at 100°C; leachant: deionized water, replaced daily.

Cements are chemically reactive, and after hydration, they have a mineralogy capable of incorporating a range of radionuclides. They are also slightly water-soluble and give rise to waters with high pHs. Cement is also susceptible to failure as a result of the action of stress, its environment, and naturally occurring microorganisms (54). However, a great deal of information exists on working with cements in natural environments. A thermodynamic model of major crystalline phases, such as hydrogarnet ($Ca_3Al_2O_6 \cdot 6H_2O$), ettringite ($Ca_6Al_2Si_3O_{21}[OH]_{12}$), hydrotalcite ($4MgO \cdot Al_2O_3 \cdot 10H_2O$), and gehlenite hydrate ($Ca_2Al_2SiO_7 \cdot 8H_2O$), has been developed to predict the composition of solid and aqueous phases in blended cements as a function of the bulk composition (55). Departures from the predicted model occur in cements with alkali-bearing components.

Use of bentonites for immobilization of radioactive waste is frequently identified as a worst-case scenario. However, in Switzerland, montmorillonite is used as a natural safety barrier to seal construction-caused joints and rock fractures around containers holding vitrified waste because the clay swells in the presence of water. The solidified waste is a borosilicate glass matrix that will be encapsulated in a 25-cm-thick steel canister with a minimum life expectancy of 1000 years. The canisters will be placed in horizontal tunnels 3.7 m in diameter at a depth of around 1000 m (56).

2.1.12 Vitrification Technologies

Two major, well-recognized types of vitrification technologies are differentiated by their heating methods, either electrical heating or heating by firing a fossil fuel. Usually, electric heating is subdivided into Joule heating, plasma heating, and microwave heating. These types of heating are potentially applicable in vitrification of nuclear wastes (13).

Electric heating, also called ex situ Joule heating, is an efficient method of transferring energy to a waste, since no combustion air needs to be heated with the waste as is necessary when a fossil fuel is fired. The method is readily applied to glasses since glass resistivity decreases by a factor of 10^{13}–10^{14} as temperature increases from ambient to 1300°–1400°C. Since the conductivity of molten glass is a result of its ionic character, an alternating current must be used to avoid the risk of electrolysis, anodization of the electrode, and the depletion of charge carriers. Electrodes must withstand corrosion from the molten glass bath, offer adequate mechanical strength at high temperatures, and possess low resistivity. These limitations imply that the maximum temperatures of the melt should range between 1000° and 1600°C (57). The commercial glass industry uses graphite and molybdenum for electrodes. Figure 2 illustrates the typical glass melter used in the glass industry.

For a Joule-heated ceramic melter, the variation in resistivity of a glass with temperature is a very important parameter, and it is highly correlated with liquidus temperature and glass viscosity. The glass liquidus temperature constraint for the Hanford melters (Hanford Waste Vitrification Plant, Westinghouse Hanford Company, WA) has been $T_L < T_M - 100°C$, where T_L and T_M are the liquidus and melter temperatures, respectively (58). In this type of melting, the ability to predict the electrical resistivity of a glass from its composition has the same importance as prediction of viscosity from composition (59). The electrical conductivity requirement at T_M, 10–100 S/m, is usually satisfied for any glasses with viscosity within 2–10 Pa · s (20–100 poise) at T_M (60).

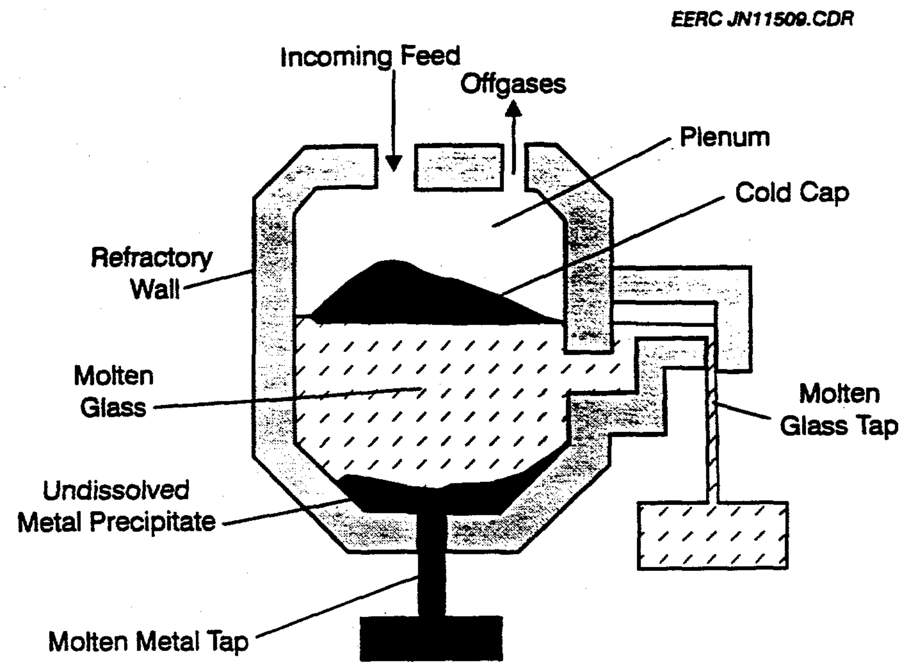


Figure 2. Schematic of a Joule-heated ceramic melter (JHCM).

Electric furnaces may encounter several of the following processing problems:

- Foaming leading to unstable operations and pressure surges
- Cold-cap bridging occurring when liquid flows under the cold cap
- High electrical conductivity in the melt causing the current to exceed the recommended maximum
- Low electrical conductivity in the melt resulting in a high voltage potential causing conduction within the refractory material
- High viscosity slowing the processing rate
- Low viscosity (< 100 poise) increasing refractory corrosion

At the Savannah River Site (SRS) in Aiken, South Carolina, the vitrification of HLLW is accomplished in a Joule-heated melter. The nominal glass temperature beneath the cold cap is 1150°C, the nominal glass weight is 6500 kg, and the average residence time in the melter is about 65 hours (61). It has been suggested that the HLLW will be mixed with glass frit and vitrified to form a durable, solid borosilicate glass. A small amount of sodium titanate would be added to adsorb the traces of soluble strontium and plutonium in sludge (62).

Another Joule heating process is induction heating, developed in France and known as the AVM process (Atelier de Vitrification Marcoule). This process is accomplished by inducing currents in the material using a solenoid, which creates a variable magnetic field inside the coil and around it.

Plasma heating relies on the conversion of surrounding gas into a plasma (an ionized gas) by an electric arc. The technique offers high operating temperatures and high power densities. An argon plasma may theoretically offer temperatures as high as 19,000°C, but in the partially ionized plasmas that occur in industrial applications, the temperature varies between 2000° and 5000°C. Usually, the plasma torch operates in the transferred arc mode. The transferred arc mode uses a flow of gas (Ar, N_2, air) to stabilize an electric discharge (arc) between a high-voltage electrode (inside the torch) and a molten pool of waste maintained at ground potential. The longer the arc, the more of the arc energy is diverted to the walls of the melter by radiation. Retech, Inc., of Ukiah, California, has developed a plasma-heating furnace called the plasma centrifugal reactor (PCR) that allows the material to exceed a temperature of 10,000°C (Figure 3). The rotating reactor helps to transfer heat evenly throughout the molten phase. Periodically, the melted material is allowed to fall into a slag chamber where it is collected in waste containers. Electro-Pyrolysis Incorporated (EPI) of Wayne, Pennsylvania, employs a similar direct-current plasma arc technology in its vitrification process. The technology was developed in cooperation with the Massachusetts Institute of Technology and Pacific Northwest Laboratories.

In microwave heating, a form of dielectric heating is introduced to the body through the absorption of electromagnetic radiation. A microwave installation consists of a microwave

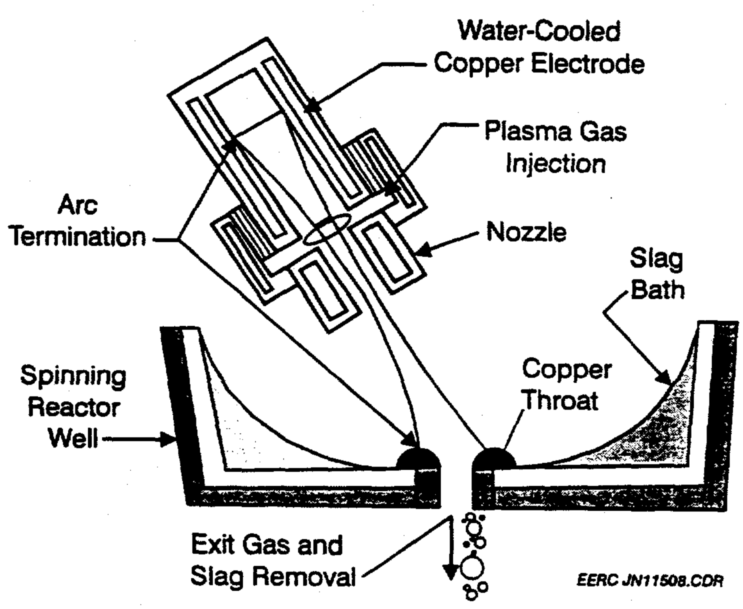


Figure 3. Schematic of the plasma centrifugal reactor (PCR).

generator, a waveguide, an applicator, and ancillary monitoring devices. The main disadvantage is its relatively high energy consumption.

The next group of thermal process heating devices is based on burning of fossil fuels in a rotary kiln incinerator. These methods are inherently less efficient at transferring the energy to the waste material since a large mass of combustion air must also be heated. However, the fuel is cheap and is used directly for heating the waste, unlike electrical heating, where the fuel must first be converted to electricity, a process that is approximately 35% efficient. Inorganic Recycling Inc. (IRI) has developed a vitrification process using only incineration, while Marine Shale Processors has developed a vitrification process in which only a portion of the incineration products is vitrified. Figure 4 shows a schematic of the IRI process. Vortec Corporation has developed a portable system that can fire natural gas or coal. The gas flow within the combustor is forced into a strong cyclonic motion causing the molten waste to separate efficiently from the gas for casting into ingots.

2.1.13 Summary and Recommendations

This literature review provides an overview of low- and high-level nuclear waste immobilization. Emphasis is on vitrification technologies based on borosilicate glass, since this glass will be used in the United States and in Europe to immobilize radioactive HLLW for ultimate geological disposal. Vitrification of aqueous radioactive wastes will achieve large volume reductions (86–97 vol%) and will ensure their stabilization. Borosilicate waste glasses are the most studied and probably best understood waste form that has been developed. The application of synrocs, cements, and bentonites for radionuclide immobilization is also discussed.

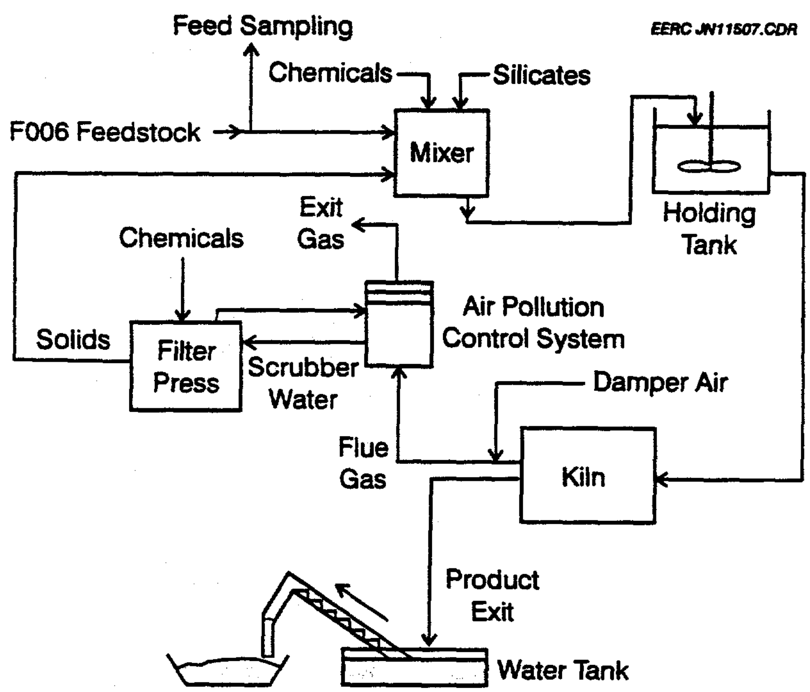


Figure 4. Schematic of IRI process (13).

Generally, radioactive wastes contain volatile hazardous components such as lead, mercury, cadmium, cesium, and strontium compounds, which must be captured in scrubbers and treated as secondary waste. Any immobilization technology must consider alkaline–acidic environmental conditions.

This survey indicates that a lack of information exists in the following areas:

- Vaporization of heavy or radioactive metals from the melts and whether vaporization behavior could be controlled by modifying the heating environment in order to separate the hazardous materials from the bulk waste.

- How to avoid the formation molten sodium sulfate on the cold cap.

- Catalytic activity of radionuclides at the surface of the glass and glass corrosion in water.

- The effect of the glass cooling rate on the generation of residual stresses below the temperature of glass transformation and its effect on the leachability of nuclear waste glass.

- The effect of foaming of the melt on the homogenization of nuclear waste during vitrification using plasma technology.

- Immobilization of scrubber condensed volatized hazardous components such strontium, cesium, lead, cadmium, and others in inorganic materials with low melting temperatures not related to silicate glasses. Survey of these materials has begun.

2.2 Subtask 2 Survey of Cleanup Sites

2.2.1 Introduction

DOE has recognized and documented waste sites and contaminant categories under their jurisdiction in a series of reports (63–67). The U.S. Environmental Protection Agency (EPA) has also documented information regarding DOE waste sites (68). This information is readily available to research organizations and the general public through the respective government agencies. These agencies have made a commitment to both direct remediation and restoration activities and to basic research to improve the understanding of contaminant behavior in subsurface environments. DOE has also made a commitment to bringing new technologies, particularly those involving small businesses, into commercialization to facilitate remediation and restoration efforts at DOE waste sites (69–72). Numerous programs have focused on the basic research and development of technologies. The EERC has specific experience in scientific and engineering research and in working with industry in environmental management (73).

The focus for immediate EERC efforts will be on cleanup of non-high-level wastes, most likely including those wastes designated as low-level waste, hazardous waste, or low-level hazardous waste, also referred to as low-level mixed waste and mixed waste. Mixed waste is the most broadly defined of these waste types and has the potential to benefit from innovations in waste management technologies. Each of these waste types has been explicitly defined in several DOE documents. For reference, these definitions are in the glossary of terms in Appendix A, which includes all defined DOE waste types and site description terminology.

2.2.2 Summary of DOE Information on Waste Sites

Extensive information has been developed by DOE on the waste sites under its jurisdiction (63, 65, 68, 74). The EERC reviewed much of this information in order to make preliminary selections of waste types and potential sites for coordination with small business for environmental management activities. DOE includes the following in its environmental management activities: 1) waste management, 2) environmental restoration, 3) nuclear material and facility stabilization, and 4) technology development. Several key factors must be summarized in order to focus the EERC's potential participation in this DOE Environmental Management activity.

Eighty-one waste sites are listed in DOE's 1995 Baseline Environmental Management Report (74). These sites are located in 30 states. Cleanup activities are completed at nine of the sites listed. These are all Uranium Mill Tailings Remedial Action projects with long-term Surveillance and Maintenance (UMTRA S&M) activities. Further definition of UMTRA sites is given in Appendix A. In another report (63), it is stated that there are 91 waste sites at the 18 DOE facilities within the weapons complex. There are also 46 FUSRAP (Formerly Utilized Sites Remedial Action Program) sites in 14 states (65,74). Both UMTRA and FUSRAP are DOE programs mandated by Congress (64). Since 1974, more than 400 sites were identified as potential FUSRAP candidates, but 300 have been eliminated. Eighteen of the 46 FUSRAP sites have been completely cleaned up and 11 have undergone partial cleanup. The waste at these facilities is low-level waste, but the volume is estimated to be 2.3 million cubic yards. These sites are not currently in use for any energy- or defense-related activities. Following the original decommissioning of many of these sites, commercial and industrial use of the sites was allowed for a variety of activities including storage, manufacturing, and salvage operations. The EERC's review indicates that these activities have ceased until final cleanup to current environmental standards has been completed. Some of these industrial and commercial activities resulted in distribution of low-level waste into surrounding areas, which now must also be considered in environmental restoration activities.

DOE has identified five sites that are the most complex from the standpoint of waste types and quantities present, as well as the extent of environmental impact. These sites are 1) the Hanford site (Washington), 2) the Savannah River site, South Carolina, 3) the Rocky Flats Environmental Technology site, Colorado, 4) the Oak Ridge Reservation (including the K-25 site, the Y-12 Plant, and the Oak Ridge National Laboratory Tennessee), and 5) the Idaho National Engineering Laboratory, Idaho. These sites are also the major environmental management sites based on estimated life-cycle costs, potentially requiring $164 billion to clean up, which is 71% of the overall DOE Environmental Management program budget.

The expected time frame for cleanup activities at all DOE sites varies widely. Cleanup has been completed at many sites, as noted earlier; however, more require it. The five major sites are scheduled to complete remediation by approximately 2050. Remediation at other DOE sites is generally expected to be completed sooner, with typical dates ranging from 2000 to 2030.

Site characterization is currently under way at numerous sites, but it is important to note that this task is often difficult because acceptable/common waste management practices used in the past frequently did not provide accurate record keeping of waste generation or disposition. It is also important to note that some sites were originally owned and operated by private companies and some site contamination may not be directly related to U.S. energy and defense activities. The responsibility for cleanup at these sites generally includes the original industrial owner or company that has since assumed liability for that entity's actions. DOE has developed waste management practices for sites still in service that meet current waste management requirements and do not add to current environmental restoration requirements at those sites.

Almost all identified sites have one or more type of radioactive waste, but these wastes vary widely. Generally, radioactive waste is a solid, liquid, or gas that contains radionuclides. DOE manages four categories of radioactive waste: 1) high-level waste (HLW); 2) transuranic (TRU) waste; 3) low-level waste (LLW); and 4) uranium mill tailings. Detailed definitions of these waste types and radionuclides are included in Appendix A. DOE also manages hazardous waste, mixed waste or low-level hazardous waste, spent nuclear fuel, and sanitary waste, also defined in Appendix A. Meeting regulatory requirements and resolving questions related to various regulations is one of DOE's most significant waste management challenges. A large portion of DOE's mixed waste is mixed low-level waste found in soils. It is generally true that contamination from all wastes has been identified in soils, subsurface sediments, and in groundwater, but it is important to note that each site is different, not only because of varying types and concentrations of contaminants but also because the sites are located throughout the U.S. and have a variety of geologic characteristics (63).

The magnitude and variety of contaminants that need to be cleaned up is difficult to summarize; however, DOE provided an overview in the document entitled "Chemical Contaminants on DOE Lands and Selection of Contaminant Mixtures for Subsurface Science Research," published in April 1992. While this report does not include the UMTRA sites, it provides information on the waste types and combinations that are applicable to DOE's overall Environmental Management program. The report delineates contamination by contaminant class and the presence in soil/sediments and groundwater at each of the 18 facilities and 91 waste sites. Appendix B includes several tables and graphics from the DOE report that effectively summarize the complexity of waste types and contaminants requiring action at DOE sites. Table B1 indicates the waste compound classes and representative constituents, providing more detail than the simple broad waste classifications generally used in other DOE reports. Several of these (radionuclides, polychlorinated biphenyls [PCBs], and explosives) have special handling requirements. Figures B1 and B2 indicate the occurrence of the contaminants in soil/sediment and groundwater at the 18 facilities and 91 sites surveyed for the report. This graphical representation provides insight to the most common contaminants found. It does not provide information on the levels of contamination reported. Table B2 provides information on common combinations of compound classes. This information is significant in developing remediation strategies. Again, the number of sites with a common combination of contaminants allows some prioritization of effort. More detailed information on the specifics of each contaminant class is provided in Figures B3 through B7. DOE included only the most common contaminant classes. For this graphical representation, more specifics about the contaminants are provided and the number of sites reporting these contaminants indicated. Concentration ranges of specific constituents reported in groundwater and soil/sediment are reported in Table B3. The most significant general information that can be drawn from this table is that the reported concentration ranges are extremely broad, and the maximum values reported all drastically exceed the regulatory guidelines (also noted in Table B3). Additional information is presented in DOE's document; however, these tables and figures summarize the primary information used to facilitate waste and site selection for the EERC's participation in the overall DOE Environmental Management program.

More site-specific information is included in the 1995 Baseline Environmental Management Report (65, 74), but it does not include a great deal of detail on contaminant classes. The site-specific information required to make good decisions regarding the applicability of a innovative technology is not readily available or cross-referenced in the DOE documents that were reviewed for this report. Based on the review performed, it can be concluded that small businesses and others trying to determine whether or not a specific technology has a role in the DOE Environmental Management program will find this information difficult to obtain. Since the amount of information is so extensive, assembling it in a user-friendly format is expected to be a difficult task; however, if DOE is to take advantage of small business innovation, the information must be made more readily available. As discussed at a DOE-hosted session at the American Ceramic Society Conference on Emerging Technologies in Hazardous Waste Management VII, the best way to determine site-specific needs is to have direct contact with the appropriate individuals at any given site.

2.2.3 Summary of Potentially Applicable Waste Management Technologies

Much of the information on waste management technology has been developed and reported by EPA (68, 75–79). DOE has numerous projects under its EM Technology Development program (64, 67, 69, 71, 72). In several cases, remediation technologies have been identified for use with the various waste types, and several waste disposal sites have been selected. In the 1995 Baseline Environmental Management Report, DOE gives distinct site remediation and restoration plans. DOE documents estimate that a high volume of the wastes at many sites requires removal and disposal in an appropriate disposal facility (65, 74).

The EPA report entitled "Remediation Technologies Screening Matrix and Reference Guide" (77) summarizes numerous remediation technologies for solids, groundwater, and emissions/offgases. The information presented in that document was used in the following summaries of remediation technologies of high interest to the EERC. The technologies of highest interest to the EERC are those that would be applied to solids (soils, sediments, and sludges) or groundwater. Many of these technologies are used in combinations dependent on the actual waste requiring remediation.

Vitrification

The EERC's evaluation of vitrification technology indicates that vitrification is DOE's best available technology for stabilization and disposal of HLW. The evaluation also indicates that development of vitrification technology has been the focus of both private industry and government agencies. Vitrification processes include in situ and ex situ vitrification. Only one vendor is licensed for in situ vitrification, while five are actively promoting proprietary ex situ vitrification technology processes. EERC participation in commercialization of vitrification technologies is currently only loosely defined and will likely require further baseline investigations.

Solidification/Stabilization

Solidification/stabilization (S/S) technology may also be applied in situ or ex situ, like vitrification. Both in situ and ex situ S/S have been demonstrated to reduce mobility of inorganic constituents up to 95%. S/S is most applicable to inorganic constituents, with only limited effectiveness for many organic constituents, although S/S technologies for organics are under development and testing. S/S technologies have the advantage of being relatively simple using readily available equipment. However, destruction of organics if final, while S/S still presents a potential future problem.

Thermal Treatment

Low- or high-temperature thermal desorption is used to volatilize water and organics, which are transported to a gas treatment system. Vendors are currently promoting both the low- and high-temperature thermal desorption as an ex situ remedy.

Incineration and pyrolysis are also used for hazardous wastes containing halogenated and nonhalogenated organics (both volatile and semivolatile), pesticides, and fuels. These are generally ex situ techniques. Incineration, one of the most mature remediation technologies, is in use at Superfund sites. Pyrolysis is in the early stages of development. Since these techniques offer true destruction, future release is not a consideration.

Biological Treatment or Degradation

In situ biodegradation relies on the naturally occurring microbes whose activity is stimulated to enhance degradation of organic compounds. There are numerous limitations to this technology, but it is targeted at nonhalogenated volatile and semivolatile organics and fuel hydrocarbons. It is less effective for halogenated compounds and pesticides.

Biological treatment is also currently being used to treat both slurries of soil or sludge and controlled solid phases. Again, this approach is most effective in treating nonhalogenated organics and fuel hydrocarbons.

Soil Vapor Extraction

Volatile constituents are extracted from the waste (in situ or ex situ) by application of a vacuum or through direct ventilation. The process may be thermally enhanced, which extends its applicability to include semivolatile constituents and some pesticides. In situ techniques are limited to the vadose zone, and the soil type is extremely significant to the effectiveness of the technology. Treatment of offgases and collected groundwater must also be considered.

Chemical Reduction/Oxidation

Chemical reduction/oxidation is used to convert hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert. The target constituents are inorganics, although it can be used less effectively to treat nonhalogenated organics, fuel hydrocarbons, and pesticides. Reducing/oxidizing agents commonly include ozone, hydrogen peroxide, hypochlorites, ozone, chlorine, and chlorine dioxide. Use of these agents in combination or with the addition of ultraviolet oxidation makes the treatment more effective. This is a well-established technology for water and wastewater treatment.

2.2.4 Waste Sites and Environmental Management Technologies for EERC Focus

The EERC objective is to facilitate commercialization of near-commercial innovative waste/site remediation technology from small businesses. Since most government and large industry efforts are focused on high-level wastes and spent nuclear fuel, the EERC will focus more on low-level wastes, mixed wastes, and hazardous wastes.

The EERC research staff has extensive expertise and experience related to DOE's requirements for environmental management at DOE sites. The EERC also has excellent facilities for participating in DOE's technology development effort related to environmental management. There are, however, technical limitations and University of North Dakota safety requirements that limit some materials handling in laboratories on-site at the EERC. The limitations provide preliminary selection criteria for waste and contaminant types for EERC efforts under this task: 1) high-level wastes, transuranic wastes, or spent nuclear fuel will generally not be considered; 2) PCBs and explosives will generally not be considered; and 3) most frequently occurring toxic metals within low-level mixed and hazardous wastes will be given priority. These three preliminary selection criteria focus the EERC's waste site selection for this task.

Using these three preliminary selection criteria, all of DOE's wastes sites as described in the 1995 Baseline Environmental Management Report (65, 74) were evaluated. All the sites for which information was reviewed are listed in Appendix C. The site summaries do not provide all the information required to make final site selections for EERC participation; however, several waste sites were identified as examples of the type of waste sites that would provide the opportunity to investigate innovative technologies that would be broadly applicable to numerous DOE sites as well as industrial sites and processes. Each of the identified waste sites requires environmental restoration and is scheduled for remediation in the future. Remediation activities are not currently under way at the sites identified. The sites identified as examples for potential EERC participation are listed in Table 5. Site summaries for each identified site developed by DOE and reported in the 1995 Baseline Environmental Management Report are also included in Appendix C.

These sites, which have been characterized (at least preliminarily), have a variety of waste types. Specific waste types that do not match the EERC's preliminary criteria are not currently under consideration for this project. Since the site characterization information varies in detail between sites, more complete information will be needed as the site selection proceeds. In many cases, the waste/site descriptions do not provide adequate information on the disposition of the wastes and whether or not they are intermingled. This information may change which sites are selected. Identification of technologies for commercialization may also change or narrow the site selection.

It is worth noting that any site remediation and environmental restoration will result in production of wastes for disposal, and waste minimization should be considered as a part of the technology evaluation.

TABLE 5

DOE Environmental Management Waste Sites Identified by EERC

Site	Waste Types Identified at Site
Geothermal Test Facility, California	Treated and untreated brine; arsenic-contaminated debris Mineral- and salt-contaminated sediments; asbestos
Oxnard Site, California	PCBs Organic coolants and lubricants
South Valley Superfund Site, New Mexico	Soil and groundwater contaminated with organic solvents (trichloroethylene and dichloroethane)
UMTRA Sites, North Dakota	Soil, grave, and rubble contaminated with uranium-containing ash
Fernald Environmental Management Project, Ohio	Low-level waste storage; radium-bearing residues Metal oxides Soil and construction debris with low levels of radioactivity Fly ash Lime sludge ponds Solid waste landfill
Pantex Plant, Texas	Organic solvents Explosives Heavy metals

Site characterization is still required for many sites, and the development of "Expedited Site Characterization" (Appendix A) allows innovative field and laboratory characterization techniques to be applied. This would be an ideal area for EERC participation as it requires multidisciplinary teaming to make decisions to perform the most cost-effective site characterization. Long-term surveillance and monitoring of many of the DOE waste sites is scheduled and, in some select cases, may be the only activity at a site where minimal environmental risk is assessed. These activities may have limited opportunity for development and commercialization of innovative technologies, but they should not be ignored or excluded from the EERC program.

2.3 Subtask 3 Selection and Characterization of Test Mixtures for Vitrification and Crystallization

Based on the findings of the literature surveys described in Sections 2.1 and 2.2 of this report, it was decided that inducing crystallization in vitrified wastes would not be the most efficient way to stabilize them. Instead, it was decided to pursue the idea of removing certain heavy metals from the waste during vitrification through enhanced vaporization. Section 2.4 of this report describes the results of that work.

2.4 Subtask 4 Selection of Crystallization Methods Based on Thermochemistry Modeling

2.4.1 Introduction

As a result of the survey of vitrification technologies reported in Section 2.1 of this report, it was decided to modify the original scope of work to delete enhanced crystallization of vitrified waste as a stabilization technique. Instead, the idea of removing some toxic elements from a waste during vitrification by enhancing the vaporization of the elements and collecting the condensed materials separately from the vitrified material would be investigated. The specific elements to be focused on were delineated through a site survey described in Section 2.2 of this report.

The two main types of waste vitrification technology are based on either Joule-heated ceramic melters or plasma torch systems. In the former technology the temperature of a silicate melt may reach 1600°C but in the latter the contact temperature between the surface of the melt and plasma may produce localized temperatures of over 10,000°C. Common oxides such as silica, alumina, calcium, and boron are durable under these extreme conditions in an oxidizing atmosphere but the stability of other oxides such as mercury, lead, and even plutonium are questionable in silicate melts. If they vaporize during vitrification extra care must be taken in treating the offgases. However, vaporization of the elements may also present a way to remove them from the melt and reclaim them, leaving the vitrified product much easier to dispose. Therefore, we have begun to define the vaporization temperatures of toxic trace elements and their oxides from melts using thermochemical equilibrium modeling of borosilicate mixtures. In addition we have begun to determine conditions that will enhance their deposition downstream of the melt.

2.4.2 Modeling of the Vaporization–Condensation Behavior of Trace Elements and Their Oxides

In order to accomplish the modeling effort, it was necessary to identify the trace metals that are commonly associated with nuclear wastes. Radionuclides, heavy metals, and other trace metals are commonly found in combination in high-level waste and mixed wastes at numerous DOE waste sites. It was found from the site survey described in Section 2.2 that the radionuclides commonly found in waste forms were tritium, uranium, strontium, plutonium, and cesium. The trace metals most commonly noted were lead, chromium, arsenic, zinc, copper, mercury, and cadmium. Because of the difficulties associated with performing tests on mixtures containing radioactive elements, we focused primarily on the heavy trace metals for modeling.

To determine the conditions of vaporization of the heavy elements from silicate melts, thermochemical equilibrium calculations of the stable phases of the elements over a range of temperatures were performed. The best-developed commercially available computer code for performing these calculations is the result of work of Canadian–Swedish team at the École Polytechnique de Montréal in Canada. Tailored for the treatment of about five thousand species, it is known as the Facility for the Analysis of Chemical Thermodynamics (FACT) code. We have employed the code to calculate the vaporization temperatures of trace elements and their oxides from borosilicate melt/glass in the temperature range of 600°C to 2000°C. The condensation temperatures for pure metals/oxides were taken from database stored in FACT code. For convenience the composition of the borosilicate glass and trace oxides were expressed by mole fraction (Table 5). The concentrations of the trace oxides were varied between mole fractions of 10^{-3} and 10^{-6}. The calculations were performed at three different oxygen pressures: 1, 0.001 and 0.000001 Atm. The lower pressures simulate reducing atmospheres. For some temperatures and mainly lower oxygen pressures the FACT code was unable to calculate the vapor concentration since the code was not able to calculate a solution for the equilibrium composition.

Figures 5–8 illustrate the variation of trace elements concentration in vapor phase over borosilicate melt/glass with temperature. Generally, there is a characteristic temperature (T_{cr}) at which the elements and their oxides vaporize, and this depends on the oxygen pressure over the melt/glass. Usually, T_{cr} decreases with oxygen pressure and is very well defined below 1 atm. Table 6 lists these temperatures for the seven elements and their oxides released from borosilicate melt/glass at 1 atm oxygen pressure. Table 6 also provides information on the composition of vapor phase. The mole fraction of associated atoms in a vapor phase such as M_2 is usually below 10^{-6}.

It is found that lead may vaporize from borosilicate melts above 1530°C; cadmium, zinc, arsenium, chromium, and copper may vaporize at temperatures between 1230° and 1430°C; and mercury above 530°C. Also, it is found that for the range studied, the concentration of the elements in the melt does not significantly affect the vaporization temperatures.

Usually, their mole fraction in the vapor phase is very low, below 10^{-6}. Figure 6b illustrates an example of log mole fraction variation of all mercury species in the vapor phase with temperature. The temperatures of phase transformations 1) solid → liquid, 2) solid → gas and 3) liquid → gas, for all discussed components are listed in Table 6.

3.0 FUTURE WORK

Thermochemical equilibrium calculations of the behavior of heavy elements during vitirification of waste have shown that it may be possible to vaporize some of the elements, reducing their concentration in the vitrified materials. Because of the lower concentrations, the vitrified material may be much easier to subsequently dispose, and it is also likely possible to reclaim the materials in relatively pure form from the melter by selective condensation. However, this type of work will take significant development, including more detailed computer modeling as well as laboratory- and bench-scale testing before field testing could commence. Therefore, the work does not met the EERC's brokering criteria of an identified industrial partner and a high probability of near-term commercialization, and it was not proposed for continuation in 1996. Opportunities exist to work with commercial partners in both vitrification and leachability testing, and a new task will be proposed when a defined activity meeting the commercialization criteria are met.

In addition to the vaporization work, another area for EERC focus is waste cleanup and site remediation. This area will allow small business to benefit most from EERC staff expertise and facilities. Specific technologies that fit most readily include solidification, fixation, and encapsulation (SFE) techniques. SFE would be most applicable to hazardous solid wastes, but may also have extensive application to mixed wastes. The EERC could participate in materials characterization, mix design, and solidified waste form evaluation for both physical integrity and mobility of constituents.

TABLE 6

Phase Transformation of Metallics and Their Oxides

Vapor Phase Component	Solid → Liquid K	Solid → Gas K	Liquid → Gas K
PbO	1159	---	---
Pb	600	---	---
Pb_2	Gas	Gas	Gas
HgO	---	811.6	---
Hg	---	---	630.5
Hg_2	Gas	Gas	Gas
As_4O_6	Gas	Gas	---
As	---	2290	---
As_2	Gas	Gas	---
As_3	Gas	Gas	---
CrO_3	470	---	---
CrO_2	---	---	---
CrO	---	---	3687
Cr	2179	---	---
CuO	---	---	---
Cu	1358	---	---
Cu_2	Gas	Gas	---
Cd	594	---	---
Zn	692	---	---

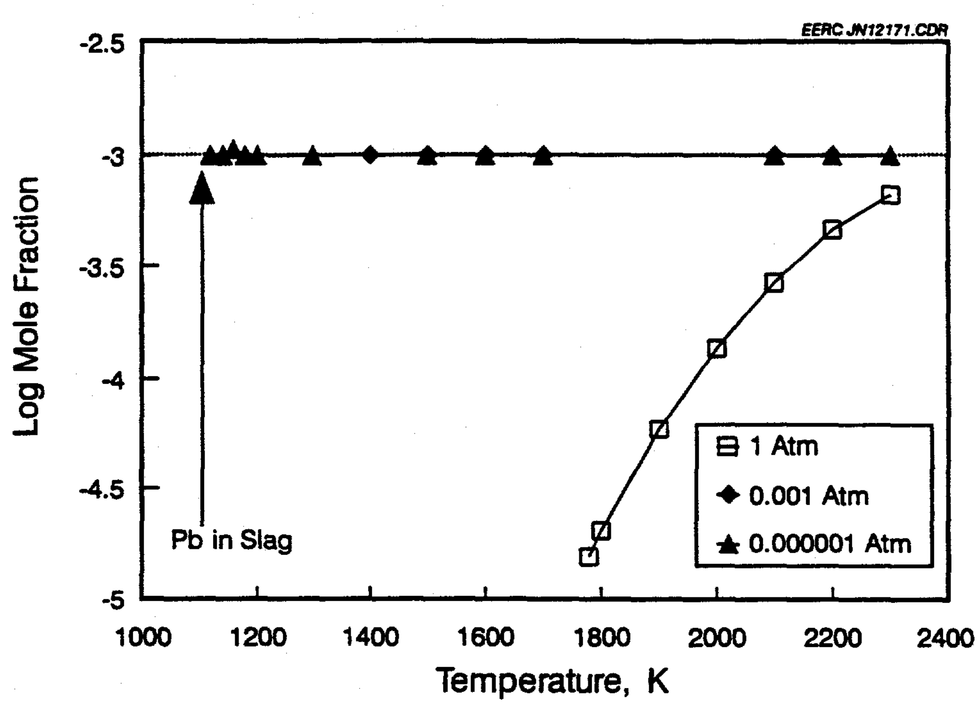
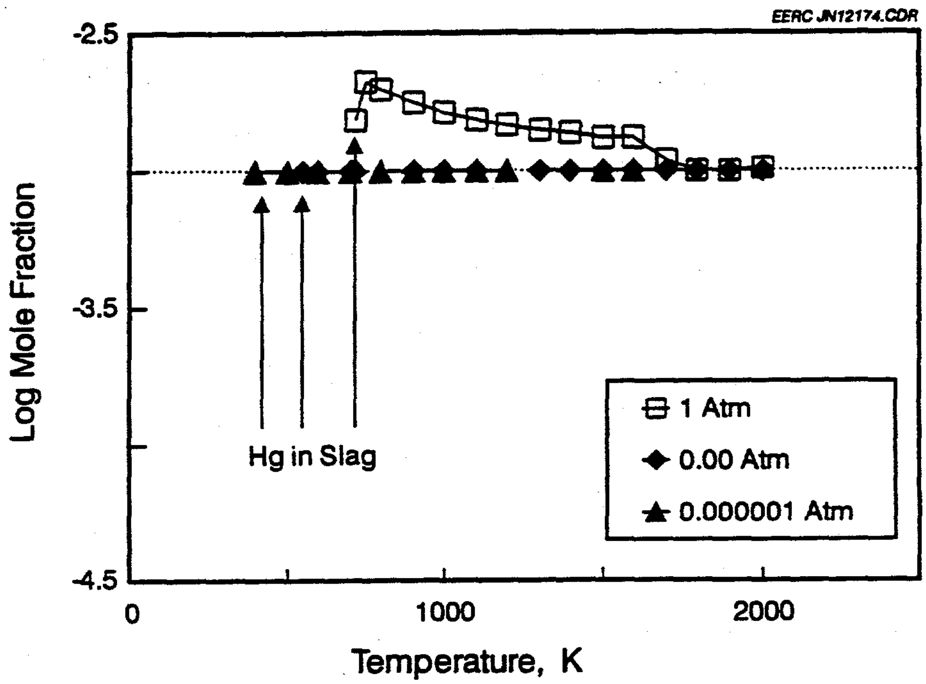


Figure 5. Log mole fraction of lead-derived constituents in vapor phase versus temperature. The arrow represents the temperature at which a significant vaporization can occur.

(a)



(b)

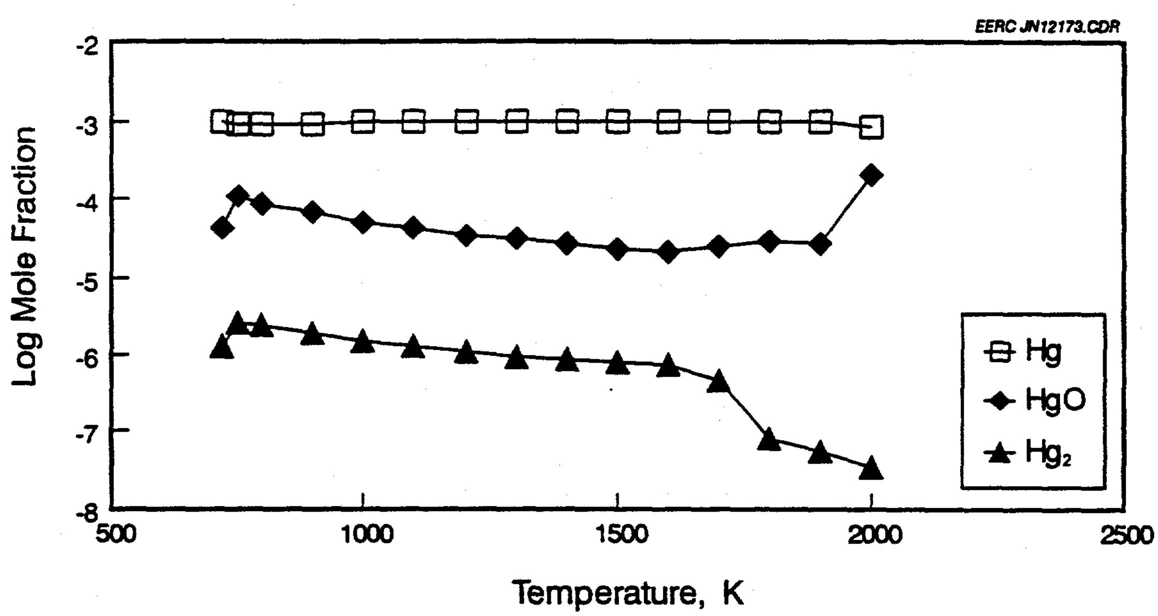


Figure 6. Log mole fraction of all (a) and single (b) mercury-derived constituents in vapor phase versus temperature. The arrows represent temperatures at which a significant vaporization can occur.

