

**Idaho
National
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INEL-95/0129

Addendum System A-8

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May 1996

Integrated Thermal Treatment System Study Phase 2

Addendum System A8

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**C. Biagi
B. Teheranian
W. J. Quapp
W. E. Schwinkendorf**

MASTER

LOCKHEED MARTIN



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Phase 2

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C. Biagi
B. Teheranian
W. J. Quapp
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MASTER

Idaho National Engineering Laboratory
Lockheed Martin Idaho Technologies Company
Idaho Falls, ID 83415

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ADDENDUM

This is an addendum to the Integrated Treatment System Study - Phase 2 Results report. This addendum describes the technology and the operation of System A-8, Rotary Kiln, Air Combustion Gas, Dry-Wet APC, and Grout Stabilization. A Process Flow Diagram (PFD), functional allocation diagrams (FAD), and plan views and perspective views for this system are attached. Detailed cost information for this subsystem is reported in Appendix A.

1.0 System A-8: Rotary Kiln, Air Combustion Gas, Dry-Wet APC, and Grout Stabilization

System A-8 is identical to System A-1 except that a grout stabilization subsystem is used to provide the primary stabilization function in place of the vitrification subsystem. Functions of other subsystems remain the same as those for System A-1.

2.0 Primary Stabilization Subsystem

The primary stabilization subsystem receives ash from the incinerator subsystem, the air pollution control system subsystem, and other solid waste from the receiving and preparation subsystem. The stabilization process may be classified as microencapsulation, which meets EPA requirements for stabilizing solid wastes. The mass ratio of waste feed to grout is 1:2 by weight. Waste solidified by this process must meet EPA TCLP test objectives, or other testing requirements specified in 40 CFR 268.

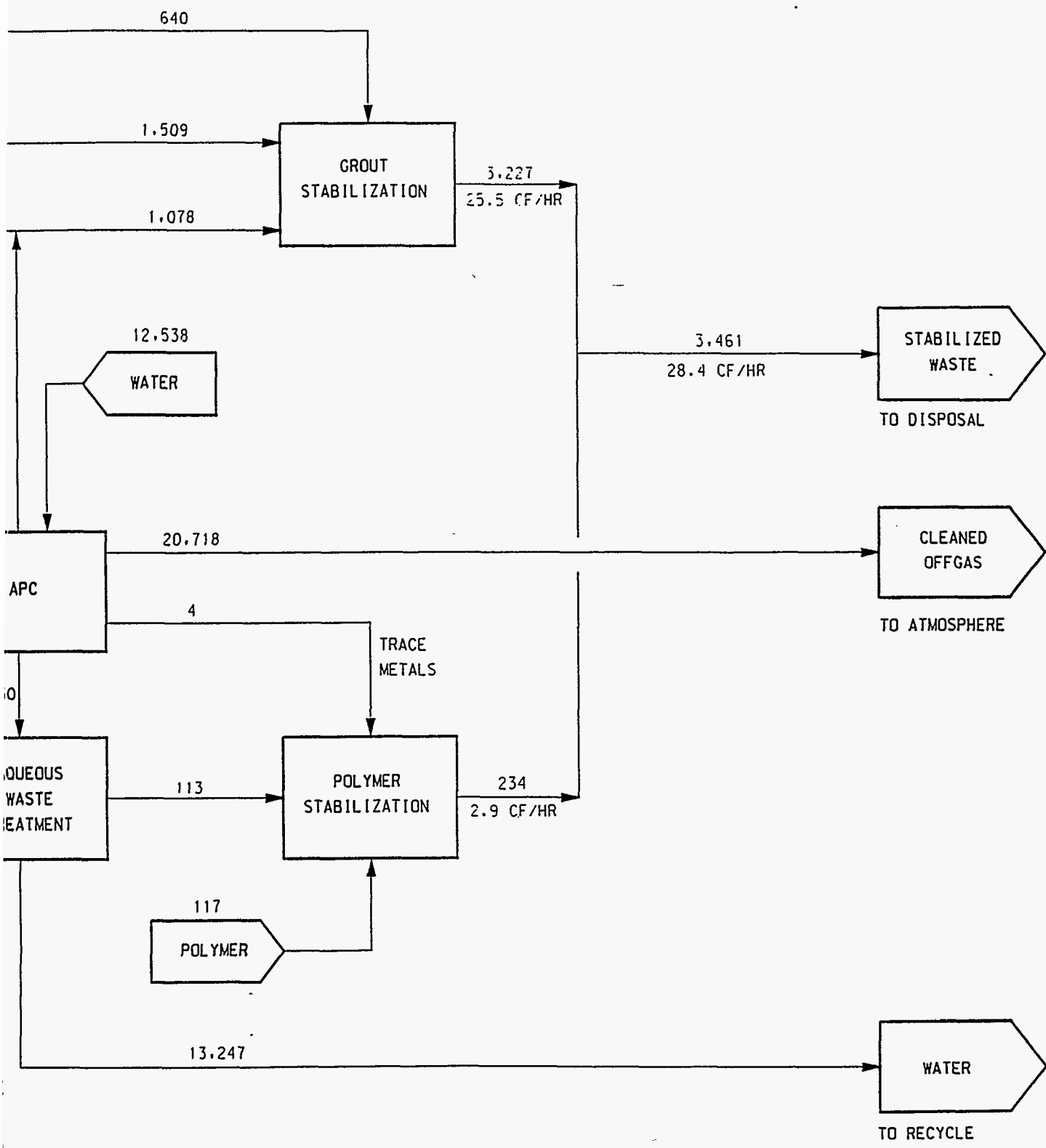
This subsystem has preparation and mixing, and container filling, capping, swiping, and decontamination devices. A concrete core sampling unit is also provided for obtaining samples. A grout mixer blends grout with solids and processed residues. Grout formulation may consist of cement, water, and sand. The blended product is poured into containers and allowed to cure. Once the stabilized waste has solidified, containers are capped, wipe tested, washed if necessary, and moved to the certification and shipping subsystem. Figure 1 shows the PFD for System A-8, Figure 2 illustrates the FAD for the System A-8, grout stabilization subsystem, and Figure 3 provides the equipment layout for grout stabilization subsystem.

3.0 Comparison of Systems

Tables 1 through 9 present comparison of outputs and costs between Systems A-1 and A-8. As expected System A-8 has lower off-gas due to use of a non-thermal primary stabilization technology (Table 1). The final volume sent to disposal from System A-8 is 2.3 times larger less than the volume sent to disposal System A-1 (Table 2). The volume reduction factor in this analysis is defined as volume input to the system divided by volume output from the system. The volume reduction factor for system A-8, and System A-1 are 1.47 and 3.37 respectively (Table 3).

The life cycle cost of System A-8, not including disposal costs is 11% higher than that of System A-1 (Table 5). This increase is primarily due to the increased operating expense associated with the certification and shipping function (Table 6).

Including disposal costs, the total life cycle cost for System A-8 is 24% higher than that of System A-1 as presented in Table 5. When compared to the other nineteen ITTS systems, System A-8 has higher the median treatment cost as presented in Table 7. It has the third highest final waste volume as presented in Table 8. System A-8 has the fourth highest total life cycle cost (total treatment and disposal cost) of the nineteen systems as presented in Table 9.



PRIMARY KILN USING AIR AND GROUT STABILIZATION (SYSTEM A-8)

