WM'01 Conference, February 25-March 1, 2001, Tucson, AZ

INNOVATIVE APPROACHES FOR MEETING THE CHALLENGES OF WASTE MINIMIZATION/POLLUTION PREVENTION AT THE HANFORD SITE

S. R. Parikh, MSE, MBA, PE, CVS-Life
Bechtel Hanford, Inc.
3350 George Washington Way
Richland, WA 99352

ABSTRACT

Bechtel Hanford, Inc. (BHI), under contract with U. S. Department of Energy (DOE), has committed to identify areas of Environmental Remediation (ER) activities that would lead to potential waste minimization and, as such, be identified and reported as a waste reduction activity.

BHI has developed a highly successful Pollution Prevention Program to minimize waste during ER activities at the Hanford Site. A key element of the Pollution Prevention Program is the integration of several techniques to identify and achieve waste reductions. These waste reductions are attributed to application of some innovative approaches at the Hanford Site, which include adoption of systematic **Value Methodology (VM)**, instituting the **data quality objective (DQO) process, partnering with regulators**, and deploying **innovative technology**.

Through the deployment of above-mentioned approaches, 20 waste streams were selected for further detailed study, out of 57 potential waste streams identified for waste reduction.

Under detailed study, several leading "Options" were identified, analyzed, and carefully evaluated for each of the 20 waste streams, using rough order of magnitude (ROM) estimates for each of the selected options. In generating these estimates a 15-year life cycle was selected, based upon Soil Remediation *Tri-Party Agreement* compliance.

In the final analysis, seven waste minimization opportunities were identified and recommended for implementation in support of ER Project waste minimization efforts. The potential minimum savings in these areas are estimated at $2 million per year.

INTRODUCTION

BHI's Environmental Restoration (ER) project groups were ascertained that, by adopting Value Methodology's phased and disciplined approach in identifying and analyzing ER activities and processes, they would be able to generate an effective and a meaningful list of potential candidate waste streams for waste volume reduction in FY2000.

BHI formed a team of experts from the Remedial Action and Waste Disposal (RAWD), Groundwater and Vadose Zone (GW/VZ), Decontamination and Decommissioning (D&D), and Surveillance, Maintenance, and Transition (SM&T) projects to perform Value Engineering (VE) studies in support of ER Project Waste Minimization/Pollution Prevention goals. The VE studies were facilitated by a Certified Value Specialist (CVS), and were performed in two phases:

- *Phase I*: Prescreening of waste streams from the RAWD, GW/VZ, D&D, and SM&T Projects to identify potential candidates for waste minimization (1)

- *Phase II*: Detailed evaluation of selected waste streams for potential waste minimization.

The team members were briefed on the scope of each phase of the study, and were informed about the deliverables required at the end of each study phase. Team members were also informed that Value Methodology (VM) techniques would be used in generating the deliverables, and were given a short presentation on the VM process that uses a systematic job plan consisting of three major activities:

- Pre-Study Stage
- Value Study Stage
- Post-Study Stage.

ORGANIZATION OF THE VE STUDIES

The Phase I Study, which is discussed in subsequent paragraphs, covers the requirements of the VM Pre-Study Stage. The Phase II Study covers the requirements of the VM Value Study Stage, and is further subdivided into three studies, as follows:

- *Phase IIA*: RAWD Contaminated Waste Streams (2)
- *Phase IIB*: D&D and Construction Equipment Contaminated Waste Streams (3)
- *Phase IIC*: Selection of Water Barrier for the plutonium-uranium extraction (PUREX) #2 Filter. (4)

Figure 1 provides a flowchart that depicts the overall logic of the VM standard process (5) for a) screening waste streams under Phase I; and b) selecting options for selected waste streams, under Phase II.