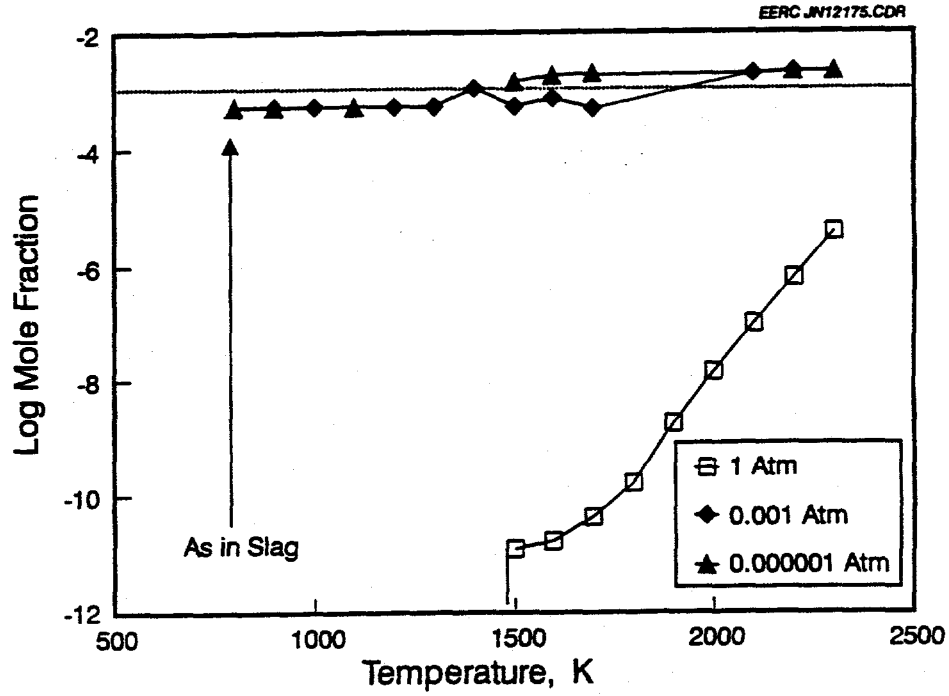


Figure 7. Log mole fraction of arsenic-derived constituents in vapor phase versus temperature. The arrow represents the temperature at which a significant vaporization can occur.

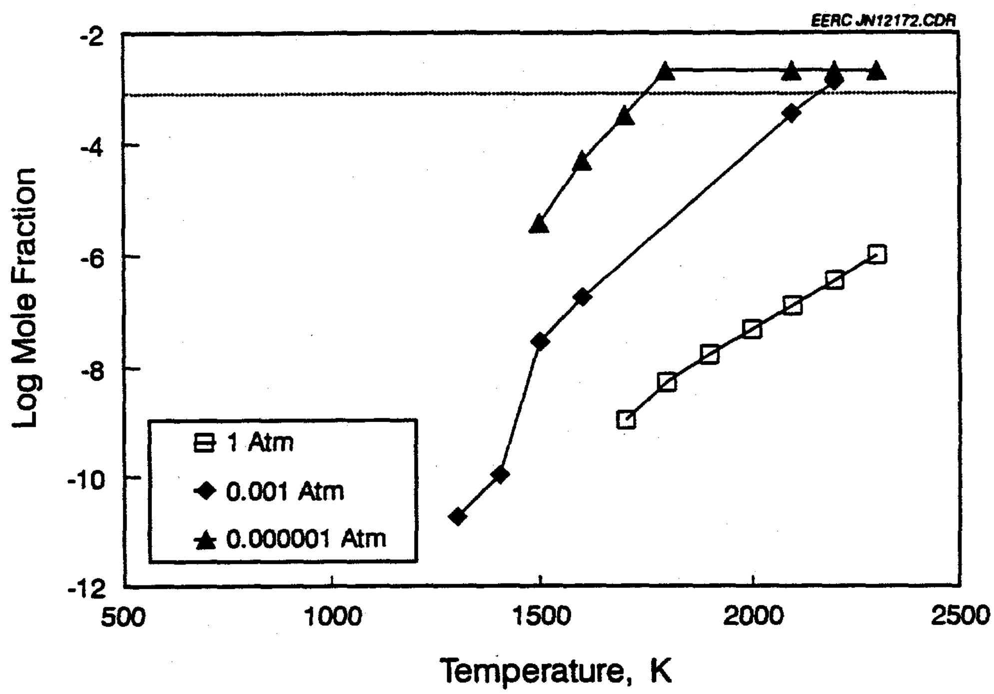


Figure 8. Log mole fraction of chromium-derived constituents in vapor phase versus temperature.

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78. U.S. Environmental Protection Agency. "Superfund Innovative Technology Evaluation Program Technology Profiles Sixth Edition," EPA/540/R-93/526; Office of Research and Development: Washington, DC, Nov. 1993.

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APPENDIX A

GLOSSARY OF TERMS

DOE "Environmental Management Fact Sheets," August 1994

Radioactive Waste Solid, liquid, or gaseous waste that contains radionuclides.

High-Level Waste (HLW) Highly radioactive material from the reprocessing of spent nuclear fuel. HLW includes spent nuclear fuel, liquid waste, and solid waste derived from the liquid. It contains elements that decay slowly and remain radioactive for hundreds or thousands of years. HLW must be handled by remote control from behind protective shielding to protect workers.

Transuranic (TRU) Waste Contains human-made elements heavier than uranium that emit alpha radiation. TRU waste is produced during reactor fuel assembly, weapons fabrication, and chemical processing operations. It decays slowly and requires long-term isolation. TRU waste can include protective clothing, equipment, and tools.

Low-Level Waste (LLW) Any radioactive waste not classified as a high-level waste, transuranic waste, or uranium mill tailings. LLW often contains small amounts of radioactivity dispersed in large amounts of material. It is generated by uranium enrichment processes, reactor operations, isotope production, medical procedures, and research and development activities. LLW is usually made up of rags, papers, filters, tools, equipment, discarded protective clothing, dirt, and construction rubble contaminated with radionuclides.

Uranium Mill Tailings By-products of uranium mining and milling operations. Tailings are radioactive rock and soil containing small amounts of radium and other radioactive materials. When radium decays, it emits radon, a colorless, odorless radioactive gas. Released into the atmosphere, radon gas disperses harmlessly, but the gas is harmful if a person is exposed to high concentrations for long periods of time under conditions of limited air circulation.

Hazardous Waste Chemicals and nonradioactive materials that are one or more of the following characteristics: toxic, corrosive, reactive, ignitable, or listed. Some environmental laws list specific materials as hazardous waste. For example, hazardous waste can exist in the form of a solid, liquid, or sludge and can include materials such as polychlorinated biphenyls (PCBs), chemicals, explosives, gasoline, diesel fuel, organic solvents, asbestos, acid, metals, and pesticides. Environmental laws also list materials that must be treated and managed as hazardous.

DOE hazardous waste is strictly characterized to ensure it contains no radionuclides. Some hazardous waste is stored at DOE sites in buildings that have been issued a permit through the Resource Conservation and Recovery Act. If hazardous waste has no added radioactivity, it can be shipped off-site to commercially owned and operated disposal facilities. Some hazardous wastes can be reused instead of disposed, saving money and disposal site resources.

Mixed Waste Radioactive waste contaminated with hazardous waste regulated by the Resource Conservation and Recovery Act (RCRA). A large portion of DOE's mixed waste is mixed low-level waste found in soils. No mixed waste can be disposed of without complying with RCRA's requirements for hazardous waste and meeting RCRA's Land Disposal Restrictions, which require waste to be treated before disposal in appropriate landfills. Meeting regulatory requirements and resolving mixed waste questions related to various regulations is one of DOE's most significant waste management challenges.

Spent Nuclear Fuel Nuclear reactors burn uranium fuel, creating a chain reaction that produces energy. Over time, as the uranium fuel is burned, it reaches the point where it no longer contributes efficiently to the chain reaction. Once the fuel reaches that point, it is considered spent. Spent nuclear fuel is high in temperature and highly radioactive.

Sanitary Waste Solid and liquid sanitary wastes are generated from normal housekeeping activities. Solid sanitary waste is typical garbage. Liquid sanitary waste is sewage. DOE owns and operates treatment facilities and sanitary landfills at many of its sites.

"Committed to Results: DOE's Environmental Management Program, an Introduction," DOE/EM-0152P April 1994

Radionuclide Any naturally occurring or artificially produced radioactive element or isotope.

Waste Management Treats, stores, and disposes of radioactive waste, hazardous waste, mixed waste (radioactive and hazardous waste mixed together), and sanitary waste at DOE sites.

Environmental Restoration Cleans up radioactive, hazardous, and mixed waste contamination at DOE sites. Activities include remedial actions—the assessment and cleanup of inactive waste sites—and decontamination and decommissioning—the cleanup and demolition or reuse of surplus facilities.

Technology Development Develops new and more effective technologies for addressing contamination and managing waste at DOE sites. Technology Development conducts research and development of new technologies and demonstrates, tests, and evaluates technologies developed by DOE and private industry.

Facility Transition and Management Safely transitions contaminated facilities from other offices or programs within DOE to the Environmental Management organization. Responsibilities include developing criteria facilities must meet before transition, safely deactivating the ones designated as surplus, negotiating uses for facilities and land after restoration, and maintaining a database.

From combined sources listed above:

Formerly Utilized Sites Remedial Action Program (FUSRAP) Established in 1974 to evaluate the environmental conditions of sites that had been used by universities and private firms (under government contract) for research projects involving radioactive materials. To date, 45 sites in 14 states have been designated for cleanup, and work has been completed at 15 of these sites.

Uranium Mill Tailings Remedial Action (UMTRA) Project Concentrates on cleaning up uranium tailings (leftover rock and soil containing residual uranium and radium) that were left behind during the uranium ore milling process. Is now cleaning up about 24 million tons of uranium tailings at 24 inactive sites in 10 states and more than 5000 vicinity properties (residences, businesses, and open lands where the tailings were used as fill dirt or put to other uses that contaminated the area).

APPENDIX B

SUMMARY INFORMATION ON CONTAMINANTS IDENTIFIED AT DOE WASTE SITES

TABLE B1

Compound Classes and Selected Representative Constituents

Compound Class	Representative Constituents	Class Number[1]
Metals	Lead, chromium, mercury	1
Anions	Nitrate, flouride, cyanide	2
Radionuclides	Tritium, plutonium, technetium	3
Chlorinated hydrocarbons	Trichloroethylene	4
Fuel hydrocarbons	Benzene, toluene, xylenes	5
Phthalates	Bis-2-ethylhexylphthalate	6
PCBs	Arochlor 1248, Arochlor 1260[2]	7
Explosives	HMX, RDX, trinitrotoluene	8
Ketones	Acetone, methyl ethyl ketone	9
Pesticides	Chlordane[3], lindane, 4,4'-DDT[4]	10
Alkyl phosphates	Tributyl phosphate	11
Complexing agents	EDTA, DTPA[5], NTA[6]	12
Organic acids	Oxalic acid, citric acid	13

[1] These numbers refer to specific compound classes.
[2] Arochlor 1248 and 1260 consist of a mixture of different individual PCBs.
[3] Mixture of different chlorinated compounds.
[4] Dichlorodiphenyltrichloroethane.
[5] Diethylenetriamine pentaacetic acid.
[6] Nitriloacetic acid.

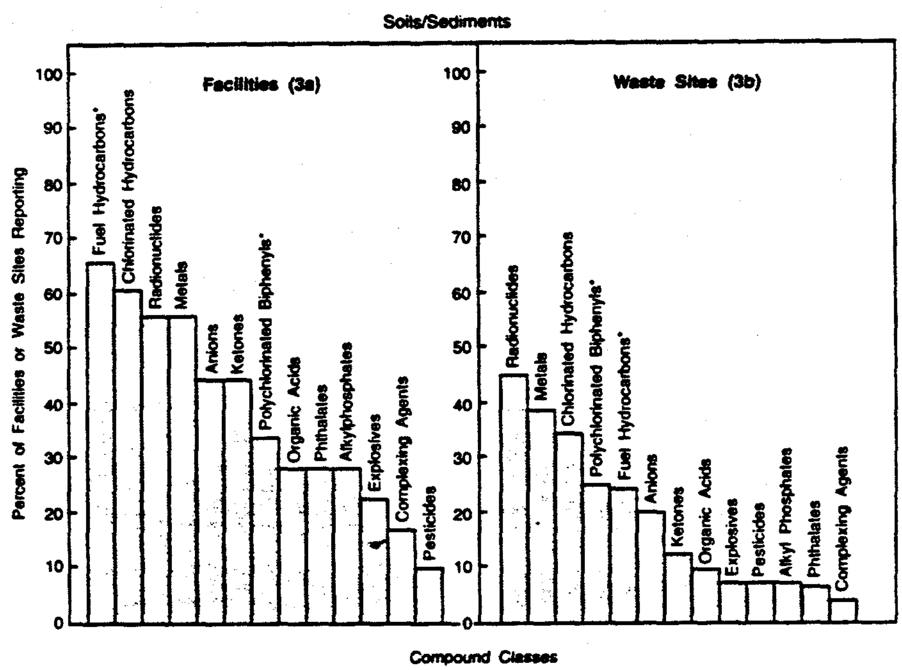

Figure B1. Distribution of compound classes in soils/sediments at 18 DOE facilities and 91 waste sites.

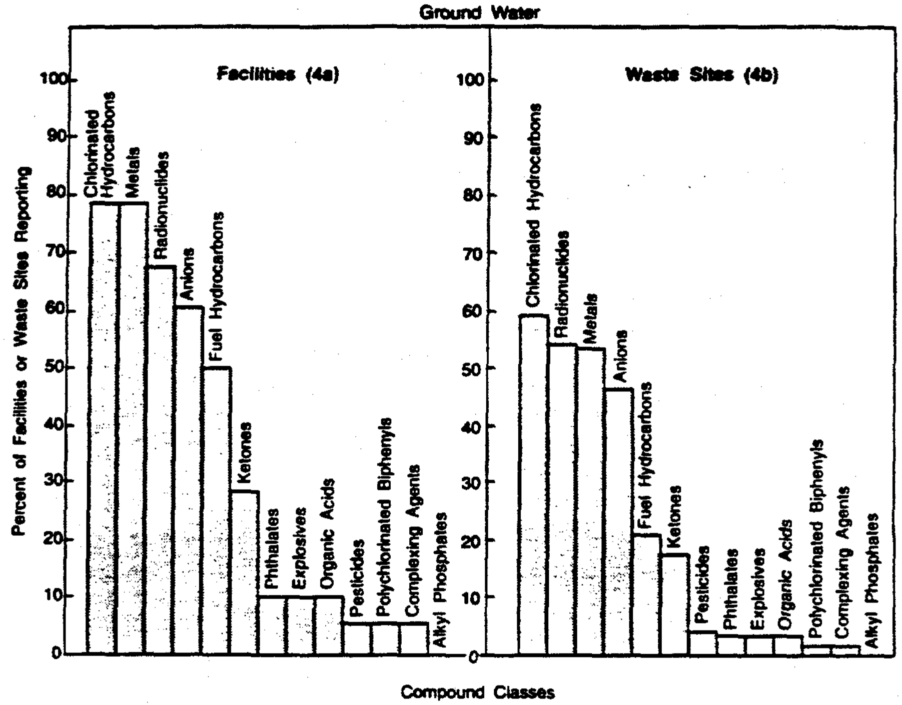

Figure B2. Distribution of compound classes in groundwater at 18 DOE facilities and 91 waste sites.

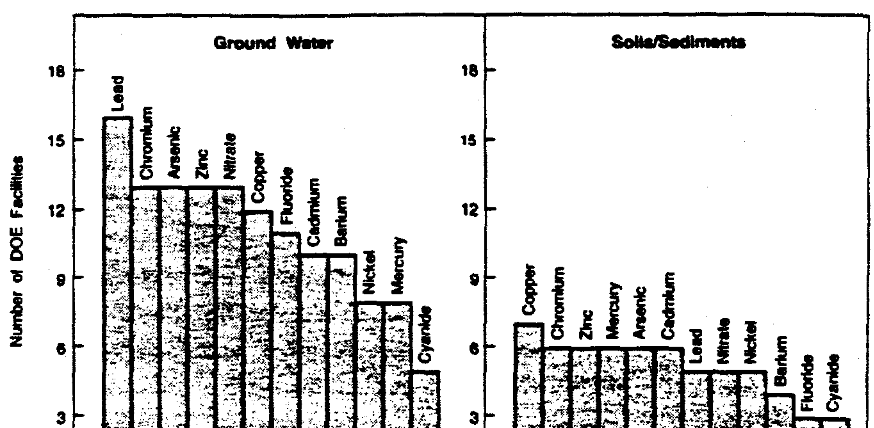

Figure B3. Frequency of occurrence of selected metals and inorganic anions in groundwater and soils/sediments at DOE facilities.

TABLE B2

Combinations of Compound Classes of Contaminants Reported Most Frequently in Soils/Sediments and Ground Waters at DOE Facilities

Soils/Sediments			Groundwater		
Class	No. of Sites	No. of Facilities[2]	Class	No. of Sites[1]	No. of Facilities[2]
Metals, radionuclides	25	7	Metals, chlorinated hydrocarbons	38	12
Metals, PCBs	18	6	Metals, radionuclides	36	11
Metals, chlorinated hydrocarbons	16	9	Metals, anions	33	11
Radionuclides, PCBs	15	4	Anions, radionuclides	33	10
Chlorinated hydrocarbons, fuel hydrocarbons	15	11	Radionuclides, chlorinated hydrocarbons	32	10
Anions, radionuclides	14	8	Anions, chlorinated hydrocarbons	26	9
Radionuclides, chlorinated hydrocarbons	14	6	Chlorinated hydrocarbons, fuel hydrocarbons	17	7
Chlorinated hydrocarbons, PCBs	13	6	Metals, fuel hydrocarbons	16	8
Metals, anions	12	7	Metals. ketones	16	5
Metals, fuel hydrocarbons	11	9	Radionuclides, fuel hydrocarbons	16	6
Anions, chlorinated hydrocarbons	11	6	Chlorinated hydrocarbons, ketones	16	5
Fuel hydrocarbons, PCBs	10	5	Anions, fuel hydrocarbons	12	5
Metals, radionuclides, PCBs	13	4	Metals, anions, radionuclides	29	10
Metals, chlorinated hydrocarbons, fuel hydrocarbons	8	8	Metals, radionuclides, chlorinated hydrocarbons	29	10
Metals, radionuclides, chlorinated hydrocarbons	11	6	Metals, anions, chlorinated hydrocarbons	25	9
Metals, chlorinated hydrocarbons, PCBs	10	6	Anions, radionuclides, chlorinated hydrocarbons	23	9
Metals, anions, radionuclides	9	6	Metals, chlorinated hydrocarbons, ketones	16	5
Metals, anions, chlorinated hydrocarbons	9	6	Radionuclides, chlorinated hydrocarbons, fuel hydrocarbons	15	5
Radionuclides, chlorinated hydrocarbons, PCBs	9	4	Metals, radionuclides, fuel hydrocarbons	13	5
Metals, fuel hydrocarbons, PCBs	7	5	Metals, chlorinated hydrocarbons, fuel hydrocarbons	12	5
Anions, radionuclides, chlorinated hydrocarbons	7	5	Metals, anions, fuel hydrocarbons	12	5
Anions, chlorinated hydrocarbons, fuel hydrocarbons	7	6	Metals, radionuclides, ketones	12	3
Metals, anions, radionuclides, chlorinated hydrocarbons	7	5	Anions, radionuclides, fuel hydrocarbons	11	4
Metals, anions, radionuclides, chlorinated hydrocarbons	7	5	Metals, anions, radionuclides, chlorinated hydrocarbons	23	9
Metals, radionuclides, chlorinated hydrocarbons, PCBs	7	4	Metals, radionuclides, chlorinated hydrocarbons, fuel hydrocarbons	12	4
Metals, anions, radionuclides, alkyl phosphates	5	4	Metals, radionuclides, chlorinated hydrocarbons, ketones	12	3
Metals, anions, chlorinated hydrocarbons, fuel hydrocarbons	5	5	Metals, anions, radionuclides, fuel hydrocarbons	11	4
Metals, anions, chlorinated hydrocarbons, PCBs	5	4	Metals, anions, chlorinated hydrocarbons, ketones	11	3
Metals, radionuclides, chlorinated hydrocarbons, fuel hydrocarbons	5	5	Metals, chlorinated hydrocarbons, fuel hydrocarbons, ketones	11	3

[1] Number of waste sites (out of 91) reporting specific class combination.
[2] Number of facilities (out of 18) reporting specific class combination.

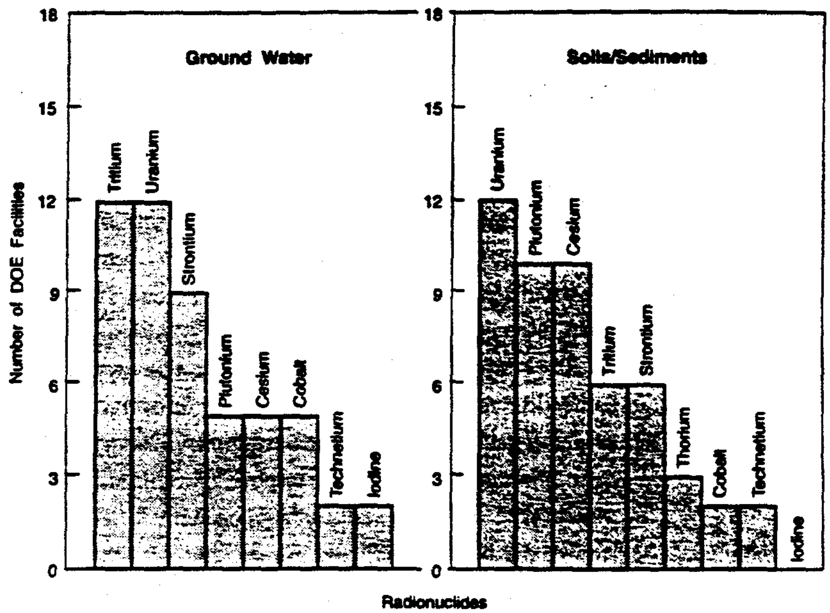

Figure B4. Frequency of occurrence of selected radionuclides in groundwater and soils/sediments at DOE facilities.

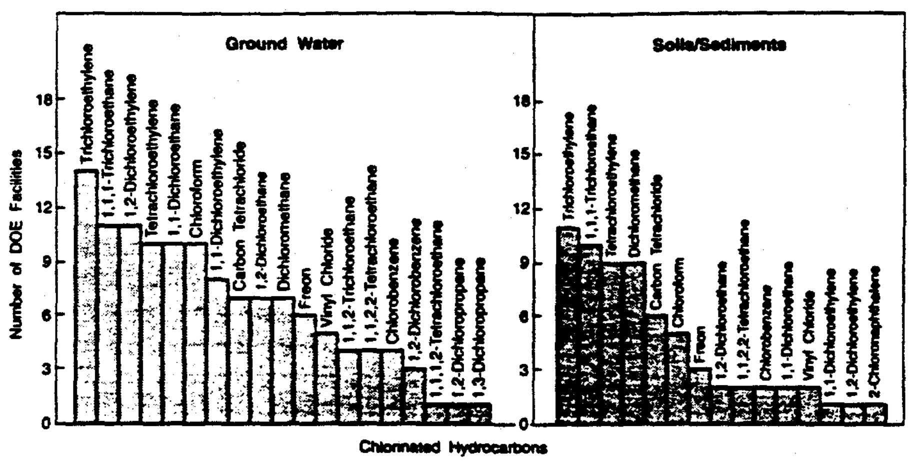

Figure B5. Frequency of occurrence of chlorinated hydrocarbons in groundwater and soils/sediments at DOE facilities.

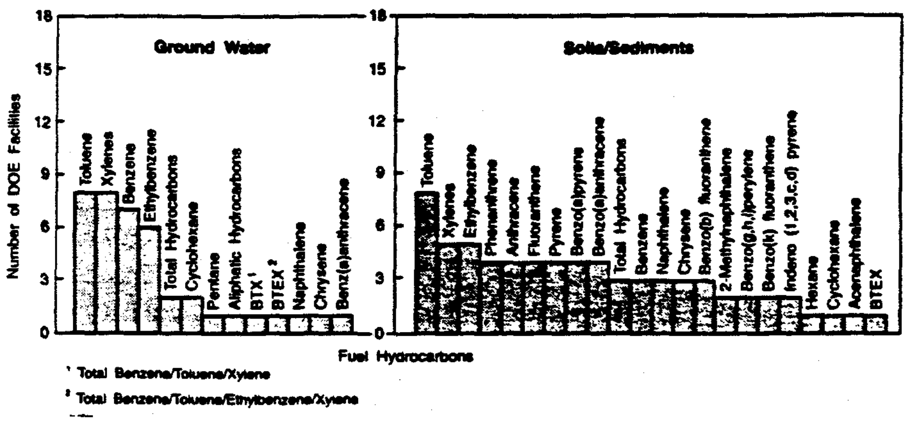

Figure B6. Frequency of occurrence of fuel hydrocarbons in groundwater and soils/sediments at DOE facilities.

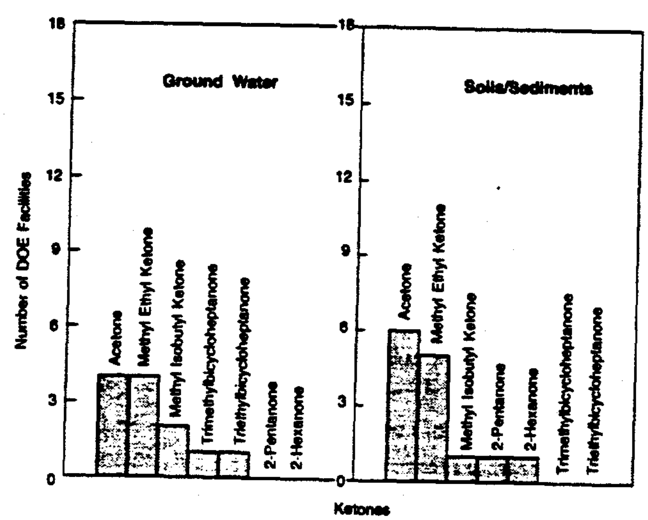

Figure B7. Frequency of occurrence of ketones in groundwater and soils/sediments at DOE facilities.

TABLE B3

Concentration Ranges[1] and Guidelines for Regulation of Most Frequently Reported Constituents in Groundwater and/or Soils and Sediments at DOE Facilities[2]

Class/Constituent	Groundwater	Soils/Sediments	Guidelines
METALS			
Lead	0.56–120,000	1000–6,900,000	[3]0; [4]50; [5]5
Chromium	0.42–9010	5.1–3,950,000	[3]100; [4]50; [5]100
Arsenic	0.3–32,100	100–102,000	[4]5
Zinc	1–697,000	150–5,000,000	[6]5000
Copper	1–3300	30–550,000	[3]1300; [5]1300
Mercury	0.08–216,900	0.1–1,800,000	[3]2; [4]2; [5]2
Cadmium	0.005–7600	100–345,000	[3]5; [4]10; [5]5
ANIONS			
Nitrate	2.6–100,000,000	30–1,480,000	[3,4,5]10,000
RADIONUCLIDES			
Tritium	[7]3.3–20,900,000,000	[7]7.8–124,000,000	[8]20,000; [9]2,000,000
Uranium	[10]0.001–11,700,000	[11]0.2–16,000	
	[7]0.02–22,700	[12]0.06–18,700	[9]500–600
Strontium	[7]0.05–231,000	[13]0.02–540,000	[8]8; [9]1000
Plutonium	[7]0.0009-12.8	[13]0.00011-3,500,000	[9]300–400
Cesium	[7]0.0027-1830	[13]0.02–46,900	[8]200; [9]3000
CHLORINATED HYDROCARBONS			
Trichloroethylene	0.2–870,000	0.2–12,000,000	[4]5
1,1,1-Trychloroethane	0.2–16,600	1–200,000	[4]200
1,2-Dichloroethylene	0.7–50,000	10–1,000,000	[3,5]70(cis); [3,5]100(trans)
Tetrachloroethylene	0.18–272,000	1.3–2,045,000	[3]0; [5]5
1,1-Dichloroethane	0.3–7800	27,000–84,000	---
Chlorogorm	0.3–2070	0.3–1300	---
Dichloromethane	0.29–2,400,000	6–890	[3]0; [5]5
FUEL HYDROCARBONS			
Benzene	0.01–46,000	0.3–310,000	[4]5
Toluene	0.19–26,000	0.3–2,000,000	[3]2000; [5]2000
Xylenes	1–14,000	0.3–2,800,000	[3]10,000; [5]10,000
Ethylbenzene	1.5–540	0.7–70,000	[3]700; [5]700
KETONES			
Acetone	3-24,500	13–350,000	---
Methyl ethyl ketone	4–1500	9–470	---
PHTHALATES			
Bis-2-ethylexylphthalate	2–1050	200–57,000	[3]0; [5]4

[1] Micrograms per liter (μg/L) and micrograms per kilograms (μg/kg) unless otherwise indicated.
[2] Concentration data synthesized from references listed in Appendix A.
[3] Proposed U.S. EPA Maximum Contaminant Level Goals (MCLG,μg/L) in drinking water.
[4] Existing U.S. EPA Maximum Contaminant Level (MCL,μg/L) in drinking water.
[5] Proposed U.S. EPA MCL (μg/L) in drinking water.
[6] Nonenforceable U.S. EPA secondary level standard (μg/L) based on taste, odor, or appearance guidelines.
[7] Picocuries per liter (pCi/L).
[8] National Interim Drinking Water Regulations, Table IV-2A (EPA 1976). Derived Guidelines (pCi/L) based on 4 millirem annual dose to target organ.
[9] DOE-derived concentration guides (pCi/L) based on effective dose limit not to exceed 100 millirem/year. Derived from DOE Order 5480.1A (Jaquish and Bryce 1990).
[10] Micrograms per liter (μg/L).
[11] Micrograms per gram (μg/g).
[12] Picocuries per gram (pCi/g).
[13] Picocuries per kilogram (pCi/kg).

APPENDIX C

DOE WASTE SITE SUMMARIES

DOE/EM-0232

Volume II: Site Summaries March 1995

Stan Miller

Estimating the Cold War Mortgage

The 1995 Baseline Environmental Management Report

U.S. Department of Energy
Office of Environmental Management

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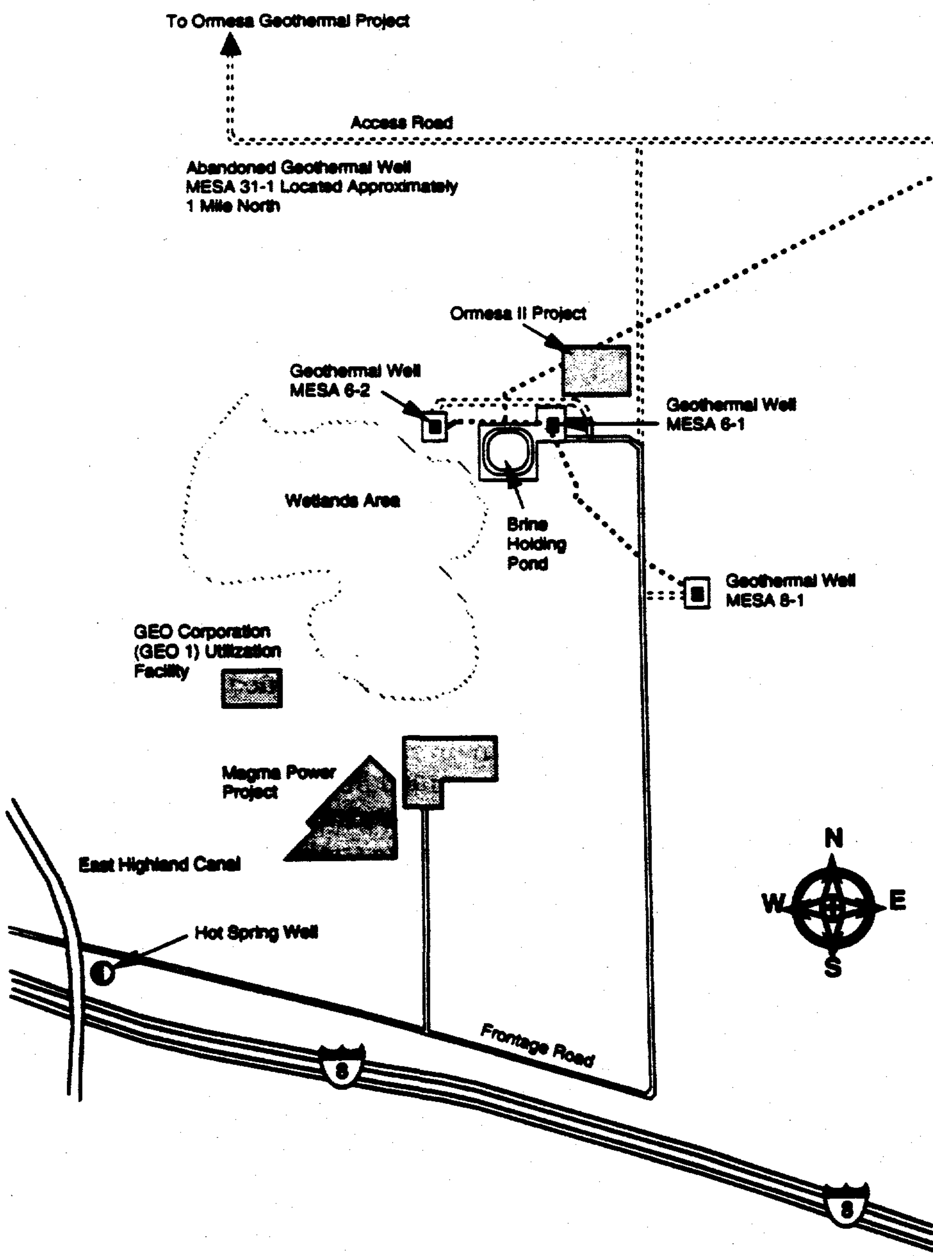
GEOTHERMAL TEST FACILITY

The East Mesa Geothermal Test Facility, an inactive Department of Energy (DOE) geothermal research facility, is in the Imperial Valley, Imperial County, California, about 20 miles east of El Centro and 1.5 miles north of Interstate Highway 8.



Estimated Site Total

(Thousands of Current 1995 Dollars)*

	FY 1995	1996	1997	1998	1999	2000
Environmental Restoration	0	0	2,000	2,000	1,000	1,500
Program Management**	7,982	7,595	12,879	12,551	12,985	13,150
Total	7,982	7,595	14,879	14,551	13,985	14,650

* Costs for FY 1995 reflect Congressional Appropriation, costs for FY 1996 reflect EM budget submission, costs for FY 1997-2000 reflect Budget Shortfall Scenario, costs for shaded area assume 3% annual inflation.

** Program Management Costs for FY 1996-2000 include DOE Oakland Operations Office Costs.

Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle***
Environmental Restoration	983	0	0	0	0	0	0	5,898
Program Management	240	0	0	0	0	0	0	1,438
Total	1223	0	0	0	0	0	0	7,336

** Costs reflect a five-year average in constant 1995 dollars, except in FY 1995 - 2000, which is a six-year average.

*** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

PAST, PRESENT, AND FUTURE MISSIONS

In 1968, the U.S. Bureau of Reclamation constructed the East Mesa Geothermal Test Facility for the investigation and development of geothermal resources in the East Mesa area. DOE became the site operator in 1978 and continued the site's energy research mission.

The 82-acre site includes a 6-acre, PVC-lined holding pond installed in 1972 to temporarily store and evaporate brine blowdown water, as well as untreated brine extracted in the geothermal exploration process. Geothermal research activities at the site were discontinued in 1987 as commercial scale geothermal power developed in the region.

Once restoration activities are complete, the facility will be turned over to the U.S. Bureau of Land Management for unrestricted use. Environmental Management program costs are presented in the Estimated Site Total table for the Geothermal Test Facility.

ENVIRONMENTAL RESTORATION

The Environmental Restoration Projects table provides costs for all environmental restoration activities at the Geothermal Test Facility. These costs are presented by activity in the Environmental Restoration Activity Costs table.

No active processes or experiments involving DOE research are currently operating or planned at Geothermal Test Facility. Sources of contamination are related to past operations at the site; however, hazardous waste may be generated during site restoration and disposed at a permitted Class I or II landfill.

Untreated brine extracted during geothermal exploration and brine blowdown water were stored in a holding pond at the facility. Storage of brine in the holding pond resulted in contamination of sediments due to the concentration of water soluble salts and the precipitation of minerals. The volume of contaminated sediments is estimated at 9,150 cubic meters. On the basis of previous sampling, the quantity of hazardous waste to be generated from restoration activities is expected to be minimal.

A field investigation report on the brine holding pond was prepared in 1992; and a site characterization study of the balance of the site was completed in 1993.

Contamination of the brine pond resulted from salts and minerals concentrated in sediment by evaporation. Decontamination activities will generate two waste streams: nonaqueous soil/debris contaminated with arsenic and nonaqueous, nonhazardous debris contaminated with salts and minerals.

During an asbestos survey conducted in 1992 three types of materials were identified as containing asbestos. These materials included:

- a joint compound used around pipe joints and flanges,
- cooling tower millboard, and
- floor tile and mastic inside the yellow laboratory building.

These asbestos-containing materials will be removed and disposed offsite at an appropriate disposal facility. Several other areas containing potentially airborne asbestos were remediated.

Under the terms of the lease agreement between DOE and U.S. Bureau of Land Management, the site must be restored to its original condition.

Environmental Restoration Activity Costs

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration								
Assessment	57	0	0	0	0	0	0	343
Remedial Actions	926	0	0	0	0	0	0	5,554
Total	983	0	0	0	0	0	0	5,898

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

WASTE MANAGEMENT

No treatment of hazardous, radioactive, or mixed wastes occurs now or is anticipated in the future. Generated hazardous waste will be stored in accordance with generator requirements for non-permitted facilities. Any hazardous waste to be generated, by decontamination efforts, will be treated and disposed at appropriate facilities. Waste management at the Geothermal Test Facility is conducted within the scope of environmental restoration.

NUCLEAR MATERIAL AND FACILITY STABILIZATION

There are no current or planned nuclear material and facility stabilization activities at the Geothermal Test Facility.

LANDLORD FUNCTIONS

The Department's Office of Energy Efficiency is currently the landlord at the Geothermal Test Facility and is responsible for associated activities and costs.

PROGRAM MANAGEMENT

Because the Geothermal Test Facility is an inactive site and no restoration activities are underway, there are no current site management tasks other than planning for future potential restoration efforts. Once funding is available for restoration, program management will include typical management tasks such as strategic planning, liaison with DOE and external regulatory agencies, scheduling, document preparation, budget control, and financial forecasting. See the Program Management Cost Estimate table for costs associated with these activities.

Program management costs include overall program management costs for the DOE Oakland Operations Office. These costs include funding for the agreements-in-principle program, grants, program support and waste management.

FUNDING AND COST INFORMATION

The following tables present funding information and major activity milestones for Geothermal Test Facility.