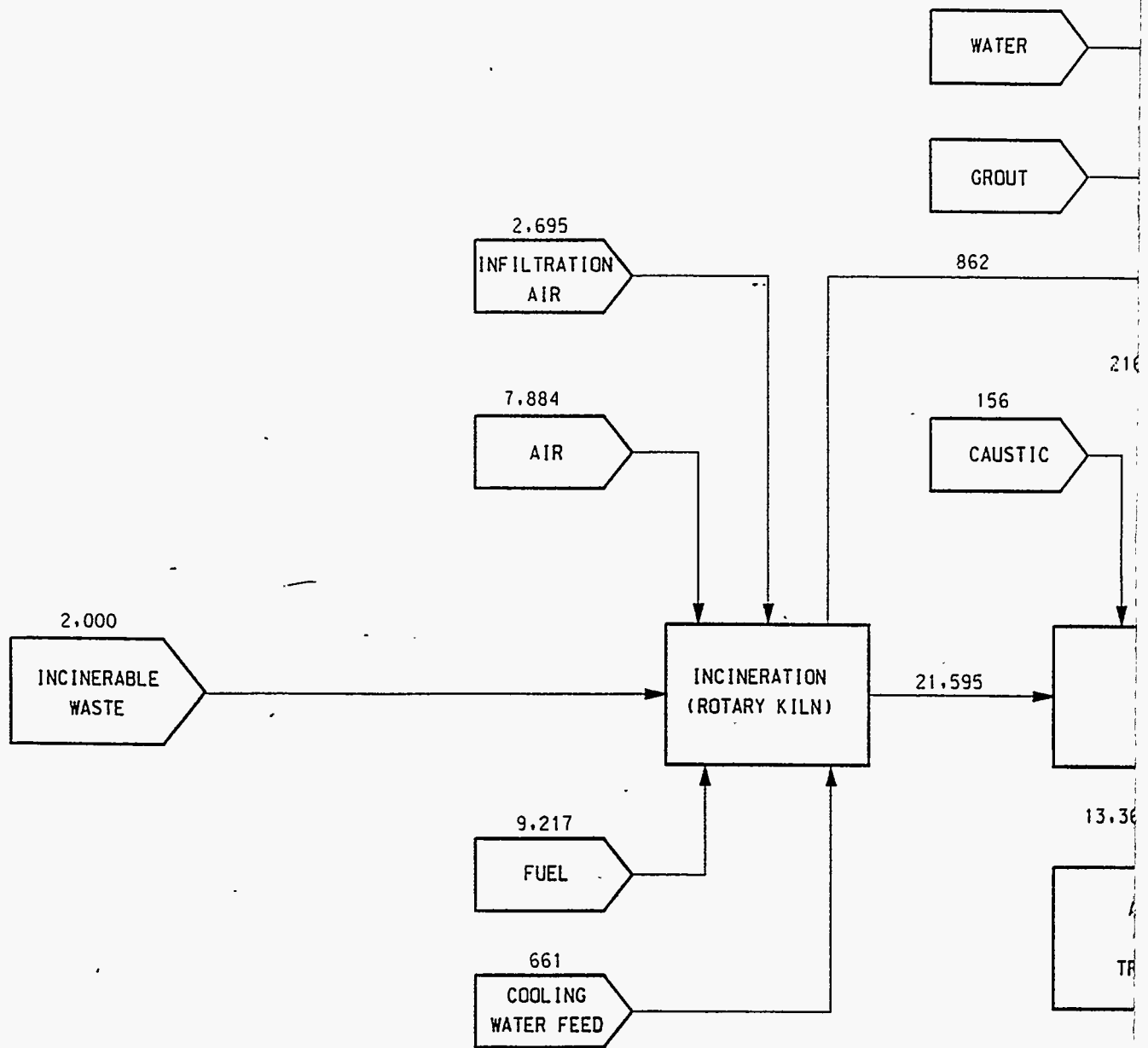


FIGURE 1. GENERAL MASS FLOW RATES (lbs/hr) FOR ROT

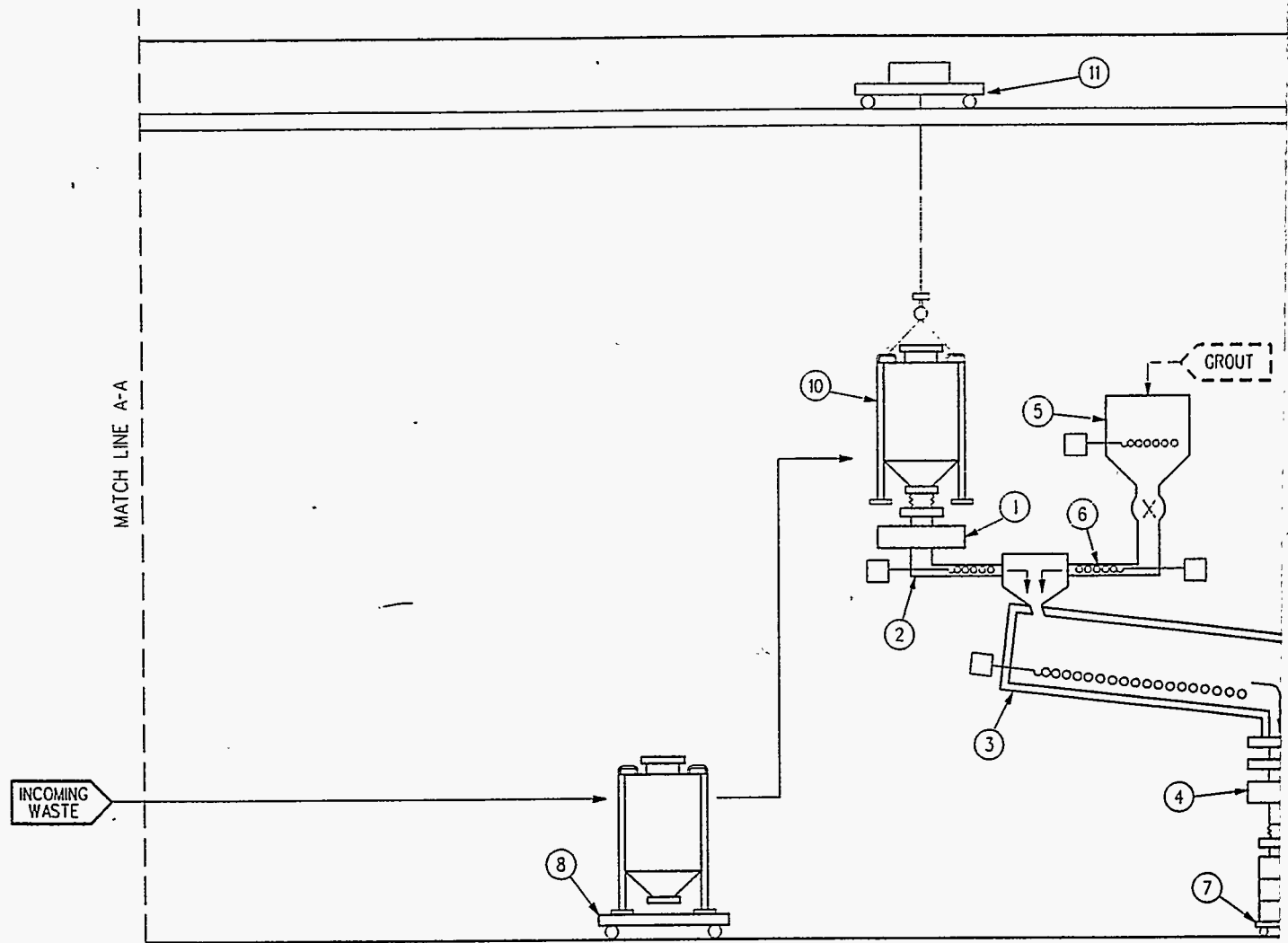


<p>⑤ GROUT TANK (CA)</p>	<p>⑥ GROUT FEEDER (CA)</p>
<p>⑪ OH CRANE (CA)</p>	

———→ PRIMARY MATERIAL FLOW
 - - - - -→ SECONDARY MATERIAL FLOW

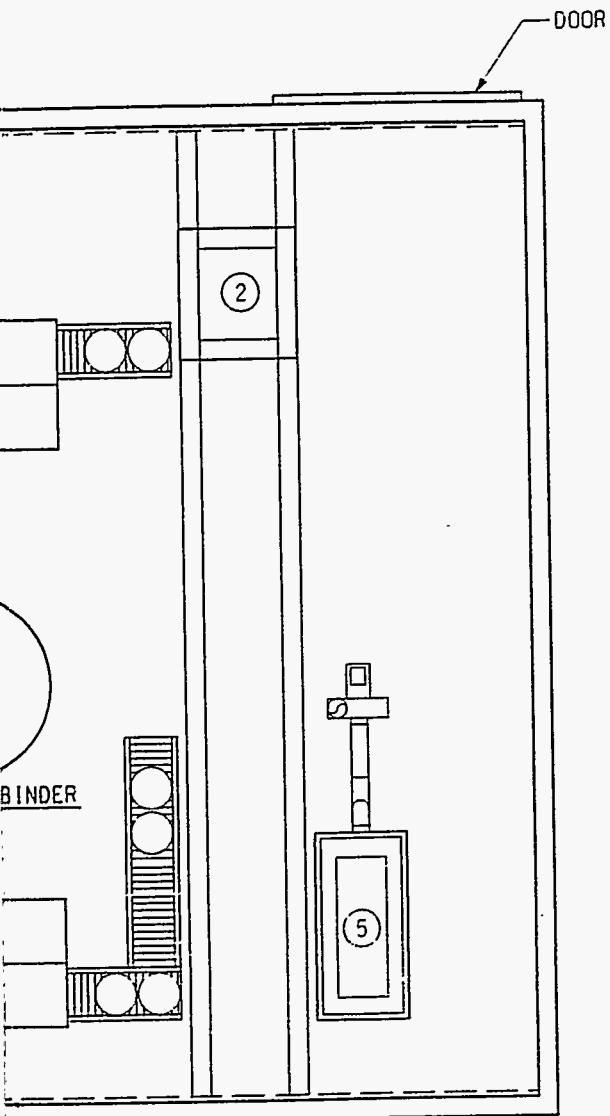
CA • COMMERCIALY AVAILABLE
 ND • NEEDS DEVELOPMENT
 SI • SYSTEMS INTEGRATION NEEDED

BILIZATION SUBSYSTEM (SYSTEM A-8)



① HOPPER INTAKE AIRLOCK (SI)	② GROUT FEEDER (CA)	③ STABILIZATION MIXER (SI)	④ DISCHARGE VALVE & FLANGE (SI)
⑦ TRANSFER DOLLY (CA)	⑧ TRANSFER DOLLY (CA)	⑨ CAPPING & WASHING (SI)	⑩ PORTABLE WASTE HOPPER (HD)

FIGURE 2. FAD FOR GROUT STA



EQUIPMENT LIST

- ① WASTE TRANSFER DOLLY
- ② 5 TON OVERHEAD CRANE
- ③ LIVE BOTTOM BULK STORAGE HOPPER
- ④ GROUT FEEDER
- ⑤ DUST COLLECTOR, FAN AND HEPA FILTER
- ⑥ DRUM STAGING CONVEYOR (POWERED ROLL)
- ⑦ DAY BIN
- ⑧ SOLIDIFICATION SYSTEM
- ⑨ DRUM CAPPING & WASHING SYSTEM
- ⑩ STORAGE BIN
- ⑪ CONVEYOR

UT STABILIZATION SUBSYSTEM (SYSTEM A-8)

10
FEET

DOOR (TYP)