Program Management Cost Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Program Management	240	0	0	0	0	0	0	1,438

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

**Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Nondefense Funding Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration	983	0	0	0	0	0	0	5,898
Program Management	240	0	0	0	0	0	0	1,438
Total	1,223	0	0	0	0	0	0	7,336

*Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

**Total Life Cycle is the sum of annual costs in constant 1995 dollars.

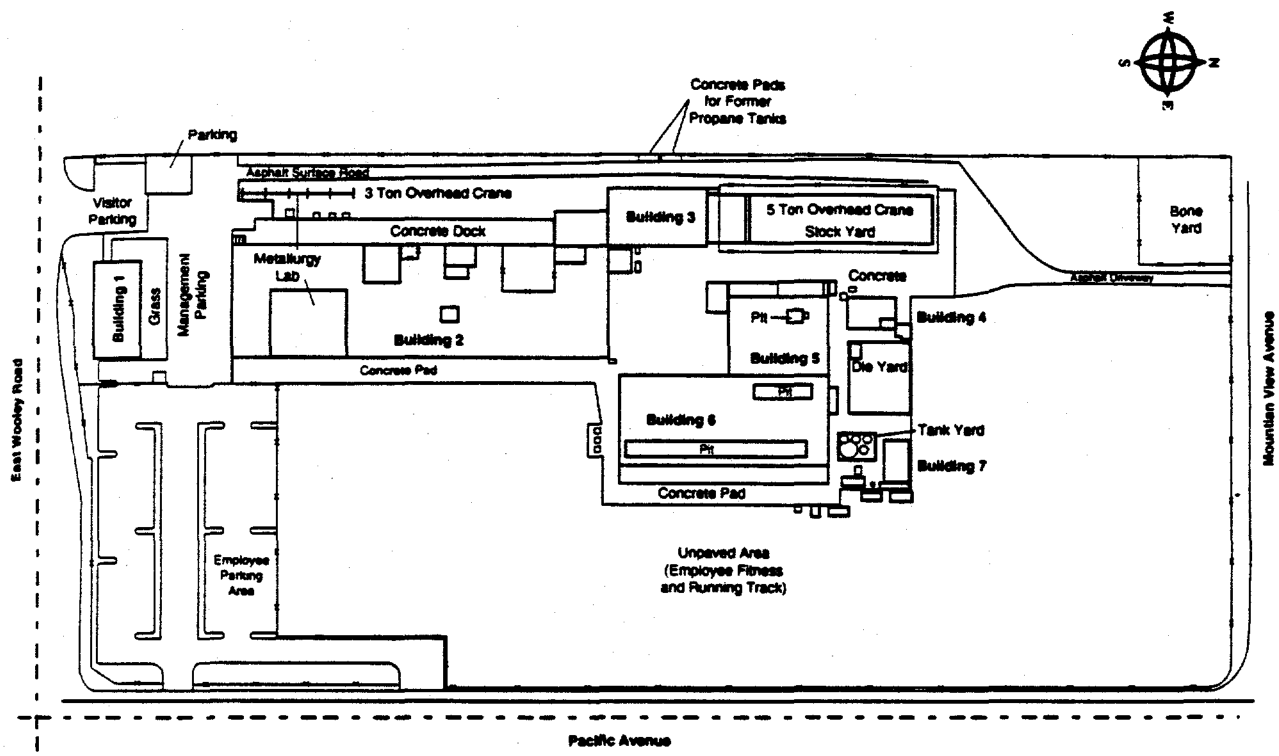
Major Activity Milestones

ACTIVITY	TASK	COMPLETION DATE
Environmental Restoration		Fiscal Year
	Complete Site Characterization	1997
	Start Site Remediation Activities	1998
	Complete Decommissioning and Site Remediation Activities	1999

For further information on this site, please contact : *Public Participation Office* *(510) 637-1812*
Public Affairs Office *(510) 637-1809*
Technical Liaison: Rich Fallejo *(510) 637-1639*

OXNARD SITE

The Oxnard site is a 14-acre area located in the industrial section of Oxnard, California, approximately 50 miles northwest of Los Angeles.



Estimated Site Total

(Thousands of Current 1995 Dollars)

	FY 1995	1996	1997	1998	1999	2000
Environmental Restoration	3,000	7,210	3,183	1,093	0	0
Program Management	500	515	530	546	0	0
Total	3,500	7,725	3,713	1,639	0	0

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration	2,414	0	0	0	0	0	0	14,484
Program Management	349	0	0	0	0	0	0	2,092
Total	2,763	0	0	0	0	0	0	16,576

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

PAST, PRESENT, AND FUTURE MISSIONS

Oxnard is a 45-year-old industrial plant originally used from 1949 to 1981 to produce farm equipment. A contractor for the Department of Energy (DOE), Precision Forge, occupied the site from 1981 to 1984. The Department purchased the property in 1984 and will continue to produce forgings for weapon parts through calendar year 1995. The facility will then be returned to private concerns for economic development. DOE-Rocky Flats is the current landlord but landlord responsibilities will likely transfer to Environmental Management (EM) following completion of production. The Grand Junction Projects Office, Grand Junction, Colorado, has recently assumed responsibility for the remediation of the Oxnard site.

ENVIRONMENTAL RESTORATION

The Oxnard facility has been contaminated during its use as a metals-forging plant. Possible hazardous contaminants include polychlorinated biphenyls (PCBs), organic lubricants and coolants, chlorinated solvents, and heavy metals. While several environmental sampling programs have been conducted to determine the type of contamination, an extensive site assessment has not been performed and the extent of contamination has not been defined. Preliminary assessments indicated low concentrations of PCBs (less than 50 parts per million) and the presence of tetrachloroethane and fuel products in soil gases.

The next step is a characterization of the site. This will include collecting and analyzing soil and ground-water samples and assessing hydrogeologic conditions.

Depending on the extent of contamination, corrective measures may include the excavation of contaminated soils, the demolition and replacement of concrete structures, the disposal of contaminated materials, the installation of a water treatment system, and site restoration. Remediation of the Oxnard site is currently planned for completion in FY 1997. Regulatory drivers for this project will be defined when characterization activities are completed.

WASTE MANAGEMENT

There are no current or planned waste management activities conducted at Oxnard.

NUCLEAR MATERIAL AND FACILITY, STABILIZATION

There are no current or planned nuclear material and facility stabilization activities at the Oxnard site.

LANDLORD FUNCTIONS

The landlord functions for Oxnard are managed through the Grand Junction Projects Office. Please see the Colorado site summary for details.

PROGRAM MANAGEMENT

Program management services are tracked and charged to waste management and environmental restoration activity budgets. However, for the purpose of this report program management costs are discretely identified.

FUNDING AND COST INFORMATION

The following tables present funding information and major activity milestones for the Oxnard Site.

Environmental Restoration Activity Costs

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Oxnard								
Assessment	638	0	0	0	0	0	0	3,828
Remedial Actions	1,776	0	0	0	0	0	0	10,656
Total	2,414	0	0	0	0	0	0	14,484

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

Program Management Cost Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)***

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle
Program Management	349	0	0	0	0	0	0	2,092

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Defense Funding Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration	2,414	0	0	0	0	0	0	14,484

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Nondefense Funding Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Program Management	349	0	0	0	0	0	0	2,092

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

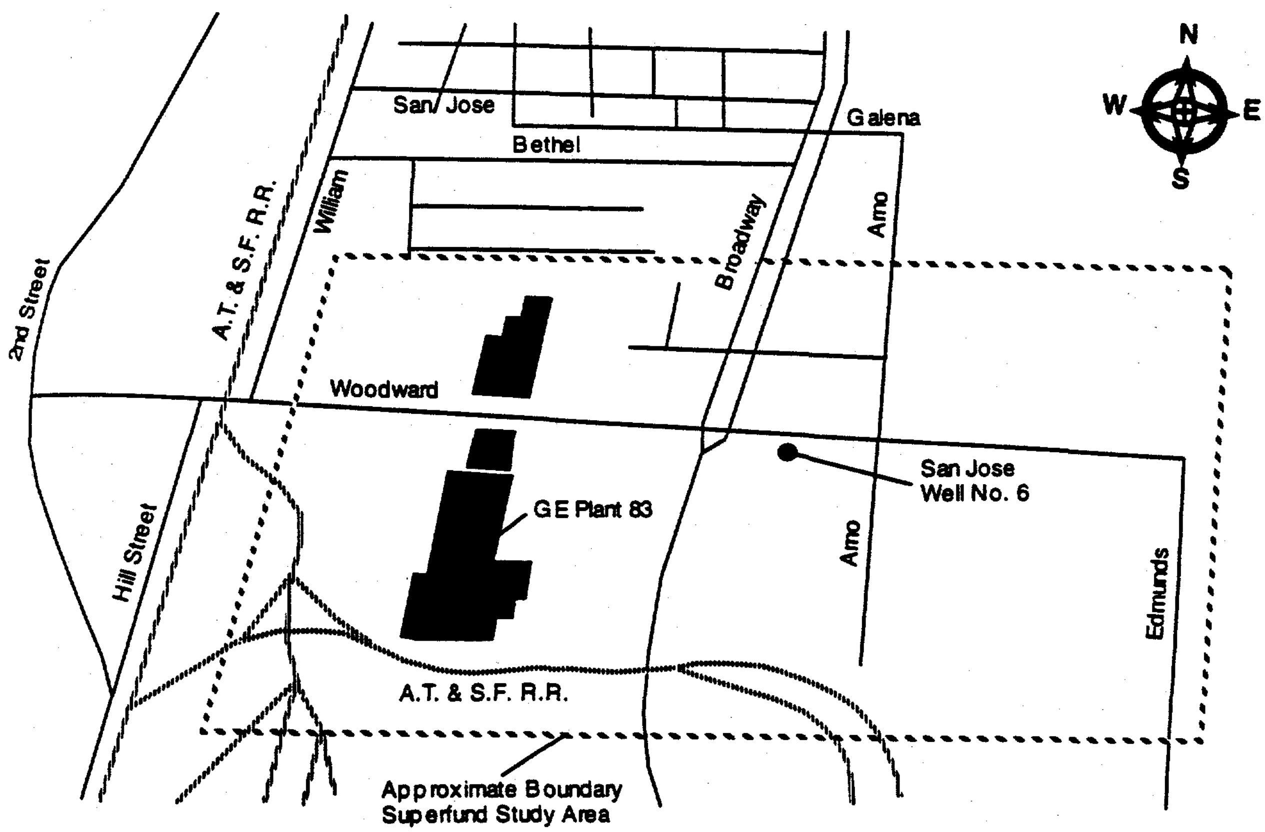
Major Activity Milestones

ACTIVITY	TASK	COMPLETION DATE
Environmental Restoration		Fiscal Year
	ER Characterization Complete	1995
	ER Remediation Complete	1997

For further information on this site, please contact : *Public Participation Office* *(505) 845-5951*
Public Affairs Office *(505) 845-6202*
Technical Liaison: Marilyn Bange *(505) 845-5160*

SOUTH VALLEY SUPERFUND SITE

The South Valley Superfund Site is located in the south valley area of Albuquerque, New Mexico. The site covers an area of 1 square mile. The site houses industrial facilities that require environmental cleanup under the Comprehensive Environmental Response, Compensation and Liability Act.



Estimated Site Total

(Thousands of Current 1995 Dollars)*

	FY 1995	1996	1997	1998	1999	2000
Environmental Restoration	2136	4590	956	735	735	735

* *Costs for FY 1995 reflect Congressional Appropriation, costs for FY 1996 reflect EM budget submission, costs for FY 1997-2000 reflect Budget Shortfall Scenario, costs for shaded area assume 3% annual inflation.*

Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle***
Environmental Restoration	1,576	871	972	880	0	0	0	23,066

** *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995 - 2000, which is a six-year average.*

*** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

PAST, PRESENT, AND FUTURE MISSIONS

From 1951 to 1967, the site was owned by the Atomic Energy Commission. The Commission built the South Valley Works there for the manufacturing of nonnuclear components for nuclear weapons. From 1967 to 1983, the plant was owned by the U.S. Air Force and operated by General Electric. At that time, the South Valley Works was renamed Plant 83. In 1983, the plant was bought by General Electric, which remains the current owner.

The U.S. Environmental Protection Agency (EPA) has identified three parties that are potentially responsible for cleaning up the contamination generated by past operations at the site: the Department of Energy (DOE), the U.S. Air Force, and General Electric. All three parties are responsible for meeting the requirements stated in two records of decision.

The three parties reached an agreement outlining the percentage of cleanup costs that each party was responsible for providing. General Electric is currently responsible for operating the facility. The Department's only remaining mission at this site is to successfully complete the requirements of both records of decision and to reimburse General Electric for the percentage of cleanup costs as specified by the settlement agreement. The Department's mission at the site will end when environmental restoration has been completed.

ENVIRONMENTAL RESTORATION

At the South Valley site, ground-water contamination is present in both shallow and deep aquifers, which are separated by an impermeable clay layer. The EPA believes that industrial activities under all three of the site's owners contributed to contamination with solvents, primarily trichloroethylene and dichloroethane. Soil contamination at several areas resulted from spills and solvents leaking from waste storage areas. The extent of contamination is low enough that no action beyond cleanup with a pilot-scale vacuum extraction system is expected to be necessary.

Planned activities include ground-water remediation in the shallow aquifer with a pump-and-treat system that involves extracting contaminated water, treating it, and then reinjecting the water into the aquifer. Ground water in the deep aquifer will be remediated with a pump-and-treat system that is expected to become operational during FY 1996. The remaining remediation activities will be related to operation, maintenance, and monitoring. These activities are expected to continue into FY 2015.

Under the terms of the settlement agreement, DOE does not manage the cleanup project but is liable for reimbursing General Electric for the cleanup costs. The Department will fund 43.2 percent of the cleanup costs incurred by General Electric in meeting the EPA cleanup standards.

WASTE MANAGEMENT

The Department is not involved in any waste management activities because it neither owns nor operates the facility. It is expected that the ground-water treatment will not create any waste streams.

NUCLEAR MATERIAL AND FACILITY STABILIZATION

Under the terms of the settlement agreement, the Department only funds a portion of the cleanup project. The Department is not responsible for facility stabilization, maintenance, or monitoring.

LANDLORD FUNCTIONS

The Department has no landlord functions at this site.

PROGRAM MANAGEMENT

For this report, the program management responsibilities for South Valley are performed under the Albuquerque Operations Office cost estimate.

Environmental Restoration Activity Costs

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration								
Remedial Actions	1,576	871	972	880	0	0	0	23,066

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

FUNDING AND COST INFORMATION

The following tables present funding information and major activity milestones for South Valley.

Defense Funding Estimate

	Five-Year Averages (Thousands of Constant 1995 Dollars)*							
	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration	1,576	871	972	880	0	0	0	23,066

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Major Activity Milestones

ACTIVITY	TASK	COMPLETION DATE
Environmental Restoration:		Fiscal Year
Shallow Ground-Water Remediation	Start Cleanup	1994
	End Cleanup	1997
Deep Ground-Water Remediation	Start Cleanup	1995
	End Cleanup	2015

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

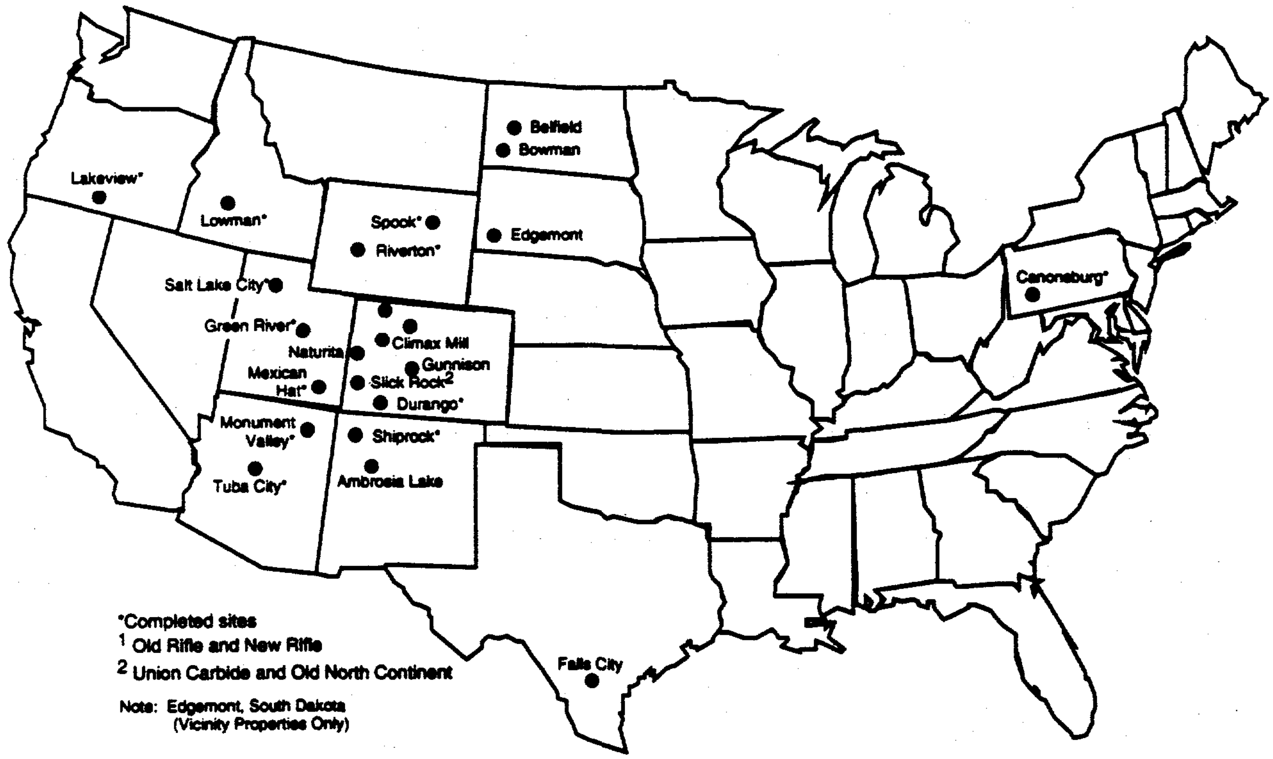
For further information on this site, please contact:

Public Participation Office	*(505) 845-5951*
Public Affairs Office	*(505) 845-6202*
Technical Liaison: John Corimer	*(505) 845-5956*

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM OFFICE

24 Surface and Ground-Water Sites in 10 States

There are 24 designated Uranium Mill Tailings Remedial Action (UMTRA) sites located in 10 States. These States include Arizona (2 sites), Colorado (9 sites), Idaho (1 site), New Mexico (2 sites), North Dakota (2 sites), Oregon (1 site), Pennsylvania (1 site), Texas (1 site), Utah (3 sites), and Wyoming (2 sites). The UMTRA Program Office is located in Albuquerque, New Mexico.



PAST, PRESENT, AND FUTURE MISSIONS

The U.S. Congress passed the Uranium Mill Tailings Radiation Control Act in 1978 in response to public concerns regarding potential health hazards from long term exposure to radiation from uranium mill tailings. The Act authorized the Department of Energy (DOE) to stabilize, dispose of, and control uranium mill tailings and other contaminated material at 24 uranium mill processing sites and approximately 5,000 vicinity properties.

Most uranium ore mined in the United States in the 1950's and 1960's was processed by private firms for the Atomic Energy Commission, a predecessor of DOE. The processing plants were shut down, and the tailings piles from mill operations were abandoned. The tailings piles present a potential long term health hazard because they contain low-level radioactive and other hazardous materials that migrated to surrounding soil, ground water, and surface water. Furthermore, the piles often emit radon gas. The tailings, and other ontaminated material were also used as fill dirt or incorporated into various construction materials at numerous offsite locations (vicinity properties).

The mission is to remediate 24 designated processing sites as required by the Act. By the end of FY 1995, 15 sites will have been completed and 7 sites will be under active remediation. The final two sites will begin remediation in FY 1996.

Remediated processing sites will not be returned to the public for either limited or unrestricted use until compliance with Environmental Protection Agency (EPA) standards for ground water have been met through the Uranium Mill Tailings Ground-water Compliance Project. Also, approximately 5,000 vicinity properties are being remediated by the project. Disposal cells containing the contaminated material will be maintained by the Federal Government as defined in the long-term surveillance plan.

ENVIRONMENTAL RESTORATION

Former uranium processing activities at most of the 24 inactive mill sites resulted in contamination of ground water beneath, and in some cases, downgradient of the sites. This contaminated ground water often has elevated levels of contaminants such as uranium or nitrates. After completion of the Uranium Mill Tailings Ground-Water Compliance Project; all of the sites will be returned, at least in part, to the State as identified in the UMTRA Surface Project Plan.

For the 11 sites using the stabilize-in-place or stabilize-onsite disposal option, only the portion of the site not having a disposal cell will be available for restricted use. The portion of the site that contains the disposal cell will be maintained by the Federal Government under the Long-Term Surveillance and Maintenance program. For the 13 remaining sites using the relocation option, the entire site will be available for unlimited use. In most cases, the title to the site will return to the State or to the original owners.

A programmatic environmental impact statement will be used as a decisionmaking framework for determining the project wide ground-water compliance strategy. The programmatic approach proposed, in the UMTRA Ground-Water Programmatic Environmental Impact Statement, is to evaluate specific conditions at each site and select a compliance strategy that will meet the applicable EPA standards. The proposed compliance strategies reflect the variety of ground-water conditions anticipated at the UMTRA sites. These strategies range from no further action required to engineered remedial actions.

The draft programmatic environmental impact statement is scheduled to be published in the spring of 1995. In conjunction with that activity, the project is proceeding with preparation of site-specific baseline risk assessments. These assessments serve to evaluate risks to human health and the environment by collecting field data and performing calculations and simulations. With one exception, the baseline risk assessments will be complete by FY 1995. The last baseline risk assessment is scheduled for completion in FY 1996. Site observational work plans for applicable sites began in FY 1994 and will continue through 2004 per the project schedule.

The site observational work plans will define the technical scope, objectives, and strategies for the anticipated activities at the site from characterization through engineering design and remediation. Site-specific environmental assessments, borrowing from the programmatic framework defined in the programmatic environmental impact statement, will describe each site's compliance strategy. Because they follow the completion of the site observational work plans, preparation of environmental assessments will be initiated in FY 1996 and continue, according to the project schedule, through FY 2005.

The site-specific remedial action plans will describe regulatory compliance strategies for the sites where active remediation strategies are proposed. The remedial action plans will contain sufficient information for the Nuclear Regulatory Commission, States, and Tribes to concur upon the selection of the compliance strategy. Remedial action plans will be initiated just prior to finalization of environmental assessments and publishing of the Findings of No Significant Impacts in the Federal Register. They are scheduled to begin in FY 1997 and continue through FY 2007.

Each site's compliance strategy will ultimately be consistent with the proposed action in the UMTRA Ground Water Programmatic Environmental Impact Statement. This impact statement will reflect the results of site-specific risk evaluations. The UMTRA Ground-Water Compliance Project, for purposes of creating a budget estimate, has proposed three primary compliance strategies. These strategies include no further action, passive, and active.

Although no decisions can be made prior to release of the programmatic environmental impact statement, budget preparation needs require that site-specific scenarios be addressed as described above. For budgeting purposes only, two sites were suggested for active compliance strategies. The remaining sites would have passive (natural flushing) strategies imposed, additional characterization, or no further action. This would mean that active remediation could begin as early as FY 2002, with completion possible by FY 2014.

Future assessment efforts for the UMTRA Surface Project will center around the assessment of new vicinity properties (particularly Climax Mill in Grand Junction, Colorado) and the certification and licensing of all completed disposal cells. Remediation will consist of completing those six sites started prior to FY 1995, starting the cleanup of the last five processing sites in FY 1995 and FY 1996, and completing cleanup of all sites by the end of FY 1998. Activities in FY 1999 will consist of finalization of site and vicinity property completion reports.

WASTE MANAGEMENT

Waste management at all UMTRA sites is conducted within the scope of environmental restoration activities.

NUCLEAR MATERIAL AND FACILITY STABILIZATION

There are no current or planned nuclear material and facility stabilization activities required at the UMTRA sites.

LANDLORD FUNCTIONS

Landlord activities are the responsibility of the owner at each site. In cases where DOE will maintain control of the site and continue long-term surveillance and maintenance, landlord costs are represented in the UMTRA life cycle cost estimate for the State in which that site is located.

PROGRAM MANAGEMENT

Program management supports management efforts for the National Environmental Policy Act process, site characterization and licensing, public information/participation, quality assurance audits, program and management support for the technical assistance contractor, special studies, document control, technical assistance contractor site and technical management, cost and schedule controls, planning and preparation of the Federal budget, and the Environmental Management Progress Tracking System. Also included is indirect support required by the DOE Program Office for operations and coordination.

For further information on this site, please contact:

Public Participation Office	*(505) 845-5951*
Public Affairs Office	*(505) 845-6202*
Technical Liaison: Jody Metcalf	*(505) 845-6146*

NEW MEXICO UMTRA SITES

The Ambrosia Lake former processing site is one of 24 uranium mill processing sites designated by the Uranium Mill Tailings Radiation Control Act for remediation by the Department of Energy (DOE). Most uranium ore mined in the United States in the 1960's was processed by private firms for the Atomic Energy Commission, a predecessor of DOE. The Act was passed in 1978 in response to public concerns regarding potential health hazards from long term exposure to uranium mill tailings. It authorized the DOE to stabilize, dispose of, and control uranium mill tailings and other contaminated material at 24 uranium mill processing sites and vicinity properties. Uranium Mill Tailings Remedial Action (UMTRA) activities are funded through the Albuquerque Operations Office.

The cost estimate model used for this report provides costs for each of the UMTRA sites. All costs for waste management activities, program management, and relevant landlord activities attributable to DOE are provided for within the scope of environmental restoration. There are no Uranium Mill Tailings Radiation Control Act sites with either current or planned nuclear material and facility stabilization activity needs. Funding for all sites is 100 percent nondefense.

NORTH DAKOTA UMTRA SITES

The Belfield site and the Bowman site are 2 of 24 uranium mill processing sites designated by the Uranium Mill Tailings Radiation Control Act for the U.S. Deparment of Energy (DOE) remediation. Most uranium ore mined in the United States in the 1960's was processed by private firms for the Atomic Energy Commission, a predecessor of DOE. The Act was passed in 1978 in response to public concerns regarding potential health hazards from long-term exposure to uranium mill tailings. It authorized DOE to stabilize, dispose of, and control uranium mill tailings and other contaminated material at 24 uranium mill processing sites and vicinity properties.

Uranium Mill Tailings Remedial Action (UMTRA) activities are funded through the Albuquerque Operations Office.

The model used as an estimation tool for this report provides costs for each of the UMTRA sites located in each State. All costs for waste management activities, program management, and relevant landlord activities attributable to DOE are provided for within the scope of environmental restoration. There are no UMTRA sites with either current or planned nuclear material and facility stabilization activity needs. Funding for all sites is 100 percent nondefense. For a general discussion of UMTRA and associated costs, see the UMTRA Site Summary found in the New Mexico section.

Estimated Site Total

(Thousands of Current 1995 Dollars)*

	FY 1995	1996	1997	1998	1999	2000
Environmental Restoration	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* Costs for FY 1995 reflect Congressional Appropriation, costs for FY 1996 reflect EM budget submission, costs for FY 1997-2000 reflect Budget Shortfall Scenario, costs for shaded area assume 3% annual inflation.

Five-Year Averages (Thousands of Constant 1995 Dollars)*

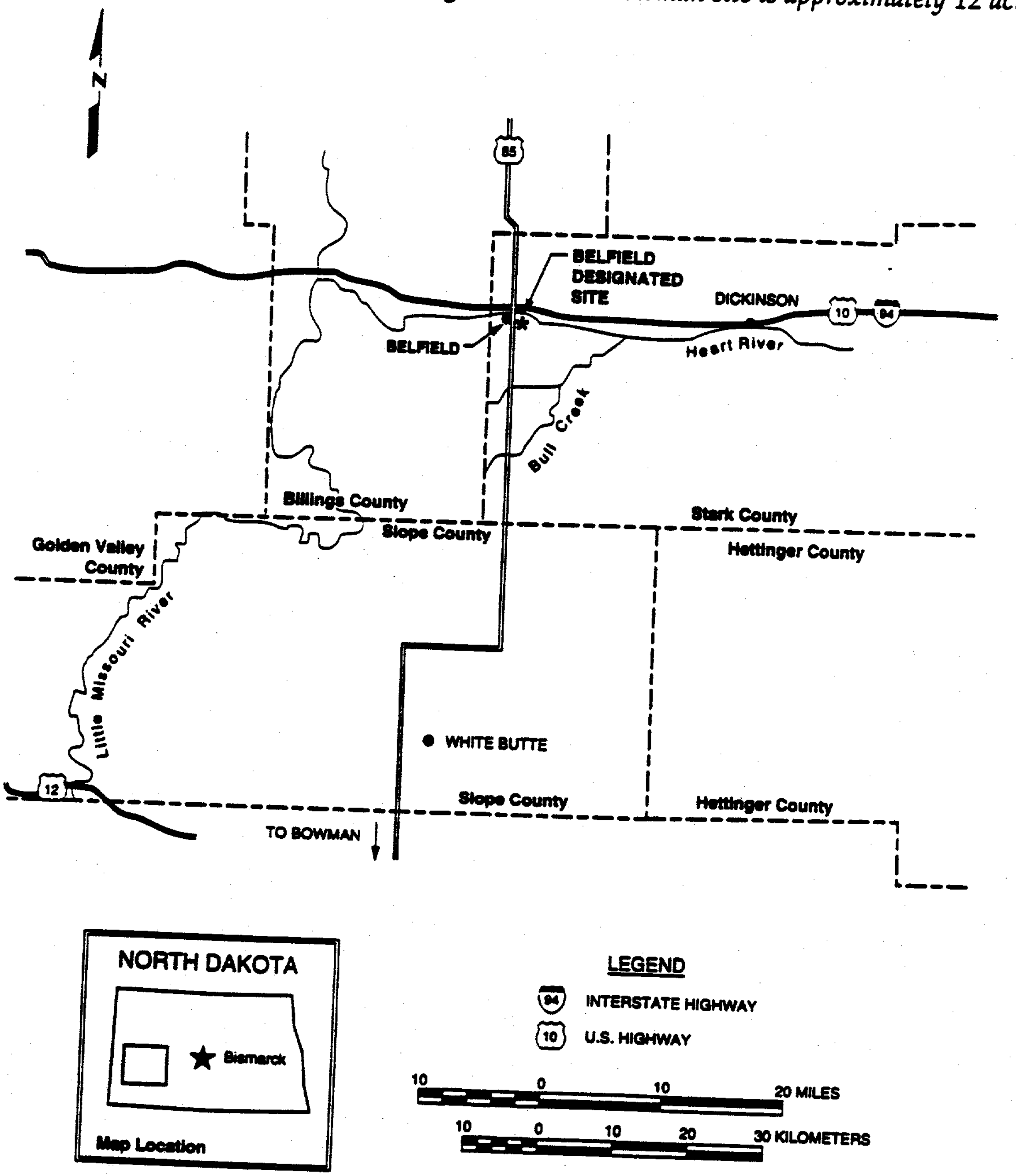
	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle***
Environmental Restoration	4,204	516	0	0	0	0	0	27,805

** Costs reflect a five-year average in constant 1995 dollars, except in FY 1995 - 2000, which is a six-year average.

*** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

BELFIELD AND BOWMAN
(Uranium Mill Tailings Remedial Action Project)

The Belfield site is located in southwestern North Dakota, one mile southeast of the Town of Belfield in Stark County. The former ashing site occupies 10.7 acres. The Bowman site is located seven miles west of Bowman, North Dakota. The site is located on nearly level land near the head of Spring Creek, a part of the Grand River drainage basin. The Bowman site is approximately 12 acres.



PAST, PRESENT, AND FUTURE MISSIONS

Union Carbide Corporation leased the Belfield site for an ashing operation from 1964 to 1966. Dakota Industries leased the site in 1968 for clay calcination operations to produce cat litter. In 1972, LP Anderson Construction Company of Miles City, Montana, purchased one of the buildings and leased a portion of the site for construction equipment, maintenance, and storage. Another building on the site housed a honey processing operation. Cenex Exploration, an agricultural cooperative, maintains an oil and gas exploration office and shop adjacent to the site. There is no discernible pile remaining.

During ashing operations from 1963 to 1967, the Bowman site was owned by Viola Soderstrom, who leased the property to Kermac Nuclear Fuels Corporation, a subsidiary of Kerr-McGee Oil Industries. The property was subsequently purchased by the Milwaukee Road and leased by Bowman Grain, Inc. Ashing operations were suspended in February 1967, and the Atomic Energy Commission Source Material License was terminated on May 16, 1967.

Site use will remain restricted until surface remediation and ground-water compliance is achieved.

ENVIRONMENTAL RESTORATION

No mill tailings pond or pile is present because the ash was shipped to another location. However, activities at these sites have resulted in contaminated soil, gravel, and rubble, as well as contaminated windblown soil. All activity has been suspended pending resolution of State funding issues. The costs for environmental restoration projects at this site are shown in the following table. All funding is from nondefense sources.

Environmental Restoration Projects

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
UMTRA-Ground Water - North Dakota	235	516	0	0	0	0	0	3,990
UMTRA-Soils - North Dakota	3,969	0	0	0	0	0	0	23,815
Total	4,204	516	0	0	0	0	0	27,805

*Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

**Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Nondefense Funding Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration	4,204	516	0	0	0	0	0	27,805

*Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

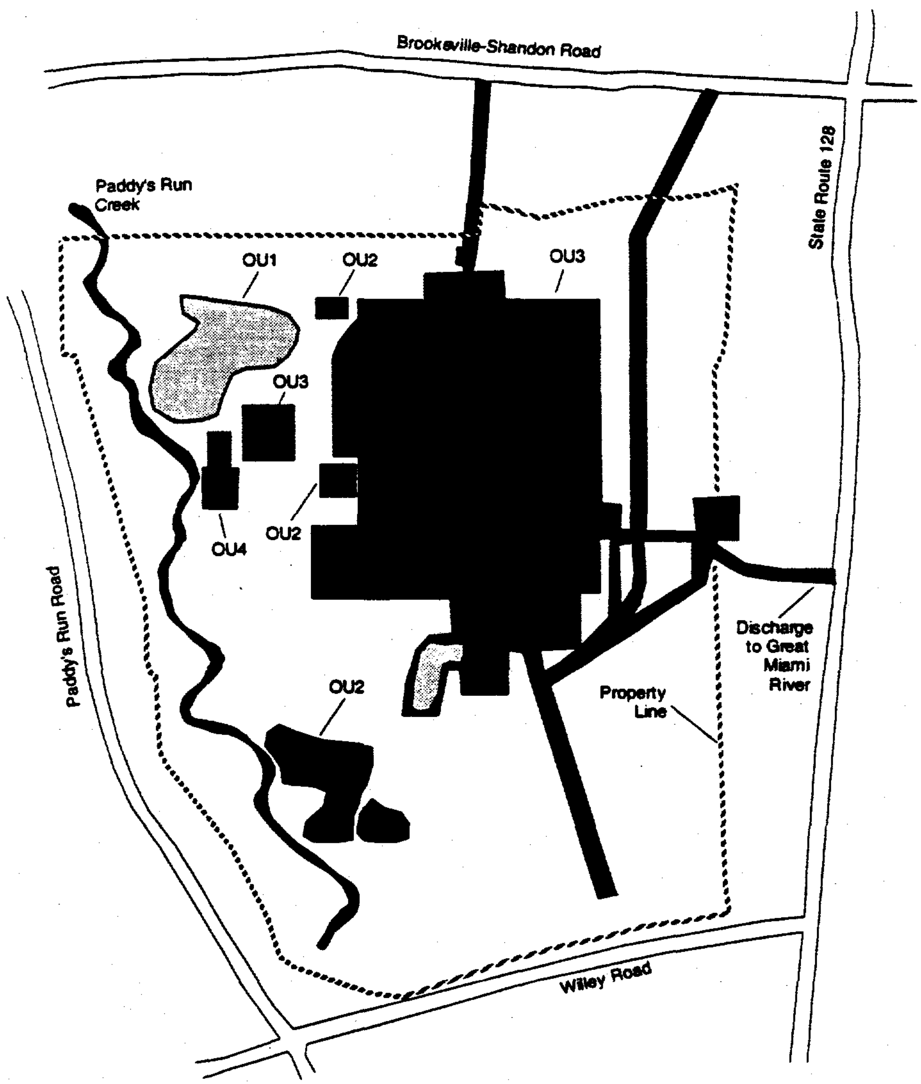
**Total Life Cycle is the sum of annual costs in constant 1995 dollars.

For further information on this site, please contact :

	Public Participation Office	*(505) 845-5951*
	Public Affairs Office	*(505) 845-6202*
	Technical Liaison: Jody Metcalf	*(505) 845-6146*

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

The former Fernald Feed Materials Production Center is located on a 1,050-acre tract that overlaps the boundary between Hamilton and Butler Counties near the southwest corner of Ohio. It is approximately 20 miles northwest of Cincinnati. The Great Miami River flows nearby in a southerly direction, approximately one mile east of the site. Paddy's Run, a small stream, runs southward along the western boundary of the site. The Great Miami Aquifer flows beneath the Fernald site. The former production facilities and supporting infrastructure comprise approximately 136 acres of the 1,050-acre site.



Estimated Site Total

(Thousands of Current 1995 Dollars)*

	FY 1995	1996	1997	1998	1999	2000
Environmental Restoration	159,000	177,700	187,400	210,400	195,700	327,600
Directly Appropriated Landlord	63,100	52,300	49,000	49,800	49,300	70,000
Program Management	86,500	77,100	65,400	66,200	65,200	76,100
Total	308,600	307,100	301,800	325,600	310,200	473,700

* Costs for FY 1995 reflect Congressional Appropriation, costs for FY 1996 reflect EM budget submission, costs for FY 1997-2000 reflect Budget Shortfall Scenario, costs for shaded area assume 3% annual inflation.

Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Environmental Restoration	184,184	244,800	69,078	33,588	12,868	12,630	8,862
Directly Appropriated Landlord	51,515	57,840	45,560	24,680	3,360	2,088	2,506
Program Management	67,859	90,308	55,276	30,504	7,358	4,888	3,244
Total	303,558	392,948	169,914	88,772	23,586	19,606	14,612

	2035	2040	2045	2050	2055	2060	2065	Life Cycle***
Environmental Restoration	70	200	200	240	400	160	0	3,020,548
Directly Appropriated Landlord	4,176	1,253	0	0	0	0	0	1,016,403
Program Management	0	0	0	0	0	0	0	1,365,046
Total	4,246	1,453	200	240	400	160	0	5,402,034

** Costs reflect a five-year average in constant 1995 dollars, except in FY 1995 - 2000, which is a six-year average.

*** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

PAST, PRESENT, AND FUTURE MISSIONS

The Fernald Feed Materials Production Center, later renamed the Fernald Environmental Management Project, was constructed in the early 1950's to convert uranium ore into uranium metal, and then to fabricate the uranium metal into target elements for reactors that produced weapons-grade plutonium and tritium. Production operations spanned more than 36 years until they were suspended on July 10, 1989. Following necessary notifications, the facility was formally shut down on June 19, 1991. During the facility's production mission, over 500 million pounds of high-purity uranium products were yielded to support U.S. defense initiatives.

In 1986, the U.S. Environmental Protection Agency (EPA) and the Department of Energy (DOE) entered into a Federal Facility Compliance Agreement covering environmental impacts associated with site activities. The Fernald site was placed on EPA's National Priorities List in 1989. A Consent Agreement was signed by DOE and EPA in

1990 and amended in 1991. This agreement established five operable units, as follows:

- Operable Unit 1 - Waste Pit Area
- Operable Unit 2 - Other Waste Areas
- Operable Unit 3 - Former Production Area
- Operable Unit 4 - Silos 1 through 4
- Operable Unit 5 - Environmental Media

The Ohio EPA is an active participant in the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process and is the lead agency overseeing the treatment, storage, and disposal of hazardous waste.

In addition to the five operable units, there is remnant production waste, referred to as legacy waste, which is stored in containers at the Fernald site. This waste has been designated for permanent disposal.

Fernald's current mission is environmental restoration, consistent with the remedies defined in a final record of decision for each operable unit and in an approved Treatment, Storage, and Disposal Plan.

The future use of all areas at Fernald is currently under consideration by the Fernald Citizens' Task Force. A preliminary recommendation is that there should be no new agricultural or residential uses on the Fernald property following its remediation. Evaluations are continuing regarding the potential for establishing recreational, commercial/industrial, or undeveloped open space (i.e., green space) on the portions of Fernald property outside the area of an engineered, onsite disposal facility. Formal recommendations on waste disposition and land use will be presented in a final report from the Task Force scheduled for release in July 1995.

All areas of Fernald, with the exception of an engineered, onsite disposal facility, are assumed to attain cleanup levels which provide for: (1) the protection of persons engaged in on-property industrial and/or recreational uses, and (2) the protection of an offsite farmer. The remedies would provide a maximum estimated risk to a future industrial or recreational user of the Fernald property within an acceptable range of 10^{-5} to 10^{-6}. The engineered, onsite disposal facility will be established as a continuing, restricted access area. The Great Miami Aquifer is scheduled to be remediated and returned to its full beneficial use by FY 2028.

The projected life-cycle costs for the Fernald Environmental Management project are provided in the following table.

ENVIRONMENTAL RESTORATION

During production, many uranium-bearing materials were used in the manufacturing process. These materials included uranium concentrates, recyclable enriched residues, uranium hexafluoride, and a variety of recycled uranium metals (both depleted and enriched) from various facilities. In the production processes, Fernald produced large quantities of solid and liquid low-level radioactive waste. Air was the predominant pathway by which the facility released radioactive particles, but Fernald also routinely released radionuclides into the soil and water, as well. In addition to the former production facilities, the major sources of contamination include:

- six low-level waste storage pits;
- a burnpit;
- a clearwell;
- two concrete silos containing radium-bearing residues;
- one concrete silo containing metal oxides;
- the South Field area, which was a depository of soil and construction debris with low levels of radioactivity; and
- two flyash disposal areas.

Two lime sludge ponds and a solid waste landfill are additional sources of contamination.

Several primary release mechanisms – including air, wastewater discharge, spills, leaks, and land disposal – provided the vehicles for transport of contaminants to environmental media and, subsequently, to potential human and ecological receptors. Secondary releases, such as, resuspension in air of contaminated soil through wind action, contributed to further contaminant migration and transport to other media.