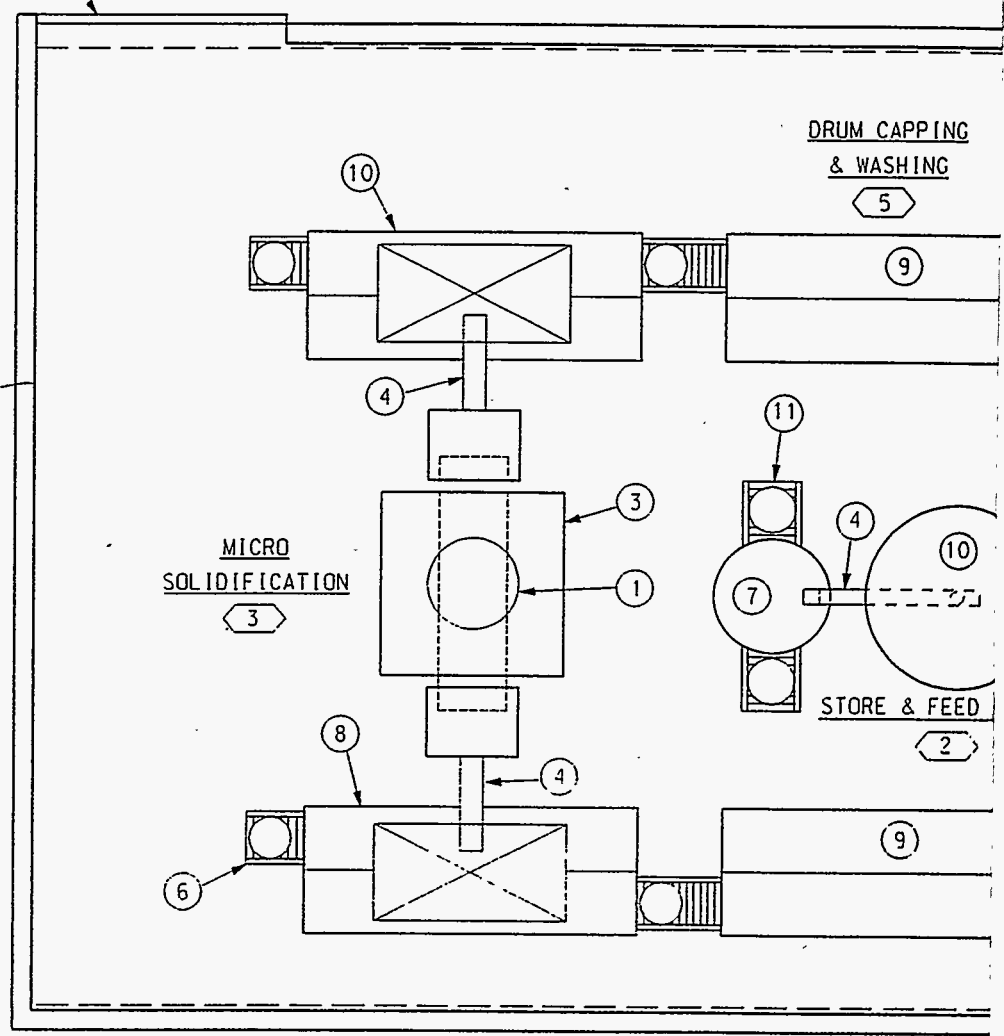


FIGURE 3. EQUIPMENT LAYOUT FOR GRO

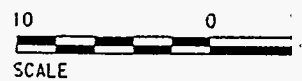


Table 1. Comparison of Offgas from Systems A-8 and A-1 (lb/hr).

Subsystem	Rotary kiln, air, Grout	Rotary kiln, air
	A-8	A-1
Main thermal treatment APC (1)	20,200	20,200
Metal melting	46	46
Lead recovery	35	35
Mercury amalgamation	97	97
Primary stabilization	-	319
Total	20,378	20,697

Note:

1. The actual number calculated for APC throughput for System A-8 was 20,718 but the previously calculated throughput of 20,200 for system A-1 was used since the thermal treatment subsystems of A-1, and A-8 are identical.

Table 2. Comparison of Waste volume reduction for Systems A-8 and A-1

Subsystem	Rotary kiln, air, Grout	Rotary kiln, air
	A-8	A-1
Main thermal treatment (ft ³ /hr)	-	-
Primary stabilization (ft ³ /hr)		
Source: Main thermal treatment	-	7.99
Source: Metal melting	0.12	0.12
Source: Lead recovery	0.004	0.004
Grout stabilization (ft ³ /hr)		
Source: Main thermal treatment	25.50	-
Source: Lead recovery	0.007	0.007
Source: Mercury amalgamation	0.01	0.01
Polymer stabilization (ft ³ /hr)		
Source: Aqueous waste treatment, unprocessed Halide and Sulfate salts, trace metals from main thermal treatment APC.	2.95	2.95
Source: Metal decontamination	0.11	0.11
Special waste treatment (ft ³ /hr)	2.39	2.39
Total system output to disposal (ft ³ /hr)	31.09	13.58
Stabilized waste output to disposal from main thermal treatment and APC subsystems	28.4	10.9
Total system input for 20 years (1000ft ³) [same for all systems]	3,688	3,688
Total system output for 20 years (1000ft ³)	2,507	1,095
Volume reduction factor (Input volume /Output volume)	1.47	3.37

Table 4: Total life-cycle cost comparison for Systems A-1 and A-8.

	Rotary kiln, air	Rotary kiln, grout stabilization
	A-1	A-8
TREATMENT (a)		
Items 1.0, 2.0, and 4.0	\$196,919	\$205,674
Item 3.0	\$554,377	\$513,656
Item 5.0	\$1,361,850	\$1,631,400
Item 6.0	\$54,171	\$55,642
Total Treatment PLCC	\$2,167,318	\$2,406,372
DISPOSAL		
Disposal PLCC	\$266,242	\$609,420
TOTAL TREATMENT & DISPOSAL		
PLCC	\$2,433,560	\$3,015,792

Table 5. Normalized treatment life-cycle cost comparison for Systems A-1 and A-8.

	Rotary kiln, air	Rotary kiln, grout stabilization
	A-1	A-8
TREATMENT (a)		
Items 1.0, 2.0, and 4.0	\$196,919	1.04
Item 3.0	\$554,377	0.93
Item 5.0	\$1,361,850	1.20
Item 6.0	\$54,171	1.03
Total Treatment PLCC	\$2,167,318	1.11
DISPOSAL		
Disposal PLCC	\$266,242	2.29
TOTAL TREATMENT & DISPOSAL PLCC	\$2,433,560	1.24

(a) Work Breakdown Structure Elements used in developing Treatment PLCC are as follows:

- 1.0 Studies & Bench Scale Tests
- 2.0 Demonstration Costs
- 3.0 Production Facility Construction Costs
- 4.0 Operating Budget Funded Activities
- 5.0 Operating & Maintenance Costs
- 6.0 Decontamination & Decommissioning Costs

Table 6. Treatment Life-Cycle Cost Estimate per Subsystem

No.	Subsystem	System A-1	System A-8
		PLC Cost \$ Millions	PLC Cost \$ Millions
1	Administration Building Subsystem	\$139	\$139
2	Receiving & Inspection Subsystem	\$667	\$667
3	Metal Decontamination Subsystem	\$62	\$62
4	Metal Melting Subsystem	\$92	\$92
5	Lead Recovery Subsystem	\$81	\$81
6	Incineration Subsystem	\$161	\$161
7	Thermal Desorption Subsystem	NA	NA
8	Air Pollution Control Subsystem	\$115	\$115
9	Aqueous Waste Treatment Subsystem	\$149	\$149
10	Primary Stabilization Subsystem	\$244	NA
11	Secondary Stabilization Subsystem	\$81	\$81
12	Special Waste	\$29	\$29
13	Mercury Amalgamation Subsystem	\$52	\$52
14	Certify & Shipping Subsystem	\$193	\$588
15	Grout Stabilization Cost Package	NA	\$88
16	Salt Recovery Cost Package	NA	NA
17	Support Subsystem	\$101	\$101
	Total Planning Life Cycle Cost	\$2,167	\$2,406

Table 7. ITTS Systems Ranked by Treatment Costs
Normalized with respect to system A-1 costs

System	Total treatment cost
K-1 Thermal desorption and MEO	1.21
E-1 Rotary kiln, air, thermal desorption	1.20
L-1 Thermal desorption and SCWO	1.17
A-4 Rotary kiln, oxygen, CO2 retention	1.13
A-5 Rotary kiln, air, polymer stabilization	1.12
A-8 Rotary kiln, grout stabilization	1.11
D-1 Fixed hearth pyrolyzer, CO2 retention	1.10
F-1 Molten salt oxidation	1.07
A-3 Rotary kiln, air, wet APC	1.04
B-1 Indirectly heated pyrolyzer	1.03
A-6 Rotary kiln, air, maximum recycling	1.03
H-1 Steam gasification	1.01
A-1 Rotary kiln, air	1.00
A-2 Rotary kiln, oxygen	1.00
C-2 Plasma furnace, CO2 retention	0.99
C-1 Plasma furnace	0.91
A-7 Slagging rotary kiln	0.90
C-3 Plasma gasification	0.89
J-1 Joule-heated vitrification	0.89
G-1 Molten metal waste destruction	0.87

AVERAGE= 0.98

Table 8. ITTS Systems Ranked by Final Waste Volumes
Normalized with respect to system A-1 final waste volumes

System	Final waste vol.
K-1 Thermal desorption and MEO	3.14
L-1 Thermal desorption and SCWO	2.98
A-8 Rotary kiln, grout stabilization	2.29
E-1 Rotary kiln, air, thermal desorption	2.27
A-5 Rotary kiln, air, polymer stabilization	2.10
A-4 Rotary kiln, oxygen, CO2 retention	1.45
A-3 Rotary kiln, air, wet APC	1.25
D-1 Fixed hearth pyrolyzer, CO2 retention	1.12
C-2 Plasma furnace, CO2 retention	1.11
F-1 Molten salt oxidation	1.07
A-7 Slagging rotary kiln	1.07
A-1 Rotary kiln, air	1.00
A-2 Rotary kiln, oxygen	1.00
B-1 Indirectly heated pyrolyzer	1.00
J-1 Joule-heated vitrification	1.00
H-1 Steam gasification	1.00
C-3 Plasma gasification	0.97
C-1 Plasma furnace	0.97
G-1 Molten metal waste destruction	0.85
A-6 Rotary kiln, air, maximum recycling	0.79

AVERAGE= 1.35

Table 9. ITTS Systems Ranked by Total Life Cycle Costs
Normalized with respect to system A-1 life cycle costs

System	Total life cycle cost
K-1 Thermal desorption and MEO	1.42
L-1 Thermal desorption and SCWO	1.37
E-1 Rotary kiln, air, thermal desorption	1.31
A-8 Rotary kiln, grout stabilization	1.24
A-5 Rotary kiln, air, polymer stabilization	1.23
A-4 Rotary kiln, oxygen, CO2 retention	1.17
D-1 Fixed hearth pyrolyzer, CO2 retention	1.10
F-1 Molten salt oxidation	1.07
A-3 Rotary kiln, air, wet APC	1.06
B-1 Indirectly heated pyrolyzer	1.03
H-1 Steam gasification	1.01
A-6 Rotary kiln, air, maximum recycling	1.01
C-2 Plasma furnace, CO2 retention	1.00
A-1 Rotary kiln, air	1.00
A-2 Rotary kiln, oxygen	1.00
C-1 Plasma furnace	0.92
A-7 Slagging rotary kiln	0.92
C-3 Plasma gasification	0.90
J-1 Joule-heated vitrification	0.90
G-1 Molten metal waste destruction	0.87

AVERAGE= 1.02

APPENDIX -A-

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
Rotary kiln, air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
1	Administration Building Subsystem	II							
-	Administration Office								
-	Office Furniture - EMPLOYEE	E		49	7.0	343.0	1.0	49.0	392.0
-	Computers	E		Lot	500.0	500.0	50.0	50.0	550.0
-	Communication	E		Lot	250.0	250.0	35.0	35.0	285.0
	Testing Laboratory								
-	ICP-Mass Spectrometer	D		1					
-	Gas Chromatography - Mass Spec.	D		1					
-	Scintillation Counter - Alpha	D		1					
-	Scintillation Counter - Gamma	D		1					
-	Geiger - Muller Counter	D		1					
-	Fume Hood	A		2					
-	Centrifuge	A		2					
-	Autoclave	A		1					
-	Scrubber/Blower	C		1					
-	Hood/HEPA Filtration	C		1					
-	Glovebox	D		1					
-	Wet Chemistry Equipment	D		1					
-	Refrigeration / Storage	A		1					
-	Computer & Data Communication	D		2					
-	Atomic Absorption Spectrography	D		1					
-	Soil / Physical Testing Equipment	D		Lot					
-	Complete Package per Above Detail	E		Lot	1,500.0	1,500.0	300.0	300.0	1,800.0
-	Office Equipment & Furnishing	E		Lot	80.0	80.0	7.0	7.0	87.0
-	Allowance for Mechanical/Piping	E		Lot	801.9	801.9	264.6	264.6	1,066.5
-	Allowance for Electrical/Control	E		Lot	401.0	401.0	220.5	220.5	621.5
-	Calibration, Testing & Startup	E		Lot	77.5	77.5	37.0	37.0	114.5
-									
-									
	Total Administration Building Subsystem					3,953.4		963.1	4,916.5
2	Receiving & Inspection Subsystem	II							
-	Unloading, Staging & Storage (A-RCINS)								
-	O/H Bridge Crane & Rigging - 20 TN	E		1	625.0	625.0	125.0	125.0	750.0
-	Forklift - 10 TN	E		2	65.0	130.0	10.0	20.0	150.0
-	Airlock	E		1	124.0	124.0	39.0	39.0	163.0
-	Inspect & Assay (A-RCINS)								
-	Transfer Cart - 2 TN	B							
-	Gamma Spectroscopy (GS)	D							
-	Passive Active Neutron Assay (PAN)	D							
-	Real Time Radiography (RTR)	D							
-	Load Cell	D							
-	CCTV	D							
-	RHMMS Barrel Monitor including above	E		1	2,000.0	2,000.0	400.0	400.0	2,400.0
-	Personnel Contamination Monitor	E		1	35.0	35.0	5.0	5.0	40.0
-	Container Decontamination Enclosure	E		1	140.0	140.0	15.0	15.0	155.0
-	Open, Dump, & Sort								
-	Self Guided Vehicle	E		2	425.0	850.0	64.0	128.0	978.0
-	DeCap Device	E		2	50.0	100.0	9.0	18.0	118.0
-	Sort Hopper	E		2	40.0	80.0	4.0	8.0	88.0
-	Sort/Rotating Table	E		2	200.0	400.0	30.0	60.0	460.0
-	Special Waste Glove Box	E		1	400.0	400.0	48.0	48.0	448.0
-	Dump Hopper	E		3	40.0	120.0	4.0	12.0	132.0
-	Maintenance Crane	E		1	800.0	800.0	120.0	120.0	920.0
-	Bins	E		80	5.0	400.0	1.0	80.0	480.0
-	Bin Conveyor 8 ft long	E		20	10.0	200.0	4.0	80.0	280.0

**Table E - 47: Equipment Purchase & Installation
Budgetary Cost Estimates -
Integrated Thermal Treatment System
(Cost Module ITTS)**

SYSTEM A-8
Rotary kiln. air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
-	Bin Conveyor 70 ft long	E		2	70.0	140.0	28.0	56.0	196.0
-	Bin Pusher	E		34	10.0	340.0	4.0	136.0	476.0
-	Main Cell Gantry Robot	E		1	2,000.0	2,000.0	400.0	400.0	2,400.0
-	Sorting Table Hydraulic Manipulator	E		2	120.0	240.0	40.0	80.0	320.0
-	Sorting Master Slave Manipulator	E		4	100.0	400.0	40.0	160.0	560.0
-	Box Size Reduction Unit	E		1	1,500.0	1,500.0	400.0	400.0	1,900.0
-	Drum Opening Gantry Robot	E		2	400.0	800.0	80.0	160.0	960.0
-	Glovebox Hydraulic Manipulator	E		2	120.0	240.0	40.0	80.0	320.0
-	Container Grapppler	E		4	50.0	200.0	8.0	32.0	232.0
-	Decap Enclosure	E		2	100.0	200.0	30.0	60.0	260.0
-	CCTV	E		8	10.0	80.0	2.0	16.0	96.0
-	Airlock	E		4	124.0	496.0	39.0	156.0	652.0
-	Motor Control Center	E		132	1.5	198.0	0.5	66.0	264.0
-	Roller up Door (CA)	E		2	20.0	40.0	2.0	4.0	44.0
-	Allowance for Mechanical/Piping	E		Lot	3,983.4	3,983.4	1,778.4	1,778.4	5,761.8
-	Allowance for Electrical/Control	E		Lot	1,991.7	1,991.7	1,482.0	1,482.0	3,473.7
-	Calibration, Testing & Startup	E		Lot	385.1	385.1	249.0	249.0	634.1
-									
-						19,638.2		6,473.4	26,111.6
3	Metal Decontamination Subsystem	II							
-	Pretreatment (GTCC-II)								
-	High Pressure Water Rinse Station								
-	Hot Air Dryer Station								
-	Chemical Storage Tank								
-	Chemical Mixing Tank								
-	Chemical Metering Pump								
-	Solution Pump								
-	Complete Package per Above Detail	E		Lot	150.0	150.0	50.0	50.0	200.0
-	CCTV	E		2	10.0	20.0	2.0	4.0	24.0
-	Size Reduction (GTCC-II)								
-	Hydraulic Manipulator	E		1	120.0	120.0	50.0	50.0	170.0
-	Gantry Robot	E		1	800.0	800.0	160.0	160.0	960.0
-	Size Reduction Table and Tools	E		1	205.0	205.0	40.0	40.0	245.0
-	Fugitive Dust Collection System	E		2	100.0	200.0	15.0	30.0	230.0
-	Master Slave Manipulator	E		1	65.0	65.0	15.0	15.0	80.0
-	Airlock	E		2	124.0	248.0	39.0	78.0	326.0
-	Assay/Inspection (GTCC-II)								
-	Assay Unit - Mini	E		1	500.0	500.0	100.0	100.0	600.0
-	Roller Conveyor			10	6.0	60.0	1.0	10.0	70.0
-	Shielding Window	E		3	130.0	390.0	44.0	132.0	522.0
-	Allowance for Mechanical/Piping	E		Lot	827.4	827.4	401.4	401.4	1,228.8
-	Allowance for Electrical/Control	E		Lot	413.7	413.7	334.5	334.5	748.2
-	Calibration, Testing & Startup	E		Lot	80.0	80.0	56.2	56.2	136.2
-									
-									
	Total Metal Decontamination Subsystem					4,079.1		1,461.1	5,540.2
4	Metal Melting Subsystem	II							
-	Prepare and Feed Incoming Waste (A-MMELT)								
-	Bulk Solids Dump Hopper	F		1	45.0	45.0	10.0	10.0	55.0
-	Gantry Robot	F		1	525.0	525.0	105.0	105.0	630.0
-	Master Slave Manipulator	E		1	65.0	65.0	15.0	15.0	80.0
-	Size Reduction Table with Tools	E		1	120.0	120.0	24.0	24.0	144.0
-	Drum/Bin Conveyor	F		20	6.0	120.0	1.0	20.0	140.0
-	CCTV	E		2	10.0	20.0	4.0	8.0	28.0
-	Airlock	E		2	124.0	248.0	39.0	78.0	326.0