Water releases to the environment occurred through leaking wastewater lines, discharges into the Great Miami River and Paddy's Run, and stormwater runoff. Surface water runoff is a significant pathway for the migration of contaminants in environmental media. There have been offsite environmental impacts to th Great Miami Aquifer and to surface soils adjacent to the site.

Risks to human and ecological receptors have been evaluated for the site as it presently exist and for simulated conditions up to 1,000 years in the future. The results demonstrate that existing concentrations of radiological and chemical contamination in both the source material and the environmental media pose risks to human and ecological receptors at levels sufficient to trigger the need for remedi actions.

Potential noncarcinogenic health effects for a waste site are assessed in terms of an EPA hazard index for each contaminant of concern A threshold hazard index value of 1.0 (unitles

Environmental Restoration Projects

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Fernald Treatment/Storage/Disposal	8,659	3,660	3,660	2,722	2,094	2,094	1,256
Operable Unit 1	49,930	48,322	60	66	60	66	66
Operable Unit 2	27,969	43,838	900	720	0	0	0
Operable Unit 3	51,699	112,598	29,650	0	0	0	0
Operable Unit 4	21,038	1,508	0	0	0	0	0
Operable Unit 5	24,889	34,874	34,808	30,080	10,714	10,470	7,540
Total	184,184	244,800	69,078	33,588	12,868	12,630	8,862

	2035	2040	2045	2050	2055	2060	2065	Life Cycle**
Fernald Treatment/Storage/Disposal	0	0	0	0	0	0	0	129,302
Operable Unit 1	30	0	0	0	0	0	0	542,931
Operable Unit 2	0	0	0	0	0	0	0	395,186
Operable Unit 3	0	0	0	0	0	0	0	1,021,404
Operable Unit 4	0	0	0	0	0	0	0	133,771
Operable Unit 5	40	200	200	240	400	160	0	797,961
Total	70	200	200	240	400	160	0	3,020,548

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

has been established as the level above which there is the potential for noncarcinogenic effects on exposed individuals. For current land use with access controls, the hazard index ranges from 1.8 to 260, depending on the receptor. For future land use – without any removal of contaminated sources, and with somewhat less restrictive controls than the site access controls now employed – the hazard index would range from 37 to 260.

Carcinogenic risk is the potential for a contaminant to induce human cancer and is expressed as an incremental lifetime cancer risk. Contaminants present in sufficient concentrations to create an excess lifetime cancer risk within or less than the range of 1 chance in 10,000 to 1 chance in 1,000,000 are considered acceptable to the EPA. For current land use with access controls, the incremental life cancer risk ranges from 1 in 100,000 for a site worker to 1 in 100 for an offsite farmer. For future land use – without any removal of contaminated sources, and with somewhat less restrictive controls than the site access controls now employed – the incremental lifetime cancer risk would range from 1 in 14,000 to 1 in 5.

These elevated risk factors, both carcinogenic and noncarcinogenic, support the need for environmental restoration efforts at Fernald.

Operable Units

A brief description and status of each operable unit and the low-level legacy waste restoration activities are given below:

Operable Unit 1

The Operable Unit 1 area consists of six waste pits, a burn pit, and a clearwell. All waste material would be excavated, treated by drying to meet waste acceptance criteria, then shipped to a commercial disposal facility. Contaminated surface soils and soils beneath the waste areas would be forwarded to Operable Unit 5 for final disposition. Residual water, which includes surface water, perched ground water incidental to waste unit remediation, and residual process water, will be treated at Fernald's Advanced Wastewater Treatment Facility. All impacted Operable Unit 1 material is being processed as a low-level waste.

Both the Remedial Investigation and the Feasibility Study/Proposed Plan/Environmental Assessment were approved by the EPA, and the Operable Unit 1 Record of Decision was approved by the EPA on March 1, 1995. Remedial design work is underway. A field demonstration program has been initiated to evaluate dewatering and waste excavation techniques further. Remedial action activities are scheduled to commence during June 1996.

Operable Unit 2

Operable Unit 2 consists of five waste units and their associated berms, liners, and soils. Specifically, the waste units include the Solid Waste Landfill, the Lime Sludge Ponds, the Inactive Flyash Pile, the South Field Depository, and the Active Flyash Pile. Construction and operation of an engineered, onsite disposal facility is also an Operable Unit 2 function. All material in Operable Unit 2 waste units which exceeds the required cleanup levels will be excavated, processed for size reduction and moisture control, and disposed of in the onsite disposal facility. An exception will be an expected small fraction of excavated material that will exceed the onsite disposal facility waste acceptance criteria. This latter material will be shipped to a commercial disposal facility. Surface water and perched ground water incidental to waste unit remediation will be treated at Fernald's Advanced Waste Water Treatment Facility. All impacted Operable Unit 2 material is classified as low-level waste.

The Operable Unit 2 Remedial Investigation is approved by the EPA, and the Feasibility Study/Proposed Plan/Environmental Assessment is conditionally approved by the EPA. Additionally, the draft record of decision is under review by the EPA. A predesign investigation has been initiated to determine the area with the most suitable geology for an engineered, onsite disposal facility. Remedial action activities are scheduled to commence during August 1996. Under current plans, Operable Unit 2 will be assigned the long-term surveillance and monitoring responsibility for any onsite disposal facility following completion of assigned remedial actions.

Active Operable Unit 2 environmental restoration activities that are being conducted as CERCLA Removal Actions include the South Field Surface Seep Control Project and continued maintenance of the Active Flyash Pile and the Paddy's Run Erosion Control Structure.

Operable Unit 3

Operable Unit 3 consists of all artificial aboveground and belowground structures at Fernald that are not included in the other operable units. This includes existing storage pads, roads, the wastewater treatment system, the sewer and electrical systems, railroads, fences, inventory, drums, and material piles. Most of these are located within the 136-acre former production area at the Fernald site.

There are 128 buildings designated for decommissioning and dismantling. Each structure is initially processed by the Fernald safe shutdown project to remove residual process wastes, and then gross contamination is removed from above-grade surfaces. Once gross decontamination is complete, all asbestos, electrical lines, and heating, ventilating, and air conditioning ductwork are removed. The structural components are then dismantled, followed by the structure's foundations and associated below-grade facilities. Most Operable Unit 3 materials are currently classified as low-level waste.

For Operable Unit 3, DOE estimates that 36 percent of low-level radioactive waste material will be shipped to the Nevada Test Site for burial, 2 percent of waste will be recycled, and the remaining 62 percent will be placed in an onsite disposal facility. Existing facilities will be used for interim storage until the onsite disposal facility is ready to receive waste material. Evaluations are in progress to determine the feasibility of recycling structural and low-grade steels and disposing of concrete and asbestos siding in the onsite disposal facility. Contaminated soils will be excavated and dispositioned by Operable Unit 5. Any surface water and perched ground water that are generated incidental to facility remediation will be treated at the Fernald Advanced Waste Water Treatment Facility.

An Operable Unit 3 Interim record of decision has been approved by the EPA for the decommissioning and dismantling of plant area buildings. Most of the buildings in the former Fernald process area will be decommissioned and dismantled as an interim remedial action. Treatment and final disposition of the dismantled material will be defined in the final record of decision. The Remedial Investigation and Feasibility Study/Proposed Plan to support the final record of decision are in the development stage.

Active Operable Unit 3 environmental restoration activities being conducted as CERCLA removal actions include: safe shutdown; asbestos abatement; decommissioning and dismantling of the Plant 1 Ore Silos and Plant 7; the Plant 1 Storage Pad Upgrade project; and the removal and temporary storage of contaminated media at the former Fire Training Facility.

Operable Unit 4

The K-65 residues and cold metal oxides will be removed from Silos 1, 2, and 3 and treated in an onsite vitrification facility. The sludges from the decant sump tank will also be removed and vitrified. Following treatment, the vitrified residues will be containerized and transported offsite for disposal at the Nevada Test Site. Silo 4 is empty except for some infiltration water.

Following removal of residues, the concrete silo structures and associated facilities will be demolished. Construction debris will be processed for size reduction and permanently stored in the Fernald onsite disposal facility. Contaminated soils immediately adjacent and under the silos would be forwarded to Operable Unit 5 for final disposition. Residual water, which includes surface water, perched ground water, and residual process water, will be treated at the Fernald Advanced Waste Water Treatment Facility.

All residue material in the silos and decant sump tank are classified as "by-product material" as defined in section 11, paragraph e(2), of the Atomic Energy Act of 1954, as amended. All contaminated soils, concrete debris, and ground water will be processed as low-level waste.

Both the Operable Unit 4 Remedial Investigation and the Operable Unit 4 Feasibility Study/Proposed Plan/ Environmental Impact Statement are approved by the EPA. The final record of decision was signed by the EPA on December 7, 1994. As part of the remedial design phase, a pilot plant is being constructed to evaluate further the vitrification process. Construction of the pilot vitrification plant commenced during FY 1994. Remedial action activities were scheduled to commence during March 1995.

Operable Unit 5

Operable Unit 5 consists of contamined soils (except those associated with Operable Unit 2), on-property and off-property ground water, surface water, flora, and fauna. Remedial activities involve excavation and transport to the onsite disposal facility soil that exceeds required cleanup levels; excavation of contaminated soil that exceeds the onsite waste acceptance criteria and its shipment to a commercial disposal facility; extraction and treatment of contaminated storm water runoff. Operable Unit 5 operations will fund the construction of the Advanced Waste Water Treatment Facility. Most waste is tentatively designated as low-level waste, with a small fraction potentially classified as low-level mixed waste.

Cleanup levels for site soils are being established in the Operable Unit 5 Feasibility Study for a wide range of land use objectives. Final cleanup levels will be established in the Operable Unit 5 Record of Decision, once land use recommendations are formalized by the Fernald Citizens' Task Force.

The Remedial Investigation is conditionally approved by the EPA, and the Feasibility Study/Proposed Plan is undergoing review by the EPA. Remedial action activities are scheduled to commence during October 1996.

Active Operable Unit 5 environmental restoration activities that are being conducted as CERCLA Removal Actions include the removal and treatment of contaminated, perched ground water located beneath the former plant area; use of a surface water runoff control and treatment system for the Waste Pit Area; and use of an offsite ground-water migration control system to minimize migrations into the Great Miami Aquifer. The ground-water migration control system will extract ground water and treat surface waters prior to their subsequent discharge to the Great Miami River. Installation of additional advanced wastewater treatment capacity is integral to the removal actions.

Low-Level Legacy Waste

Fernald's legacy of low-level waste is in containerized storage. It consists largely of wastes generated as part of activities associated with former production operations and maintenance activities, utility operations, and laboratory analyses. Approximately 80 percent of the 167,400 cubic yards of low-level waste material has been shipped to the Nevada Test Site as a CERCLA removal action. The remaining 20 percent is scheduled for disposal at the Nevada Test Site during FY 1995 and FY 1996.

That legacy waste which is classified as low-level mixed waste is being processed as a Federal Facility Compliance Act action. A draft treatment, storage, and disposal plan has been submitted to the Ohio EPA for review and approval. Low-level mixed waste associated with the hydrofluoric acid neutralization system, the uranyl nitrate hexahydrate treatment system, and the wastewater treatment system will be treated using existing, onsite facilities and will be shipped for final disposition at the Nevada Test Site. Waste designated for stabilization or chemical processing will be treated by a mobile vendor and disposed of at the Nevada Test Site. Selected low-level mixed waste was treated during FY 1993 and FY 1994 at the Toxic Substance Control Act incinerator at the DOE K-25 Site in Oak Ridge, Tennessee. The remaining waste is scheduled for final disposition from FY 1995 through FY 1997. Disposal of treated low-level mixed waste at existing commercial facilities is being explored.

WASTE MANAGEMENT

Treatment, Storage and Disposal Operations

Production operations at the former Fernald Feed Materials Production Center were suspended during FY 1989 and the facility was formally shut down during FY 1991. All current activities at Fernald are associated with environmental restoration. Fernald's waste management organizational costs are funded within the scope of environmetal restoration activities. Legacy low-level waste are being dispositioned as stated in the preceding section.

NUCLEAR MATERIAL AND FACILITY STABILIZATION

A facility stabilization activity titled "safe shutdown" was initiated at Fernald to place existing equipment and structures in the former plant area in a safe, shutdown configuration. Safe shutdown activities include program planning and scheduling; engineering; isolation of process equipment, piping systems and associated utilities; the removal and packaging of residual process or excess materials; and the disposition of materials to an approved onsite, interim, storage location. All safe shutdown activities fall under the responsibility of Operable Unit 3 and are funded within the scope of environmental restoration.

LANDLORD FUNCTIONS

Landlord provides for common environmental, safety, and health functions not associated with restoration activities. Responsibilities include the operation and maintenance of the Fernald steam plant; compressed air system; potable water treatment system; process water treatment system; cooling water system; sanitary waste treatment system; site utilities; office buildings and warehouses; vehicle maintenance; and maintenance of former plant area buildings, roads, and parking facilities. Maintenance of the remedial action construction infrastructure, such as, construction office facilities, laydown areas, interim storage areas, roads, and parking, are also landlord functions. Landlord is also responsible for site custodial services, porter service, the site laundry, offsite facility leases and maintenance, inventory control, and site security.

Environmental Restoration Activity Costs

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Environmental Restoration TSD	8,659	3,660	3,660	2,722	2,094	2,094	1,256
Operable Unit 1							
Assessment	3	0	0	0	0	0	0
Remedial Actions	49,927	48,310	0	0	0	0	0
Surveillance and Maintenance	0	12	60	66	60	66	66
Operable Unit 2							
Assessment	75	0	0	0	0	0	0
Remedial Actions	27,894	43,658	0	0	0	0	0
Surveillance and Maintenance	0	180	900	720	0	0	0
Operable Unit 3							
Assessment	3,163	0	5,930	0	0	0	0
Facility Decommissioning	48,536	112,598	23,720	0	0	0	0
Operable Unit 4							
Assessment	1,088	0	0	0	0	0	0
Remedial Actions	19,950	1,470	0	0	0	0	0
Surveillance and Maintenance	0	38	0	0	0	0	0
Operable Unit 5							
Assessment	285	0	0	0	0	0	0
Remedial Actions	24,603	34,874	34,808	30,080	10,714	10,470	7,540
Surveillance and Maintenance	0	0	0	0	0	0	0
Total	184,184	244,800	69,078	33,588	12,868	12,630	8,862

	2035	2040	2045	2050	2055	2060	2065	Life Cycle**
Environmental Restoration TSD	0	0	0	0	0	0	0	129,382
Operable Unit 1								
Assessment	0	0	0	0	0	0	0	19
Remedial Actions	0	0	0	0	0	0	0	541,112
Surveillance and Maintenance	30	0	0	0	0	0	0	1,800
Operable Unit 2								
Assessment	0	0	0	0	0	0	0	450
Remedial Actions	0	0	0	0	0	0	0	385,656
Surveillance And Maintenance	0	0	0	0	0	0	0	9,000
Operable Unit 3								
Assessment	0	0	0	0	0	0	0	48,628
Facility Decommissioning	0	0	0	0	0	0	0	972,806
Operable Unit 4								
Assessment	0	0	0	0	0	0	0	6,529
Remedial Actions	0	0	0	0	0	0	0	127,051
Surveillance and Maintenance	0	0	0	0	0	0	0	192
Operable Unit 5								
Assessment	0	0	0	0	0	0	0	1,713
Remedial Actions	0	0	0	0	0	0	0	790,049
Surveillance and Maintenance	40	200	200	240	400	160	0	6,200
Total	70	200	200	240	400	160	0	3,020,548

** Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

*** Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

PROGRAM MANAGEMENT

Fernald program management includes performing legal and public affairs functions to ensure conformance to applicable Federal and State laws and regulations, with due consideration of stakeholder concerns. Program management activities also include those associated with executive and technical management, business management required to implement the Project Management System per DOE Orders 4700.1 and 4700.5, management of contractual and related issues, quality assurance, regulatory and technology management, systems integration, DOE oversight, ongoing litigation, and regulatory oversight. Oversight of waste minimization activities is also a program management function, whereas actual implementation is part of the operating unit and legacy waste environmental activities.

Technology Development

Technology programs conducts vigorous technology development programs which have integrated several cost-saving improvements into Fernald activities in areas such as robotics and materials handling technology; cleanup and integrated demonstrations involving uranium in soils, including real-time monitoring and analysis; and decontamination by plant update. Technology programs also conducts advanced development work through special contracts with the Alliance of Ohio Universities and the Historically Black Colleges and Universities/Minority Institute Environmental Technology and Waste Management Consortium.

Landlord Cost Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	
Directly Appropriated Landlord	51,515	57,840	45,560	24,680	3,360	2,088	2,506	
	2035	**2040**	**2045**	**2050**	**2055**	**2060**	**2065**	**Life Cycle****
Directly Appropriated Landlord	4,176	1,253	0	0	0	0	0	1,016,403

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Program Management Cost Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Program Management	67,859	90,308	55,276	30,504	7,358	4,888	3,244	1,365,046

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995 - 2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

FUNDING AND COST INFORMATION

The following tables present funding information and major activity milestones for Fernald.

Defense Funding Estimate

Five-Year Averages (Thousands of Constant 1995 Dollars)*

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Environmental Restoration	184,184	244,800	69,078	33,588	12,868	12,630	8,862
Directly Appropriated Landlord	51,515	57,840	45,560	24,680	3,360	2,088	2,506
Program Management	67,859	90,308	55,276	30,504	7,358	4,888	3,244
Total	303,558	392,948	169,914	88,772	23,586	19,606	14,612

	2035	2040	2045	2050	2055	2060	2065	Life Cycle**
Environmental Restoration	70	200	200	240	400	160	0	3,020,548
Directly Appropriated Landlord	4,176	1,253	0	0	0	0	0	1,016,403
Program Management	0	0	0	0	0	0	0	1,365,046
Total	4,246	1,453	200	240	400	160	0	5,402,034

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

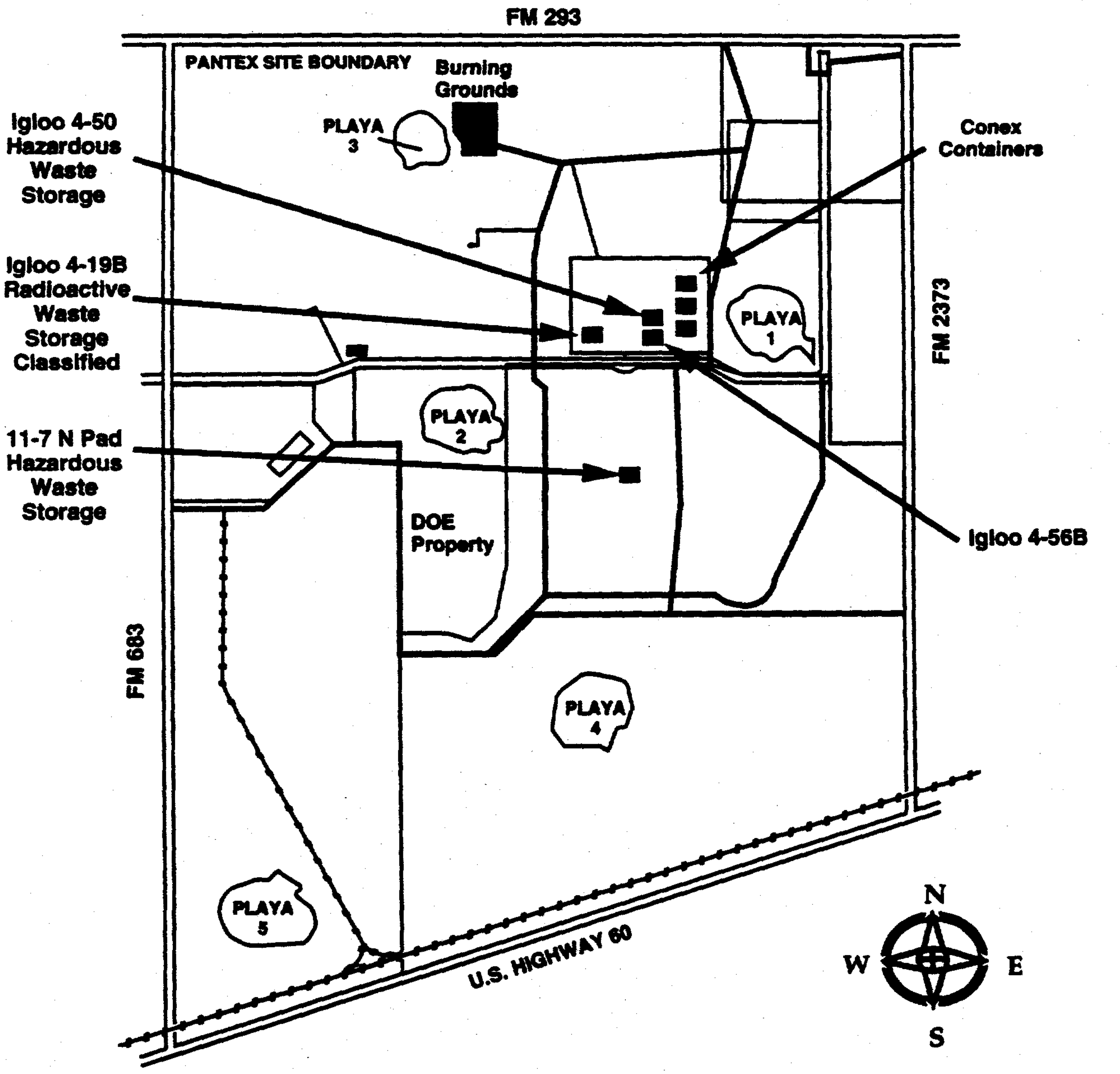
Major Activity Milestones

ACTIVITY	TASK	COMPLETION DATE Fiscal Year
Operable Unit 1 - Waste Pit Area	Final Record of Decision Signed by EPA	1995
	Remedial Action Starts	1996
	Remedial Action Ends	2004
Operable Unit 2 - Other Waste Areas	Final Record of Decision Signed by EPA	1995
	Remedial Action Starts	1996
	Remedial Action Ends: Waste Areas	2001
	Remedial Action Ends: Onsite Disposal Facility	2014
Operable Unit 3 - Former Production Area	Interim Remedial Action Starts	1995
	Final Remedial Investigation Report Submitted to EPA	1996
	Final Feasibility Study Report Submitted to EPA	1996
	Final Record of Decision Signed by EPA	1996
	Final Remedial Action Ends	2010
Operable Unit 4 - Silos 1 through 4	Vitrification Pilot Plant Project Started	1994
	Final Record of Decision Signed by EPA	1994
	Remedial Action Starts	1995
	Remedial Action Ends	2003
Operable Unit 5 - Environmental Media	Final Record of Decision Signed by EPA	1996
	Remedial Action Starts	1997
	Remedial Action Ends: Soils	2014
	Remedial Action Ends: Ground Water	2028
Legacy Waste	Site Treatment Plan Submitted to Ohio EPA	1995
	Removal Action Ends: Low-Level Waste	1996
	Removal Action Ends: Low-Level Mixed Waste	1997

For further information on this site, please contact: *Public Participation Office* *(513) 865-3968*
Public Affairs Office *(513) 865-3968*
Technical Liaison: Dave Lojek *(513) 648-3127*

PANTEX PLANT

The Pantex Plant is located in the panhandle of Texas, about 17 miles northeast of downtown Amarillo. The site covers about 16,000 acres.



Estimated Site Total

*(Thousands of Current 1995 Dollars)**

	FY 1995	1996	1997	1998	1999	2000
Environmental Restoration	10,347	11,043	10,836	10,751	10,804	10,313
Waste Management	13,808	11,164	12,899	13,996	13,093	14,529
Nuclear Material and Facility Stabilization	2,530	2,830	2,830	2,830	2,830	2,830
Program Management	5,952	5,299	5,725	4,199	5,873	5,957
Total	40,837	30,136	31,290	34,776	32,430	33,129

* *Costs for FY 1995 reflect Congressional Appropriation, costs for FY 1996 reflect EM budget submission, costs for FY 1997-2000 reflect Budget Shortfall Scenario, costs for shaded area assume 3% annual inflation.*

*Five-Year Averages (Thousands of Constant 1995 Dollars)***

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Environmental Restoration	11,130	872	0	10,949	2,737	0	0
Waste Management	12,422	12,514	13,840	12,522	12,557	12,515	10,233
Nuclear Material and Facility Stabilization	2,609	2,615	6,547	109	0	0	0
Program Management	4,118	3,544	3,460	5,211	3,659	3,129	2,558
Total	30,278	19,545	23,847	28,791	18,954	15,644	12,791

	FY 2035	2040	2045	2050	2055	2060	2065	Life Cycle***
Environmental Restoration	0	0	0	0	0	0	0	139,572
Waste Management	897	0	0	0	0	0	0	449,920
Nuclear Material and Facility Stabilization	0	0	0	0	0	0	0	62,007
Program Management	224	0	0	0	0	0	0	133,637
Total	1,121	0	0	0	0	0	0	785,136

** *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995 - 2000, which is a six-year average.*

*** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

PAST, PRESENT, AND FUTURE MISSIONS

The Pantex Plant was built by the U.S. Army in 1942 as a conventional bomb plant. It was decommissioned after World War II and sold to Texas Tech University as excess government property. In the 1950's, the Atomic Energy Commission recovered 10,000 acres of the site, renovated portions of the plant, and constructed new facilities for the manufacture of high explosives used in nuclear weapons and for the final assembly of nuclear weapons. During the mid-1960's, the plant was expanded when it assumed weapons maintenance and modification tasks from plants closed in San Antonio, Texas, and Clarksville, Tennessee. The last expansion came with the closing of a sister plant in Burlington, Iowa in 1975. Pantex has been the only plant of its type since Burlington's closing in 1975.

The mission of the Pantex Plant is fabricating high explosives for nuclear weapons, assembling nuclear weapons, maintaining and evaluating nuclear weapons in the stockpile, and dismantling nuclear weapons as they are retired from the stockpile. At present the principal operation is disassembly of nuclear weapons.

The basic mission is not expected to change in the foreseeable future. The Pantex Plant will continue to be the only facility for the dismantlement and maintenance of the nation's nuclear weapons stockpile. It will also provide interim storage for plutonium in a facility the Department of Energy (DOE) plans to develop. The Pantex Plant is managed by DOE's Office of Defense Programs, which will continue to serve as the landlord.

ENVIRONMENTAL RESTORATION

The production of high-explosives components for nuclear weapons has resulted in the contamination of soils, primarily from organic solvents and high explosives. In addition, tests of weapons components have contaminated some areas with high explosives and heavy metals. The contaminants may migrate to subsurface soils and eventually to ground water. Ground-water contamination has been detected in the perched aquifer, located a few hundred feet above the Ogallala Aquifer. In May 1994, the U.S. Environmental Protection Agency (EPA) placed Pantex on the National Priorities List. The Amarillo Area Office is currently negotiating a tri-party Federal Facility Agreement with the EPA and the State of Texas Natural Resources Conservation Commission.

Environmental restoration activities at the Pantex Plant are conducted in compliance with a Resource Conservation Recovery Act (RCRA) permit issued by the Texas Natural Resources Conservation Commission in April 1991. They began in 1992 and are expected to be completed by FY 2000 because the environmental restoration program has been accelerated.

Operable Units

Pantex has 144 solid waste management units grouped into 15 operable units for investigation purposes. The latter included 110 potential release sites identified at the plant. RCRA Facility Investigations have been completed for all operable units. For operable units PX-3 and PX-4, no further action is recommended. Unit PX-15, the Hypalon Pond, was closed in 1992. Voluntary corrective actions are being taken at several sites with no further actions planned at several other sites. Brief descriptions of the active operable units follow.

Operable Unit PX-1: Burning Ground Sites

No further action is recommended for all closed burning ground sites except for the flashing pits, which will require further investigation. A voluntary corrective action is planned to accelerate cleanup. Removal and disposal or incineration is planned for the contaminated soil. This project is scheduled for completion in fall 1997.

Operable Unit PX-2: High Priority Potential Release Sites

No further action is recommended for six of these potential release sites. However, a voluntary corrective action will be conducted at two sites. One is building FS-16, where the surface impoundment and sump will be removed; the other is the FS-22 container, which will also be removed. In both cases, sampling will be conducted in the area to confirm cleanup. One site, the concrete sump in building 12-68, requires further investigation.

A recommendation of no further action is expected to be submitted to the Texas Natural Resources Conservation Commission in the spring of 1996.

Operable Unit PX-5: Fire Training Area Burn Pits

A voluntary corrective action study recommended the removal and offsite disposal of contaminated soil. The investigation concluded the soil contamination at the Fire Training Area Burn Pits is restricted to the upper four feet. Remediation, with design starting in FY 1995, will involve the removal of shallow contaminated soil, sampling, and reclamation. Closeout is expected by fall 1995.

Operable Unit PX-6: Ground Water in Zone 12 North

An expedited site characterization is to be conducted by the Argonne National Laboratory. Three additional wells for monitoring perched aquifers and one well for monitoring the Ogallala aquifer were proposed. Ground-water monitoring is also conducted for several other operable units that are a potential source of contaminants to ground water.

Operable Unit PX-7: Landfills

Preliminary data packages are still being validated. The landfills are expected to be further investigated to determine levels of contamination. The extent of remediation will not be known until all investigations have been completed. It is nonetheless expected remediation can be completed by the year 2000.

Operable Unit PX-8: Ditches and Playas

Three of the six water flow systems in this operable unit require additional surface and subsurface sampling. Two of the six require additional sampling of surface areas only. The sixth flow system requires the drilling of additional subsurface monitoring wells. This last activity will become part of the Zone 12 ground-water assessment, scheduled for summer 1997.

Operable Unit PX-9: Firing Sites

Soil investigations for the firing sites are scheduled for Spring 1995. They will be followed by surveying and recovering visible depleted uranium from surface and near surface soils. Any depleted uranium will be sent to the Nevada Test Site for disposal. A closeout of this operable unit is expected by summer 1997.

Operable Unit PX-10: Leaking Underground Storage Tanks at Buildings 12-35 and 16-1

Further investigation of potential sources of trichloroethylene is recommended, but it will be conducted under Operable Unit PX-12. On the basis of the RCRA Facility Investigation, corrective action is not recommended for the site of the underground storage tank at building 16-1. Additional field work is required to further characterize the site of the underground storage tank at building 12-35.

Operable Unit PX-11: Miscellaneous Sites with Explosives and Radioactive Materials

Soil investigations are in process and a voluntary corrective action is planned. It will combine in situ bioremediation, soil removal, and offsite disposal. The project is expected to be closed out in the summer of 1997.

Operable Unit PX-12: Miscellaneous Chemical Spills and Releases

No further action will be recommended for 8 of the 17 sites and voluntary corrective action is recommended for the remaining 9 sites. A one-year treatability study is planned to study the ground water at Operable Unit PX-15, the Hypalon Pond. The project is scheduled for completion in Spring 1998.

Operable Unit PX-13: Supplemental Verification Sites

No further action was recommended for 7 of 8 supplemental verification sites. Site 8 in Zone 10, an abandoned landfill, is included in the RCRA Facility Investigation for Operable Unit PX-7 landfill because of its proximity to the sanitary landfills. Decisions of no further action are being pursued for spring 1996.

Operable Unit PX-14: Underground Storage Tanks at Other Locations

No further action was recommended for all sites in this operable unit except for underground storage tank 9 that requires fieldwork. Six additional borings will be drilled to determine the extent of contamination by petroleum hydrocarbons. A treatability study will be conducted at the site of this underground tank. Ground-water monitoring will be conducted under Operable Unit PX-12. Additional investigations are underway to include bioventing operations. Closeout is expected by summer 1996.

Waste from Environmental Restoration

The assessment activities at 12 of 14 operable units have resulted in the determination that 97 percent of the waste material generated is nonhazardous. In situ remediation will be the primary technology used for remediation of the hazardous waste. As a result, this waste will not be sent to waste management for treatment and disposal.

Pantex has implemented strategies to reduce the amount of waste generated during investigations, as well as the amount of waste handled, treated, or disposed of during site cleanups. A key point of this strategy is minimizing the amount of waste generated

Environmental Restoration Activity Costs

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration								
Assessment	5,488	0	0	0	0	0	0	32,930
Remedial Actions	5,641	872	0	0	0	0	0	38,210
Facility Decommissioning								
Facility Decommissioning	0	0	0	10,949	2,737	0	0	68,432
Total	11,130	872	0	10,949	2,737	0	0	139,572

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

during remedial feasibility investigations by using sonic drilling, geophysical and soil gas survey techniques, and other types of surveys that generate minimal waste.

WASTE MANAGEMENT

Pantex operations generate various types of waste. The waste produced by the assembly and dismantlement of weapons includes high explosives and solvents. These operations also produce radioactive process water, debris contaminated with radioactive materials, liquid and solid low-level waste, low-level mixed waste, hazardous waste, sanitary waste, heavy metals, and solvents. Waste is also produced by various support operations, such as the chemistry laboratories, maintenance, and the vehicle fleet.

Pantex does not currently generate any high-level radioactive waste or transuranic waste. Four drums of transuranic waste generated from an isolated event are being stored at the plant and will be sent to another DOE site for storage until they can be shipped to the Waste Isolation Pilot Plant for disposal.

In 1993, the quantities of waste managed at Pantex were 130 cubic meters of low-level radioactive waste; 37.5 cubic meters of low-level mixed waste; 1615.26 metric tons of hazardous waste regulated by RCRA, the State of Texas, or the Toxic Substances Control Act; and 304 metric tons of sanitary waste. In the future, the volume of operations-generated waste is expected to decrease due to waste minimization efforts and reduced dismantlement levels.

Waste Treatment

For low-level mixed waste, Pantex has developed a site treatment plan, as required by the Federal Facility Compliance Act. The plan

Waste Management Activity Costs

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Treatment							
Low-Level Mixed Waste	1,456	1,466	1,466	1,477	1,512	1,470	1,286
Low-Level Waste	4,547	4,579	4,579	4,579	4,579	4,579	3,774
Hazardous Waste	6,280	6,327	7,654	6,325	6,325	6,325	5,060
Sanitary Waste	140	141	141	141	141	141	113
Total	12,422	12,514	13,840	12,522	12,557	12,515	10,233

	2035	2040	2045	2050	2055	2060	2065	Life Cycle**
Treatment								
Low-Level Mixed Waste	454	0	0	0	0	0	0	54,394
Low-Level Waste	443	0	0	0	0	0	0	162,852
Hazardous Waste	0	0	0	0	0	0	0	227,754
Sanitary Waste	0	0	0	0	0	0	0	4,920
Total	897	0	0	0	0	0	0	449,920

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

calls for the development and use of (1) existing onsite facilities, (2) commercial treatment, and (3) onsite treatment using mobile treatment units. The engineering and fabrication of the mobile treatment units will start in FY 1996. Validation and startup will occur in FY 1998, with regular treatment operations beginning in FY 2000. Mobile treatment units are expected to require upgrading every 12 years (in FY 2010 and FY 2022).

A proposed Hazardous Waste Treatment and Processing Facility is designed for low-level waste, mixed waste, and hazardous waste. It will also accommodate the mobile treatment units. Construction is anticipated to be completed in FY 1999, with processing beginning in FY 2000.

Waste contaminated with high explosives is treated at the Pantex Plant burning grounds. Burning ground ash is packaged and disposed of offsite. At present, the burning grounds are being upgraded, with completion expected in FY 1997. Alternatives to burning, such as base hydrolysis and molten-salt extraction, are being explored.

Treatment for low-level radioactive waste consists of stabilization and solidification to meet the acceptance criteria for the Nevada Test Site. Low-level waste is shipped to Nevada Test Site for disposal.

Waste Storage

A RCRA hazardous waste staging facility has been designed and is planned for completion in FY 1996. This facility will provide storage for 1,600 drums of hazardous, mixed, and low-level radioactive waste. The staging facility will require upgrading in FY 2026.

Waste Disposal

For the near future, two quarterly shipments of low-level waste will be shipped to the Nevada Test Site annually. Hazardous waste is shipped monthly and one shipment of low-level mixed waste was made in FY 1994.

NUCLEAR MATERIAL AND FACILITY STABILIZATION

The facility stabilization and maintenance process began at Pantex in 1995. All eight Pantex facilities have begun stabilization. Some of these facilities include a chlorination building, a digester, explosives machining, synthesis buildings, and an electrical substation. It is assumed for the purposes of this report that the remaining facility (a sewage tank) will begin the stabilization process in 1996. This report assumes the stabilization and maintenance process at Pantex will be completed by 2015.

Nuclear Material and Facility Stabilization Cost Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Nuclear Material and Facility Stabilization	2,609	2,615	6,547	109	0	0	0	62,007

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

LANDLORD FUNCTIONS

The Department's Office of Defense Programs is the landlord at Pantex and is responsible for associated costs and activities.

PROGRAM MANAGEMENT

Pantex has no separate funding for program management. All program management activities are performed within the budgets for waste management and environmental restoration activities. This estimate employed a factor based on current and anticipated program needs to create an independent cost category. For FY 1995-FY 2000, program management activities at the site consume approximately 20 percent of the total budget. Program management activities included in the budget for the Environmental Management program consist of general program management, quality assurance, waste minimization, public participation, and activities related to the environment, safety, and health.

FUNDING AND COST INFORMATION

The following tables present funding information and major activity milestones for Pantex.

Program Management Cost Estimates

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	
Program Management	4,118	3,544	3,460	5,211	3,659	3,129	2,558	
	2035	**2040**	**2045**	**2050**	**2055**	**2060**	**2065**	**Life Cycle****
Program Management	224	0	0	0	0	0	0	133,637

* Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.