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
Rotary kiln, air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
-	Dust Collection Assembly	E		1	100.0	100.0	15.0	15.0	115.0
-	Melter (A-MMELT)								
-	Melter								
-	Melter Feed Assembly								
-	Melter Secondary Combustion Chamber								
-	Melter Oxygen Feed Controller								
-	Melter Inlet Air Blower								
-	Melter Discharge System								
-	Melter Room Temperature Monitoring & Cooling								
-	Melter Vacuum Pumps								
-	Melter Slag/ Ingot Vacuum Chamber								
-	Melter Hearth Removal System								
-	Cost Per Package Above	F		Lot	1,200.0	1,200.0	500.0	500.0	1,700.0
-	Maintenance Crane	E		1	450.0	450.0	100.0	100.0	550.0
-	Monorail Hoist	F		1	85.0	85.0	20.0	20.0	105.0
-	Cool Melter (A-MMELT)								
-	Melter Cooling Water Unit								
-	Cooling Water Pump 150 GPM								
-	Cooling Water Pump 200 GPM								
-	Cooling Water Pump 2500 GAL								
-	Elevated Water Tank								
-	Cooling Tower								
-	Circulation pump	E							
-	Complete Package per Above Detail	E		Lot	150.0	150.0	60.0	60.0	210.0
-	Metal Cooling & Packaging (A-MMELT)								
-	Metal Canister Capper	F		1	150.0	150.0	50.0	50.0	200.0
-	Canister Decon Unit	F		1	70.0	70.0	20.0	20.0	90.0
-	Canister Cooling System	F		1	200.0	200.0	60.0	60.0	260.0
-	Canister Conveyor	F		15	4.0	60.0	1.0	15.0	75.0
-	Air Pollution Control System								
-	Quench System	E		1	100.0	100.0	20.0	20.0	120.0
-	Filter Baghouse	E		1	30.0	30.0	6.0	6.0	36.0
-	Activated Carbon Filters	E		1	50.0	50.0	10.0	10.0	60.0
-	HEPA Filters	E		1	50.0	50.0	10.0	10.0	60.0
-	Stack	E		1	20.0	20.0	4.0	4.0	24.0
-	Stack Monitor (Radioactive)	E		1	200.0	200.0	80.0	80.0	280.0
-	Stack Monitor (Non-Radioactive)	E		1	150.0	150.0	60.0	60.0	210.0
-	Allowance for Mechanical/Piping	E		Lot	1,262.4	1,262.4	774.0	774.0	2,036.4
-	Allowance for Electrical/Control	E		Lot	631.2	631.2	645.0	645.0	1,276.2
-	Calibration, Testing & Startup	E		Lot	122.0	122.0	108.4	108.4	230.4
-									
-									
	Total Metal Melting Subsystem					6,223.6		2,817.4	9,041.0
5	Lead Recovery Subsystem	II							
-	Battery Disassembly (A-PBRCR)								
-	Roller Conveyors (ft)	F		50	4.0	200.0	1.0	50.0	250.0
-	Shredder	F		1	42.0	42.0	7.0	7.0	49.0
-	Hydraulic Drum Dumper	F		1	3.0	3.0	1.0	1.0	4.0
-	Hydraulic Drum Dumper w/ Spout	F		1	10.0	10.0	2.0	2.0	12.0
-	Acid Resist Sorting Table	E		1	5.0	5.0	1.0	1.0	6.0
-	Acid Drain Tank	E		1	5.0	5.0	1.0	1.0	6.0
-	Battery Cutting Saw	F		1	2.0	2.0	1.0	1.0	3.0
-	Airlock	E		1	124.0	124.0	39.0	39.0	163.0
-	Crane	E		1	525.0	525.0	105.0	105.0	630.0
-	CCTV	E		2	10.0	20.0	2.0	4.0	24.0
-	Decontamination (A-PBRCR)								

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
 Rotary kiln. air/grout stabilization

DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			Total U.O.
			QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	
- Drum Lid Detacher	F		1	4.0	4.0	1.0	1.0	5.0
- Roller Conveyors (Straight)	F		12	5.0	60.0	1.0	12.0	72.0
- Decon Booth	F		1	175.0	175.0	25.0	25.0	200.0
- Hydraulic Drum Dumper	F		1	4.0	4.0	2.0	2.0	6.0
- Sorting Table (1 Hole)	E		2	4.0	8.0	1.0	2.0	10.0
- Sorting Table (4 Holes)	E		1	6.0	6.0	1.0	1.0	7.0
- Rolling Conveyor (L-Shaped)	F		1	5.0	5.0	2.0	2.0	7.0
- Drum Pusher	F		1	1.0	1.0	1.0	1.0	2.0
- Aqueous Waste Tank	E		1	5.0	5.0	2.0	2.0	7.0
- Aqueous Waste Pump	E		1	3.0	3.0	2.0	2.0	5.0
- Lead Melter (A-PBRCR)								
- Melting Furnace w/ Hood	F		1	100.0	100.0	30.0	30.0	130.0
- Crucibles	E		1	1.0	1.0	0.2	0.2	1.2
- Sodium Carbonate Tank	E		1	5.0	5.0	0.2	0.2	5.2
- Sodium Carbonate Pump	E		1	5.0	5.0	0.2	0.2	5.2
- Stirrer	E		1	15.0	15.0	2.5	2.5	17.5
- Casting (A-PBRCR)								
- Lead Casting	F		1	88.0	88.0	10.0	10.0	98.0
- Cast Lead Cooling Bin	F		4	5.0	20.0	0.3	1.2	21.2
- Assay/Drumming (A-PBRCR)								
- Drum Pusher	F		1	10.0	10.0	0.2	0.2	10.2
- Lid Attacher	F		1	2.0	2.0	0.3	0.3	2.3
- Assay Station	F		1	500.0	500.0	3.0	3.0	503.0
- Drum Washer	E		1	70.0	70.0	10.0	10.0	80.0
- Miscellaneous Equipment								
- Transfer Cart (CA)	E		1	100.0	100.0	20.0	20.0	120.0
- Air Pollution Control								
- Quencher System	E		1	100.0	100.0	20.0	20.0	120.0
- Baghouse	E		1	30.0	30.0	6.0	6.0	36.0
- Activate Carbon	E		1	50.0	50.0	10.0	10.0	60.0
- HEPA Filter	E		1	50.0	50.0	10.0	10.0	60.0
- Stack	E		1	20.0	20.0	4.0	4.0	24.0
- Stack Monitor (Radioactive)	E		Lot	200.0	200.0	80.0	80.0	280.0
- Stack Monitor (Non-Radioactive)	E		Lot	150.0	150.0	60.0	60.0	210.0
- Allowance for Mechanical/Piping	E		Lot	816.9	816.9	317.3	317.3	1,134.2
- Allowance for Electrical/Control	E		Lot	408.5	408.5	264.4	264.4	672.9
- Calibration, Testing & Startup	E		Lot	79.0	79.0	44.4	44.4	123.4
-								
-								
Total Lead Recovery Subsystem					4,027.4		1,154.9	5,182.3
6 Incineration Subsystem	II							
- Prepare & Feed Incoming Waste (A-INCIN)								
- Feed Conveyor/Lift/Hoist/Bins	E		5	33.0	33.0	8.0	8.0	41.0
- Disch. & Oversize Load Hopper (100 CF)	E		1	30.0	30.0	8.0	8.0	38.0
- Shredder Primary/Secondary	E		250	1,500.0	1,500.0	400.0	400.0	1,900.0
- Magnetic & Eddy Current Separation Equipment	E							
- Tertiary Shredder	E							
- Conveyor / Canister Handler	E		5	40.0	40.0	10.0	10.0	50.0
- Manipulate Crane 10 TN	E		15	790.0	790.0	160.0	160.0	950.0
- Organic Liquid Feed	E		Lot	100.0	100.0	20.0	20.0	120.0
- Liquid Waste Feed	E		Lot	100.0	100.0	20.0	20.0	120.0
- Airlock	E		1	124.0	124.0	39.0	39.0	163.0
- CCTV	E		2	10.0	20.0	2.0	4.0	24.0
- Incinerator (A-INCIN)								
- Incinerator Assembly & Feed System	E							
- Ash Transfer System	E							

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
Rotary kiln. air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
-	Ventilation Blower	E							
-	Complete Package Above	E		1	1,700.0	1,700.0	800.0	800.0	2,500.0
-	Oxygen Feed	E							
-	OH Crane	E		1	525.0	525.0	105.0	105.0	630.0
-	Allowance for Mechanical/Piping	E		Lot	1,488.6	1,488.6	944.4	944.4	2,433.0
-	Allowance for Electrical/Control	E		Lot	744.3	744.3	787.0	787.0	1,531.3
-	Calibration, Testing & Startup	E		Lot	143.9	143.9	132.2	132.2	276.1
-	Total from A-1								
-	Allowance for O2 Feed System	E		Lot					
	Total Incineration Subsystem					7,338.8		3,437.6	10,776.4
7	Thermal Desorption Subsystem	II							
-	Feed Preparation								
-	Kiln feeder	E							
-	Storage Tank	E							
-	Thermal Desorption								
-	Kiln/ Calciner	E							
-	Condensor								
-	Primary	E							
-	Secondary	E							
-	Filter	E							
-	Carbon Adsorption								
-	Vapor Phase Carbon	E							
-	Centrifugal Blower (100 scfm)	E							
-	Stack	E							
-	Stack Monitor (Non-radioactive)	E							
-	Stack Monitor (Radioactive)	E							
-	OH Crane	E							
-	Airlock	E							
-	CCTV	E							
-									
-	Allowance for Piping/Mechanical	E		Lot					
-	Allowance for Electrical/Control	E		Lot					
-	Calibration, Testing & Startup	E		Lot					
-									
	Total Thermal Desorption Subsystem								
8	Air Pollution Control Subsystem	II							
-	DRY OFFGAS TREATMENT								
-	Baghouse Assembly	E		1	240.0	240.0	48.0	48.0	288.0
-	Quencher Assembly	E		1	150.0	150.0	48.0	48.0	198.0
-	Inter Connection Ducts.	E		Lot	2.0	2.0	100.0	100.0	102.0
-	Carbon Filter (Mercury)	E		4	50.0	200.0	20.0	80.0	280.0
-	Prefilter	E		2	26.0	52.0	12.0	24.0	76.0
-	HEPA Filters	E		Lot	825.0	825.0	165.0	165.0	990.0
-									
-	WET OFFGAS TREATMENT								
-	Packing Tower	E		1	250.0	250.0	70.0	70.0	320.0
-	Induced Fan	E		2	25.0	50.0	3.0	6.0	56.0
-	Recycle Pump	E		2	10.0	20.0	1.0	2.0	22.0
-	Sludge Discharge Pump	E		2	15.0	30.0	3.0	6.0	36.0
-	Dissolved Solids Pump	E		2	5.0	10.0	1.0	2.0	12.0
-	Condensate Pump	E		2	5.0	10.0	1.0	2.0	12.0
-	Quench Water Pump	E		2	5.0	10.0	1.0	2.0	12.0
-	Vacuum Pump	E		2	15.0	30.0	3.0	6.0	36.0
-	Slurry Pump	E		2	15.0	30.0	3.0	6.0	36.0
-	Condensate Tank	E		1	5.0	5.0	1.0	1.0	6.0

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
 Rotary kiln. air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
-	NaOH Day Tank	E		1	5.0	5.0	1.0	1.0	6.0
-	Scrubber Solution Tank	E		1	5.0	5.0	1.0	1.0	6.0
-	Evaporator System	E		1	300.0	300.0	90.0	90.0	390.0
-	Dioxin/ Denox Filter	E		2	500.0	1,000.0	100.0	200.0	1,200.0
-	Hydrosonic Scrubber	E		1	150.0	150.0	30.0	30.0	180.0
-	Liquid/ Solid Separator	E		1	100.0	100.0	20.0	20.0	120.0
-	Mist Eliminator	E		1	9.0	9.0	2.0	2.0	11.0
-	Heat Exchanger	E		2	30.0	60.0	10.0	20.0	80.0
-									
-	CO2 RETENTION								
-	Fluid Bed Absorber	E							
-	Cyclone Separator	E							
-	CaCO3 Collection Tank/ Feed	E							
-	Calciner	E							
-	Calciner Feed Assembly	E							
-	Calciner Discharge Port	E							
-	Recycled Lime Collection & Feed	E							
-	Fresh Lime Collection & Feed	E							
-	Heat Exchanger	E							
-	Compressors	E							
-	Offgas Detention Tanks	E							
-	Waste Lime Collection Tank/Feed	E							
-	HEPA Filters	E							
-	Vacuum Pump	E							
-									
-	SUPPORT SYSTEMS								
-	Stack	E		1	40.0	40.0	8.0	8.0	48.0
-	Stack Monitors - Radioactive	E		Lot	200.0	200.0	80.0	80.0	280.0
-	Stack Monitors - Non Radioactive	E		Lot	150.0	150.0	60.0	60.0	210.0
-	OH Crane	E		1	525.0	525.0	105.0	105.0	630.0
-	Airlock	E		2	124.0	248.0	39.0	78.0	326.0
-	CCTV	E		2	10.0	20.0	2.0	4.0	24.0
-									
-	Allowance for Mechanical/Piping	E		Lot	1,417.8	1,417.8	760.2	760.2	2,178.0
-	Allowance for Electrical/Control	E		Lot	708.9	708.9	633.5	633.5	1,342.4
-	Calibration, Testing & Startup	E		Lot	137.1	137.1	106.4	106.4	243.5
-									
-									
	Total Air Pollution Control Subsystem					6,989.8		2,767.1	9,756.9
9	Aqueous Waste Treatment Subsystem	II							
-	Batch Liquid Waste (A-AQWTR)								
-	High TOC Batch Tank with Agitator	E		1	27.0	27.0	5.0	5.0	32.0
-	High TOC Batch Tank Pump	E		1	5.0	5.0	1.0	1.0	6.0
-	Low TDS Batch Tank with Agitator	E		1	27.0	27.0	5.0	5.0	32.0
-	Low TDS Batch Tank Pump	E		1	5.0	5.0	1.0	1.0	6.0
-	High TDS/ Heavy Metals Batch Tank with Agitator	E		1	27.0	27.0	5.0	5.0	32.0
-	High TDS/ Heavy Metals Batch Tank Pump	E		1	5.0	5.0	1.0	1.0	6.0
-	Hg Batch Tank wth Agitator	E		1	27.0	27.0	5.0	5.0	32.0
-	Hg Batch Tank Pump	E		1	5.0	5.0	1.0	1.0	6.0
-	Airlocks	E		1	124.0	124.0	39.0	39.0	163.0
-	CCTV	E		2	10.0	20.0	2.0	4.0	24.0
-	Crane	E		1	525.0	525.0	105.0	105.0	630.0
-	Gross Organics Removal (A-AQWTR)								
-	Oil/ Water Separator	E		1	18.0	18.0	2.5	2.5	20.5
-	Neutralization / Settling (A-AQWTR)								
-	NeutralizationSystem	E		1	95.0	95.0	19.0	19.0	114.0

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
Rotary kiln, air/grout stabilization

DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
			QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
- Neutralization Overflow Pump	E		1	5.0	5.0	1.0	1.0	6.0
- Sludge Transfer Pump	E		1	5.0	5.0	1.0	1.0	6.0
- Sludge Settler	E		1	27.0	27.0	5.0	5.0	32.0
- Sludge Settler Pump	E		1	5.0	5.0	1.0	1.0	6.0
- Suspended Solids Filtration (A-AQWTR)								
- Suspended Solids Filter	E		1	125.0	125.0	25.0	25.0	150.0
- Dissolved Organics Removal (A-AQWTR)								
- Batch Stripper with Stripper Condensor	E		1	330.0	330.0	55.0	55.0	385.0
- UV/ Peroxide System	E		1	65.0	65.0	8.0	8.0	73.0
- Liquid Phase Carbon (55 gal drums)	E		8	5.0	40.0	0.5	4.0	44.0
- Stripper Pump	E		1	5.0	5.0	1.0	1.0	6.0
- Concentration (A-AQWTR)								
- Vapor Phase Carbon	E		2	16.0	32.0	3.0	6.0	38.0
- Evaporator with Condensor	E		1	500.0	500.0	75.0	75.0	575.0
- Condensor Liquids Pump	E		1	5.0	5.0	1.0	1.0	6.0
- Dissolved Solids Removal (A-AQWTR)								
- Ion Exchanger	E		1	61.0	61.0	9.0	9.0	70.0
- Treated Water Sampling (A-AQWTR)								
- Treated Water Tanks	E		2	45.0	90.0	12.0	24.0	114.0
- Treated Water Pumps	E		2	5.0	10.0	1.0	2.0	12.0
- Chemical Distribution (A-AQWTR)								
- Chemical Addition Pump (Acid)	E		1	5.0	5.0	1.0	1.0	6.0
- Chemical Addition Pump (Caustic)	E		1	5.0	5.0	1.0	1.0	6.0
- Chemical Addition Pump (Sulfide)	E		1	5.0	5.0	1.0	1.0	6.0
- Chemical Addition Pump (Floc/ Polymer)	E		1	1.0	1.0	0.3	0.3	1.3
- Chemical Storage Tanks	E		4	7.0	28.0	1.5	6.0	34.0
- Chemical Addition Pump (Peroxide)	E		1	5.0	5.0	1.0	1.0	6.0
- Peroxide Storage Tank	E		1	7.0	7.0	1.5	1.5	8.5
- Allowance for Mechanical/Piping	E		Lot	681.3	681.3	254.0	254.0	935.3
- Allowance for Electrical/Control	E		Lot	340.7	340.7	211.7	211.7	552.4
- Calibration, Testing & Startup	E		Lot	65.9	65.9	35.6	35.6	101.5
-								
-								
Total Aqueous Waste Treatment Subsystem					3,358.9		924.6	4,283.5
10 Primary Stabilization Subsystem	II							
- Prepare and Feed Incoming Waste (A-VITRF)								
- Bulk Solids Dump Hopper	F							
- Shredding System	E							
- Waste Prep Crane	F							
- Drum/Bin Conveyor	E							
- CCTV	E							
- Airlock	E							
- Dust Collection Assembly	E							
- Melter (A-VITRF)								
- Melter								
- Melter Feed Assembly								
- Melter Oxygen Feed Controller								
- Melter Inlet Air Blower								
- Melter Discharge System								
- Melter Room Temperature Monitoring & Cooling								
- Melter Vacuum Pumps								
- Melter Slag/ Ingot Vacuum Chamber								
- Melter Hearth Removal System								
- Cost Per Package Above	F							
- Maintenance Crane (5 TN)	E							
- Monorail Hoist (5 TN)	F							

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
 Rotary kiln. air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			Total U.O.
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	
- Cool Melter (A-VITRF)									
- Melter Cooling Water Unit									
- Cooling Water Pump 150 GPM									
- Cooling Water Pump 200 GPM									
- Cooling Water Pump 2500 GAL									
- Elevated Water Tank									
- Cooling Tower									
- Circulation pump									
- Complete Package per Above Detail	E								
- Prepare and Feed Soil (A-VITRF)									
- Melter Soil Feeder	E								
- Dryer	E								
- Soil Day Tank	E								
- Soil Storage Silos	E								
- Soil Transfer Pump	E								
- Slag Cooling & Packaging (A-VITRF)									
- Metal Canister Capper	F								
- Canister Decon Unit	F								
- Canister Cooling System	F								
- Canister Conveyor	E								
- Grouting Unit	E								
- Air Pollution Control									
- Quencher	E								
- Ceramic Filters	E								
- Primary Activated Carbon Filter	E								
- Hepa Filter	E								
- Induced Fan	E								
- Baghouse	E								
- Stack	E								
- Stack Monitor (Radioactive)	E								
- Stack Monitor (Non-Radioactive)	E								
- Allowance for Mechanical/Piping	E								
- Allowance for Electrical/Control	E								
- Calibration, Testing & Startup	E								
-									
-									
-									
Total Primary Stabilization Subsystem									
11 Secondary Stabilization Subsystem	II								
- Prepare & Feed Incoming Waste (A-PLYMR)									
- Bin Hoist / Pusher1	F		5	1	66.0	66.0	8.0	8.0	74.0
- Disch. & Oversize Load Hopper (100 CF)1	F		1	1	40.0	40.0	6.0	6.0	46.0
- Primary Shredder (.25, 1.5, 2 TPH)1	E		250	1	480.0	480.0	96.0	96.0	576.0
- Live Bottom Bulk Storage 1	F		1	1	40.0	40.0	6.0	6.0	46.0
- Conveyor / Canister Handler1	F		5	1	80.0	80.0	10.0	10.0	90.0
- Manipulation Crane - 5 TON	E		10	1	525.0	525.0	105.0	105.0	630.0
- Dust Collection System w/ Blower	F			Lot	108.0	108.0	17.0	17.0	125.0
- HEPA Filter	F			2	25.0	50.0	5.0	10.0	60.0
- CCTV	E			2	10.0	20.0	2.0	4.0	24.0
- Airlock	E			2	124.0	248.0	39.0	78.0	326.0
- Drying (A-PLYMR)									
- Drier	F			1	150.0	150.0	40.0	40.0	190.0
- Conveyor	F		5	32	6.0	192.0	1.0	32.0	224.0
- Proportioning and Blending (A-PLYMR)									
- Polymer Pellets Storage Silo	E			1	25.0	25.0	7.0	7.0	32.0
- Weigh Station	E			1	20.0	20.0	5.0	5.0	25.0
- Blender	F		2	1	24.0	24.0	3.0	3.0	27.0