** Total Life Cycle is the sum of annual costs in constant 1995 dollars.

Defense Funding Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030
Environmental Restoration	11,130	872	0	0	0	0	0
Waste Management	12,422	12,514	13,840	12,522	12,557	12,515	10,233
Nuclear Material and Facility Stabilization	2,609	2,615	6,446	0	0	0	0
Program Management	4,118	3,544	3,460	5,211	3,659	3,129	2,558
Total	31,901	19,545	23,746	17,733	16,216	15,644	12,791

	2035	2040	2045	2050	2055	2060	2065	Life Cycle**
Environmental Restoration	0	0	0	0	0	0	0	71,140
Waste Management	897	0	0	0	0	0	0	449,920
Nuclear Material and Facility Stabilization	0	0	0	0	0	0	0	60,957
Program Management	224	0	0	0	0	0	0	133,637
Total	1,121	0	0	0	0	0	0	715,654

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

Nondefense Funding Estimate

*Five-Year Averages (Thousands of Constant 1995 Dollars)**

	FY 1995 - 2000	2005	2010	2015	2020	2025	2030	Life Cycle**
Environmental Restoration	0	0	0	10,949	2,737	0	0	68,432
Nuclear Material and Facility Stabilization	0	0	101	109	0	0	0	1,050
Total	0	0	101	11,058	2,737	0	0	69,482

* *Costs reflect a five-year average in constant 1995 dollars, except in FY 1995-2000, which is a six-year average.*

** *Total Life Cycle is the sum of annual costs in constant 1995 dollars.*

Major Activity Milestones

ACTIVITY	TASK	COMPLETION DATE
Environmental Restoration:		Fiscal Year
Misc Chem Spills and Release Sites	Permit Modification Based on No Further Action/Voluntary Corrective Action	1998
Landfills	Complete Corrective measures construction	1998
Fire Training Area Burn Pits	Permit Modification Based on No Further Action/Voluntary Corrective Action	1995
Firing Sites	Permit Modification Based on No Further Action/Voluntary Corrective Action	1997
Former Cooling Tower	Permit Modification Based on No Further Action	1995
Misc HE/Rad	Permit Modification Based on No Further Action/Voluntary Corrective Action	1997
Hypalon Pond	Permit Modification Based on No Further Action	1995
Ditches and Playas	Permit Modification Based on No Further Action/Voluntary Corrective Action	1997
High Priority Potential Release Sites	Permit Modification Based on No Further Action/Voluntary Corrective Action	1996
OSTP Sludge Beds	Permit Modification Based on No Further Action	1995
Supplemental Verification Sites	Permit Modification Based on No Further Action	1996
Leaking USTs at Bldgs 12-35 and 16-1	Permit Modification Based on No Further Action	1995
Underground Storage Tanks at Other Locations	Permit Modification Based on No Further Action/Voluntary Corrective Action	1996
Zone 12 Ground Water	Complete corrective measures	1999
Burning Grounds	Permit modification based on No Further Action	1996
Waste Management:		Fiscal Year
Proposed Site Treatment Plan	Submit to State of Texas	1995
Hazardous Waste Treatment & Processing Facility	Complete Construction	1999
Mobile Treatment Units	Final Design (Title II) Complete	1996
Hazardous Waste Staging Facility	Complete Construction	1996
All Waste Management Activities	Complete	2030

For further information on this site, please contact:

Public Participation Office *(505) 845-5951*
Public Affairs Office *(806) 477-3120*
Technical Liaison: Dan Ferguson *(806) 477-3126*

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No. DE-FC21-94MC31388	2. Program/Project Title EM Task 4 – Stabilization of Vitrified Wastes	3. Reporting Period 7/1/95 through 9/30/95
4. Name and Address	Energy & Environmental Research Center, University of North Dakota, PO Box 9018, Grand Forks, ND 58202-9018 (701) 777-5000	5. Program/Project Start Date 9/30/94
		6. Completion Date 9/29/99

7. FY 95/96

8. Months or Quarters: Quarters

9. Cost Status — a. Dollars Expressed in Thousands — b. Dollar Scale

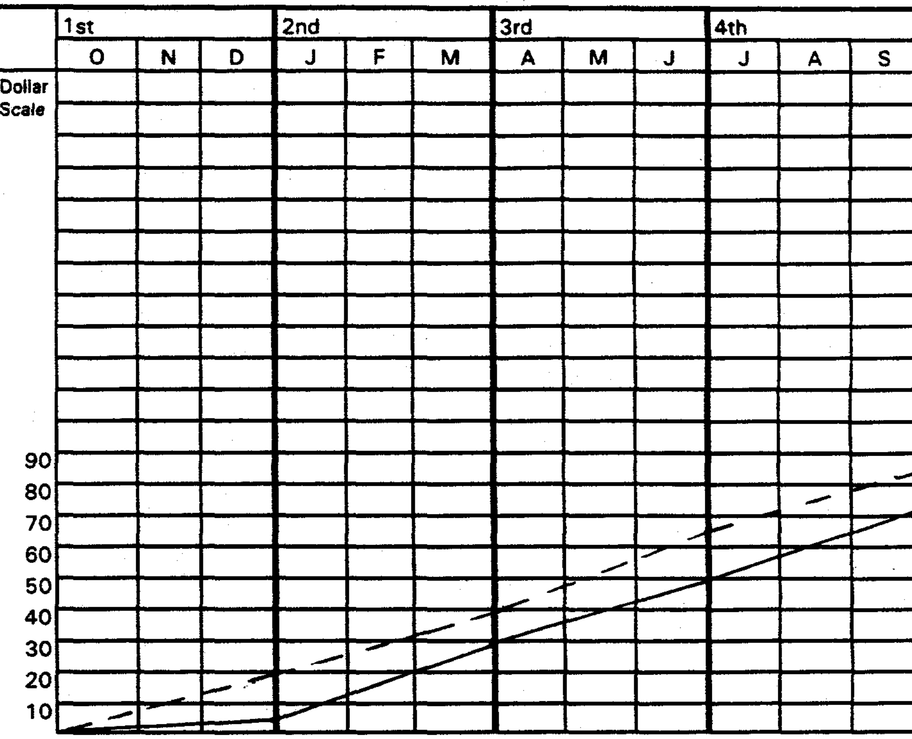
10. Cost Chart

Fund Source		Quarter 1st	2nd	3rd	4th	Cum. to Date	Tot. Plan
DOE	P	20	20	25	20	85	85
	A	4	25	21	21	71	
	P						
	A						
	P						
	A						
	P						
	A						
Total P		20	20	25	20	85	85
Total A		4	25	21	21	71	
Variance		16	<5>	4	<1>	14	

P = Planned A = Actual

Total Planned Costs for Program/Project

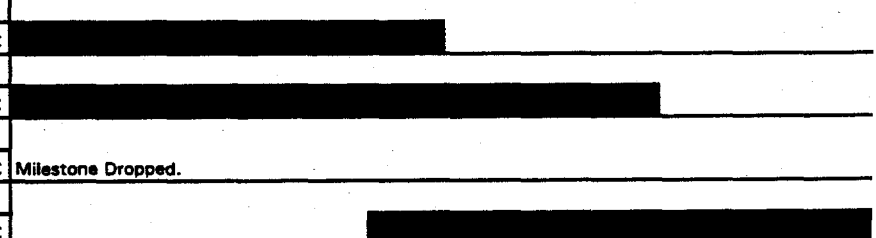
$85



c. Cumulative Accrued Costs

	O	N	D	J	F	M	A	M	J	J	A	S
Planned			20			40			65			85
Actual			4			29			50			71
Variance			16			11			15			14

11. Major Milestone Status	Units Planned / Units Complete
4.1 Survey of Vitrification Technologies	P / C
4.2 Survey of Cleanup Sites	P / C
4.3 Selection and Characterization of Test Mixtures for Vitrification and Crystallization	P / C — Milestone Dropped.
4.4 Selection Crystallization Scenarios Based on Thermochemistry	P / C
	P / C
	P / C
	P / C
	P / C
	P / C



12. Remarks

13. Signature of Recipient and Date [signature] 11/6/95

14. Signature of DOE Reviewing Representative and Date

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY
FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 4– Stabilization of Vitrified Wastes	7/1/95 through 9/30/95

4. Name and Address
Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018 (701) 777-5000

5. Program/Project Start Date
9/30/94

6. Completion Date
9/29/99

Milestone ID. No.	Description	Planned Completion Date	Actual Completion Date	Comments
4.1	Survey of Vitrification Technologies	3/95	3/95	100%
4.2	Survey of Cleanup Sites	6/95	6/95	100%
4.3	Selection and Characterization of Test Mixtures for Vitrification and Crystallization	9/95	Milestone dropped due to change in project direction	
4.4	Selection of Crystallization Scenarios Based on Thermochemistry	9/95	9/95	100%

TASK 8 - MANAGEMENT AND REPORTING

Semiannual Report

for the period April 1, 1995, through October 31, 1995

Prepared for:

Venkat K. Venkataraman

U.S. Department of Energy
Morgantown Energy Technology Center
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Morgantown, WV 26507-0880

UND EERC-DOE Environmental Management
Cooperative Agreement No. DE-FC21-94MC31388

Prepared by:

Daniel J. Daly
Edward N. Steadman

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Grand Forks, ND 58202-9018

December 1995

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TASK 8 – MANAGEMENT AND REPORTING

1.0 INTRODUCTION/OBJECTIVES

The objective of the Morgantown Energy Technology Center (METC)–Energy & Environmental Research Center (EERC) Environmental Management (EM) Cooperative Agreement program is to facilitate the development, demonstration, and rapid commercialization of technologies that address the EM needs of nuclear defense sites.

The five technology tasks included in the Year 1 program address extraction and analysis of pollutant organics from contaminated solids, pyrolysis of plastic wastes and the stabilization of vitrified wastes, and extraction of hazardous metals from mixed solid wastes.

The strategic involvement of industry in planning and implementing field demonstrations and commercialization is an important component of this program. The EERC is establishing joint ventures with small businesses to advance EM technologies and provide coordination and technical support to resolve barriers and shorten the path to commercial implementation of novel new technologies.

The primary objective of Task 8 is coordination of the METC–EERC EM Cooperative Agreement program with other programs and opportunities such as 1) the U.S. Environmental Protection Agency-sponsored Center for Air Toxic Metals, 2) the Department of Energy (DOE)-sponsored Jointly Sponsored Research Program (JSRP), and 3) other opportunities to advance the commercialization of enhanced EM technologies. In addition, management oversight will be maintained to ensure that tasks are completed and coordinated as planned and that deliverables are submitted in a timely manner.

The managers of this program are educating themselves with respect to DOE's Environmental Restoration and Waste Management Program by visiting selected DOE nuclear defense complex sites, attending conferences and meetings pertaining to this program, and fostering contacts, both in government and industry, with others involved in implementing and managing this program. In addition, the managers are focused on building government–industry teams for EM using the approach that proved successful in the EERC–DOE Fossil Energy-sponsored JSRP.

2.0 BACKGROUND

The EERC has a multidisciplinary staff of 260 scientists, engineers, and support personnel dedicated to full-time work on a wide variety of energy and environmental technologies. Since its defederalization as a former DOE coal laboratory in 1983, the EERC has developed unique scientific and technological assets, including patented, proprietary, and other specialized technologies applicable to characterizing, preventing, containing, and remediating hazardous mixed wastes comprising organic, inorganic, and radionuclide contaminants. In addition, the EERC has a proven track record for accelerating and integrating the commercialization of technology through joint venture partnerships with other organizations offering complementary EM methods. Sustained integration of fundamental research and technology development is considered to be essential to achieving success.

The special contributions that the EERC offers in addressing DOE's EM problems are rooted in a multidisciplinary core of scientists and engineers devoted to the commercial development of practical solutions to real-world problems. We believe that quality of life depends upon energy security and environmental quality and that they are fundamentally inseparable. We further believe that genuine progress in resolving intractable problems in EM can only be made by combining in-depth scientific understanding of relevant properties and processes with innovative business practices that bring together and integrate complementary technologies. The EERC has its own patented or proprietary technologies and world-class experience and expertise in the following areas:

- Geological, physical, chemical, mineralogical, and biological site characterization
- Groundwater occurrence, flow, and quality
- Physical, chemical, mineralogical, and biological contaminant characterization
- Contaminant–site interactions
- Geochemistry
- Organic analytical chemistry using supercritical fluid extraction
- Trace metal inorganic analytical chemistry
- Waste disposal site characterization, selection, and design
- Chemical, physical, and mineralogical materials characterization
- Environmental leaching protocols
- Low-temperature plasma reactions
- High-temperature combustion systems
- Phase fractionation chemistry and predictive methods
- Reductive energy conversion processes
- Atmospheric emission control
- Air toxics release and control mechanisms
- Waste utilization and recycling
- Waste prevention and disposal
- Advanced fixation methods: cementitious, pozzolanic, and vitreous
- Mine land reclamation
- Trace element transport and attenuation
- Agricultural chemical impacts on groundwater quality

These capabilities offer important opportunities for resolving EM problems identified by DOE in the following categories:

- Characterization, sensors, and monitoring
- Low-level mixed-waste processing
- Material disposition technology
- Improved waste forms
- In situ containment and remediation
- Efficient separation technologies for radioactive wastes
- Technology demonstration and commercialization

The management task for this project is designed to meet the overall program objectives by capitalizing on the technical and partnership-building experience present in the EERC management.

3.0 ACCOMPLISHMENTS/WORK PERFORMED

In addition to overall program management and reporting, significant efforts have been expended on enhancing task effectiveness, taking part in key EM-related gatherings, learning the needs and capabilities of EM sites, and developing effective information transfer packages to support demonstration and commercialization activities. Specific activities and accomplishments during the period April 1, 1995, to October 31, 1995, are as follows:

- Contacts with EM site personnel, private sector groups, DOE EM contractors, and government agencies:
  - Trip to Los Alamos National Laboratory (LANL), September 6–7, with the purpose of exploring the potential for teaming with LANL to integrate their unique expertise in radionuclide analysis and handling to facilitate the rapid commercialization of EERC's technology for the thermal treatment of organic mixed wastes. EERC attendees included Ted Aulich, Steve Benson, John Hendrikson, Edward Steadman, Everett Sondreal, and Robert Ness.
  - Telephone contacts with Robert Honeyman, Director of the Tank Waste Program, Hanford Site, concerning the potential for demonstration and application of technologies at that site.
  - Evaluation and recommendations concerning cooperation with the Federal Advisory Committee to Develop On-Site Innovative Technologies (DOIT).
  - Efforts to identify commercial partners and promising technologies are ongoing.
- The proposal for Year 2 of the METC–EERC EM Cooperative Agreement was prepared and submitted August 25, 1995. Year 2 activities were geared to focus on demonstration and commercialization of the five technologies listed in Table 1.
- National meeting of EM Office of Environmental Restoration contractors, ER'95, held in Denver, Colorado, August 16–19.
  - EERC attendees included Daniel Stepan and Daniel Daly
  - Preparation of a detailed trip report for internal EERC circulation
- METC Environmental Technology Development Through Industry Partnership meeting, October 3–5, at METC in Morgantown, West Virginia.
  - EERC attendees included Edward Steadman, Gerald Groenewold, Gregory Weber, Daniel Daly, and John Hendrikson

TABLE 1

FY96 Technology Activities for the METC–EM Cooperative Agreement

Focus Area	Technology	Commercial Partner	EERC Manager	METC $K	Description
Mixed Waste Characterization, Treatment, and Disposal	Supercritical fluid extraction infrared/ Fourier transform infrared (SFE-IR/ FT-IR) analysis	Suprex Inc.	Hawthorne	250	EERC technology for extraction and analysis of organic and metal pollutants by SFE in CO_2 and IR/FT-IR analysis.
	Thermal treatment (organics)	—	Ness	400	EERC technology for thermal conversion and destruction of organic substances and separation of inorganics based on pyrolysis of mixed organic wastes and staged low-severity depolymerization, hydrolysis, and hydrogenation.
Facility Stabilization, Decommissioning, and Final Disposition	Laser surface cleaning	F2 Associates	Erickson	110	Technical support for development of on-line analytical systems for trace metals; economic assessment; laser cleaning unit decontamination design.
Radioactive Tank Waste Remediation	Centrifugal membrane filtration	SpinTek Membranes Inc.	Stepan	120	Technical support for optimizing separation of organics and inorganics from liquid waste streams using selective self-cleaning membranes.
	Fluidized-bed calcination	Idaho National Engineering Laboratory (INEL)	Mann	100	Technical support to optimize an existing INEL unit for thermal conversion and destruction of organic substances and concentration of inorganics through fluidized-bed calcination; control of bed ash chemistry to effect capture of pollutants while preventing unacceptable bed agglomeration (inorganics).

- Preparation and presentation of a poster entitled "Environmental Management Technology Demonstration and Commercialization," which provided an overview of the METC–EERC EM Cooperative Agreement concept and technology commercialization activities. A paper based on the poster was prepared for the meeting proceedings.

- Preparation of a detailed trip report for internal EERC circulation.

- Sixth SPECTRUM International Conference on Nuclear and Hazardous Waste Management, Seattle, Washington, August 18–23, 1996.

  - Initiated the preparation of an extended summary (approximately 1500 words) for a presentation portraying the METC–EERC EM Cooperative Agreement as a model for facilitating the rapid commercialization of innovative EM technologies. Summary due November 10, 1995.

- METC–EERC EM Cooperative Agreement Program Review Meeting

  - Tentatively scheduled for Tuesday, November 21, 1995, at the EERC in Grand Forks, North Dakota (after the close of the reporting period, the meeting was rescheduled for December).

  - Attendees may include Thomas Bechtel, Venkat Venkataraman, Madav Ghate, Robert Dedick, James Marsh, and Floyd Crouse of METC; John Wilson and Sheila Cleary of the Waste Policy Institute (WPI).

  - Initiated logistical planning and preparation of oral presentations and presentation handouts

- Technology development data sheets (TDDS) were initiated for each of the five technologies currently under the METC–EERC EM Cooperative Agreement. Draft TDDS will be reviewed by Roger Wetzel of Energetics.

- EERC Task 8 management personnel and management support systems

  - Daniel Daly, Research Manager, was assigned technical coordinator duties in August. Responsibilities include acting as liaison for EERC principal investigators, coordination and management of day-to-day Task 8 activities, and preparation of written reports, presentations and posters.

  - Gregory Weber, Senior Research Advisor, was assigned management support activities in August geared toward facilitating the development of relationships with private sector and EM site personnel and groups.

- Support systems

  - Initiation of a personal computer-based listing and evaluation of technical documents in support of technology development activities. This database was built on the file database initiated in the previous reporting period.

- Initiation of a personal computer-based listing of EM-related contacts in support of technology development activities.

- Initiation of a technology and site characterization activity to support technical demonstration and marketing.

4.0 WORK PLANNED FOR NEXT 6 MONTHS

Efforts during the period November 1, 1995, through April 30, 1996, will focus on the following: 1) Complete TDDS, 2) Submit presentation summary for SPECTRUM meeting, 3) complete preparations and host Program Review Meeting, 4) continue to identify commercial partners, promising technologies, and outreach opportunities, 5) continue efforts to team with EM sites to match needs with technologies and provide demonstration venues, and 6) continue enhancement of Task 8 effectiveness.

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 8 – Management and Reporting	7/1/95 through 9/30/95

4. Name and Address: Energy & Environmental Research Center
University of North Dakota
PO Box 9018, Grand Forks, ND 58202-9018 (701) 777-5000

5. Program/Project Start Date: 9/30/94

6. Completion Date: 9/29/99

7. FY: 95/96

8. Months or Quarters: Quarters

1st			2nd			3rd			4th		
O	N	D	J	F	M	A	M	J	J	A	S

9. Cost Status — a. Dollars Expressed in Thousands — b. Dollar Scale

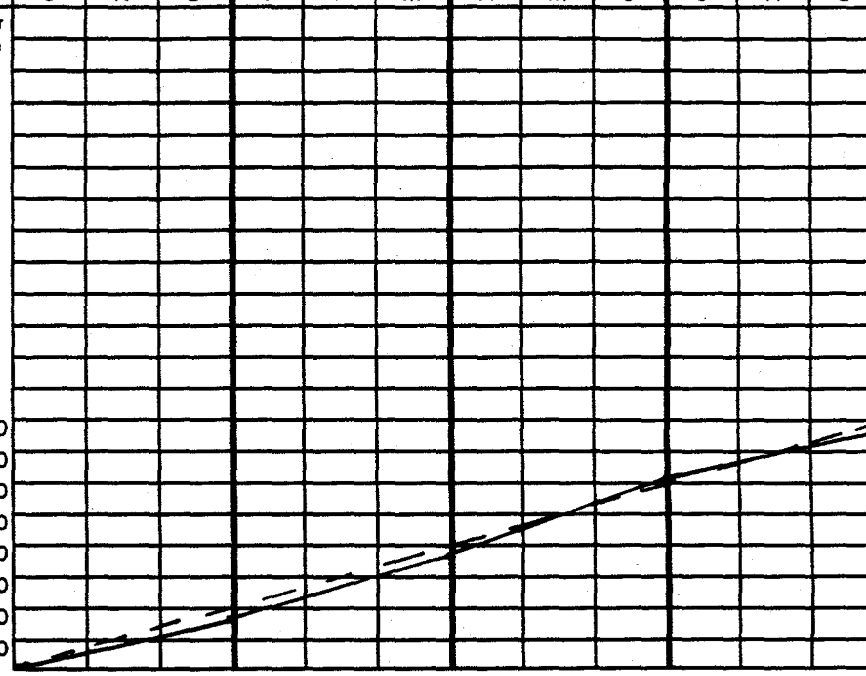
10. Cost Chart

Fund Source		Quarter 1st	2nd	3rd	4th	Cum. to Date	Tot. Plan
DOE	P	20	20	20	19	79	79
	A	17	21	23	17	78	
	P						
	A						
	P						
	A						
	P						
	A						
Total P		20	20	20	19	79	79
Total A		17	21	23	17	78	
Variance		3	<1>	<3>	2	1	

P = Planned A = Actual

Total Planned Costs for Program/Project

$79



c. Cumulative Accrued Costs

	O	N	D	J	F	M	A	M	J	J	A	S
Planned			20			40			60			79
Actual			17			38			61			78
Variance			3			2			<1>			1

11. Major Milestone Status	Units Planned / Units Complete
8.2 Provide Overall Management and Coordination of the Proposed Effort	P
	C
	P
	C
	P
	C
	P
	C
	P
	C
	P
	C
	P
	C
	P
	C
	P
	C

12. Remarks

13. Signature of Recipient and Date

14. Signature of DOE Reviewing Representative and Date

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY
FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
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1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 8 – Management and Reporting	7/1/95 through 9/30/95

4. Name and Address		
	Energy & Environmental Research Center University of North Dakota PO Box 9018 Grand Forks, ND 58202-9018 (701) 777-5000	5. Program/Project Start Date 9/30/94 6. Completion Date 9/29/99

Milestone ID. No.	Description	Planned Completion Date	Actual Completion Date	Comments
8.0	Management and Reporting			
8.2	Provide Overall Management and Coordination of the Proposed Effort			100%

TASK 9 - CENTRIFUGAL MEMBRANE FILTRATION

Semiannual Report

for the period April 1, 1995, through October 31, 1995

Prepared for:

Venkat K. Venkataraman

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880, MS C05
Morgantown, WV 26507-0880

UNDEERC/DOE Environmental Management
Cooperative Agreement No. DE-FC21-94MC31388

Prepared by:

Daniel J. Stepan

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018

November 1995

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- 3.2 Equipment Procurement and Training 2
- 3.3 Baseline Data Collection 2

4.0 WORK PLANNED 2

CENTRIFUGAL MEMBRANE FILTRATION

1.0 BACKGROUND

Work under this task is designed to establish the utility of a novel centrifugal membrane filtration technology for the remediation of liquid mixed waste streams at U.S. Department of Energy (DOE) facilities in support of the DOE Environmental Management (EM) program. The Energy & Environmental Research Center (EERC) has teamed with SpinTek Membrane Systems, Inc., a small business and owner of the novel centrifugal membrane filtration technology, to establish the applicability of the technology to DOE site remediation and the commercial viability of the technology for liquid mixed waste stream remediation.

The technology is a uniquely configured process that utilizes ultrafiltration and centrifugal force to separate suspended and dissolved solids from liquid waste streams, producing a filtered water stream and a low-volume contaminated concentrate stream. This technology has the potential for effective and efficient waste volume minimization, the treatment of liquid tank wastes, the remediation of contaminated groundwater plumes, and the treatment of secondary liquid waste streams from other remediation processes as well, as the liquid waste stream generated during decontamination and decommissioning activities.

2.0 OBJECTIVES

The overall project consists of several integrated research phases related to the applicability, continued development, demonstration, and commercialization of the SpinTek centrifugal membrane filtration process. Specific objectives of Phase I research activities include the following:

- A problem and opportunity assessment to identify applicable waste streams, including mixed wastes, associated with DOE sites
- Development of detailed process data that will provide information with regard to the application of the technology at DOE sites
- Testing and evaluation of a laboratory centrifugal membrane filtration unit using surrogate waste streams under a variety of operating conditions
- Development of process data that will allow optimization of the technology for appropriate DOE waste stream remediation

3.0 ACCOMPLISHMENTS

Activities during this reporting period have included a problem identification and opportunity assessment for the centrifugal membrane filtration process, equipment procurement and operational training sessions, and the initiation of baseline process performance data collection.

3.1 Problem Identification and Opportunity Assessment

Activities under this task have involved a review of available information to identify liquid waste streams at DOE facilities that may be amenable to treatment using the centrifugal membrane filtration process. The review provides information on the nature of individual contaminants and contaminant mixtures, their frequency of occurrence at DOE facilities, the potential application of the centrifugal membrane filtration process, and potential problems associated with the remediation of the identified waste streams.

3.2 Equipment Procurement and Training

The equipment to be used for testing and process evaluation, the ST-IIL, was received at the EERC on October 4, 1995. Mr. Richard Hayes, chemical engineer at SpinTek, arrived at the EERC on October 11, 1995, to provide system start-up and training in the operation of the system.

3.3 Baseline Data Collection

Baseline data collection activities were initiated using distilled water during this reporting period. This will be followed by preliminary testing using a variety of materials, including clay suspensions to evaluate suspended solids-loading capabilities and latex or similar solutions to determine viscosity limitations.

4.0 WORK PLANNED

Projected work on the project will include the continuation of baseline data collection and process performance verification, the selection of representative waste stream surrogate contaminants, membrane screening and selection, testing of the system using the selected surrogate waste stream(s), data reduction and evaluation, and final report preparation.

Based on the information compiled during the problem identification activities, representative radionuclide surrogates will be selected for evaluation. Based on the nature of the radionuclide surrogates and other contaminants present in the identified waste streams, membrane screening and selection activities will be accomplished using the SpinTek STC–X4, a cross-flow filtration device that allows the simultaneous testing of up to four different types of membranes under the same temperature, pressure, and velocity conditions. Membranes exhibiting the best overall performance, based on membrane throughput and permeate water quality, will then be evaluated using the ST-IIL unit.

Testing and evaluation of the selected membrane(s) on the ST-IIL unit will be based on a statistical matrix design that considers the interdependence of operating parameters such as temperature, pressure, membrane rotational velocity, and suspended solids loading. All experimental runs will be performed in randomized order to prevent experimental bias. Up to 27 different runs of up to 8 to 10 hours each will be conducted for statistical analysis of the data.

The system will then be operated for extended periods of time to determine the effect of filtration rates and process throughput on membrane cleaning frequency. Evaluations of equipment corrosion, scaling, and general fouling potential will also be conducted.

Following completion of testing and data reduction and analysis, a comprehensive report will be prepared detailing process performance of the SpinTek centrifugal membrane filtration process, along with recommendations for DOE facility application and continued demonstration activities.

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 9 – Centrifugal Membrane Filtration	7/1/95 through 9/30/95

4. Name and Address Energy & Environmental Research Center
University of North Dakota
PO Box 9018, Grand Forks, ND 58202-9018 (701) 777-5000

5. Program/Project Start Date 9/30/94

6. Completion Date 9/29/99

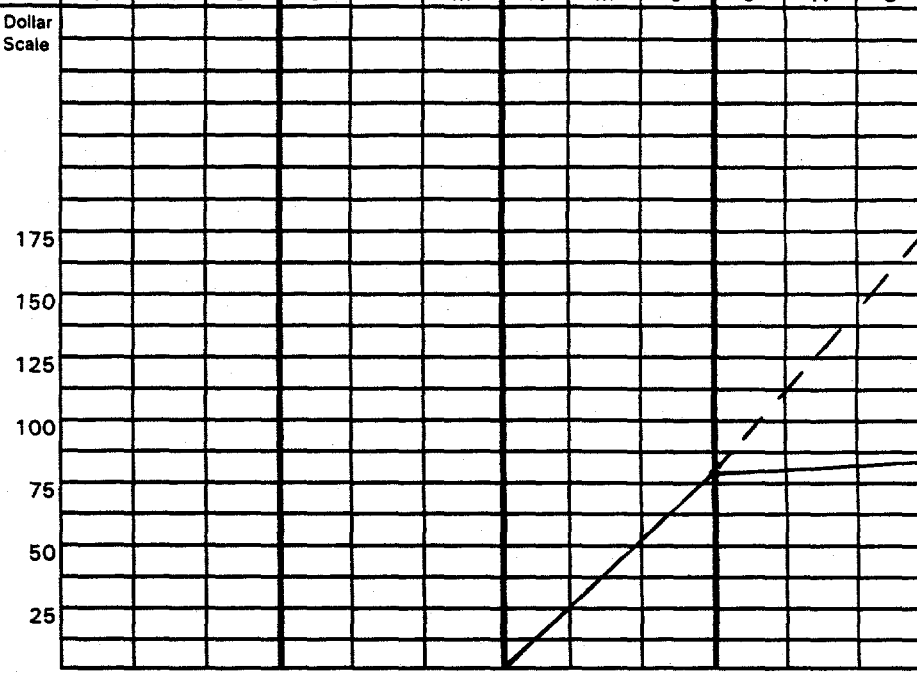
7. FY	8. Months or Quarters	1st			2nd			3rd			4th		
95/96	Quarters	O	N	D	J	F	M	A	M	J	J	A	S

9. Cost Status a. Dollars Expressed In Thousands b. Dollar Scale

10. Cost Chart

Fund Source		Quarter 1st	2nd	3rd	4th	Cum. to Date	Tot. Plan
DOE	P	0	0	80	94	174	174
	A			80	8	88	
	P						
	A						
	P						
	A						
	P						
	A						
Total P		0	0	80	94	174	174
Total A				80	8	88	
Variance				0	86	86	

P = Planned A = Actual



Total Planned Costs for Program/Project

$174

c. Cumulative Accrued Costs

	O	N	D	J	F	M	A	M	J	J	A	S
Planned									80			174
Actual									80			88
Variance			--			--			0			86

11. Major Milestone Status	Units Planned / Units Complete
9.1 Problem Definition	P / C
9.2 Process Performance Verification	P / C
9.3 Membrane Screening and Selection	P / C
9.4 Performance Evaluation	P / C
	P / C
	P / C
	P / C
	P / C
	P / C

12. Remarks

13. Signature of Recipient and Date

14. Signature of DOE Reviewing Representative and Date

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	Task 9 – Centrifugal Membrane Filtration	7/1/95 through 9/30/95

4. Name and Address: Energy & Environmental Research Center, University of North Dakota, PO Box 9018, Grand Forks, ND 58202-9018 (701) 777-5000

5. Program/Project Start Date: 9-30-94

6. Completion Date: 9-29-99

Milestone ID. No.	Description	Planned Completion Date	Actual Completion Date	Comments
9.1	Problem Definition			
9.1.1	Interim Report Preparation	8/31/95		
9.2	Process Performance Verification	9/30/95		
9.3	Membrane Screening and Selection	10/31/95		
9.4	Performance Evaluation	3/31/96		
9.4.1	Final Report Preparation	5/10/96		

TASK 10 – TECHNOLOGY DEVELOPMENT INTEGRATION

Semiannual Report

for the period April 1, 1995, through October 31, 1995

Prepared for:

Venkat K. Venkataraman

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880, MS C05
Morgantown, WV 26507-0880

UND EERC–DOE Environmental Management
Cooperative Agreement No. DE-FC21-94MC31388

Prepared by:

John H. Hendrikson
Daniel J. Daly

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018

December 1995

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Waste Policy Institute Monthly Report to the EERC, August 1995 . . . . Appendix B

Waste Policy Institute Monthly Report to the EERC, September 1995 . . . . Appendix C

Waste Policy Institute Monthly Report to the EERC, October 1995 . . . . Appendix D

TASK 10 – TECHNOLOGY DEVELOPMENT INTEGRATION

1.0 INTRODUCTION

The Energy & Environmental Research Center (EERC) in conjunction with the Waste Policy Institute (WPI) will identify and integrate new technologies to meet site-specific environmental management (EM) requirements at contaminated sites appropriate to Department of Energy (DOE) interests. EM technologies offered by developers will be evaluated to determine their complementary contribution to new cleanup systems focused on particular characterization and remediation problems at specific EM sites. The technology clusters identified will provide EM cleanup capabilities that are significantly faster, better, safer, and cheaper than systems that are currently available. Work will be performed under the DOE–EERC EM Cooperative Agreement, which includes provisions "to develop, demonstrate, and commercialize technologies that address environmental management needs of contaminated sites" together with "management activities which accelerate transfer of technologies." The effort began July 1, 1995.

2.0 OBJECTIVES AND ACTIVITIES

This task will develop new approaches for evaluating technology focus areas and other research and development technical programs and activities. This includes creating technology development scenarios and formulating streamlined technical approaches that will expedite technology focus area initiatives, other technical programs, and projects. In addition, this task is designed to validate technologies and systems through all phases of research, development, demonstration, testing, and evaluation and ensure public involvement during the development process.

The work is divided into three activities. As part of the Task 10.1, technology management, activity, technical reviews of requirements, needs, and assessments related to waste characterization, containment, in situ and ex situ treatment, waste storage, disposal, robotics handling, monitoring, laboratory analysis, and site characterization and remediation will be performed. The activities will include but are not limited to the following: development of systems, experimental design, plans, verification of technology performance, establishing regulatory documentation and intermediate products required for testing, demonstration, validation and testing, and preparation of review documentation. In addition, studies will be performed in various focus areas to facilitate rapid deployment of waste management technologies to the specific DOE sites and transfer to the private sector.

As part of project management, Task 10.2, the participants will conduct reviews and analyze and develop strategies for program management systems to integrate and control programs, projects, tasks, and documentation. This includes financial and technical management systems, decision analysis tools and program-planning software, and cost or schedule variance analysis and related software. In addition, the following activities will be carried out: conduct project reviews, public hearings, meetings, and public briefings; develop technical briefings; prepare related materials; plan for the transportation of hazardous waste, including acting as a liaison with the public on routes, safety, and preparedness; provide emergency management plans, training, and exercises for facility and transportation preparedness; and develop protocols for collecting, handling, analyzing, and shipping environmental samples.

As part of the technology integration (Task 10.3) activities to the private sector, criteria for identifying risks to public health and safety posed by conditions at weapons complex facilities will be established, the extent of these risks will be evaluated, the urgency and priorities for eliminating or minimizing the risks will be determined, and the cost of activities required to meet applicable compliance agreements will be assessed.

3.0 ACCOMPLISHMENTS/WORK PERFORMED

Because Task 10 activities were initiated in July, part way through this reporting period, activities have focused on working out management and coordination issues. Several meetings were held between representatives of WPI, EERC, and DOE to facilitate Task 10 coordination and management:

- Mr. Dean Eymans (Chief Executive Officer, WPI) and Mr. Tom Gibb (Chief Operating Officer, WPI) visited the EERC in early July and met with EERC technical and management personnel in order to facilitate the initiation of activities under Task 10.

- Representatives of WPI and EERC met with DOE personnel at METC July 25, 1995, for a review and discussion of Task 10 activities.

- Mr. Rudy Luyendijk of WPI visited the EERC in August to discuss technical coordination issues

Activities were undertaken by WPI in each of the Task 10 activities: Technical Management, Program Management, and Technology Integration. Specifics are included in Appendices A–D, the detailed monthly reports from WPI.

WPI established offices at the field sites near each of the EM-50 focus area lead organizations:

- A permanent office was established in Morgantown, West Virginia, to liaison with the Morgantown Energy Technology Center (METC) lead group for the decontamination and decommissioning focus area.

- Temporary offices have been established in 1) Idaho Falls, Idaho, 2) Aiken, Georgia, and 3) Richland, Washington.

4.0 WORK PLANNED FOR NEXT 6 MONTHS

During the coming reporting period, WPI activities will vary by focus area under the three activity areas – technology management, project management, and technology integration. The EERC will continue to perform program integration and coordination activities.

For technology management (Task 10.1), WPI will perform technical reviews and assessments as appropriate related to waste and site/facility characterization, containment, in situ and ex situ treatment, waste handling, storage, and disposal, laboratory analysis, and monitoring technologies.

For project management (Task 10.2), WPI will continue to conduct reviews and analyze and develop strategies and systems for the integration and implementation of focus area programs, projects, and tasks.

For technology integration (Task 10.3), WPI will continue to assess regulatory and public health and safety risks posed by conditions at nuclear defense complex facilities that might impede the successful implementation or transfer of focus area developed technologies.

WASTE POLICY INSTITUTE MONTHLY REPORT TO THE EERC, JULY 1995

APPENDIX A

WPI
WASTE POLICY INSTITUTE
A Virginia Tech Affiliated Corporation

Corporate Office
1872 Pratt Drive, Suite 1600
Blacksburg, VA 24060-6363
Telephone (703) 231-3324
Telefax (703) 231-3968

Washington Operations Office
Quince Diamond Executive Center
555 Quince Orchard Road, Suite 600
Gaithersburg, MD 20878-1437
Telephone (301) 990-7200
Telefax (301) 990-6150

August 18, 1995
VIA FEDERAL EXPRESS

John G. Hendrikson
Assistant to the Director
Energy and Environmental
Research Center
University of North Dakota
15 North 23rd Street
Grand Forks, ND 58203

Subject: UNDEERC Fund No. 4624-0936, Technology Development Integration
WPI Subcontract No. 359636

Dear Mr. Hendrikson:

The Waste Policy Institute (WPI) is pleased to submit the enclosed report of activities conducted during the period of June 27, 1995 through July 31, 1995 in compliance with Article VI and Appendix A of Subcontract Number 359636. A list of products developed during this period is provided at Attachment A to the activities report. Our monthly cost and labor report is also enclosed.

Please do not hesitate to call me if you have any questions or require additional information.

Very truly yours,

Sheila A. Cleary

Sheila A. Cleary
Corporate Counsel/Director of Contracts

cc: L. D. Eyman
W. D. Wiley
T. W. Gibb

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SUBCONTRACT NUMBER: 359636 **REPORT PERIOD: 06/28/95 - 07/31/95**

SUBCONTRACTOR NAME: **Waste Policy Institute**
555 Quince Orchard Road
Suite 600
Gaithersburg, MD 20878-1437

SUBCONTRACT PERIOD: **06/28/95 - 09/30/95**

1. **CONTRACT DELIVERABLES:**

This report is submitted in fulfillment of requirements specified for the University of North Dakota Energy and Environmental Research Center (UNDEERC) Subcontract Number 359636. A list of products developed under this subcontract is provided as Attachment A.

2. **SUMMARY OF ACTIVITIES:**

ACTIVITIES: TASK A - TECHNOLOCY MANAGEMENT

- Initiated analysis of technical issues connected with the EM-Polish Institute for Ecology of Industrial Areas (IETU) joint project in Katowice, Poland. Documented evaluations related to project planning, preparation of Program Plan and meetings in the U.S. and Poland in August and September, 1995.

- Tracked clearance process and documented issues relevant to a Memorandum of Cooperation (MoC) between EM and Polish Institute.

- Coordinated efforts to facilitate participation of Czech environmental officials in EM-40 Environmental Restoration Conference in Denver, Colorado, in August, 1995, and for DOE delegation visit to Prague, Czechoslovakia in September, 1995.

- Planned for a meeting in Gaithersburg, Maryland with representative of Lawrence Livermore National Laboratory regarding Central/East European participation in the November, 1995 Erice, Sicily conference "Risk Management Strategies Applied to Environmental Cleanups in Central and Eastern Europe."

- Assessed international proposed FY96 program tasks for Central/East European and technology transfer projects.

- Coordinated Chinese Delegation travel to DOE sites in July, 1995.

- Coordinated with participants for a DOE sponsored conference in Berlin, Germany, to be held on September 3-10, 1995.

- Coordinated with participants of the 5th Joint Coordinating Committee for Environmental Restoration and Waste Management (JCCEM) meeting to be held in September, 1995.

- Attended intra-agency meetings on the Newly Independent States held on July 12, 1995 and July 25, 1995 in Washington, D.C.

- Provided revised text of the U.S. - Former Soviet Union Activities Report (the "Red Book"), including maps and photographs.

- Compiled data and reports related to International Programs as part of the Department of Energy (DOE) Field Office Coordination Task.

Mixed Waste Focus Area

- Reviewed a Congress-mandated report entitled "Waste Isolation Pilot Plant Land Withdrawal Act Radioactive Waste Processing and Volume Reduction Technology Study". This draft report was prepared by the National Transuranic Program Office (NTPO) in accordance with the Land Withdrawal Act. Developed descriptions of process, scope, and schedule in the report for 20 mixed waste destruction and stabilization technologies.

- Participated in several planning meetings to assess the structure and content of the FY96 Mixed Waste Focus Area technical program and the final version of the FY96 Program Execution Guidance package.

- Visited the SAIC Science and Technology Applied Research (STAR) Center to witness and discuss the testing of the large-volume, flow-through alpha detector currently under development at LANL.

Minimum Additive Waste Stabilization Program

- Developed a paper for ER95 conference highlighting the various oilfield technologies that can and have been adapted for use in environmental restoration of underground contaminants.

- Created one-page technology summary slides.

- Coordinated efforts and planning for a plutonium vitrification and immobilization workshop which will be held in late August. Prepared speaker and participant invitation letters to solicit papers and develop interest in attending. Coordinated an agenda planning meeting. Developed lists of speakers and potential attendees.

Characterization, Monitoring, and Sensors Technology (CMST) Program

- Prepared metrics, major milestones and technology demonstrations for CMST projects with application to the Decontamination and Deactivation Focus Area.

- Prepared narrative of important milestones (e.g., demonstrations) for CMST-CP and an explanation of their relevance. Narrative was categorized by Focus Area, by quarter of FY95, and by State in which milestone occurred.

- Developed a paper for the Superfund Conference '95.

- Coordinated and attended CMST-CP exhibit at the Rayburn/Hart buildings in downtown Washington D.C.

- Continued coordination and planning for a follow-up Expedited Site Characterization course to be given at Savannah River Site in conjunction with the demonstration of the Ames Expedited Site Characterization methodology there.

- Developed an Expedited Site Characterization presentation to be given to the Interagency Environmental Technology Office.

- Conducted evaluation with Innovative Treatment Remediation Demonstration (ITRD) Program to assess in situ, real-time sensors for measuring uranium at Fernald and plutonium-238 at Mound.

- Reviewed several proposed FY96 projects relating to characterization for the Landfill Focus Area. Assimilated and distributed comments of all scientific reviewers to Landfill Focus Area field team and Principal Investigators for their possible rebuttal. Participated in a conference call with Landfill Focus Area leaders regarding written comments.

- Reviewed several proposed FY96 projects related to characterization for the Mixed Waste Focus Area. Comments of all scientific reviewers were assimilated and distributed to Mixed Waste Focus Area field team and Principal Investigators for their possible rebuttal. Participated in a conference call with Mixed Waste Focus Area leaders regarding written comments.

- Reviewed draft program summary booklets from all Focus Areas and Crosscutting Programs for relevance to CMST.

- Prepared a CMST presentation to be given at a National Academy of Sciences meeting in Woodshole, July 31-August 2, 1995.

- Prepared a CMST presentation of FY95 and FY96 projects.

- Developed list of all FY95 projects with an analysis of why they were closed out or continued and the associated Focus Areas.

- Developed a cross-walk table relating FY95 and FY96 TTP numbers, projects names and project funding.

Innovative Technology Program

- Continued development of Technology Summary book for Innovative Technology Program.

- Prepared charts for all Industry Program and Innovative Technology Program activities identifying applicability to Focus Areas and Crosscutting Programs.

- Reviewed and evaluated 42 technical proposals in support of the MOU for Environmental Security Technology Certification Program.

Robotics

- Updated Transparency and Photo Presentation Manuals with latest Robotics technologies.
- Prepared guidelines for, and coordinated the, Robotics Program exhibit for Robotics Forum.
- Coordinated robot displays at Hart Senate Office Building on July 11, 1995.
- Coordinated update of Mixed Waste and Landfill Operations Major Thrust Package.
- Developed list of scheduled demonstrations for Community Leaders Network.
- Compiled letters of commitment from industry on Robotics technologies.
- Prepared robotics presentation to be given at National Academy of Sciences meeting in Woodshole, July 31- August 2, 1995.
- Participated in conference calls regarding the future development of the tank waste retrieval program.
- Collected information on Robotics Program technologies for international exhibit.
- Participated in meetings regarding scope of work for Institute for Defense Analysis and commonality with DOE/Department of Defense environmental contamination.
- Reviewed fiscal year 1996 Program Execution Guidance.
- Created Robotics Technology Development Program July Calendar of Events.
- Coordinated update of program exhibit for Robotics Program 6th Annual Forum.