Table E - 47: Equipment Purchase & Installation
 Budgetary Cost Estimates -
 Integrated Thermal Treatment System
 (Cost Module ITTS)

SYSTEM A-8
 Rotary kiln. air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS			
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's	Amount \$1000's	Total U.O.
-	Mercury Amalgamation & Packaging (A-RMERC)								
-	Liquid Mercury Storage Tank	E		1	7.0	7.0	1.0	1.0	8.0
-	Liquid Mercury Pump	E		1	5.0	5.0	1.0	1.0	6.0
-	Copper Powder Bin (1 ft ³)	E		1	5.0	5.0	0.6	0.6	5.6
-	Steel Shot Bin (0.5 ft ³)	E		1	5.0	5.0	0.6	0.6	5.6
-	Nitric Acid Tank (1 GAL)	E		1	5.0	5.0	0.5	0.5	5.5
-	Nitric Acid Pump (1 GPH)	E		1	5.0	5.0	1.0	1.0	6.0
-	Amalgam Mixer (5 GAL)	F		1	26.0	26.0	5.0	5.0	31.0
-	Amalgam packager	F		1	2.0	2.0	0.4	0.4	2.4
-	Allowance for Mechanical/Piping	E		Lot	587.4	587.4	288.1	288.1	875.5
-	Allowance for Electrical/Control	E		Lot	293.7	293.7	240.1	240.1	533.8
-	Calibration, Testing & Startup	E		Lot	56.8	56.8	40.3	40.3	97.1
-									
-									
	Total Mercury Amalgamation Subsystem					2,895.9		1,048.6	3,944.5
14	Certify & Shipping Subsystem	II							
-	Incoming Material Storage (B-CSHIP)								
-	Overhead Bridge Crane 20 TN	E		1	625.0	625.0	125.0	125.0	750.0
-	Forklift 10 TN	E		1	65.0	65.0	10.0	10.0	75.0
-	Inspect & Assay (B-CSHIP)								
-	Transfer Cart 2 TN	E							
-	Real Time Radiography (ND)								
-	Passive Active Neutron (ND)								
-	Segmented Gamma Spectroscopy (ND)								
-	Complete Package per Above	E		1	1,500.0	1,500.0	150.0	150.0	1,650.0
-	Self Guided Vehicle (ND)	E		1	425.0	425.0	850.0	850.0	1,275.0
-	Truck Loading (B-CSHIP)								
-	Roll-up Door	E		2	20.0	40.0	2.0	4.0	44.0
-	Bridge Crane	E		1	525.0	525.0	105.0	105.0	630.0
-	Roller Conveyor (CA)	E		20	2.0	40.0	1.0	20.0	60.0
-	Allowance for Mechanical/Piping	E		Lot	966.0	966.0	758.4	758.4	1,724.4
-	Allowance for Electrical/Control	E		Lot	483.0	483.0	632.0	632.0	1,115.0
-	Calibration, Testing & Startup	E		Lot	93.4	93.4	106.2	106.2	199.6
-									
-									
	Total Certify & Shipping Subsystem					4,762.4		2,760.6	7,523.0
15	Grout Stabilization Cost Package	II							
-	Store & Feed Binder								
-	Pneumatic Feed								
-	Binder Storage Silo								
-	Silo Discharge Feeder								
-	Mixing Station								
-	Binder Feed Pump								
-	Complete Package per Above Detail	E		Lot	250.0	250.0	100.0	100.0	350.0
-	Micro-Solidification								
-	Binder Feed Prep			1.0	30.0	30.0	10.0	10.0	40.0
-	Binder Feed Hopper			1.0	50.0	50.0	15.0	15.0	65.0
-	Waste Feeder			1.0	15.0	15.0	5.0	5.0	20.0
-	Drum Tumbler								
-	Grout/Water Mixer			1.0	175.0	175.0	40.0	40.0	215.0
-	Drum Capping and Washing								
-	Drum Wash /Cap Unit	E		1.0	140.0	140.0	35.0	35.0	175.0
-	Flush Water Collection & Conveying	E					36.0		
-	Conveyor	E					2.0		
-	Allowance for Mechanical/Piping	E		Lot	198.0	198.0	123.0	123.0	321.0
-	Allowance for Electrical/Control	E		Lot	99.0	99.0	102.5	102.5	201.5

**Table E - 47: Equipment Purchase & Installation
Budgetary Cost Estimates -
Integrated Thermal Treatment System
(Cost Module ITTS)**

SYSTEM A-8
Rotary kiln. air/grout stabilization

	DESCRIPTION	CAT.	HP O.	MATLS. & EQUIP.		INST. COSTS		Total U.O.	
				QTY	Unit Cost \$1000's	Amount \$1000's	Unit Cost \$1000's		Amount \$1000's
-	Calibration, Testing & Startup	E		Lot	19.1	19.1	17.2	17.2	36.3
-									
-									
	Total Grout Stabilization Cost Package					976.1		447.7	1,423.8
16	Salt Recovery Cost Package								
-									
-									
	Total Salt Recovery Cost Package								
17	Support Subsystem								
-	Electrical Distribution and MCC								
-	Control Panel - FT	E		110	10.0	1,100.0	2.0	220.0	1,320.0
-	Emergency Power Generator	E		1	500.0	500.0	100.0	100.0	600.0
-	Main Control Panel	E		20	10.0	200.0	2.0	40.0	240.0
-	Motor Control Center	E		100	1.5	150.0	0.5	50.0	200.0
-	Stand by Emergency Power	E		1	230.0	230.0	80.0	80.0	310.0
-	Utilities and Mechanical								
-	Breathing Air Package	E		Lot	70.0	70.0	30.0	30.0	100.0
-	Compressed Air Package	E		Lot	100.0	100.0	25.0	25.0	125.0
-	Instrument Air	E		1	70.0	70.0	30.0	30.0	100.0
-	Instrument Air Package	E		Lot	90.0	90.0	25.0	25.0	115.0
-	Plant Steam/Boiler	E		1	75.0	75.0	25.0	25.0	100.0
-	Service Water	E		1	130.0	130.0	40.0	40.0	170.0
-	Sump Pump	E	3	10	5.0	50.0	2.0	20.0	70.0
-	Heating, Ventilation & Exhaust								
-	Included with Building Cost								
-	Radiation Monitoring								
-	Air Monitors	E		44	10.0	440.0	2.0	88.0	528.0
-	Area Monitoring	E		44	4.5	198.0	1.0	44.0	242.0
-	Personnel Monitoring Portals	E		6	35.0	210.0	5.0	30.0	240.0
-	Portal Monitors	E		6	35.0	210.0	5.0	30.0	240.0
-	Allowance for Mechanical/Piping	E		Lot	38.2	38.2	263.1	263.1	301.3
-	Allowance for Electrical/Control	E		Lot	573.5	573.5	526.2	526.2	1,099.7
-	Calibration, Testing & Startup	E		Lot	88.7	88.7	100.0	100.0	188.7
-									
	Total Support Subsystem					4,523.4		1,766.3	6,289.7
18									
-									
-									
	Total								
19									
-									
-									
	Total								
20									
-									
-									
	Total								

05:26 PM

Table E - 48 : Development, Testing & Evaluation Cost Estimates - Integrated Thermal Treatment System

		SYSTEM A-8								
		Rotary kiln, air/grout stabilization								
		Primary Paper Evaluation Research	Bench Scale Studies Research	Sec. Paper Evaluation Research	Total Research Manpower	Bench Scale Studies Equipment	Bench Scale Studies Installation	Pilot Plant Mock-up Test Demo.	Pilot Plant Mock-up Test Bldg.	Pilot Plant Mock-up Test Equip.
1	Administration Building Subsystem									
2	Receiving & Inspection Subsystem	10			10			21	1000	5000
3	Metal Decontamination Subsystem									
4	Metal Melting Subsystem	6			6					
5	Lead Recovery Subsystem	6	6	2	14	500	150			
6	Incineration Subsystem	10			10			21	1000	7000
7	Thermal Desorption Subsystem									
8	Air Pollution Control Subsystem	10	6	5	21	200	500	30	1000	5000
9	Aqueous Waste Treatment Subsystem	5			5					
10	Primary Stabilization Subsystem									
11	Secondary Stabilization Subsystem		8		8	300	50			
12	Special Waste	5	15		20	500	200			
13	Mercury Amalgamation Subsystem	3	9		12	200	100			
14	Certify & Shipping Subsystem									
15	Grout Stabilization Cost Package									
16	Salt Recovery Cost Package									
17	Support Subsystem									
18										
19										
20										
	Unit Cost (\$/Unit)				\$150,000			\$150,000		
	Total Cost				15,900	1,700	1,000	10,800	3,000	17,000
	Post Totals To Table O-6, Item				1.1	1.2	1.3	2.1	2.5.1	2.5.2