Landfill Stabilization Focus Area

- Developed briefing materials for a July meeting with the National Academy of Sciences Subcommittee on Landfills.

- Developed briefing materials for a July meeting with the National Academy of Sciences Committee on Environmental Management Technologies.

- Developed one-page summary briefing slides for Landfill Stabilization Focus Area (LSFA) FY95 technologies.

- Created one-page summary slides for each Product Line addressed in the LSFA proposed FY96 program review.

- Reviewed and developed spreadsheet information for the FY96 Performance Measures Plan.

- Prepared project summary notebook for the in situ vitrification project.

Tanks Focus Area

- Developed briefing materials for the proposed FY96 program for the Tanks Focus Area (TFA). Developed draft materials prepared for a briefing to the National Academy of Sciences Committee on Environmental Management Technologies.

- Conducted a technical review and provided an evaluation of the draft proposed FY96 Execution Guidance for the TFA.

- Reviewed TFA technologies and plans and developed briefings related to the proposed TFA program.

- Reviewed the proposed FY96 program for the Efficient Separations and Processing Program and compared the technical objectives with those in the TFA Program to identify any overlap in the programs.

- Gathered information and assessed the Tanks Focus Area needs for development of Technical Activity Data Sheets (TADS).

- Analyzed data in the draft proposed FY96 program and the Multi-Year Program Plan for the TFA to prepare a table detailing the technical and resource leveraging for the FY96 Tasks.

- Gathered and reviewed technology information to produce a draft TFA brochure explaining the purpose, need, test results, and advantages of implementing Cesium removal technologies at Department of Energy facilities.

- Analyzed the technologies and program of the Tank Focus Area to develop a brochure delineating the program flow and major technical elements.

- Conducted a technical review of the proposed FY97 TFA program and provided assessment of the Internal Review Budget submission.

- Conducted a technical analysis of the TFA enhanced retrieval deployment program and provided assessment of a strategy for reconfiguring the program to meet current identified needs.

- Initiated a technical evaluation of the Laser Ablation/Mass Spectrometry (LA/MS) technology being developed in the TFA.

- Gathered and reviewed technical data to develop a description of the Structured Light Mapping System to be included in the Tank Focus Area Technology Success Book.

- Conducted a technical analysis of the document "Evaluation of Selected Ion Exchangers for the Removal of Cesium from MVST W-25 Supernate".

- Reviewed the document "System Requirements Review Hanford Tank Waste Remediation System Final Report" in order to locate information associated with pretreatment cost savings.

- Analyzed technical and programmatic requirements to initiate the development of a Roles and Responsibilities document for the TFA.

- Evaluated FY95 TFA plans and current program status to provide updated information on Performance Metrics.

- Analyzed FY96 TFA plans, including the draft TFA proposed FY96 program, to develop detailed tables of technologies being developed, demonstrated, and readied for transfer.

- Analyzed TFA technologies and programs to develop draft materials for a briefing to the National Academy of Sciences Committee on Environmental Management Technologies, scheduled for July, 1995.

- Gathered information on TFA technologies and programs to provide materials for use in conjunction with the signing of a Memorandum of Understanding between DOE-Richland, Pacific Northwest National Laboratory, and EM-1 on the TFA.

- Analyzed and compiled a list of technologies implemented and the commercial partners involved for the TFA.

Decontamination and Decommissioning

- Developed a presentation given at the proposed FY96 program for Decontamination and Decommissioning Program, on July 14, 1995.

- Developed information and presentation regarding surface and volumetric free release and controlled release standards for radioactively contaminated materials.

- Completed updated strawman draft of D&D Strategic Plan.

- Participated in planning session to outline presentation to the NAS D&D subpanel.

Decontamination and Decommissioning

- Developed presentation given at the FY96 Program Execution Guidance, on July 14, 1995.

- Developed information and presentation regarding surface and volumetric free release and controlled release standards for radioactively contaminated materials.

- Completed updated strawman draft of D&D Strategic Plan.

ACTIVITIES: TASK B - PROJECT MANAGEMENT

- Researched and compiled information regarding technologies developed and successfully transferred.

- Created an Interstate Technology and Regulatory Cooperation (ITRC) Working Group memorandum regarding the four state MOU among California, Massachusetts, New Jersey, and Illinois.

- Analyzed and evaluated status of the Annual Performance Plan.

- Evaluated the 3rd Quarter Performance Measures status.

- Assessed the Technical Activity Data Sheets (TADS) status.

- Continued technical assessment and evaluation of the FY96 Program Execution Guidance.

- Reviewed and analyzed the monthly report on uncosted/unobligated technology development funding.

- Developed Decision Support Materials for the Environmental Research and Technology Development Steering Committee Meeting held on July 20, 1995.

- Developed a Decision Record for the Environmental Research and Technology Development Steering Committee Meeting held on July 20, 1995.

- Participated in EM-13 planning conference calls and prepared written highlights of discussions.

- Participated in the weekly conference calls of the Strategic Laboratory Council and prepared minutes for each of the Council conference calls.

- Coordinated the review of papers for the International Conference on Radioactive Waste Management and Environmental Restoration.

- Analyzed information for the Progress Tracking System (PTS) and the Cost Performance Variance Analysis (CPVA) databases, and evaluated the June 1995 submittal.

- Analyzed information for the Internal Review Budget (IRB).

- Assessed and developed recommendations for the development of a monthly program review process and format.

- Conducted a demonstration of the System Navigation Aid Program (SNAP) prototype.

- Developed a summary report on feedback obtained and recommendations resulting from the SNAP discussion/demonstration session.

- Conducted quality check and updated FY94 Kairos program data.

- Reviewed and revised a paper entitled "Establishing A Structured Process for Managing Information."

- Created an outline for a strategic plan for DOE's information systems and compiled information for the plan.

- Analyzed results from recent data call.

Special Studies

- Coordinated with members of the Technical Support Group of the Integrated Nonthermal Treatment Systems Study for development of the draft report of the Technical Support Group meeting held in June and published a final.

- Coordinated logistics and stakeholder participation for the first meeting of the Tribal and Stakeholders Working Group of the Integrated Nonthermal Treatment Systems Study to be held in Denver, CO., August 8-9, 1995.

- Prepared summaries of nonthermal technologies and accumulated material on previous thermal systems studies to be incorporated into mailings to the Tribal and Stakeholders Working Group.

- Assisted stakeholder consultant in identifying and selecting members of the Tribal and Stakeholders Working Group and communicated with them on the purposes of these study, objectives of the group, and reasons for the meeting.

- Prepared briefing to the Tribal and Stakeholders Working Group on the Integrated Nonthermal Treatment Systems Study Baseline Assumptions.

- Communicated with DOE General Counsel on its deliberations on material that could legally be withheld from publication of the draft Technical Review Panel report on Molten Metal Technology.

- Reviewed Depleted Uranium Summary report, capsulizing previous reports on the subject.

- Created 22 overheads used by RCI Action Committee in presenting RCI status to their individual agencies.

Liaison and Communications

- The Transportation and Emergency Management Resource Center (TEMRC) delivered:

  Assisted 44 visitors to the TEMRC
  Processed 43 reference requests
  Processed 24 research requests
  Acquisitions: 2 Serials checked-in 14
  Deleted 12 existing records, updated 15 records
  Fulfilled 255 in-house requests for information items
  Sent 21 requests to SAIC for fulfillment
  Circulated 14 documents
  Performed 61 online searches
  Patron Access Terminal usage: 10

- Revised and edited draft TEMRC Operations Manual.

- Developed Records Management classification scheme.

- Obtained online (Pagemaker) versions of EM Factsheets and information booklets and arranged to upload information onto the Internet.

Transportation Management

- Traveled to and attended Transportation External Coordination Working Group meeting July 18-10, 1995 in Kansas City, MO.

- Reviewed and assessed comments on DOE Order 1540.1B.

- Reviewed and provided technical comments to Chapter 3 Imports/Exports Section of the Transportation Operations Manual.

- Formulated daily maintenance of the Transportation Address Manager (TAM) database.

- Technical review of transportation regulatory changes. In particular, reviewed numerous Department of Transportation (DOT) and Coast Guard (CG) federal registers regarding the DOT Hazardous Materials Transportation Fees, Alcohol and Drug Testing procedures, and Coast Guard Policy on vessel transportation of hazardous materials.

- Developed information sharing document on activities, i.e., meetings, conferences, etc. field and contractor transportation managers should be planning for in fiscal year 1996.

- Answered the training registration line; mailed out or faxed information as requested; received and processed registrations, prepared and mailed confirmation letters. Made logistical arrangements for September workshops.

- Formatted training materials for pilot course to be given in August.

- Developed automation initiative to transmit latest planning information to the Field.

- Prepared discussion paper on routing highway route-controlled quantities of radioactive materials in National Environmental Policy Act documents and stakeholder involvement process based on TEC/WG member comments.

Emergency Management

- Continued development of a Transportation Emergency Program Roles and Responsibilities document.

- Demonstrated the Emergency Management Issues Tracking System (EMITS) to the Emergency Management Coordinators meeting on July 31, 1995.

- Began review of "Options for Funding for States, Local and Tribal Groups."

- Continued scheduling and maintenance implementation documentation for the new Transportation Emergency Management Program.

- Reviewed and analyzed the "Draft State Agreement-in-Principle (AIP) Program Guidance." Prepared comments and a memorandum forwarding comments to the Office of Environmental Activities.

- Organized review comments on four 5500 draft Orders.

- Attended the Emergency Management Coordinators July meeting. Compiled minutes from the June and July meetings.

- Compiled a listing of information on current status of the EM Emergency Management Program. This document identifies major milestones for fiscal year 1995, person responsible for this milestone, current status of activity, and specific tasks completed.

- Prepared short document describing the current EM Emergency Management Program.

- Researched and assessed equipment needs to be identified under the new Transportation Emergency Management Program (TEMP).

- Developed briefing for the Emergency Management Plenary Session at the TEC/WG semi-annual meeting held July 14-16 in Kansas City.

- Updated the Emergency Management Issue Tracking System (EMITS), a computerized system for tracking corrective actions.

Analytical Services

- Reviewed and prepared material for several presentations for a program review meeting on the Analytical Services Resource Management Program that will be held in September in California.

- Prepared meeting agenda and other documents for the annual Resource Management Program Review of new program tasks.

- Developed a listing of activities for the Oak Ridge cost of analytical services survey.

- Revised draft model contract for analytical services into a standard contract which should enhance efficiency as this procurement is centralized.

- Prepared extended abstract for a paper to be presented on management of sampling and analysis activities in EM at a symposium on Emerging Technologies in Hazardous Waste Management in Atlanta in September, 1995.

- Participated in a review of National Sample Management Program activities.

- Participated in a meeting review of Oak Ridge project on holding times for volatile organic compounds in soil and water.

- Prepared materials and handouts for two presentations at the 11th annual American Chemical Society/Environmental Protection Agency Waste Testing and Quality Assurance Symposium. Presentations were: "Proposed Consensus Change to VOC Holding Times for Water Analysis" and "Planning for Radiochemical Data Validation as Part of the Sample and Analysis Collection Process."

- Completed abstract for the 36th ORNL/DOE Conference on Analytical Chemistry in Energy Technology, October 10-12, 1995. The title of the paper to be presented at the conference is "Sensitivity Limits of Field Instrumentation Used to Measure Radionuclides."

- Attended work group meeting on waste characterization in Knoxville, Tennessee on July 24-25. The work group discussed the recommendations of the Defense Nuclear Facilities Safety Board that standards and guidance be developed on low level waste characterization, waste form and packaging, and waste acceptance criteria for the DOE sites.

- Attended Radioactive Mixed Waste Analytical Methods Working Group Meeting. The group discussed the analytical chemical needs of EM.

Peer Review by National Academy of Sciences/Committee on Environmental Management Technologies (NAS/CEMT)

- Coordinated with NAS Staffers on agenda items, speakers, and logistic requirements for NAS/CEMT peer review of Integrated EM Technology development Program held at Woods Hole, Ma, for the July 31-August 2, 1995.

- Developed guidance for preparation of Focus Area and Crosscut Area briefings including schedules and topical briefing outlines.

- Organized and participated in a dry-run of briefings, and provided subsequent guidance for finalizing briefings.

- Set up a "Story Board" of the five Focus Area briefings to compare briefings for standardization.

- Completed the preparation of briefing packages (5 Focus Areas, Crosscut Areas Overview).

- Developed briefing, Feedback on Programmatic and Technical Progress, based on technology development successes and R&D 100 Awards.

- Prepared a briefing, Technology Focus Areas: A Partnership for Implementation, for presentation at the NAS Workshop on Science, Engineering, and Technology held on July 12, 1995.

- Prepared a briefing, Technology Focus Areas and Crosscut Areas Overview, for presentation at the NAS Landfill Subcommittee held on July 20, 1995.

Literature Search

- Performed a literature search to obtain biographical information on NAS/CEMT members.

Legislative Liaison and Analyses

- Summarized legislative hearing schedules for July 1995.

- Prepared the July 1995 Issue of the Legislative Bulletin.

Domestic Technology Transfer and Related White House Issues

- Performed assessment of budget analysis protocol manual.
- Completed first phase (July 7-14, 1995) of Technical Data Analysis Process.
- Continued revisions and updates to Kairos screens.

Interagency Environmental Technology Processes

- Evaluated initiatives (version 1) for the environmental education and training activities of the Interagency Environmental Technology Office (IETO).
- Coordinated and participated in the following meetings:
- Environmental Technology Working Group;
    - IETO's Expedited Site Characterization technical seminar;
    - Georgia Tech on an upcoming teleconference on environmental education;
    - IETO's technical seminar series, to include preparation of meeting minutes.
- Provided information to companies interested in state-of-the art information on technologies and the procurement process.
- Coordinated activities in the areas of outreach, international technical transfer, and education and training, including the development of a research project on "Criteria for Environmental Investment in Small - Medium sized Companies."
- Outlined the preliminary IETO publication activities.
- Performed preliminary analysis to identify DOE-DoD environmental health and safety training requirements.

- Continued work on development of IETO's strategic plan and programs in environmental education, to include timeline on environmental education for the Environmental Technology Working Group's (ETWG) Education and Training committee in developing the "Blueprint for Environmental Education."

ACTIVITIES: TASK C - TECHNOLOGY INTEGRATION

- Compiled data for Program Execution Guidance for domestic Technology Transfer and Strategic Policy tasks.

- Developed summary of Rapid Commercialization Initiative to be used within agencies of interagency Rapid Commercialization Initiative Action Committee.

- Created agenda and action items for Rapid Commercialization Initiative Action Committee meetings and conference calls held on July 3, July 14, and July 20, 1995 and distributed draft copies of Rapid Commercialization Initiative Announcement and Interagency Memorandum of Understanding.

- Developed memorandum regarding EM performance of customer satisfaction surveys.

- Reviewed DOE-wide outreach plan under preparation by Technology Partnership office.

- Created technical presentation summarizing Rapid Commercialization Initiative status for individual agencies.

ATTACHMENT A

PRODUCTS DELIVERED: TASK A - TECHNOLOGY MANAGEMENT

- Summary information regarding the 5th Joint Coordinating Committee for Environmental Restoration and Waste Management.
- Letter regarding a visit of Russian nationals to Pacific Northwest Laboratories.
- Technical information for the Berlin '95 conference.
- Technical information regarding DOE meeting on France.
- Faxes, program summary and memoranda regarding project with Polish Institute.
- Technical information and correspondence to facilitate participation of Czech environmental officials in EM-40 Environmental Restoration Conference in Denver, Colorado, in August, 1995.
- Technical information and coordination with participants in Manufactured Gas Plants Cleanup Conference in Prague, the Czech Republic, September 19-21, 1995.
- Technical information regarding EM activities in Poland and the Czech Republic and Draft U.S. - Former Soviet Union Activities Report.

Mixed Waste Focus Area

- MWFA Performance Measures Table.
- FY96 Program Execution Guidance briefing materials.
- NAS briefing materials.

Minimum Additive Waste Stabilization Program Support

- Comments and Recommendations on the Technology Demonstration Plan Manual and Project Management Guidance.

Characterization, Monitoring, and Sensor Crosscutting Program

- Metrics, major milestones and technology demonstrations for CMST-CP projects with application to the Decontamination and Deactivation Focus Area.

- Narrative of important milestones for CMST-CP and an explanation of their relevance.

- Expedited Site Characterization presentation for the Interagency Environmental Technology Office.

- CMST-CP portion of the presentation of the Crosscutting Programs given to the National Academy of Sciences.

- Scientific reviewers comments for several proposed FY96 projects related to characterization for the Mixed Waste Focus Area.

- Scientific reviewers comments for several proposed FY96 projects related to characterization for the Landfill Stabilization Focus Area.

- Cross-walk table relating FY95 and FY96 TTP numbers, projects names and project funding.

Innovative Technology and Program Support

- Bubble charts for Industry Program and Innovative and Support Technology Program.

Robotics

- National Academy of Sciences briefing.

- Robotics Scheduled Demonstrations in FY95.

- Evaluation of FY96 Program Execution Guidance.

Landfill Stabilization Focus Area

- Briefing for a July meeting with the National Academy of Sciences Subcommittee on Landfills.

- Briefing for a July meeting with the National Academy of Sciences Committee on Environmental Management Technologies.

- Comments and Assessment of the Draft Copy of the Technology Demonstration Plan Manual and Project Management Guidance.

Tanks Focus Area

- List of Technologies Implemented and Commercial Partners for the Tanks Focus Area.

- Descriptions of Technology Development Successes for the Tanks Focus Area.

- Briefing Materials and Analyses on the Tanks Focus Area for Internal proposed FY96 program reviews.

- Tanks Focus Area Technical Activity Data Sheets (TADS).

- Description of the Structured Light Mapping System.

- A Tanks Focus Area brochure titled "Baseline and Alternative Technologies for Removal of Cesium from Tank Waste".

- Review of a Tanks Focus Area document titled "Evaluation of Selected Ion Exchangers for the Removal of Cesium from MVST W-25 Supernate".

- Summary of the Structured Light Mapping System to be included in the Tank Focus Area Technology Success Book.

- Technical analysis of the Tanks Focus Area enhanced retrieval deployment program with comments on strategy for reconfiguring the program to meet current identified needs.

- Review of the document ORNL/TM-12938, "Evaluation of Selected Ion Exchangers for the Removal of Cesium from MVST W-25 Supernate".

- Brochure "Baseline and Alternative Technologies for Removal of Cesium from Tank Waste".

- Analysis of planned FY95 technology Performance Metrics for the Tanks Focus Area.

- Analyses of planned FY96 technology Performance Metrics for the Tanks Focus Area.

- Briefing for the Tanks Focus Area Presentation to the National Academy of Sciences Committee on Environmental Management Technologies.

PRODUCTS DELIVERED: TASK B - PROJECT MANAGEMENT

- Presentation to the Stakeholders Working Group of the Integrated Nonthermal Treatment Systems Study.

- Integrated Nonthermal Treatment Systems Baseline Assumptions presentation.

- Report of the Technical Support Group on the Integrated Nonthermal Treatment System Study.

- Overview of Nonthermal Mixed Waste Treatment Technologies.

- Preliminary technical assessment of the FY96 Program Execution Guidance for the Office of Technology Development, July 28, 1995.

- Analysis of the Uncosted Reports for the May FY95 FIS Data Report and the June 1995 Financial Plan Report, July 3, 1995.

- Analysis of the Uncosted and Unobligated Reports for the June FY95 FIS Data Report and the July 1995 Financial Plan Report, July 27, 1995.

Peer Review by NAS/CEMT

- Logistic requirements for NAS/CEMT peer review meeting, July 31-August 2, 1995 at Woods Hole.

- Guidance for preparation of Focus Area and Crosscut Area briefings, to include schedules and topical briefing outlines.

- Dry-run of briefings, and subsequent guidance for finalizing briefings.

- "Story Board" of the five Focus Area briefings to compare briefings for standardization.

- Briefing package, DOE Evaluation of Progress in Focus Areas and Crosscut Areas, for NAS/CEMT peer review.

- Briefing, Feedback on Programmatic and Technical Progress, based on technology development successes and R&D 100 Awards.

- Briefing, Technology Focus Areas: A Partnership for Implementation, for presentation at the NAS Workshop on Science, Engineering, and Technology held on July 12, 1995.

- Briefing, Technology Focus Areas and Crosscut Areas Overview, for presentation at the NAS Landfill Subcommittee held on July 20, 1995.

Literature Search

- Literature search for biographical information on NAS/CEMT members.

Legislative Liaison and Analyses

- Weekly summaries of legislative hearing schedules for July 1995.

- July 1995 Issue of the Legislative Bulletin.

Domestic Technology Transfer and Related White House Issues

- First phase (July 7-14, 1995) of Technical Data Analysis Process.

Interagency Environmental Technology Processes

- Revision of IETO initiatives (version 1) for the environmental education and training activities.

- Minutes for Sustainable Communities Task Force.

- Information to companies interested in state-of-the art information on technologies and the procurement process.

- Outline of preliminary IETO publication activities.

- Timeline on environmental education for ETWG's Education and Training committee in developing the "Blueprint for Environmental Education."

- Prepared summary list of successful technologies.

- Prepared technologies narrative for Senate exhibit.

- Prepared calendar for cyclical activities.

- Summary analysis and status of the Annual Performance Plan.

- "Decision Support Materials" for DOE Environmental Research and Technology Development Steering Committee Meeting of July 20, 1995.
- System Navigation Aid Program Status Report for July, 1995.
- Decision Record for DOE Environmental Research and Technology Development Steering Committee, dated June 1, 1995.
- Decision Record for DOE Environmental Research and Technology Development Steering Committee Meeting, dated July 20, 1995.
- Highlights of Planning Conference Call on June 20, 1995.
- Highlights of Planning Conference Call on June 27, 1995.
- Technical analysis of the Proposed Program Review Package.
- Technical review and assessment of the FY95 July Financial Plan.
- Technical review of the FY95 July TTP Submittal Status Reports.
- Technical review of the FY96 Program Execution Guidance for the Office of Technology Development.
- Technical analysis of the Uncosted Reports for the May FY95 FIS Data Report and the June 1995 Financial Plan Report.
- Technical analysis of the Uncosted and Unobligated Reports for the June FY95 FIS Data Report and the July 1995 Financial Plan Report.
- Technical analysis of the Executive Summary Reports of June 30, 1995.
- Technical analysis of the Executive Summary Reports of July 31, 1995.
- Review of the May Cost Performance Variance Analysis Reports.
- Technical analysis of the June Headquarters Progress Tracking System reports.
- System Navigator Aid Program demonstration.
- Kairos decision support system for ETWG and updates to support system.

- Paper entitled "Establishing A Structured Process for Managing Information".
- Draft outline for a strategic plan for DOE's information systems.

PRODUCTS: TASK C - TECHNOLOGY INTEGRATION

- "Summary of Rapid Commercialization Initiative," delivered July 19, 1995.
- "RCI Action Committee, July 20, 1995 Meeting/Conference Call - Action Items," delivered July 20, 1995.
- Agenda: RCI Action committee, Meeting/Conference Call," delivered July 20, 1995.
- Memorandum entitled "Customer Satisfaction Surveying for Technology Partnerships," delivered July 14, 1995.
- Technology Partnership Outreach Plan, Guidance for Message Section," delivered July 3, 1995.

WPI Waste Policy Institute
A Virginia Tech Affiliated Corporation

Monthly
Cost and Labor
Report

University of North Dakota
Energy and Environmental Research Center

Subcontract No. 359 636

July 1995

PROGRAM SUMMARY

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through JUL-95

08-14-1995
12:38:54

SELECTION CRITERIA: WBS ID: ********************

WBS: ******************** 1029 PROJECT
Perf Dept:
Resp Dept:
Manager:
Chg No :
/ :
/ :
/ :
Alias :

Parent:

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________

Task Description:

PROVICE ASSISTANCE TO EERC's CONDUCT OF TECHNOLOGY DEVELOPMENT INTEGRATION ACTIVITIES.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	18,428	15,710	2,718	19,865	15,859	4,007	42,173	38,166	4,007
Price:	1252	1240	12	1341	1249	92	2796	2704	92

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89	1,252	1,455	0	0	0	0	0	0	0	0	0
Cum Price:	89	1,341	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796
Actuals												
Mon Hrs:	149.0	15,709.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	149.0	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8	15,858.8
Mon Price:	8	1,240	0	0	0	0	0	0	0	0	0	0
Cum Price:	8	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249
ETC												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89	1,252	1,455	0	0	0	0	0	0	0	0	0
Cum Price:	89	1,341	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796

TASK A

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through JUL-95

08-14-1995
12:38:56

WBS: 1029.01 TECH MANAGEMENT
TASK A
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : 1029-001

/ :
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Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

PERFORM TECHNICAL REVIEWS OF REQUIREMENTS, NEEDS AND ASSESSMENTS RELATED TO WASTE CHARACTERIZATION, CONTAINMENT, IN-SITU AND EX-SITU TREATMENT, WASTE STORAGE, DISPOSAL, ROBOTICS HANDLING, MONITORING, LABORATORY ANALYSIS, SITE CHARACTERIZATION AND REMEDIATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	7,196	6,255	941	7,525	6,305	1,220	16,236	15,016	1,220
Price:	498	534	-36	512	537	-24	1083	1107	-24

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14	498	571	0	0	0	0	0	0	0	0	0
Cum Price:	14	512	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083
Actuals												
Mon Hrs:	50.0	6,255.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	50.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0	6,305.0
Mon Price:	3	534	0	0	0	0	0	0	0	0	0	0
Cum Price:	3	537	537	537	537	537	537	537	537	537	537	537
ETC												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14	498	571	0	0	0	0	0	0	0	0	0
Cum Price:	14	512	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083

TASK B

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through JUL-95

08-14-1995
12:38:58

WBS: 1029.02 PROJECT MNGT
TASK B
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : 1029-002

/ :
/ :
/ Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

CONDUCT REVIEWS, ANALYZE AND DEVELOP STRATEGIES FOR PROGRAM MANAGEMENT SYSTEMS FOR INTEGRATION AND CONTROL OF PROGRAMS, PROJECTS, TASKS AND DOCUMENTATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	6,643	8,116	-1,473	6,952	8,214	-1,262	14,994	16,256	-1,262
Price:	454	600	-146	475	606	-131	1002	1133	-131

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21	454	528	0	0	0	0	0	0	0	0	0
Cum Price:	21	475	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002
Actuals												
Mon Hrs:	98.0	8,116.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	98.0	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3	8,214.3
Mon Price:	6	600	0	0	0	0	0	0	0	0	0	0
Cum Price:	6	606	606	606	606	606	606	606	606	606	606	606
ETC												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21	454	528	0	0	0	0	0	0	0	0	0
Cum Price:	21	475	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002

TASK C

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through JUL-95

08-14-1995
12:38:59

WBS: 1029.03 TECH INTEGRATION
TASK C
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : 1029-003

/ :
/ :
/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

PROVIDE SUPPORT IN ESTABLISHING CRITERIA FOR IDENTIFYING RISKS TO THE PUBLIC HEALTH AND SAFETYPOSED BY CONDITIONS AT THE WEAPONS COMPLEX FACILITIES, EVALUATE THE EXTENT OF THESE RISKS, DETERMIN THE URGENCY AND PRIORITIES FOR ELIMINATING OR MINIMIZING THE RISKS, AND ACCESS THE COST OF ACTIVITIES REQUIRED TO MEET APPLICABLE COMPLIANCE AGREEMENTS.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	4,589	1,339	3,250	5,388	1,340	4,049	10,943	6,894	4,049
Price:	300	107	193	354	107	247	711	463	247

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54	300	357	0	0	0	0	0	0	0	0	0
Cum Price:	54	354	711	711	711	711	711	711	711	711	711	711
Actuals												
Mon Hrs:	1.0	1,338.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1.0	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5	1,339.5
Mon Price:	0	107	0	0	0	0	0	0	0	0	0	0
Cum Price:	0	107	107	107	107	107	107	107	107	107	107	107
ETC												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54	300	357	0	0	0	0	0	0	0	0	0
Cum Price:	54	354	711	711	711	711	711	711	711	711	711	711

(End of Report)

WASTE POLICY INSTITUTE MONTHLY REPORT TO THE EERC, AUGUST 1995

APPENDIX B

WPI
WASTE POLICY INSTITUTE
A Virginia Tech Affiliated Corporation

Corporate Office
1872 Pratt Drive, Suite 1600
Blacksburg, VA 24060-6363
Telephone (703) 231-3324
Telefax (703) 231-3968

Washington Operations Office
Quince Diamond Executive Center
555 Quince Orchard Road, Suite 600
Gaithersburg, MD 20878-1437
Telephone (301) 990-7200
Telefax (301) 990-6150

September 15, 1995
VIA FEDERAL EXPRESS

John G. Hendrikson
Assistant to the Director
Energy and Environmental
Research Center
University of North Dakota
15 North 23rd Street
Grand Forks, ND 58203

Subject: UNDEERC Fund No. 4624-0936, Technology Development Integration
WPI Subcontract No. 359636

Dear Mr. Hendrikson:

The Waste Policy Institute (WPI) is pleased to submit the enclosed report of activities conducted during the period of August 1, 1995 through August 31, 1995, in compliance with Article VI and Appendix A of Subcontract Number 359636. A list of products developed during this period is provided at Attachment A to the activities report.

Through August 31, 1995, WPI has expended a total of $2,549,083.00 (51% of subcontract funding) and 33,582 hours (47% of subcontract hours). Our monthly cost and labor report is also enclosed.

Please do not hesitate to call me if you have any questions or require additional information.

Very truly yours,

Sheila A. Cleary

Sheila A. Cleary
Corporate Counsel/Director of Contracts

cc: L. D. Eyman
T. W. Gibb

H:\WP51\SHEILA\CONT\SAC91402.DOC

SUBCONTRACT NUMBER: 359636 **REPORT PERIOD: 08/01/95 - 08/31/95**

SUBCONTRACTOR NAME: **Waste Policy Institute**
Quince Orchard Road
Suite 600
Gaithersburg, MD 20878-1437

SUBCONTRACT PERIOD: **06/28/95 - 09/30/95**

1. **SUBCONTRACT DELIVERABLES:**

This report is submitted in fulfillment of requirements specified for the University of North Dakota Energy and Environmental Research Center (UNDEERC) Subcontract Number 359636. A list of products developed under this subcontract is provided as Attachment A.

2. **SUMMARY OF ACTIVITIES:**

ACTIVITIES: TASK A - TECHNOLOGY MANAGEMENT

- Coordinated and implemented joint Russian-EM technology development projects for Mixed Waste and High-Level-Waste Tank Focus Areas and Characterization and Separations Crosscutting Programs.

- Developed logistics, briefing materials, and planning activities for the 5th Russian-American Joint Coordination Committee on Environmental Management (JCCEM) meeting and the Berlin '95 Conference to be held September 3, 1995 - September 9, 1995 in Berlin, Germany.

- Coordinated signing of a Memorandum of Cooperation between Polish Institute of Ecology of Industrial Areas and EM.

- Coordinated visit of Polish delegation from the Institute of Ecology of Industrial Areas to the Savannah River Site to review potential Expedited Site Characterization technologies for demonstration in Poland.

- Coordinated technical and management support for establishment of a Moscow Project Office for in-country coordination of joint EM-Russian environmental technology development projects.

- Participated in a meeting concerning Russian contaminant transport activities held in Washington, D.C. on August 14, 1995.

- Participated in a meeting with Oak Ridge National Laboratory regarding FY96 Rusian and international technology transfer activities, held August 2, 1995 in Gaithersburg, Maryland.

- Participated in a meeting on August 17, 1995 in Washington, D.C. to develop a speech on international partnering to be delivered at the Berlin '95 Conference.

- Attended a meeting on August 25, 1995 in Washington, D.C. regarding Russian involvement in an upcoming plutonium stabilization workshop.
- Participated in meeting on August 29, 1995 in Washington, D.C. to regarding the 5th JCCEM and activities at the Berlin '95 Conference.
- Gathered data related to International Programs from each DOE Field Office.
- Prepared a two-page article on the Environmental Restoration and Waste Management (ERWM) Market and U.S. export options for the EM International Publication.
- Developed poster depicting various aspects of EM's International Program and developed activity card booklet highlighting selected international projects and activities.
- Coordinated publication of several international documents: Industry Communique, International Technology Transfer Initiatives and Case Studies, and two ERWM market assessments.
- Participated in meeting on August 25, 1995 in Gaithersburg, Maryland, regarding concepts for EM involvement in international technology transfer.
- Coordinated daily efforts for Visits and Assignments Management Systems (VAMS) with special emphasis on the coordination and processing of Russian delegation visits to DOE sites.

Mixed Waste Focus Area (MWFA)

- Developed briefing materials for a presentation on the FY96 Program Execution Guidance (PEG) presented at the meeting in Washington, DC on August 31, 1995.
- Performed extensive analysis and redesign of FY96 Performance Metrics Tables, incorporating comments into six summary and detailed tables. These summaries and tables provided data on Technology Demonstrations (bench, pilot, and full-scale), Technologies Available for Transfer, and Funds Allocated to the Private Sector. Data provided on a quarterly and annual basis.
- Analyzed EM 3rd Quarter Management Review Report for discrepancies and developed updated FY97 Internal Review Budget (IRB) data for Mixed Waste to reflect comments from the Community Leaders Network (CLN).

- Developed draft of performance metrics for the Mixed Waste Focus Area (MWFA) for FY95 and projections for FY96.

- Developed briefing materials regarding Russian vitrification projects funded by DOE/EM/OTD, entitled "Mixed Waste Cooperative Program."

- Analyzed eleven PEG documents and three Fin Plan Change forms to move FY95 funds among MWFA-funded projects.

- Analyzed and assessed OTD Technology Database.

Tanks Focus Area (TFA)

- Analyzed and provided comments on proposed revisions to draft TFA FY96 PEG.

- Analyzed proposed technical and funding scenarios for FY96 TFA program and developed briefings.

- Analyzed TFA documentation and reviewed TFA narrative portion of 1996 Baseline Environmental Management Report (BEMR).

- Compiled TFA budget and performance data from FY95 and FY96.

- Analyzed "Validation of Technologies and Systems Supported by the EM-50 Office of Technology Development" database to assess completeness and quality of information relating to TFA technology development projects.

- Conducted technical analyses of Laser Ablation/Mass Spectrometry program relevant to TFA needs and overall characterization strategies proposed at Hanford site. Developed options for tank characterization strategy.

- Attended meeting with pretreatment Technical Integration Manager regarding FY96 goals for the TFA (pretreatment program) and Efficient Separations and Processing Crosscutting Program.

- Gathered and analyzed technical data on past research activities for the ACT*DE*CON process (a sludge washing process) to provide analyses for FY96 TFA PEG.

- Gathered data during Progress Review for the planned FY96 Cesium Removal Demonstration.

- Gathered technical data during pretreatment conference calls discussing status and concerns pertaining to solid/liquid separations, supernate processing, and sludge processing.

- Gathered and developed data for the "Tank Farm 2000 - The Vision" poster.

- Created posters depicting the Cone Penetrometer, Light Duty Utility Arm, three-dimensional in-tank video, Mobile Evaporator, Cesium removal, and Waste Dislodging and Conveyance technologies to be displayed at various facilities.

- Analyzed input from Community Leaders Network on TFA section of draft FY97 Internal Review Budget submission, and developed technical responses.

- Gathered data and developed draft document defining roles and responsibilities of TFA team members.

- Analyzed draft TFA - Characterization Crosscutting Program Call for Proposals (Technical Task Plans) and developed technical comments.

- Assessed TFA Joint Statement of Objectives between EM-1, DOE-RL and PNL.

- Analyzed TFA plans and documents to develop spreadsheet detailing leveraging of FY96 TFA projects with work funded by other EM sources.

- Compiled and analyzed data on proposed TFA FY96 Performance Metrics.

- Gathered and analyzed data on TFA progress relative to FY95 Performance Metrics.

Landfill Stabilization Focus Area (LSFA)

- Reviewed LSFA draft FY96 PEG documentation.

- Prepared briefing materials for FY96 PEG review meetings held on August 4 and 31, 1995.

- Developed spreadsheet data for FY95 Performance Measures.

- Developed spreadsheet data for FY96 Performance Measures Plan.

- Reviewed data for FY95 Annual Report to Congress.

- Developed long-form Technical Task Plan and initiated Minimum Additive Waste Stabilization Program technical peer review preparations currently underway at Savannah River field office.

- Developed paper and briefing on <u>Application of Oilfield Technologies to Remediation of Underground Contaminant Problems</u> to be presented in Denver, Colorado August 17, 1995.

- Chaired Innovative Technologies session at Mixed Waste Symposium in Baltimore, Maryland, August 9, 1995.

- Developed series of responses to Community Leaders Network comments on FY97 Draft IRB Package.

- Developed agenda sessions, letters, and meeting minutes, and coordinated speakers and invitees for the Plutonium Immobilization Workshop.

Plumes Focus Area (PFA)

- Prepared PFA presentation for the U.S. Army Corps of Engineers and DOE Hazardous, Toxic, and Radioactive Waste Innovative Technology Initiative Meeting, August 10, 1995.

- Developed document, Needs, Strategy, and Technologies on DNAPLs, for the National Academy of Sciences Subcommittee briefing.

- Analyzed development of Air Sparging Optimization Report.

- Analyzed Tier 2 Report: Demonstration of Four Technologies for the Drilling and Installation of Environmental Horizontal Wells.

- Analyzed Tier 2 Report: In Situ Bioremediation Demonstration.

- Prepared presentation on Barriers, for presentation at International Containment Technology Workshop, Baltimore, MD. August 29, 1995.

- Prepared response to Separation Oil Services letter concerning ex-situ process for cleaning fuel-contaminated soils.

- Reviewed FY96 BEMR Report for PFA.

- Finalized table of DOE sites suitable for electrokinetic remediation for incorporation into a presentation to the American Chemical Society at the Industrial and Engineering Chemistry Special Symposium to be given September 17-20, 1995.

- Updated list of demonstrations for the PFA.

- Developed briefing materials for FY96 PEG presentation.

- Analyzed External Integration Team Work Plan.

- Analyzed PNL-10633, UC-600, Geologic, Geochemical, Microbiologic, and Hydrologic Characterization at the In Situ Redox Manipulation Test Site.

- Reviewed data for PFA section of Annual Report to Congress.

- Developed draft Informational Brochure for the PFA.

- Developed PFA Accomplishments Summary.

Decontamination and Decommissioning (D&D) Focus Area

- Developed and analyzed technical D&D data for 1995 Robotics Forum in Albuquerque, NM.
- Completed comparative study of laser cutting and decontamination technologies applicable to D&D, and initiated summary report.
- Developed data for NAS subcommittee briefing for the D&D focus area and prepared list of programmatic concerns and action items.
- Prepared analysis of Electric Power Research Institute's D&D related activities for reference material to establish baseline technology from the electric utility industry relevant to the D&D focus area.
- Reviewed and assessed Annual Operating Plan for the D&D focus area for METC.
- Developed focus area briefing to the Operations Office Managers, scheduled for August 31, 1995 in Washington, DC.
- Developed update of annual performance plan for the D&D Focus Area.
- Reviewed update and final draft of D&D Focus Area PEG.
- Developed D&D briefing to Florida International University.
- Provided documentation on EM needs in D&D to Florida International University for use in planning their R&D program.
- Developed presentation for National Academy of Sciences Subcommittee on D&D.
- Compiled and distributed D&D presentation posters to Triodyne, Inc. for a conference in Prague, Czech Republic.
- Developed research topics for FY96 D&D industry solicitation.
- Developed D&D focus area response to the International Union of Operating Engineers on EM-50 funded technologies with potential to be demonstrated at the Mining Safety & Health Administration's site in Beckley, WV.
- Initiated preparation of D&D research topics for the FY96 Research Opportunity Announcement.
- Initiated development of summaries of the research proposals submitted for the Large Scale Facility Demonstration.

Robotics Technology Development Program (RTDP)

- Coordinated program conference call and agenda.
- Developed briefing for National Academy of Sciences review of Crosscutting Programs on August 2, 1995.
- Reviewed data for 1995 Annual Report to Congress.
- Developed invitation letter and program agenda for Robotics D&D demonstration, scheduled for September 19, 1995.
- Reviewed data for draft FY96 PEG.
- Compiled data on impacts of cancelling long-reach arm procurement at the Hanford site and developed presentation package.
- Attended meeting on August 16, 1995 with Robotics University Program participants to discuss the 1996 scope of work for the universities.
- Prepared and coordinated focus areas FY96 performance measures.
- Analyzed Community Leaders Network comments and developed responses.
- Coordinated Robotics Forum exhibit.
- Developed presentation materials for Robotics Forum to be presented in Albuquerque, NM on August 15-17, 1995.
- Participated in meeting on August 24, 1995 with Office of Energy Research discussing plans for collaborative research in 1996 focused on Robotics Program basic research needs.

Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP)

- Coordinated completion of FY95 Laser-induced Fluorescence data collection at EPCOT Center.
- Coordinated transfer of historical aerial photography from the Savannah River Technical Center to the Expedited Site Characterization team at Ames Laboratory.
- Developed analysis of program impacts from House Appropriations Committee budget.
- Generated list of FY95 accomplishments and FY96 activities through Chicago Field Office or the three national laboratories under the Field Office (Ames, Argonne and Brookhaven national laboratories).

- Prepared full article on characterization technologies to EPA's Superfund conference to be held in November 1995.

- Prepared two-page information sheets on all CMST-CP FY95 technologies under D&D and Mixed Waste Treatment Focus Areas.

- Analyzed CMST-CP FY96 Performance Plan.

- Analyzed EM-50 FY97 Office of Management and Budget submittal.

- Developed performance metrix for x-ray K-edge, acoustic monitors for tank waste and Electric Resistivity Tomography projects.

- Developed presentation of FY96 CMST-CP program for briefing between Field Office Leaders and HQ.

- Initiated article on characterization technologies for waste management.

- Initiated project evaluation and informal peer review analysis for nondestructive assay technologies with emphasis on eliminating redundancy and non-essential technology development projects.

- Initiated collection of data on all CMST-CP FY95 technologies under Plumes, Landfill, and Tank Waste Focus Areas.

- Developed description of radiation sensor technology development project for stakeholders, EM customers and for EM-50's Innovative Technology Program.

- Organized one-day Expedited Site Characterization (ESC) meeting in conjunction with ESC demonstration at SRS to discuss ESC concept and regulatory acceptance process with site and regulatory officials.

- Developed CMST-CP briefing on Overview of ESC Project.

- Participated in the Ames Laboratory demonstration of ESC at SRS.

- Developed presentation on "Cost of Expedited Site Characterization" for delivery at Interagency Environmental Technology Office.

- Analyzed in situ, real-time sensors for measuring total uranium at Fernald and Plutonium-238 at Mound site.

- Initiated review process for proposed FY96 tasks under the Diagnostic Instrumentation Analysis Laboratory Project.

Efficient Separations and Processing (ESP) Crosscutting Program

- Developed data on ESP program for National Academy of Sciences review of Crosscutting Programs on August 2, 1995.
- Prepared ESP data for September Community Leaders Network meeting.
- Prepared FY96 performance measures document.
- Analyzed impact of future budget changes on ESP.
- Analyzed joint ESP-Tanks Focus Area Cesium Removal Demonstration Project at Oak Ridge National Laboratory.
- Reviewed new projects proposed for FY96.
- Initiated management and technical analysis of successful FY96 Small Business Innovative Research projects.
- Developed factsheet on pentaborane.

Innovative and Support Technology Program

- Reviewed Draft Bioremediation Program Plan for EM/ER collaborative initiative.
- Developed Program Summary Book for Innovative and Support Technologies.

ACTIVITIES: TASK B: PROJECT MANAGEMENT

Interagency Processes

- Defined resource requirements to make the Rapid Commercialization Initiative for the Interagency Environmental Technology Office (IETO) operational.
- Developed Benchmarking report for IETO Business Line 1 on Customer Service Centers, which included Paper Dissemination Process associated with Customer Service Centers.
- Prepared outline of convergence methodology for Paper Hotline and Online Services delivery.
- Prepared presentation addressing the Benchmarking Report.
- Developed agendas, spreadsheets, Benchmark Digest report, and meeting notes for IETO Business Line 1 Interagency Meeting on August 24, 1995; prepared and gave presentation at meeting.
- Prepared an annotated outline and first draft for the Rapid Commercialization Initiative (RCI) Operations Plan for review by Federal Working Group at August 25, 1995 meeting.
- Identified technically qualified participants among IETO, RCI, and vendors to examine the "Lasagna" technology for remediation on August 22, 1995.
- Created large chart to demonstrate the RCI Process for 10 technologies.
- Conducted analysis of the Morgantown Energy Technology Center selection process for RCI proposals.
- Prepared draft Environmental Education History Section for Chapter 1 of Blueprint and performed editing.
- Developed event concept paper on "January 1996 Forum on Education About the Environment".
- Continued analysis of IETO's strategic plan and programs in environmental education, to include the "Blueprint for Environmental Education.
- Researched the list of the national environmental awards.

Peer Review

- Coordinated with National Academy of Sciences (NAS) Staffers on the agenda, speakers, and logistics for three NAS subcommittee peer reviews (Decontamination and Decommissioning, August 7;

Plumes, August 21; and Tanks, August 23) held in Washington, D.C.

- Prepared a briefing (Technology Focus Areas and Crosscut Areas Overview: A Partnership for Implementation) for presentation at the three peer review subcommittees.
- Assembled and distributed copies of briefings, Technology Summary (Rainbow) books, and Technology (Baseball) cards for NAS focus area subcommittee participants.

Related White House Issues

- Prepared briefings for and participated in Office of Science and Technology Environmental Technology Working Group biweekly meetings with other Federal agencies.
- Documented and verified Kairos database functional capabilities, including validation of databases sorting mechanisms for data queries.

Special Studies

- Arranged logistics and prepared report on meeting of stakeholders group (Tribal and Stakeholders Working Group{TSWG}) to the Integrated Nonthermal Treatment Systems Study (INTS) in Denver, August 8-9,1995.
- Prepared status briefing on Special Studies activities, including INTS, depleted uranium, and systems studies; prepared "results" memo on decisions made.
- Reviewed presentation to the Mixed Waste Focus Area describing proposed systems analysis studies.
- Prepared a draft summary of four Depleted Uranium (DU) reports produced by INEL and ORNL concerning possible reuse and recycling of DU.
- Prepared a briefing on INTS, DU and system studies.
- Continued to provide liaison with Molten Metal Technologies on the draft Technical Review Panel report on the Catalytic Extraction Process.

PROGRAM INTEGRATION

- Prepared presentation on Career Opportunities in Environmental Management for the NAACP/DOE Scholars Summer Conference, August 4, 1995.
- Provided technical decision-analysis materials on regulatory requirements which must or should be considered in evaluating

integrated non-thermal treatment systems for managing DOE wastes.

- Performed research in preparation for meeting on plutonium stabilization and immobilization with Office of Materials Disposition on August 25, 1995.
- Developed the Program Integration annual cyclical calendar.
- Coordinated clarification of budget allocation for the FY96 Annual Performance Plan.
- Developed charts summarizing Critical Few (ROI) performance measures.
- Identified actions to conduct feasibility assessment on selected Performance Measures.
- Developed listing of FY96 Annual Performance Plan Technical Task Plan (TTPs) discrepancies to FIN Plan TTPs.
- Reviewed Performance Measures for EM's Third Quarter Report.
- Analyzed FY96 Annual Performance Plan.
- Reviewed International Program FY96 scope of work and developed technical comments.
- Reviewed responses to OMB questions on the FY97 Internal Review Budget (IRB).
- Generated responses to public requests for information on EM's International activities.
- Prepared written highlights of FY96 budget discussions.
- Reviewed the financial information data base of the FY95 August Financial Plan.
- Reviewed technical data for the development of a consolidated FY96 PEG and TTP.
- Reviewed and analyzed the quarterly uncosted/unobligated reports by Operations Office.
- Analyzed inputs for the monthly Executive Summary Reports.
- Analyzed information for the Progress Tracking System (PTS) reports for the August 1995 submittal.
- Reviewed and analyzed technical information for the August Cost Performance Variance Analysis (CPVA) reports.

- Evaluated and made recommendations for the development of a monthly program review process and format.

- Provided analysis of Technology Development's third quarterly EM program review.

- Coordinated development of initial FY96 Technology Development Financial Plan.

- Developed summary report on System Navigation Aid Program (SNAP) prototype demonstration/discussion, to include identification of action items.

- Identified actions for completing current phase of FY96 Data Call activities.

- Developed a protocol for exporting data to be displayed on EM's BEST with representatives from Sandia National Laboratories (SNL).

- Created a brochure for the Information for Decisions Program.

- Modified a database containing information on technologies and systems.

- Coordinated the production of an updated report entitled "Validation of Technologies and Systems Supported by the EM-50 Office of Technology Development".

- Reviewed and analyzed the Waste Information Data Management Initiative (WIDMI): EM-30 Headquarters Requirements Analysis.

Liaison and Communications

- The Transportation and Emergency Management Resource Center (TEMRC):

  - Assisted 74 visitors to the TEMRC;
  - Processed 61 reference requests;
  - Processed 42 research requests;
  - Acquisitions: 7   Serials checked-in: 16;
  - Created 85 new catalogue records;
  - Deleted 23 existing records. Updated 14 records;
  - Fulfilled 480 in-house requests for information items;
  - Sent 426 requests to SAIC for fulfillment;
  - Circulated 26 documents;
  - Performed 20 online searches;
  - Patron Access Terminal usage: 5

- Revised and edited draft TEMRC Operations Manual.

- Performed technical review of Records Management classification scheme.

- Updated the 1995 information binder for the Urgent Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel shipping campaign.

Transportation Management

- Analyzed historical briefings and overheads to establish permanent library for transportation and packaging operations library.

- Provided technical analysis of DOE Order 1540.1B with emphasis on the crosswalk and Contractor Requirements Document.

- Coordinated ATMS Users meeting to be held in Gaithersburg, Maryland, August 29-31, 1995, and Fiscal year-end TeleVideo Review.

- Developed a paper for Escorts Task Plan and revised Bad Weather Guidance in preparation for transportation external Coordination Working Group (TEC/WG) pre-planning meeting.

- Provided technical analysis of transportation regulatory changes impacting DOE transportation activities, which involved review of: Department of Transportation federal registers on final rule for single state insurance registration; RSPA dockets on implementation of UN recommendations on International Maritime Dangerous Goods codes and ICAO Technical Instructions; and the RSPA Intermediate Bulk Containers for hazardous materials Final Rule.

- Reviewed DOE orders 4120 and 1100.6A for organizational data in relation to DOE Order 1540.1B and the crosswalk from old to new orders.

- Provided analysis on routing highway route-controlled quantities of radioactive materials in National Environmental Policy Act documents and a stakeholder involvement process based on TEC/WG member comments.

- Formatted training materials for pilot course to be given in August, 1995.
- Reviewed training materials for new recurrent course to be given in September, and graded Phase I materials for this course.

- Answered the training registration line; mailed out or FAXed information as requested; received and processed registrations, prepared and mailed confirmation letters. Made logistical arrangements for September workshops.

- Performed daily maintenance of the Transportation Address Manager (TAM) database and sent weekly updates to Westinghouse Hanford Company for FaxBack transmissions.

Emergency Management

- Analyzed and provided technical comments on the revised Draft Order 5500.1C with 11 chapters attached.
- Continued to develop Transportation Emergency Program Roles and Responsibilities document.
- Reviewed and analyzed the Revised Draft State Agreement-in-Principle (AIP) Program Guidance.
- Completed development of an Emergency Management Coordinator (EMC) orientation package for alternate EMCs to support the previously developed EMC Emergency Plan Implementing Procedure (EPIP).
- Identified FY96 planning activities for Facility Emergency Preparedness Program, including analysis of five reports on the Program Tracking System.
- Initiated development of basic standardized emergency response equipment requirements for transportation incident response.
- Performed technical review for the design and development of the Emergency Management Issue Tracking System (EMITS).
- Continued developing the TEMP Project Management Plan.
- Reviewed minutes and summary materials for the semi-annual TEC/WG meeting.

Analytical Services

- Prepared informational sheet that promotes and explains EM-263 Analytical Services program.
- Attended and gave poster presentation on "Management of Analytical Resources in DOE's Office of Environmental Management" at the ER-95 meeting August 13-17, 1995.
- Completed abstract "Sensitivity Limits of Field Instrumentation Used to Measure Radionuclides" to be presented at 36th ORNL/DOE Conference on Analytical Chemistry in Energy Technology in October.
- Analyzed document, "Policy Guidance, Objectives and Criteria for Conducting DOE Radiochemical Data Validation".
- Continued development of "Planning Guidance for Appropriate Use of On-Site Measurements for Decision Making"

ACTIVITIES: TASK C - TECHNOLOGY INTEGRATION

- Continued electronic and paper file management of comments for Report to Congress.
- Reviewed and assessed FY97 Risk Data Sheets Guidance.
- Distributed the Risk Report to Congress.
- Continued developing plans for Next Steps Workshops in September time frame.
- Continued work on material assessing implications for DOE of EPA dioxin assessment.
- Developed proposed categories for comments.
- Developed summary statistics on comments received to date.
- Reviewed comments from Report to Congress drafts.
- Developed Risk Information Management System (RIMS), accessible through the Internet.
- Continued development of RIMS Help test.
- Comments on Characterization, Monitors, and Sensors Technology (CMST) Technology Catalogue.
- Participated in RCI Action Committee meetings and conference calls: August 8, August 10, August 25, 1995. Developed agenda and action items for Committee follow-up. Disseminated final copies of RCI Announcement and of interagency Memorandum of Understanding.
- Developed on-going list of RCI Action Committee (now RCI Working Group) members.
- Attended August 2, 1995 meeting to plan third annual interagency Private Enterprise Government Interaction (PEGI) Conference. Prepared summary of session proposed for November 2, 1995 conference.
- Letter addressing proposed changes in modular CRADAs.
- Transmittal memorandum to environmental technology tested holders regarding survey conducted by interagency Environmental Technology Working Group. Survey will be distributed to 25 sites currently sponsoring or proposed to sponsor environmental technology demonstrations and tests.

- Attended August 25, 1995 interagency Remediation Technologies Screening Matrix Work Group Meeting, and prepared summary of meeting activities.

- Reviewed draft of Tanks Focus Area Communications Plan.

- Addressed comments received from review of the draft Quality Assurance Program Description.

- Reviewed EPA proposed rulemaking for RCRA Phase IV Land Disposal Restrictions involving toxicity characteristic metal wastes.

- Analyzed EPA proposed rulemaking on RCRA hazardous waste identification.

- Created a paper titled, "Overcoming Regulatory Barriers: DOE Environmental Technology Development Program" for inclusion in the Superfund XVI Conference proceedings.

- Continued planning for the Pu Immobilization workshop; prepared agenda sessions and coordinated with speakers and invitees.

- Prepared notice letter when workshop placed on hold, and minutes for a series of meetings to reschedule workshop for December timeframe; new series to include new scope and objectives.

- Attended the ASME Biennial Mixed Waste Symposium in Baltimore, Maryland.

ATTACHMENT A

PRODUCTS DELIVERED: TASK A - TECHNOLOGY MANAGEMENT

- Technical information and correspondence regarding U.S. visits to Russia, August 16, 1995.
- Technical information and correspondence regarding an invitation to Berlin '95, August 10, 1995.
- Agenda, speech, and briefing book for the 5th JCCEM meeting and Berlin '95 Conference, August 31, 1995.
- Technical data and reports related to International Programs from each DOE Field Office, August 31, 1995.
- Article on the Environmental Restoration and Waste Management (ERWM) Market and U.S. export options for the EM International Publication, August 23, 1995.
- Poster depicting various aspects of EM's International Program and an activity card booklet that highlights selected international projects and activities, August 31, 1995.
- Concept paper on EM involvement in international technology transfer activities, August 25, 1995.

Mixed Waste Focus Area

- MWFA Performance Metrics Tables for FY96.
- MWFA FY96 PEG presentation at meeting in Washington, DC.
- Analysis of MWFA FY97 IRB update.
- Briefing materials describing the Mixed Waste Cooperative Program for 5th JCCEM meeting.

Tanks Focus Area

- Review of the Tanks Focus Area Baseline Environmental Management Report (BEMR) Narrative Section.
- Tanks Focus Area Poster on the 3-Dimensional Tank Waste Viewing System.
- Tanks Focus Area Poster on the Waste Dislodging and Conveyance System.
- Analysis of Tanks Focus Area Plans and Accomplishments.

- Analysis of the Waste Characterization Needs at Hanford and Potential Tanks Focus Area Responses.

- Analysis in Response to Comments From the Community Leaders Network on the Draft Internal Review Budget Documentation.

- Assessment of Roles and Responsibilities for the Tanks Focus Area Team.

- Comments on the Tanks Focus Area - Characterization Crosscutting Program Draft Call for Proposals.

- Review comments on the Press Release for the Tanks Focus Area Joint Statement of Objectives.

- Analysis Worksheet for Identifying Tanks Focus Area Leveraging with other EM Technology Development Projects.

- Summary of Tank Focus Area Proposed FY96 Projects for the 8/4/95 Program Execution Guidance (PEG) Briefing.

Landfill Stabilization Focus

- Briefing materials for the August FY96 PEG meetings.

- Analysis of spreadsheet information on FY95 Performance Measures.

- Spreadsheet information for the FY96 Performance Measures Plan.

- One-page summary slides for Landfill Focus Area technologies being demonstrated in FY95.

- Potential Session Topics for the Pu Immobilization Workshop.

- Letters to participants in planned Minimum Additive Waste Stabilization (MAWS) review.

- List of potential speakers, attendees, and reviewers for MAWS review.

- Draft agenda for MAWS technical peer review.

- Review of MAWS long form TTP parts 2 and 3.

- Pu Vitrification/Immobilization Workshop Objectives.

- Pu Immobilization Workshop Speakers contact data.

- Planning Framework for Stabilization and Immobilization Workshop.

- Tentative agendas for Plutonium Immobilization Workshop.

- Workshop postponement notice letters.
- Pu Workshop action items.
- Responses to Community Leaders Network Representatives on FY97 Draft IRB Package Comments.
- Briefing - Application of Oil Industry Technologies for Remediation of Underground Contaminants.
- Completed paper for the Contaminated Soils Conference: Landfill Stabilization Focus Area - A National Technology Development Program.

Plumes Focus Area (PFA)

- PFA presentation to the U.S. Army Corps of Engineers and DOE HTRW Innovative Technology Initiative Meeting (August 10, 1995).
- Review of Tier 2 Report: Demonstration of Four Technologies for the Drilling and Installation of Environmental Horizontal Wells.
- Review of Tier 2 Report: In Situ Bioremediation Demonstration.
- Barriers: presentation at the International Containment Technology Workshop, Baltimore, MD (August 29).
- Response to Separation Oil Services concerning an ex-situ process for cleaning fuel-contaminated soils.

Robotics Technology Development Program (RTDP)

- Briefing for 1996 Program Execution Guidance review.
- Analysis of draft 1996 Program Execution Guidance.
- Robotics Program 1996 Performance Measures.
- Robotics Program Monthly Activities Calendar for August, 1995.
- Letter to Community Leaders Network addressing review of the 1997 Internal Review Budget material.
- Briefing for 1996 Robotics Forum in Albuquerque, NM on August 16, 1995.
- Briefing on impacts of cancelling Hanford site long reach arm procurement.
- Briefing for August 2, 1995 National Academy of Sciences review of Crosscutting Programs

Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP)

- "Cost of Expedited Site Characterization" presentation to the Interagency Environmental Technology Office (IETO).
- Briefing on Overview of ESC Project.
- Description of radiation sensor technology development project.
- Presentation of FY96 CMST-CP for meeting of field office leaders of five focus areas.
- List of activities accomplished in FY95 and planned for FY96 and managed by the Chicago Field Office or the three national laboratories under the Field Office.
- Article on characterization technologies for EPA's Superfund conference to be held November 1995.
- Description of the Characterization, Monitoring and Sensors Program for the newsletter "Initiatives."
- Two page information sheets on all CMST-CP FY95 technologies under Decontamination and Deactivation and Mixed Waste Treatment Focus Areas.
- Updated Performance Plan for CMST-CP for FY96.
- Updated general presentation of FY96 CMST-CP.

Efficient Separations and Processing (ESP) Crosscutting Program

- Assessment of ESP contribution to FY96 EM/ER Collaboration.
- Analysis of ESP contribution to FY96 PEG Review.
- Review of site technology information.
- Analysis of ESP data for FY96 for Tanks FA Informational Trifold.
- ESP Performance Measures.
- ESP Performance Measures Update.
- Assessment for NAS Peer Review.
- Sorbent Verification.
- Technetium Alternative Wastforms and Uranium Removal from D&D Solutions.

- ERA vs. DOE NEPA Violation Lawsuit.
- ERA vs. DOE NEPA Violation Lawsuit : Part 2.
- Pentaborane Factsheet.

PRODUCTS DELIVERED: TASK B - PROJECT MANAGEMENT

Interagency Processes

- Resource requirements on operations of Rapid Commercialization Initiative for Interagency Environmental Technology Office (IETO).
- Assessment of Benchmarking report for IETO Business Line 1 on Customer Service Centers.
- Outline of convergence methodology for Paper Hotline and Online Services delivery.
- Presentation on Benchmarking Report.
- Spreadsheets, Benchmark Digest report, and meeting notes for IETO Business Line 1 Interagency Meeting on August 24, 1995.
- Summary Report on IETO Forum Meeting, August 31, 1995; draft report and materials, August 28, 1995.
- Annotated outline and first draft for Rapid Commercialization Initiative (RCI) Operations Plan.
- Identification of technical experts among IETO, RCI, and vendors to review "Lasagna" technology for remediation.
- Large chart to demonstrate the RCI Process for 10 technologies.
- Analysis of the Morgantown Energy Technology Center selection process for RCI proposals.
- Draft Environmental Education History Section for Chapter 1 of Blueprint.
- Event concept paper on "January 1996 Forum on Education About the Environment".
- Continued review of IETO's strategic plan and programs in environmental education.
- List of the national environmental awards.

Peer Review

- Briefing (Technology Focus Areas and Crosscut Areas Overview: A Partnership for Implementation) for three NAS peer review subcommittees.
- Distribution of briefings, Technology Summary (Rainbow) books, and Technology (Baseball) cards to NAS focus area subcommittee participants.

Related White House Issues

- Briefings for Office of Science and Technology Environmental Technology Working Group.
- Kairos database functional capabilities, including validation of databases sorting mechanisms, first version of new Kairos Decision Support System data screens, and data protocol for FY96 Data Set in the Kairos Decision Support System.

Special Studies

- Report on Tribal and Stakeholders Working Group (TSWG) to the Integrated Nonthermal Treatment Systems Study (INTS).
- Status briefing on Special Studies activities, including INTS, depleted uranium, and systems studies.
- Remarks to the Mixed Waste Focus Area describing proposed systems analysis studies.
- Summary of four Depleted Uranium (DU) reports.
- Briefing on INTS, DU and system studies.
- Liaison between OST and Molten Metal Technologies on the draft Technical Review Panel report on the Catalytic Extraction Process.

Transportation Management

- Comments on Draft Lynchburg Cesium Transportation Plan.
- Escorts Discussion Paper.
- Analysis of DOE Order 1540.1B NEPA statement.
- FY97 Site Planning Considerations for Automated Transportation Management System.
- DOE Order 1540.1B Comment Response document.
- Review of Federal Register Items of Interest.
- Lists of upcoming transportation-related events for budgetary planning purposes.
- Follow-up Report for "Advanced Hazardous Waste Transportation" July 17-21.

Emergency Management

- Paper "Building Consensus Groups and Achieving Consensus on Transportation Emergency Preparedness Issues".
- Operational Emergency Management Team write-up.
- Analysis of DOE Order 5500.1C.
- Emergency Management Coordinator (EMC) EPIP.
- Comment on Revised Draft State Agreement-in-Principle (AIP) Guidance.
- Briefing for TEC/WG meeting July 10-16, 1995.
- Discussion paper on DOE escorts for TEC/WG purposes.

Analytical Services

- Radioactive Mixed Waste Analytical Methods Working Group Meeting.
- Poster to be presented at the ER-95 Conference in Denver, CO.
- Abstract, "Sensitivity Limits of Field Instrumentation Used to Measure Radionuclides."

PROGRAM INTEGRATION

- Briefing, Career Opportunities in Environmental Management, for NAACP/DOE Scholars Summer Conference, August 4, 1995.
- Technical decision-analysis of regulatory requirements to consider in evaluating integrated non-thermal treatment systems.
- Research on plutonium stabilization and immobilization with Office of Materials Disposition.
- Review of budget allocation for FY96 Annual Performance Plan, August 10, 1995.
- Briefing charts to support Critical Few (ROI) performance measures, August 8, 1995.
- Analysis of feasibility assessment on selected Corporate Performance Measures, August 8, 1995.
- Listing of FY96 Annual Performance Plan TTP discrepancies to FIN Plan TTPs, August 28, 1995.
- Performance Measures for EM's Third Quarter Report (draft and final draft), August 8, 1995 and August 23, 1995.

- FY96 Annual Performance Plan, August 24, 1995.
- Analysis of the FY97 Internal Review Budget, August 21, 1995.
- Review of FY96 Program Execution Guidance, August 18, 1995.
- Information on EM's International activities, August 16, 1995.
- Highlights of FY96 Budget Planning Conference Calls.
- Review of Final FY96 Program Execution Guidance for technology development, August 29, 1995.
- Analysis of Quarterly Uncosted and Unobligated Reports by Operations office, August 16, 1995.
- Review of July Headquarters Progress Tracking System reports, August 30, 1995.
- Summary Report, "System Navigation Aid Program (SNAP) Prototype Demonstration/Discussion," August 14, 1995.
- Technology development materials for distribution to industry and university contacts, August 10, 1995.
- Modified database containing data on technologies and systems and modified report format, August 10, 1995.
- Revised database containing information on technologies and systems, August 11, 1995.
- Report, "Validation of Technologies and Systems Supported by the Office of Technology Development," August 11, 1995.
- Analysis of comments on the Technology Development FY96 Data Call Review and Comment Package received to date, August 18, 1995.
- Draft comments on the Waste Information Data Management Initiative (WIDMI): EM-30 Headquarters Requirements Analysis, August 22, 1995.

PRODUCTS DELIVERED: TASK C - TECHNOLOGY INTEGRATION

- Outline of an implementation plan for projected activities.
- Summary statistics on comments.
- Memo analyzing impact on DOE of EPA dioxin assessment.
- Proposed categories for comments.
- Agenda and handouts for meeting with Operations office points-of-contact (POCs).
- Minutes from two meetings with Operations office POCs.
- Rewrite on AAAS paper following revised outline.
- Defined, revised list of categories for Comment Review.
- List of comments by category.
- List of commentors.
- Guidance for FY97 RDS progress.
- Roster, "RCI Action Committee," August 8, 1995.
- "RCI Action Committee, August 8, 1995 Meeting--Action Items," August 8, 1995.
- Agenda, "PEGI 3rd Annual Round Table Conference: Session #3 -- Rapid Commercialization,: August 15, 1995.
- Agenda, "RCI Working Group Meeting," August 25, 1995.
- Memorandum, "Demonstration Site Survey," August 28, 1995.
- Memorandum, "Remediation Technologies Screening Matrix Work Group Meeting," August 24, 1995.
- "RCI Action Committee, August 25, 1995 Meeting -- Action Items," August 25, 1995.
- Paper titled, "Overcoming Regulatory Barriers: DOE Environmental Technology Development Program," for inclusion in the Superfund XVI Conference Proceedings, August 1, 1995.
- "RCI Action Committee, August 10, 1995 Meeting -- Action Items," August 10, 1995.
- Memorandum, "Concurrence with Memorandum Regarding Release of Essentially Full-Text CRADAs," August 18, 1995.

WPI Waste Policy Institute
A Virginia Tech Affiliated Corporation

Monthly
Cost and Labor
Report

University of North Dakota
Energy and Environmental Research Center

Subcontract No. 359 636

August 1995

WGB.95-0351

PROGRAM SUMMARY

Whole Dollars

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through AUG-95

09-12-1995
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SELECTION CRITERIA: All Data Included

WBS: ******************** 1029 PROJECT

Parent:

Perf Dept:
Resp Dept:

Manager:
Chg No :

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Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________

Task Description:

PROVICE ASSISTANCE TO EERC's CONDUCT OF TECHNOLOGY DEVELOPMENT INTEGRATION ACTIVITIES.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	22,308	17,723	4,584	42,173	33,582	8,591	42,173	33,582	8,591
Price:	1454843	1300381	154463	2795967	2549083	246884	2795967	2549083	246884

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89,295	1,251,829	1,454,843	0	0	0	0	0	0	0	0	0
Cum Price:	89,295	1,341,124	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967
Actuals												
Mon Hrs:	149.0	15,709.8	17,723.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	149.0	15,858.8	33,582.0	33,582.0	33,582.0	33,582.0	33,582.0	33,582.0	33,582.0	33,582.0	33,582.0	33,582.0
Mon Price:	8,492	1,240,210	1,300,381	0	0	0	0	0	0	0	0	0
Cum Price:	8,492	1,248,702	2,549,083	2,549,083	2,549,083	2,549,083	2,549,083	2,549,083	2,549,083	2,549,083	2,549,083	2,549,083
ETC												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89,295	1,251,829	1,454,843	0	0	0	0	0	0	0	0	0
Cum Price:	89,295	1,341,124	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967	2,795,967

TASK A

Whole Dollars

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through AUG-95

09-12-1995
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SELECTION CRITERIA: WBS Level: 2

WBS: 1029.01 TECH MANAGEMENT
TASK A
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

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Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ________ Initials: ____ Date: ________
Approval: ________ Initials: ____ Date: ________
Approval: ________ Initials: ____ Date: ________

Task Description:

PERFORM TECHNICAL REVIEWS OF REQUIREMENTS, NEEDS AND ASSESSMENTS RELATED TO WASTE CHARACTERIZATION, CONTAINMENT, IN-SITU AND EX-SITU TREATMENT, WASTE STORAGE, DISPOSAL, ROBOTICS HANDLING, MONITORING, LABORATORY ANALYSIS, SITE CHARACTERIZATION AND REMEDIATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	8,711	7,504	1,207	16,236	13,809	2,427	16,236	13,809	2,427
Price:	570555	582189	-11634	1083031	1118694	-35662	1083031	1118694	-35662

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14,090	498,386	570,555	0	0	0	0	0	0	0	0	0
Cum Price:	14,090	512,476	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031
Actuals												
Mon Hrs:	50.0	6,255.0	7,504.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	50.0	6,305.0	13,809.0	13,809.0	13,809.0	13,809.0	13,809.0	13,809.0	13,809.0	13,809.0	13,809.0	13,809.0
Mon Price:	2,574	533,931	582,189	0	0	0	0	0	0	0	0	0
Cum Price:	2,574	536,505	1,118,694	1,118,694	1,118,694	1,118,694	1,118,694	1,118,694	1,118,694	1,118,694	1,118,694	1,118,694
ETC												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14,090	498,386	570,555	0	0	0	0	0	0	0	0	0
Cum Price:	14,090	512,476	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031	1,083,031

TASK B

Whole Dollars

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through AUG-95

09-12-1995
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WBS: 1029.02 PROJECT MNGT
TASK B
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

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Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

CONDUCT REVIEWS, ANALYZE AND DEVELOP STRATEGIES FOR PROGRAM MANAGEMENT SYSTEMS FOR INTEGRATION AND CONTROL OF PROGRAMS, PROJECTS, TASKS AND DOCUMENTATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	8,042	8,247	-206	14,994	16,462	-1,468	14,994	16,462	-1,468
Price:	527559	566591	-39032	1002397	1172129	-169731	1002397	1172129	-169731

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21,034	453,804	527,559	0	0	0	0	0	0	0	0	0
Cum Price:	21,034	474,838	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397
Actuals												
Mon Hrs:	98.0	8,116.3	8,247.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	98.0	8,214.3	16,461.5	16,461.5	16,461.5	16,461.5	16,461.5	16,461.5	16,461.5	16,461.5	16,461.5	16,461.5
Mon Price:	5,779	599,758	566,591	0	0	0	0	0	0	0	0	0
Cum Price:	5,779	605,537	1,172,129	1,172,129	1,172,129	1,172,129	1,172,129	1,172,129	1,172,129	1,172,129	1,172,129	1,172,129
ETC												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21,034	453,804	527,559	0	0	0	0	0	0	0	0	0
Cum Price:	21,034	474,838	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397	1,002,397

TASK C

1029
PAGE 3
Whole Dollars

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through AUG-95

09-12-1995
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WBS: 1029.03 TECH INTEGRATION
TASK C
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

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Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________

Task Description:

PROVIDE SUPPORT IN ESTABLISHING CRITERIA FOR IDENTIFYING RISKS TO THE PUBLIC HEALTH AND SAFETYPOSED BY CONDITIONS AT THE WEAPONS COMPLEX FACILITIES, EVALUATE THE EXTENT OF THESE RISKS, DETERMIN THE URGENCY AND PRIORITIES FOR ELIMINATING OR MINIMIZING THE RISKS, AND ACCESS THE COST OF ACTIVITIES REQUIRED TO MEET APPLICABLE COMPLIANCE AGREEMENTS.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	5,555	1,972	3,583	10,943	3,312	7,632	10,943	3,312	7,632
Price:	356,729	151,601	205,128	710,538	258,261	452,278	710,538	258,261	452,278

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54,170	299,639	356,729	0	0	0	0	0	0	0	0	0
Cum Price:	54,170	353,810	710,538	710,538	710,538	710,538	710,538	710,538	710,538	710,538	710,538	710,538
Actuals												
Mon Hrs:	1.0	1,338.5	1,972.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1.0	1,339.5	3,311.5	3,311.5	3,311.5	3,311.5	3,311.5	3,311.5	3,311.5	3,311.5	3,311.5	3,311.5
Mon Price:	139	106,521	151,601	0	0	0	0	0	0	0	0	0
Cum Price:	139	106,660	258,261	258,261	258,261	258,261	258,261	258,261	258,261	258,261	258,261	258,261
ETC												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54,170	299,639	356,729	0	0	0	0	0	0	0	0	0
Cum Price:	54,170	353,810	710,538	710,538	710,538	710,538	710,538	710,538	710,538	710,538	710,538	710,538

(End of Report)

WASTE POLICY INSTITUTE MONTHLY REPORT TO THE EERC, SEPTEMBER 1995

APPENDIX C

WPI
WASTE POLICY INSTITUTE
A Virginia Tech Affiliated Corporation

Corporate Office
1872 Pratt Drive, Suite 1600
Blacksburg, VA 24060-6363
Telephone (703) 231-3324
Telefax (703) 231-3968

Washington Operations Office
Quince Diamond Executive Center
555 Quince Orchard Road, Suite 600
Gaithersburg, MD 20878-1437
Telephone (301) 990-7200
Telefax (301) 990-6150

October 16, 1995
VIA FEDERAL EXPRESS

John G. Hendrikson
Assistant to the Director
Energy and Environmental
Research Center
University of North Dakota
15 North 23rd Street
Grand Forks, ND 58203

Subject: UNDEERC Fund No. 4624-0936, Technology Development Integration
WPI Subcontract No. 359636

Dear Mr. Hendrikson:

The Waste Policy Institute (WPI) is pleased to submit the enclosed report of activities conducted during the period of September 1, 1995 through September 30, 1995, in compliance with Article VI and Appendix A of Subcontract Number 359636. A list of products developed during this period is provided as Attachment A to the activities report.

Through September 30, 1995, WPI has expended a total of $4,178,000. (84% of subcontract funding) and 52,743 hours (74% of subcontract hours). Our monthly cost and labor report is also enclosed.

Please do not hesitate to call me if you have any questions or require additional information.

Very truly yours,

Sheila A. Cleary

Sheila A. Cleary
Corporate Counsel/Director of Contracts

cc: L. D. Eyman
J. Wilson

SUBCONTRACT NUMBER: 359636 **Report Period: 09/01/95 - 09/30/95**

CONTRACTOR NAME: **Waste Policy Institute**
555 Quince Orchard Road
Suite 600
Gaithersburg, MD 20878-1437

CONTRACT PERIOD: **06/28/95 - 10/29/95**

1. **SUBCONTRACT DELIVERABLES:**

This report is submitted in fulfillment of requirements specified for the University of North Dakota Energy and Environmental Research Center (UNDEERC) Subcontract Number 359636. A list of products developed under this subcontract is provided as Attachment A.

2. **SUMMARY OF ACTIVITIES:**

Significant progress has been made during the month in setting up offices at the field sites near the focus area lead organizations. The permanent Morgantown office has been opened, and temporary offices have been opened at Idaho Falls, Aiken, and Richland. Managers have been hired at Morgantown, Idaho Falls, and Aiken, and progress has been made to find a candidate for the Richland office. Staffing of the offices from relocations and new hires is well under way.

TASK A - TECHNOLOGY MANAGEMENT

The activities for the month in technology management included assessments in each of the focus areas (tanks, landfill stabilization, plumes, decontamination and decommissioning, and mixed wastes) as well as the crosscutting programs (characterization and sensors, efficient separations, industry programs, and robotics). Additional efforts were carried out in conjunction with technology transfer activities.

TANKS FOCUS AREA (TFA)

Technology transfer functions predominated the efforts in the tank focus area. Information was gathered and a "Tank Farm 2000 - The Vision" poster was prepared. Posters depicting the Cone Penetrometer, Light Duty Utility Arm, Three-Dimensional In-Tank Video, Mobile Evaporator, Cesium Removal, and Waste Retrieval technologies to be displayed at various DOE facilities were assembled. A set of brochures depicting programs in the Tanks Focus Area (TFA) were prepared for distribution at meetings or displays.

The team conducted technical analyses for development of a presentation and short paper suggesting that one Hanford Tank Farm be used as a test bed for new technologies developed by universities, industries, and national labs. Technical reports were prepared on separations of transuranic and plutonium as they relate to the National Environmental Policy Act requirements.

LANDFILL STABILIZATION FOCUS AREA (LSFA)

Efforts in the Landfill Stabilization area included preparation for peer reviews of Minimum Additive Waste Stabilization, and Vitrification Technology (scheduled for November 13-15) at Savannah River.

Preparations continue for the Plutonium Immobilization Workshop to be held December 12-14, 1995. A technical paper on The Landfill Stabilization Focus Area: A National Technology Development Program was prepared for the 10th annual Contaminated Soils Conference on October 23-25 in Amherst. Planning and coordination was provided for the LSFA MAWS review meeting. A list of DOE radionuclide contaminated sites including concentrations, soil conditions, and isotope ratios was prepared.

PLUMES FOCUS AREA (PFA)

Technical analyses and review were provided for a Fiber-Optic Dosimeter proposed by the Naval Research Lab, for a USGS presentation of a plume characterization technology, and for a paper Methodology for Determining the Applicability of Air Sparging.

Technical presentations were prepared on Resource Recovery for the Resources Through Technology 1995 Conference on September 11, 1995, and for the American Chemical Society at the I&EC Special Symposium, September 17-20, 1995.

Background information on planned FY95/96 demonstrations was prepared for the Community Leaders Network (CLN) workshop, September 19, 1995. A summary presentation of Metals and Radionuclides and VOCs Product Lines was prepared.

DECONTAMINATION AND DECOMMISSIONING (D&D) FOCUS AREA

Results of technical analyses relating to the chemical decontamination of process equipment using recycling chelating solvent technology were provided.

Technical presentations were prepared describing the large scale demonstration, and the D&D focus area for the American Chemical Society's conference on emerging environmental technologies.

MIXED WASTE FOCUS AREA (MWFA)

The team participated on the Technical Review Panel September 12-14, 1995, for FY95 characterization and monitoring projects at the Diagnostic Implementation and Analyses Laboratory (DIAL) facility.

CROSSCUTTING TECHNOLOGIES

Technical information was assembled from the crosscutting areas that is pertinent to the individual field lead focus areas.

Technical evaluations were provided for Characterization and Sensors Program area at the EPA sponsored RCRA and Other Heavy Metals in Soils demonstration in Butte, Montana, September 25-27, 1995. Technical alternatives were provided for sensors to measure total uranium at Fernald and Plutonium-238 at the Mound site.

PROGRAM INTEGRATION

A number of technology transfer activities were conducted for international uses of environmental technologies. The fifth JCCEM meeting in Berlin, Germany and a separations program review in Prague, Czech Republic from September 1-9, 1995 were attended. Technical analyses have been prepared that relate to Russian and Mexican initiatives that are being planned by DOE for FY96.

ACTIVITIES: TASK B - PROJECT MANAGEMENT

Significant effort was expended during the month in performing special studies and analyses of budget impacts and review of technical plans for FY96. Reviews of cost variance performance for July were completed, and technical reviews were performed to assess the compatibility of the R&D tracking system data to the data required in the annual OSTP data call. Reviews were completed of the FY96 Annual Performance Plan. Software documentation and data validation were provided for the Environmental Technology Working Group KAIROS project.

ANALYTICAL SERVICES

A report on dose limits for radionuclides was prepared for the EPA/DOE/DoD/NRC joint effort. A paper was prepared and presented on Management of Sampling and Analysis Activities in DOE's Office of Environmental Management at the American Chemical Society symposium on Emerging Technologies in Hazardous Waste Management in Atlanta, GA., September 17, 1995. A literature search was completed and a presentation prepared on field instrumentation sensitivity limits for 36th ORNL/DOE Conference on Analytical Chemistry in Energy Technology scheduled for October 10-12, 1995.

EMERGENCY MANAGEMENT

Technical review was completed on Appendix H of the Environmental Impact Statement for the transport of Foreign Research Reactor Spent Nuclear Fuel. Technical reviews were also completed on the 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER) requirements matrix crosswalk dated 8/9/95 and the revised Fernald Environmental Management Project Emergency Readiness Assurance QPlan (ERAP). A detailed review was made of the First Responder Course developed by Analyses, Inc., including the video portion and course written materials.

INTERAGENCY PROCESSES

During the month analyses of activities for the Rapid Commercialization Initiative (RCI) were completed including a siting matrix describing relevant conditions and characteristics, identification of DOE waste sites and potential DOE sites for demonstration and testing.

A review was completed on the Environmental Education Resource Benchmark Project.

LEGISLATIVE

Legislative Hearing Synopsis and Summaries were prepared for:

- Budget Train Wreck, 9/6/95 (briefing: CATO Institute)
- Restructuring DOE Labs, 9/7/95 (hearing: House Science Committee)
- Budget Reconciliation, 9/20/95 (hearing: Energy and Natural Resources Committee)
- FY96 Appropriations for Science Programs and Budget Reconciliation, 9/26/95 (briefing: Representative Walker
- Technology Hearing, 9/28/95 (hearing: Subcommittee on Technology)
- Mission Statement Technology Hearing, 9/28/95 (hearing: Subcommittee on Technology)

SPECIAL STUDIES

A summary paper regarding Princeton Plasma Lab's participation on the Strategic Lab Council was prepared. Chemical experts from the DOE Complex were identified for a Chemical Experts Panel to review proposed nonthermal systems from a chemistry perspective, and logistics for this panel in Salt Lake City on October 31 were arranged.

TRANSPORTATION MANAGEMENT

A paper describing the revised Transportation Compliance Evaluation Assistance Program was developed for submittal to the Packaging and Transportation of Radioactive Materials (PATRAM) conference.

TASK C - TECHNOLOGY INTEGRATION

Technical reviews and analyses were conducted of the EPA proposed rulemaking on RCRA waste identification and land disposal restrictions to assess possible impacts on technology development activities. A presentation is being prepared for the Superfund XVI Conference in November to discuss the regulatory barriers to technology development.

RISK

Public comments on the Risk Report to Congress continued to be received by the Risk Team. Comments were categorized, entered into the Comment/Response database, and sorts were developed of comments by category to identify the types of comments being received. Draft responses for various categories were developed, entered into the database and a complete comment/response document was generated for use in a Comment/Response Workshop. Database sorts were developed to provide comment/response printouts by category and commentor. A number of critical issues were identifed and a draft response document was co-developed during the meeting which synthesized inputs from both Federal and contractor staff.

ATTACHMENT A

PRODUCTS DELIVERED: TASK A - TECHNOLOGY MANAGEMENT

CHARACTERIZATION, MONITORS, AND SENSORS TECHNOLOGIES CROSSCUTTING PROGRAM (CMST-CP)

- Updated Performance Plan for CMST-CP for FY95

LANDFILL STABILIZATION FOCUS AREA (LSFA)

- Analyses of Community Leaders Network Representatives comments on FY97 Draft IRB Package.
- Briefing on FY96 Program Execution Guidance for the DOE Savannah River Site management scheduled on September 4, 1995.
- Final draft of narrative for BEMR 1996.
- LSFA contact list with complete mailing address.
- List of Interagency Agreements.
- Revised WBS model to fit revised Technical Task Plans.
- Management pie chart slides (new budget distribution by product lines, managing sites distribution, FY96 performing sites distribution, WBS model, and three performance measure slides).
- Final Draft of the paper for the 10th Annual Contaminated Soils Conference - The Landfill Stabilization Focus Area A National Technology Development Program.
- Updated draft of the FY96 Landfill Stabilization Focus Area Technical Area Data Sheet.

MIXED WASTE FOCUS AREA (MWFA)

- Reviews of FY96 Long-Form Technical Task Plans.
- Revised CrossWalk Table.
- Revised MWFA FY95 and FY96 Performance Metrics.

PLUMES FOCUS AREA (PFA)

- PFA presentation on resource recovery for the Resources through Technology 1995 conference, September 11, 1995.
- Contaminant Plume Containment and Remediation Focus Area 1995-1996 Technology Demonstrations, Community Leaders Network Open house opportunities, September 19, 1995.

PROGRAM INTEGRATION

- Technical analysis of a Russian process.
- Technical needs in phytoremediation for U.S./Polish Joint Science and Technology Program.
- Technical input to the International Program Review: Central and Eastern Europe.
- Summary of highlights from August, 1995 visit to the U.S. by Polish delegation.
- Briefing on the Mexican Initiatives.
- Bi-weekly report of international activities.
- Framework for participation in international environmental trade promotion.

TANKS FOCUS AREA (TFA)

- Trip report for travel to the Solid/Liquid Separations Meeting at the Savannah River Site.
- Strategic program analysis for the Tanks Focus Area.
- Revised Tanks Focus Area Brochure Cesium Removal Technologies.
- Analysis of tank focus area program logic and resource allocation plan for FY97.
- Technical review of Tank Focus Area accomplishments and plans related to the Idaho National Engineering Laboratory.
- Summary and Detail Tables of FY96 Performance Metrics for the Tanks Focus Area.
- Summary charts of FY96 funding by Focus Area.

ROBOTICS TECHNOLOGY DEVELOPMENT PROGRAM (RTDP)

- List of Small Businesses Interacting with the Robotics Program.
- Monthly Report on D&D Demonstration at Oak Ridge.
- Robotics Calendar for September, 1995.
- FY96 Performance Measures.

PRODUCTS DELIVERED: TASK B - PROJECT MANAGEMENT

EMERGENCY MANAGEMENT

- Review of the revised Fernald Environmental Project Emergency Readiness Assurance Plan for 1994.

- Comments to Radioactive Emergency Response Training Course and Video.

INTERAGENCY PROCESSES

- Model Test Platform Profile for Savannah River test site.

- Technical review of EPA and California EPA verification documents.

- Technical inputs for consideration in the National Blueprint for Environmental Education.

- Follow-up meeting notes, including identification of factors warranting closer review, on Xerox's Corporate Quality Day Benchmark Project.

LEGISLATIVE

- Congressional and Legislative Hearing Synopsis and Summaries:

    - Budget Train Wreck, 9/6/95 (briefing: CATO Institute)
    - Restructuring DOE Labs, 9/7/95 (hearing: House Science Committee)
    - Budget Reconciliation, 9/20/95 (hearing: Energy and Natural Resources Committee)
    - FY96 Appropriations for Science Programs and Budget Reconciliation, 9/26/95 (briefing: Representative Walker
    - Technology Hearing, 9/28/95 (hearing: Subcommittee on Technology)
    - Mission Statement Technology Hearing, 9/28/95 (hearing: Subcommittee on Technology)

- Legislative Bulletin for September .

PROGRAM INTEGRATION

- Point-of-Contact listing for performance measurement, September 18, 1995.

- Final draft of the 1996 Annual Performance Plan including detail and summary level packages, September 27, 1995.

- Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Berkeley Major Activities Briefing.

- Matrix reflecting all FY96 commitments for the International Program.

- Analysis of August Headquarters Progress Tracking System reports, September 29, 1995.

- New versions of Kairos decision support system, September 1,7, 25, 1995.

- Documentation for KAIROS software support (Design/Programmer's Guide, Requirements Document. User's Manual, Testing Documentation).

- Database validation for KAIROS Project.

- System Navigation Aid Program (SNAP) Status Report, September 15, 1995.

- Briefing package on Technology Development information and activities available on the Internet, September 5, 1995.

- Instructions for Maintaining the Technology Database and Updating the Validation of Technologies and Systems Supported by the Technology Development Report, September 15, 1995.

- Timeline for Technology Development FY96 Data Call Process, September 14, 1995.

- Summary report on highlights from Technology Availability Program Integration Meeting on September 20-21, 1995.

SPECIAL STUDIES

- Logistics for November 1995 meeting of Technical Study Group (TSG) of the Integrated Nonthermal Treatment Systems Study (INTS) in Salt Lake City.

- Identification of chemical experts for participation in a Chemical Experts Panel to review proposed nonthermal systems; logistics for this panel.

- Chart summarizing technologies presented at advanced alternative technology workshop sponsored by the U.S. Army.

- Briefing on INTS for Mixed Waste Subcommittee of the National Academy of Sciences.

- Progress report on INTS for stakeholders.

- Survey to INTS stakeholders on communications needs and capabilities for conveying progress.

PRODUCTS DELIVERED: TASK C - TECHNOLOGY INTEGRATION

PROGRAM INTEGRATION

- Draft Guidelines and Procedures for CRADAs, User Facilities, and Work for Others under the Energy Policy Act of 1992.

- Summary of Rapid Commercialization Initiative (RCI), September 14, 1995.

RISK

- Access database printout, sorted by category, of the 600 plus comments received from 72 commentors on the Risk Report to Congress.

- Weekly meeting materials and minutes of meetings with Risk Team Operations Office Points-of-Contact.

- Draft of comment/response document including proposed responses for all public comments on Risk Report to Congress.

- Weekly meeting materials and minutes of two-day Comment/Response Workshop held on September 11-12, 1995.

- Errata memorandum with attached classification table and comments.

WPI Waste Policy Institute
A Virginia Tech Affiliated Corporation

Monthly Cost and Labor Report

University of North Dakota
Energy and Environmental Research Center

Subcontract No. 359 636

September 1995

WGB.95-0351

PROGRAM SUMMARY

1029
PAGE 1
Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through SEP-95

10-14-1995
12:05:35

SELECTION CRITERIA: WBS ID: ********************

WBS: ******************** 1029 PROJECT
Parent:
Perf Dept:
Resp Dept:
Manager:
Chg No :
/ :
/ :
/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ________ Initials: ____ Date: ________
Approval: ________ Initials: ____ Date: ________
Approval: ________ Initials: ____ Date: ________

Task Description:
PROVICE ASSISTANCE TO EERC's CONDUCT OF TECHNOLOGY DEVELOPMENT INTEGRATION ACTIVITIES.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	19,161	-19,161	42,173	52,743	-10,570	42,173	52,743	-10,570
Price:	0	1629	-1629	2796	4178	-1382	2796	4178	-1382

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89	1,252	1,455	0	0	0	0	0	0	0	0	0
Cum Price:	89	1,341	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796
Actuals												
Mon Hrs:	149.0	15,709.8	17,723.3	19,161.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	149.0	15,858.8	33,582.0	52,743.3	52,743.3	52,743.3	52,743.3	52,743.3	52,743.3	52,743.3	52,743.3	52,743.3
Mon Price:	8	1,240	1,300	1,629	0	0	0	0	0	0	0	0
Cum Price:	8	1,249	2,549	4,178	4,178	4,178	4,178	4,178	4,178	4,178	4,178	4,178
ETC												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89	1,252	1,455	0	0	0	0	0	0	0	0	0
Cum Price:	89	1,341	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796	2,796

TASK A

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through SEP-95

10-14-1995
12:05:38

WBS: 1029.01 TECH MANAGEMENT
TASK A
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

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/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ______ Date: ______
Approval: ______ Initials: ______ Date: ______
Approval: ______ Initials: ______ Date: ______

Task Description:

PERFORM TECHNICAL REVIEWS OF REQUIREMENTS, NEEDS AND ASSESSMENTS RELATED TO WASTE CHARACTERIZATION, CONTAINMENT, IN-SITU AND EX-SITU TREATMENT, WASTE STORAGE, DISPOSAL, ROBOTICS HANDLING, MONITORING, LABORATORY ANALYSIS, SITE CHARACTERIZATION AND REMEDIATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	7,961	-7,961	16,236	21,770	-5,534	16,236	21,770	-5,534
Price:	0	739	-739	1083	1858	-775	1083	1858	-775

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14	498	571	0	0	0	0	0	0	0	0	0
Cum Price:	14	512	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083
Actuals												
Mon Hrs:	50.0	6,255.0	7,504.0	7,961.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	50.0	6,305.0	13,809.0	21,770.3	21,770.3	21,770.3	21,770.3	21,770.3	21,770.3	21,770.3	21,770.3	21,770.3
Mon Price:	3	534	582	739	0	0	0	0	0	0	0	0
Cum Price:	3	537	1,119	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,858
ETC												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14	498	571	0	0	0	0	0	0	0	0	0
Cum Price:	14	512	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083

TASK B

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through SEP-95

10-14-1995
12:05:42

WBS: 1029.02 PROJECT MNGT
TASK B
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

/ :
/ :
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Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

CONDUCT REVIEWS, ANALYZE AND DEVELOP STRATEGIES FOR PROGRAM MANAGEMENT SYSTEMS FOR INTEGRATION AND CONTROL OF PROGRAMS, PROJECTS, TASKS AND DOCUMENTATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	9,084	-9,084	14,994	25,545	-10,551	14,994	25,545	-10,551
Price:	0	720	-720	1002	1892	-890	1002	1892	-890

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21	454	528	0	0	0	0	0	0	0	0	0
Cum Price:	21	475	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002
Actuals												
Mon Hrs:	98.0	8,116.3	8,247.3	9,083.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	98.0	8,214.3	16,461.5	25,545.0	25,545.0	25,545.0	25,545.0	25,545.0	25,545.0	25,545.0	25,545.0	25,545.0
Mon Price:	6	600	567	720	0	0	0	0	0	0	0	0
Cum Price:	6	606	1,172	1,892	1,892	1,892	1,892	1,892	1,892	1,892	1,892	1,892
ETC												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21	454	528	0	0	0	0	0	0	0	0	0
Cum Price:	21	475	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002

TASK C

Dollars in Thousands

WASTE POLICY INSTITUTE
UNDEERC
SUBCONTRACT No. 359636
LRE Actuals through SEP-95

10-14-1995
12:05:46

WBS: 1029.03 TECH INTEGRATION
TASK C
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

/ :
/ :
/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-AUG-95
Earned Value Method: No EVM Required

Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________
Approval: ____________ Initials: ____ Date: ________

Task Description:

PROVIDE SUPPORT IN ESTABLISHING CRITERIA FOR IDENTIFYING RISKS TO THE PUBLIC HEALTH AND SAFETYPOSED BY CONDITIONS AT THE WEAPONS COMPLEX FACILITIES, EVALUATE THE EXTENT OF THESE RISKS, DETERMIN THE URGENCY AND PRIORITIES FOR ELIMINATING OR MINIMIZING THE RISKS, AND ACCESS THE COST OF ACTIVITIES REQUIRED TO MEET APPLICABLE COMPLIANCE AGREEMENTS.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	2,117	-2,117	10,943	5,428	5,515	10,943	5,428	5,515
Price:	0	170	-170	711	428	282	711	428	282

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54	300	357	0	0	0	0	0	0	0	0	0
Cum Price:	54	354	711	711	711	711	711	711	711	711	711	711
Actuals												
Mon Hrs:	1.0	1,338.5	1,972.0	2,116.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1.0	1,339.5	3,311.5	5,428.0	5,428.0	5,428.0	5,428.0	5,428.0	5,428.0	5,428.0	5,428.0	5,428.0
Mon Price:	0	107	152	170	0	0	0	0	0	0	0	0
Cum Price:	0	107	258	428	428	428	428	428	428	428	428	428
ETC												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54	300	357	0	0	0	0	0	0	0	0	0
Cum Price:	54	354	711	711	711	711	711	711	711	711	711	711

WASTE POLICY INSTITUTE MONTHLY REPORT TO THE EERC, OCTOBER 1995

APPENDIX D

WPI
WASTE POLICY INSTITUTE
A Virginia Tech Affiliated Corporation

Corporate Office
1872 Pratt Drive, Suite 1600
Blacksburg, VA 24060-6363
Telephone (703) 231-3324
Telefax (703) 231-3968

Washington Operations Office
Quince Diamond Executive Center
555 Quince Orchard Road, Suite 600
Gaithersburg, MD 20878-1437
Telephone (301) 990-7200
Telefax (301) 990-6150

November 15, 1995

John G. Hendrikson
Assistant to the Director
Energy and Environmental
Research Center
University of North Dakota
15 North 23rd Street
Grand Forks, ND 58203

Subject: UNDEERC Fund No. 4624-0936, Technology Development Integration
WPI Subcontract No. 359636

Dear Mr. Hendrikson:

The Waste Policy Institute (WPI) is pleased to submit the enclosed report of activities conducted during the period of October 1, 1995 through October 31, 1995, in compliance with Article VI and Appendix A of Subcontract Number 359636. A list of products developed during this period is provided as Attachment A to the activities report.

Through October 31, 1995, WPI has expended a total of $5,250,577.00(105% of subcontract funding). Our monthly cost and labor report is also enclosed. WPI understands that costs over the funded amount of the subcontract are incurred at WPI's own risk.

Please do not hesitate to call me if you have any questions or require additional information.

Very truly yours,

Sheila A. Cleary

Sheila A. Cleary
Corporate Counsel/Director of Contracts

cc: L. D. Eyman
J. Wilson

H:\WP51\SHEILA\SUBC\SAC11133.DOC

SUBCONTRACT NUMBER: 359636 Report Period: 10/1/95 - 10/29/95

CONTRACTOR NAME: Waste Policy Institute
555 Quince Orchard Road
Suite 600
Gaithersburg, MD 20878-1437

CONTRACT PERIOD: 06/28/95 - 10/29/95

1. SUBCONTRACT DELIVERABLES:

This report is submitted in fulfillment of requirements specified for the University of North Dakota Energy and Environmental Research Center (UNDEERC) Subcontract Number 359636. A list of products developed under this subcontract is provided as Attachment A.

2. SUMMARY OF ACTIVITIES

Progress continued during the month in setting up and staffing the site offices. The Operations Director for the Richland office is in place as of November 1. The Richland staff has been working with the operations office on its space in the Environmental Engineering and Science Building. The Idaho Falls office should be permanently located on December 1. The Aiken office has moved into its permanent location. A number of staffing, space, and communications issues among the locations are being worked on as they arise.

TASK A - TECHNOLOGY MANAGEMENT

TANKS FOCUS AREA (TFA)

The team assembled an orientation package describing the Tanks Focus Area for distribution to the Environmental Management Advisory Board. The package included technical briefing and informational material on the Tanks Focus Area as well as TFA Team Directory, TFA Review Group, and TFA Users Steering Group lists. The TFA display was also updated during the month for use at the International Union of Operating Engineers National Hazmat meeting in Washington, DC.

Technical assistance and review was provided for Baseline Environmental Management Report documentation, development of approaches to systems engineering, risk analysis, and cost-benefit analysis for the TFA. Plans are also being developed for an independent technical review of various projects in the TFA.

LANDFILL STABILIZATION FOCUS AREA (LSFA)

A technical assessment was made of the completion status of 125 LSFA milestones in relation to project relevance and performance. The information will be used by DOE to close those milestones that have been superseded by project events and fiscal consideration.

Team members participated in the LSFA technology needs assessment Site Visit for INEL. Technical information gathered will form a baseline for the update of the LSFA needs assessment documentation.

Technical Fact sheets were prepared for the LSFA (Transuranic/Mixed Waste at DOE humid and arid sites -- Intrinsic Bioremediation, Slurry Carbonization of Waste, and Wet Chemical Oxidation). These sheets will be used by DOE to inform Congress, public interest, and others regarding technologies, applications & benefits of the projects being demonstrated at DOE field sites throughout the country in support of the LSFA mission.

PLUMES FOCUS AREA (PFA)

A technical investigation of In Situ Mining technologies was conducted on Chemically Enhanced Barriers to minimize migration and enhance uranium recovery from groundwater plumes. The information formed the baseline for the release of several PFA TTPs for funding.

The team assessed the technical status of TTP milestones and performance measures. The information was used by DOE to assure performance measures are met and focus area requirements are communicated to PFA personnel.

Technical analysis was provided for use in Program Execution Guidance for the new MSE scope. The PEG provides a basis for DOE decisions on the new technical scope for Western Environmental Technology Office/MSE in support of PFA.

The staff has provided technical analysis of three presentations given by Phase I Small Business Innovative Research (SBIR) grant recipients to determine applicability of the project to the PFA. Emphasis was placed on identifying EM sites and problems where the technologies being developed would have near-term applicability.

A staff member co-authored a paper, "Contaminant Plumes Containment and Remediation Focus Area," which was presented at the Environment 2000 conference at Stevens Institute in Hoboken, NJ (October 25). The paper provides an overview of the technology needs-based management structure which has been implemented by the Focus Area.

Technical inputs were provided for a briefing by Phil Washer (DOE-SR) to the Idaho Site Technology Coordination Group. The analysis included information about INEL plume problems and plume-related technology needs.

DECONTAMINATION AND DECOMMISSIONING (D&D) FOCUS AREA

A technical analysis was completed for the 3D-ICAS characterization system. This review will be used by DOE in their decision to authorize the next phase of the project.

Technical briefing materials were prepared that describe the activities in the D&D focus area for upcoming meetings.

A staff member attended the kick-off meeting for the CP-5 large scale demonstration meeting at ANL, and provided information on the technologies being developed by the D&D focus area to the group.

MIXED WASTE FOCUS AREA (MWFA)

The team reviewed and provided comments on the MWFA Technology Development Needs Report (dated October 2, 1995), and participated in a video conference on the purpose, content, and structure of the report.

MWFA-funded Plasma Hearth Process (PHP) projects were described in Quad chart format to document each project.

Team members participated in a MWFA meeting on the development of waste-type-specific treatment trains for the Technical Baseline Document.

Technical reviews were completed for the Brookhaven National Laboratory proposal on the polyethylene macro- and micro-encapsulation process, and for the statement of work for the Research Opportunity Announcement.

A staff member participated in the technical review meeting of nondestructive assay/nondestructive examination projects in Salt Lake City, Utah.

INTEGRATION

Assistance has been provided to integrate the cross-cut programs with the focus areas. The coordination of field support and headquarters support will be essential for optimum integration of the cross-cut efforts into the focus areas.

TASK B - PROJECT MANAGEMENT

Analyses were provided to several focus areas for use in preparing for the monthly status briefing to EM-50 management. Reviews were conducted for the final TTPs for FY 96 in several focus areas, as well.

TANKS FOCUS AREA (TFA)

The Mixed Waste Focus Area Public Participation Plan was reviewed and recommendations were provided that may assist the TFA in its Public Participation Plan.

The FY 96 Performance Metrics were reviewed and recommendations provided to assure consistency across all TFA documentation. The FY 96 Technology Development Data Call was reviewed and comments were provided about the content, impacts, and effectiveness of the information as it applies to the TFA.

LANDFILL STABILIZATION FOCUS AREA (LSFA)

The team provided technical input into the development of prioritization methods, established documentation requirements & weighting criteria for a revised Prioritization scheme that will be used by DOE to evaluate and rank the LSFA TTPs for current and out-year projects at task level.

The staff coordinated and participated in the LSFA Team Retreat at SRRC on Oct. 11-13, 1995. Sessions were held on management policies/ expectations, strategic and program management planning, and FY 96 prioritization.

Technical reviews were provided and recommendations were made for selecting 30 successful technologies for the US DOE/HAZMAT exhibits. The display materials were reviewed for accuracy, technical content, and programmatic concerns.

The team has continued to coordinate the assembly of speakers, reviewers, and invitees for the TRU, TRU Mixed, and LLMW Thermal Treatment Peer Review scheduled for Nov. 13-17 in Dallas, Texas, which is a joint effort with the Mixed Waste Focus Area. Logistics for the meeting have been arranged in preparation.

PLUMES FOCUS AREA (PFA)

A Schedule Variance Sheet was prepared for use by DOE PFA personnel to assess completion of milestones. Electronic information on PFA milestones was translated into database and spreadsheet formats for the development of project tracking information.

Technical inputs were provided for the Plumes Focus Area weekly and monthly reports concerning the completion status of PFA milestones, technical progress, and schedule information.

Technical inputs and coordination were provided for the construction of a Plumes Focus Area exhibit presentation hosted by the International Union of Operating Engineers at the Washington Court Hotel.

DECONTAMINATION AND DECOMMISSIONING (D&D) FOCUS AREA

A comparative analysis of focus area planning documents (strategic plans, management plans, and implementation plans) was provided. The information is being used by the focus area leaders to complete and/or update their planning documents in a consistent format.

The team provided technical input and summary documentation of all D&D funding activities in FY95 and FY96 as well as proposed activities for FY97. This material was used to support DOE during a review of D&D Focus Area by the National Academy of Science on October 30.

MIXED WASTE FOCUS AREA (MWFA)

The team analyzed the issues resulting in significant cost and schedule variances that were reported in the August 1995 inputs to the Project Tracking System.

LIAISON AND COMMUNICATION

Technical input was provided for year-end program review agenda and invitation letters.

TRANSPORTATION MANAGEMENT

Monthly Milestone/Schedule Status Report and Task Assignment Management Reports were prepared.

The staff continued to arrange for training workshops. The training registration and logistic arrangements have been processed. To date, 39 of 53 scheduled workshops in FY 1995 were supported (19 of the scheduled workshops were cancelled by DOE).

TASK C - TECHNOLOGY INTEGRATION

MIXED WASTE FOCUS AREA (MWFA)

Team members participated in the DOE-sponsored public meeting in Idaho Falls on the Draft Waste Management Programmatic Environmental Impact Statement.

COST ANALYSIS

Assistance was provided to the Richland office to prepare cost-benefit analysis of current technology development projects.

LEGISLATIVE/REGULATORY

A plan was developed to track significant legislative and regulatory developments related to environmental issues in the states where the majority of DOE's environmental cleanup costs will be incurred (Washington, South Carolina/Georgia, Tennessee, Colorado, and Idaho). Sources for computer-retrievable environmental statutes, regulations and policies for the above states are being investigated.

ATTACHMENT A

PRODUCTS DELIVERED: TASK A - TECHNOLOGY MANAGEMENT

TANKS FOCUS AREA (TFA)

- EMAB Orientation/Presentation 10/25/95
- Technology Development FY96 Data Call Review
- Review--"Taking Stock: An Overview of Public Participation Lessons Learned by the U.S. DOE"
- Review of Cost/Benefit information from TD Counsel Meeting in Butte, Montana

LANDFILL STABILIZATION FOCUS AREA (LSFA)

- Review of Non-Thermal Plasma SERDP Proposal

PLUMES FOCUS AREA (PFA)

- PFA NAS October 1995 Review Support
- PFA WETO/MSE Support Analysis
- PFA Milestones Converted into Electronic (Spreadsheet)Format
- Review of Draft Strategic Plan

DECONTAMINATION AND DECOMMISSIONING (D&D) FOCUS AREA

- Trip report detailing activities of the CP-5 large scale demonstration planning meeting

MIXED WASTE FOCUS AREA (MWFA)

- Comments on the statement of work for the Research Opportunity Announcement
- Comments on the Technology Development Needs Report
- Comments on the Brookhaven National Laboratory Proposal

PRODUCTS DELIVERED: TASK B - PROJECT MANAGEMENT

TANK FOCUS AREA (TFA)

- Guidance for Strategic Plan Program Area Summaries--10/25/95
- Phone Lists for Tanks Focus Area groups for DOE/RL to give out at EMAB review--10/24/95
- TFA TTP Database/Combined field output into one file and put on EM-50 LAN (disks to support this task at Morgantown location)

LANDFILL STABILIZATION FOCUS AREA (LSFA)

- Plan for Vitrification Peer Review--cost estimate, panel qualifications, speakers/facilitators identification, agenda, outline and guidance for reviewing technologies

PLUMES FOCUS AREA (PFA)

- Technical review to support the Release of Several TTP's for Funding
- EM-50 Weekly Management Reports
- PFA PEG/TTP Resolution Report
- Comparison of PFA FY 1995 and FY 1996 Funding by Field Office

DECONTAMINATION AND DECOMMISSIONING (D&D) FOCUS AREA

- Status report on focus area planning documentation
- Project Summary and Funding for D&D activities in FY95, FY96, and proposed FY97

LIAISON AND COMMUNICATION

- Draft invitation and Agenda for year end review.

TRANSPORTATION MANAGEMENT

- Management Milestone/Schedule Status Report for October, 1995.
- Management Task Assignment Status Report for October, 1995.
- Follow-up Report for Motor Carrier Evaluation Program - Sept. 13-15, 1995.
- Follow-up Report for Implementing Federal Motor Carrier Safety Regulations - Sept. 11-12, 1995.
- Follow-up Report for Advanced Hazardous Waste Recurrent Training - Sept.

21, 1995.

- Follow-up Report for Advanced Radioactive Material Recurrent Training - Sept. 20, 1995.
- Follow-up Report for Advanced Hazardous Materials Recurrent Training - Sept. 19, 1995.
- Follow-up Report for Advanced Radioactive Material - Sept. 27-29, 1995.
- Follow-up Report for Advanced Hazardous Materials - Sept. 25-26, 1995.

WPI Waste Policy Institute
A Virginia Tech Affiliated Corporation

Monthly Cost and Labor Report

University of North Dakota
Energy and Environmental Research Center

Subcontract No. 359 636

October 1995

WGB 95 0351

PROGRAM SUMMARY

Whole Dollars

WASTE POLICY INSTITUTE

11-12-1995
13:43:49

LRE Actuals through OCT-95

SELECTION CRITERIA: WBS ID: ********************

WBS: ******************** 1029 PROJECT
Parent:
Perf Dept:
Resp Dept:
Manager:
Chg No :
/ :
/ :
/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-OCT-95
Earned Value Method: No EVM Required

Approval: ____________ Initials: ____ Date: ____________
Approval: ____________ Initials: ____ Date: ____________
Approval: ____________ Initials: ____ Date: ____________

Task Description:

PROVICE ASSISTANCE TO EERC's CONDUCT OF TECHNOLOGY DEVELOPMENT INTEGRATION ACTIVITIES.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	10,639	-10,639	42,173	63,382	-21,209	42,173	63,382	-21,209
Price:	1100160	1072629	27531	4996287	5250577	-254290	4996287	5250577	-254290

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89,295	1,251,829	1,454,843	1,100,160	1,100,160	0	0	0	0	0	0	0
Cum Price:	89,295	1,341,124	2,795,967	3,896,127	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287
Actuals												
Mon Hrs:	149.0	15,709.8	17,723.3	19,161.3	10,638.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	149.0	15,858.8	33,582.0	52,743.3	63,382.0	63,382.0	63,382.0	63,382.0	63,382.0	63,382.0	63,382.0	63,382.0
Mon Price:	8,492	1,240,210	1,300,381	1,628,866	1,072,629	0	0	0	0	0	0	0
Cum Price:	8,492	1,248,702	2,549,083	4,177,949	5,250,577	5,250,577	5,250,577	5,250,577	5,250,577	5,250,577	5,250,577	5,250,577
ETC												
Mon Hrs:	1,437.3	18,428.1	22,307.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1,437.3	19,865.4	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0	42,173.0
Mon Price:	89,295	1,251,829	1,454,843	1,100,160	1,100,160	0	0	0	0	0	0	0
Cum Price:	89,295	1,341,124	2,795,967	3,896,127	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287	4,996,287

TASK A

Whole Dollars

WASTE POLICY INSTITUTE

11-12-1995
13:43:51

LRE Actuals through OCT-95

WBS: 1029.01 TECH MANAGEMENT TASK A
Parent: ********************
Perf Dept:
Resp Dept:
Manager:
Chg No : OPEN
/ :
/ :
/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-OCT-95
Earned Value Method: No EVM Required

Approval: ________ Initials: ____ Date: ________
Approval: ________ Initials: ____ Date: ________
Approval: ________ Initials: ____ Date: ________

Task Description:

PERFORM TECHNICAL REVIEWS OF REQUIREMENTS, NEEDS AND ASSESSMENTS RELATED TO WASTE CHARACTERIZATION, CONTAINMENT, IN-SITU AND EX-SITU TREATMENT, WASTE STORAGE, DISPOSAL, ROBOTICS HANDLING, MONITORING, LABORATORY ANALYSIS, SITE CHARACTERIZATION AND REMEDIATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	6,453	-6,453	16,236	28,224	-11,988	16,236	28,224	-11,988
Price:	427200	657545	-230345	1937431	2515208	-577777	1937431	2515208	-577777

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14,090	498,386	570,555	427,200	427,200	0	0	0	0	0	0	0
Cum Price:	14,090	512,476	1,083,031	1,510,231	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431
Actuals												
Mon Hrs:	50.0	6,255.0	7,504.0	7,961.3	6,453.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	50.0	6,305.0	13,809.0	21,770.3	28,223.5	28,223.5	28,223.5	28,223.5	28,223.5	28,223.5	28,223.5	28,223.5
Mon Price:	2,574	533,931	582,189	738,970	657,545	0	0	0	0	0	0	0
Cum Price:	2,574	536,505	1,118,694	1,857,663	2,515,208	2,515,208	2,515,208	2,515,208	2,515,208	2,515,208	2,515,208	2,515,208
ETC												
Mon Hrs:	328.2	7,196.4	8,711.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	328.2	7,524.6	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0	16,236.0
Mon Price:	14,090	498,386	570,555	427,200	427,200	0	0	0	0	0	0	0
Cum Price:	14,090	512,476	1,083,031	1,510,231	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431	1,937,431

TASK B

Whole Dollars

WASTE POLICY INSTITUTE

11-12-1995
13:43:57

LRE Actuals through OCT-95

WBS: 1029.02 PROJECT MNGT TASK B Perf Dept: Resp Dept: Manager: Chg No : OPEN / : / : / : Alias :
Parent: ********************

Start Date: 27-JUN-95
Complete Date: 31-OCT-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

CONDUCT REVIEWS, ANALYZE AND DEVELOP STRATEGIES FOR PROGRAM MANAGEMENT SYSTEMS FOR INTEGRATION AND CONTROL OF PROGRAMS, PROJECTS, TASKS AND DOCUMENTATION.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	3,578	-3,578	14,994	29,123	-14,129	14,994	29,123	-14,129
Price:	395440	341971	53469	1793276	2234035	-440759	1793276	2234035	-440759

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21,034	453,804	527,559	395,440	395,440	0	0	0	0	0	0	0
Cum Price:	21,034	474,838	1,002,397	1,397,837	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276
Actuals												
Mon Hrs:	98.0	8,116.3	8,247.3	9,083.5	3,578.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	98.0	8,214.3	16,461.5	25,545.0	29,123.0	29,123.0	29,123.0	29,123.0	29,123.0	29,123.0	29,123.0	29,123.0
Mon Price:	5,779	599,758	566,591	719,936	341,971	0	0	0	0	0	0	0
Cum Price:	5,779	605,537	1,172,129	1,892,065	2,234,035	2,234,035	2,234,035	2,234,035	2,234,035	2,234,035	2,234,035	2,234,035
ETC												
Mon Hrs:	309.3	6,643.1	8,041.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	309.3	6,952.4	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0	14,994.0
Mon Price:	21,034	453,804	527,559	395,440	395,440	0	0	0	0	0	0	0
Cum Price:	21,034	474,838	1,002,397	1,397,837	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276	1,793,276

TASK C

Whole Dollars

WASTE POLICY INSTITUTE

11-12-1995
13:44:01

LRE Actuals through OCT-95

WBS: 1029.03 TECH INTEGRATION
TASK C
Parent: ********************

Perf Dept:
Resp Dept:

Manager:
Chg No : OPEN

/ :
/ :
/ :
Alias :

Start Date: 27-JUN-95
Complete Date: 31-OCT-95
Earned Value Method: No EVM Required

Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______
Approval: ______ Initials: ____ Date: ______

Task Description:

PROVIDE SUPPORT IN ESTABLISHING CRITERIA FOR IDENTIFYING RISKS TO THE PUBLIC HEALTH AND SAFETYPOSED BY CONDITIONS AT THE WEAPONS COMPLEX FACILITIES, EVALUATE THE EXTENT OF THESE RISKS, DETERMIN THE URGENCY AND PRIORITIES FOR ELIMINATING OR MINIMIZING THE RISKS, AND ACCESS THE COST OF ACTIVITIES REQUIRED TO MEET APPLICABLE COMPLIANCE AGREEMENTS.

Cost Performance Summary:

	Current Period			Inception to Date			At Complete		
	Budget	Actuals	Variance	Budget	Actuals	Variance	Budget	Estimate	Variance
Hours:	0	608	-608	10,943	6,036	4,908	10,943	6,036	4,908
Price:	277521	73113	204407	1265579	501334	764245	1265579	501334	764245

Monthly Financial Recap:

	Jun 95	Jul 95	Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96
Budget												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54,170	299,639	356,729	277,521	277,521	0	0	0	0	0	0	0
Cum Price:	54,170	353,810	710,538	988,059	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579
Actuals												
Mon Hrs:	1.0	1,338.5	1,972.0	2,116.5	607.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	1.0	1,339.5	3,311.5	5,428.0	6,035.5	6,035.5	6,035.5	6,035.5	6,035.5	6,035.5	6,035.5	6,035.5
Mon Price:	139	106,521	151,601	169,960	73,113	0	0	0	0	0	0	0
Cum Price:	139	106,660	258,261	428,221	501,334	501,334	501,334	501,334	501,334	501,334	501,334	501,334
ETC												
Mon Hrs:	799.8	4,588.6	5,554.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cum Hrs:	799.8	5,388.4	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0	10,943.0
Mon Price:	54,170	299,639	356,729	277,521	277,521	0	0	0	0	0	0	0
Cum Price:	54,170	353,810	710,538	988,059	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579	1,265,579

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 10 – Technology Development Integration	7/1/95 through 9/30/95

4. Name and Address: Energy & Environmental Research Center
University of North Dakota
PO Box 9018, Grand Forks, ND 58202-9018 (701) 777-5000

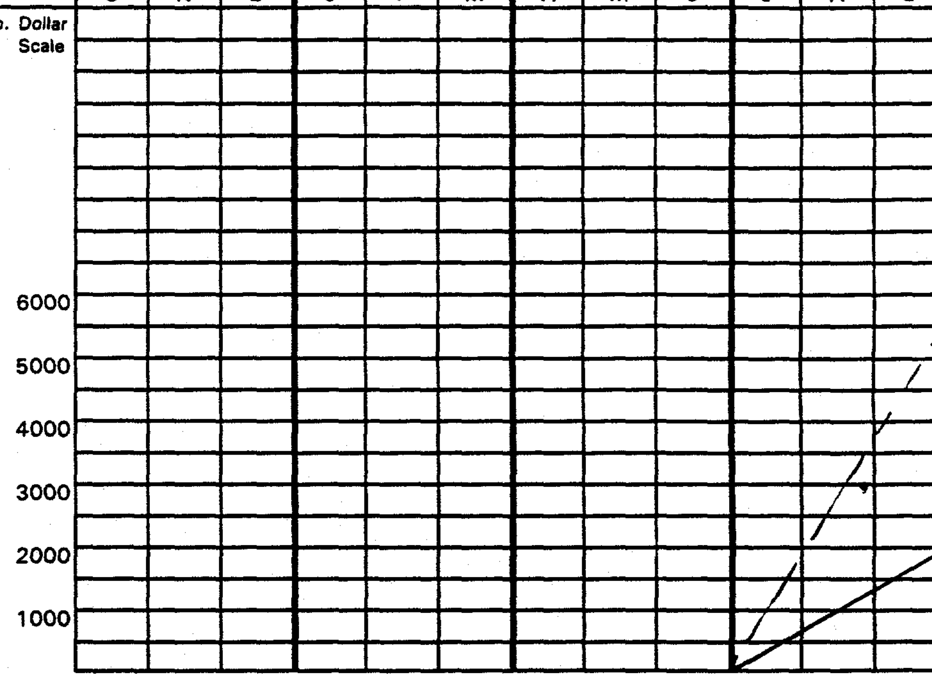
5. Program/Project Start Date: 9/30/94

6. Completion Date: 9/29/99

7. FY: 95/96

8. Months or Quarters: Quarters (1st: O N D; 2nd: J F M; 3rd: A M J; 4th: J A S)

9. Cost Status — a. Dollars Expressed In Thousands — b. Dollar Scale



10. Cost Chart

Fund Source		Quarter 1st	2nd	3rd	4th	Cum. to Date	Tot. Plan
DOE	P	0	0	0	5400	5400	5400
	A				1909	1909	
	P						
	A						
	P						
	A						
	P						
	A						
Total P		0	0	0	5400	5400	5400
Total A					1909	1909	
Variance					3491	3491	

P = Planned A = Actual

Total Planned Costs for Program/Project

$5400

c. Cumulative Accrued Costs

	O	N	D	J	F	M	A	M	J	J	A	S
Planned			0			0			0			5400
Actual												1909
Variance												3491

11. Major Milestone Status	Units Planned / Units Complete
10.1 Technology Management	P / C
10.2 Project Management	P / C
10.3 Technology Integration	P / C
	P / C
	P / C
	P / C
	P / C
	P / C
	P / C

12. Remarks

13. Signature of Recipient and Date: [signature] 11/6/95

14. Signature of DOE Reviewing Representative and Date

FORM E1A-459E
(10/80)

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

FORM APPROVED
OMB NO. 1900 0127

1. Program/Project Identification No.	2. Program/Project Title	3. Reporting Period
DE-FC21-94MC31388	EM Task 10 – Technology Development Integraton	4/1/95 through 6/30/95

4. Name and Address
Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018 (701) 777-5000

5. Program/Project Start Date
9/30/94

6. Completion Date
9/29/99

Milestone ID. No.	Description	Planned Completion Date	Actual Completion Date	Comments
10.1	Technology Management	9/29/95		80%
10.2	Project Management	9/29/95		80%
10.3	Technology Integration	9/29/95		80%