05:26 PM

**Table E - 49 : Building and Equipment Material
& Installation Cost Estimate Summary -
Integrated Thermal Treatment System**

SYSTEM A-8										
Rotary kiln, air/grout stabilization										
	UNIT OPERATION	Building Area				Material & Equipment Costs				Total Cost per Unit Oprtn. \$1000
		Cost Category 1 sq.ft	Cost Category 2 sq.ft	Cost Category 3 sq.ft	Cost Category 4 sq.ft	Total Area Cost \$1000	Purchase Cost \$1000	Installation Cost \$1000	Total Cost \$1000	
1	Administration Building Subsystem	4,000.0	1,500.0			1,350.0	3,953.4	963.1	4,917.0	6,267.0
2	Receiving & Inspection Subsystem		34,730.8	2,311.3		17,361.0	19,638.2	6,473.4	26,112.0	43,473.0
3	Metal Decontamination Subsystem		641.3	169.4	1,904.0	3,709.0	4,079.1	1,461.1	5,540.0	9,249.0
4	Metal Melting Subsystem		1,169.3	308.9	3,472.0	6,764.0	6,223.6	2,817.4	9,041.0	15,805.0
5	Lead Recovery Subsystem		829.9	219.2	2,464.0	4,800.0	4,027.4	1,154.9	5,182.0	9,982.0
6	Incineration Subsystem		829.9	219.2	2,464.0	4,800.0	7,338.8	3,437.6	10,776.0	15,576.0
7	Thermal Desorption Subsystem									
8	Air Pollution Control Subsystem		829.9	219.2	2,464.0	4,800.0	6,989.8	2,767.1	9,757.0	14,557.0
9	Aqueous Waste Treatment Subsystem		641.3	169.4	1,904.0	3,709.0	3,358.9	924.6	4,284.0	7,993.0
10	Primary Stabilization Subsystem									
11	Secondary Stabilization Subsystem		943.0	249.1	2,800.0	5,455.0	3,638.3	1,092.0	4,730.0	10,185.0
12	Special Waste		603.5	159.4	1,792.0	3,491.0				3,491.0
13	Mercury Amalgamation Subsystem		679.0	179.4	2,016.0	3,928.0	2,895.9	1,048.6	3,945.0	7,873.0
14	Certify & Shipping Subsystem		18,180.3	1,209.9		9,088.0	4,762.4	2,760.6	7,523.0	16,611.0
15	Grout Stabilization Cost Package		2200	2270	2790	8,391.0	976.1	447.7	1,424.0	9,815.0
16	Salt Recovery Cost Package									
17	Support Subsystem	3,360.0	15,440.0	5,313.0		13,465.0	4,523.4	1,766.3	6,290.0	19,755.0
18										
19										
20										
Total Cost						91,111.0			99,521.0	190,632.0
		Post Totals To Table 0-6, Item				3.4.1			3.4.2	

05:26 PM

Table E - 50 : Annual Operating & Maintenance Costs -

		SYSTEM A-8						
		Rotary kiln, air/grout stabilization						
	UNIT OPERATION	Operating FTE	Utilities \$1000	Materials \$1000	Maintenance Labor (1) \$1000	\$1000	Maintenance Materials (2) \$1000	Totals \$1000
1	Administration Building Subsystem	27	5	164	395	3953.4	158	553
2	Receiving & Inspection Subsystem	112	159	612	1,965	19638.2	786	2,751
1	Administration Building Subsystem	27	5	164	395	3953.4	158	553
2	Receiving & Inspection Subsystem	112	159	612	1,965	19638.2	786	2,751
3	Metal Decontamination Subsystem	5	7	33	408	4079.1	163	571
4	Metal Melting Subsystem	5	79	33	623	6223.6	249	872
5	Lead Recovery Subsystem	8	73	50	403	4027.4	161	564
6	Incineration Subsystem	16	36	26	735	7338.8	294	1,029
7	Thermal Desorption Subsystem							
8	Air Pollution Control Subsystem	4	60	110	700	6989.8	280	980
9	Aqueous Waste Treatment Subsystem	16	300	1,705	335	3358.9	134	469
10	Primary Stabilization Subsystem							
11	Secondary Stabilization Subsystem	8	44	158	365	3638.3	146	511
12	Special Waste	2	12	200				
13	Mercury Amalgamation Subsystem	4	2	10	290	2895.9	116	406
14	Certify & Shipping Subsystem	139	12	70	475	4762.4	190	665
15	Grout Stabilization Cost Package	8	47	847	98	976.1	39	137
16	Salt Recovery Cost Package							
17	Support Subsystem	5			453	4523.4	181	634
18								
19								
20								
	Unit cost (\$/unit)	\$140,000						
	Total Cost	50,260	836	4,018				10,142
	Post Totals To Table 0-6, Item	5.1	5.2	5.3				5.4

**Table E - 51 : Decontamination & Decommissioning Costs -
Integrated Thermal Treatment System**

		SYSTEM A-8				
		Rotary kiln, air/grout stabilization				
		Building Area				
UNIT OPERATION		Cost Category 1	Cost Category 2	Cost Category 3	Cost Category 4	Total Area Cost
		sq.ft	sq.ft	sq.ft	sq.ft	\$1000
1	Administration Building Subsystem	4,000.0	1,500.0			2,475.0
2	Receiving & Inspection Subsystem		34,730.8	2,311.3		16,669.0
3	Metal Decontamination Subsystem		641.3	169.4	1,904.0	1,222.0
4	Metal Melting Subsystem		1,169.3	308.9	3,472.0	2,228.0
5	Lead Recovery Subsystem		829.9	219.2	2,464.0	1,581.0
6	Incineration Subsystem		829.9	219.2	2,464.0	1,581.0
7	Thermal Desorption Subsystem					
8	Air Pollution Control Subsystem		829.9	219.2	2,464.0	1,581.0
9	Aqueous Waste Treatment Subsystem		641.3	169.4	1,904.0	1,222.0
10	Primary Stabilization Subsystem					
11	Secondary Stabilization Subsystem		943.0	249.1	2,800.0	1,796.0
12	Special Waste		603.5	159.4	1,792.0	1,150.0
13	Mercury Amalgamation Subsystem		679.0	179.4	2,016.0	1,293.0
14	Certify & Shipping Subsystem		18,180.3	1,209.9		8,726.0
15	Grout Stabilization Cost Package		2,200.0	2,270.0	2,790.0	3,267.0
16	Salt Recovery Cost Package					
17	Support Subsystem	3,360.0	15,440.0	5,313.0		10,851.0
18						
19						
20						
Total Cost						55,642
		Post Totals To Table 0-6, Item				6.0

Table E-52 : ROM Life-Cycle Cost Estimate Summary for

0

Cost component	Cost Items	Cost (x 1000) System A-8 Rotary kiln. air/grout stabilization
1.0	Studies and bench-scale test costs	
1.1	Manpower costs during research	\$15,900
1.2	Equipment costs	\$1,700
1.3	Installation costs	\$1,000
1.4	Project management before title 1 (10 % of 1.1 through 1.3)	\$1,860
1.5	Contingency (25 % of 1.1 through 1.4)	\$5,115
	Subtotal 1.0	\$25,575
2.0	Demonstration costs	
2.1	Manpower costs during demonstration	\$10,800
2.2	Design cost (30 % of 2.5)	\$7,740
2.3	Inspection cost (7 % of 2.5)	\$1,806
2.4	Project management (10 % of 2.5)	\$2,580
2.5	Construction cost	
2.5.1	Building structure costs	\$3,000
2.5.2	Equipment costs	\$17,000
2.5.3	Indirect (29 % of 2.5.1 & 2.5.2)	\$5,800
	Subtotal of 2.5	\$25,800
2.6	Construction management costs (17 % of 2.5)	\$4,412
2.7	Management reserve (10 % of 2.5)	\$2,580
2.8	Contingency (25 % of 2.1 through 2.7)	\$13,929
	Subtotal 2.0	\$69,647
3.0	Production facility construction costs	
3.1	Design cost (25 % of 3.4)	\$61,479
3.2	Inspection cost (7 % of 3.4)	\$17,214
3.3	Project management (10 % of 3.4)	\$24,592
3.4	Construction cost	
3.4.1	Building structure costs	\$91,111
3.4.2	Equipment costs	\$99,521
3.4.3	Indirect (29 % of 3.4.1 & 3.4.2)	\$55,283
	Subtotal of 3.4	\$245,915
3.5	Construction management (17 % of 3.4)	\$42,052
3.6	Management reserve (10 % of 3.4)	\$24,592
3.7	Contingency (25 % of 3.1 through 3.5)	\$97,813
	Subtotal 3.0	\$513,656
4.0	Operations budget funded activities (see Sect. 7)	
4.1	Conceptual design (1.5 % of 3.0)	\$7,705
4.2	Safety assurance (1 % of 3.0)	\$5,137
4.3	NEPA permitting (\$ 6 million for EIS, \$1 million for EA)	\$6,000
4.4	Preparation for operations (100 % of 5.0)	\$81,570
4.5	Project management (10 % of 4.1 through 4.4)	\$10,041
	Subtotal 4.0	\$110,453
	Total initial cost (1.0,2.0,3.0 & 4.0)	\$719,330
5.0	Operating and maintenance costs	
5.1	Annual operating costs	\$50,260
5.2	Annual utility costs	\$836
5.3	Annual material costs	\$4,018
5.4	Annual maintenance costs	\$10,142
5.5	Contingency (25 % of 5.1 through 5.4)	\$16,314
5.6	Subtotal 5.0	\$81,570
5.7	Total 20 year O & M cost (20 times Subtotal 5.0)	\$1,631,400
6.0	Decontamination & decommissioning	\$55,642
7.0	ROM life cycle costs (20 years operation)	\$2,406,372
	Total ROM Life cycle costs	\$2,406,372