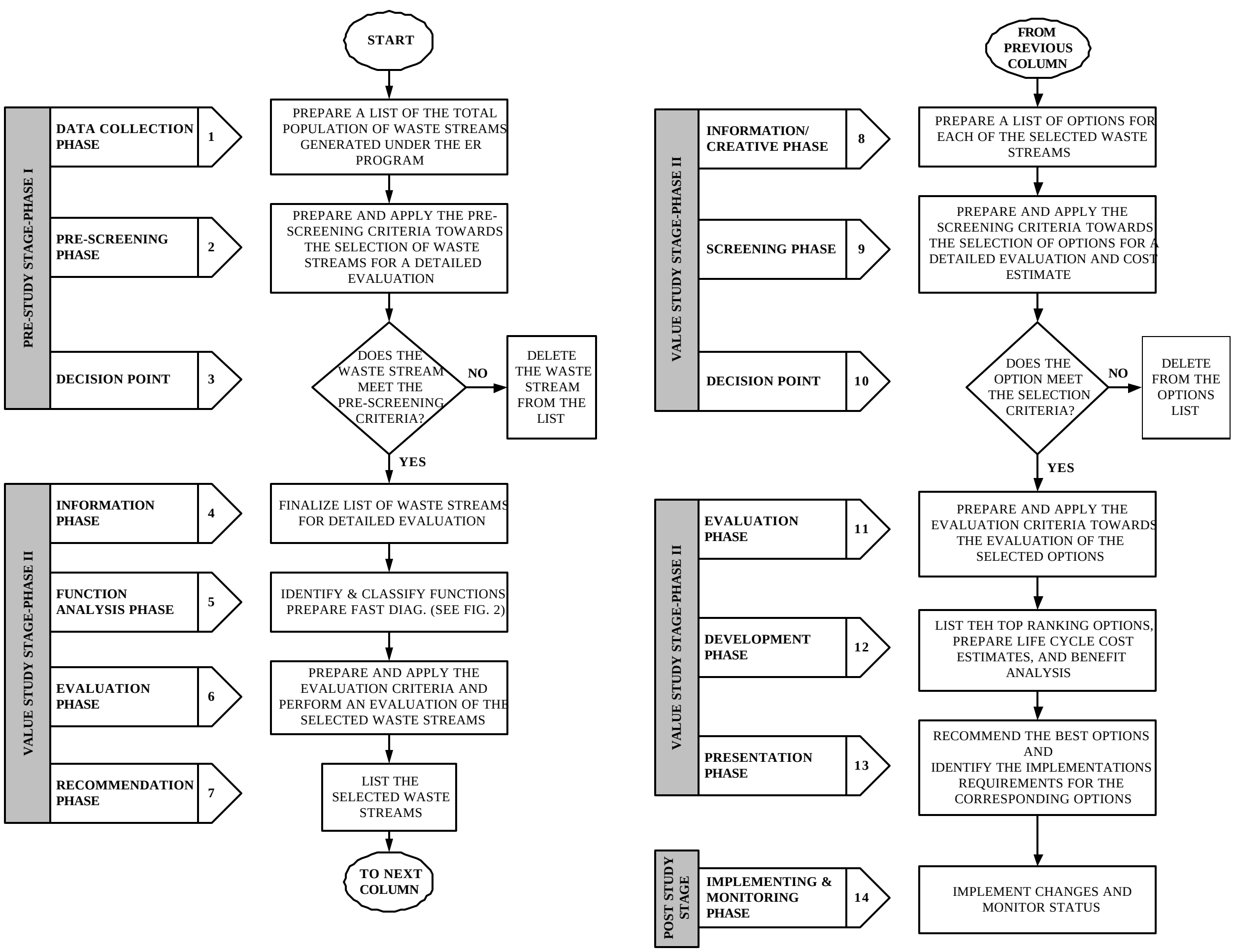

Fig. 1. Value Methodology Process for Screening Waste Streams, and Screening Options for Selected Waste Streams

PHASE I: PRESCREENING AND SELECTION OF WASTE STREAMS FROM THE RAWD, GW/VZ, D&D, AND SM&T PROJECTS AS POTENTIAL CANDIDATES FOR WASTE MINIMIZATION

Scope of the Phase I Study

The scope of the Phase I study was to identify potential candidates for waste minimization. The Phase I study was carried out through the following steps:

Step 1: Brainstorm and prepare a list of total ER waste streams that could be identified for consideration in each of the projects: namely, RAWD, GW/VZ, D&D, and SM&T.

Step 2: Review the list generated in *Step 1* and select only those waste streams with relatively large volumes, established baselines, and the potential for success in waste minimization efforts.

Step 3: Develop and weigh criteria for evaluation of the waste streams selected in *Step 2*.

Step 4: Evaluate each waste stream against the criteria developed in *Step 3*, and score/rank each waste stream.

Step 5: Select the top scoring waste streams as potential candidates for further detailed evaluation and cost analysis.

Deliverables for Phase I

- Development of lists of waste streams

  - Lists of total ER waste steams
  - A list of selected waste streams

- Criteria for evaluation of selected waste streams
- Evaluation and ranking of selected waste streams
- A list of the top ranking waste streams for further detailed evaluation.

Phase I Study Summary

For the Phase I study, activities covered under the pre-study stage were required. Hence, the team members were introduced to VM techniques such as "Paired Comparison," "Cost Model (Pareto Chart)," and "Functional Analysis System Technique (FAST) Diagram," associated with the pre-study stage.

Development of Waste Streams Lists

For this study, the team members were divided into four sub-teams, representing four separate categories of waste streams: namely, from RAWD, GW/VZ, D&D, and SM&T. Each sub-team independently developed a list of total population of waste streams in their assigned category (see Table IA).

Next, the team members reviewed the lists of a total population of about 57 waste streams (see Table 1A), and selected 20 waste streams that would be considered for further evaluation (see "Selected Waste Streams"). The selected waste streams indicated that they have relatively large volumes established baselines, and the potential for success in waste minimization efforts.

Table IA. Total Population of Waste Streams.

Waste Streams		Volumes
RAWD		
Soil (low level) (including ash Pit [126-F-1] and Chrome-Mixed Soils)		353,106 metric tons (389,123 tons) per year
Pipe (LLW)		15,240 m (50,000 ft) (verify quantities)
Asbestos on pipeline (cutting and packaging)		18 to 48 in.:810 m >48 in.:1,420 m
PPE – Check Volume		1 metric ton (1.1 tons) per year
1500 drums (DU, oil [RCRA, TSCA])		170,350 L (45,000 gallons) potential remediation in FY01
Oil		37,850 L (10,000 gallons) potential remediation in FY01
DU		46,080 kg (300,000 lbs) potential remediation in FY01
Leachate (LLW)		189,270 → 3,785,400 L (50,000 → 1,000,000 gallons) per year
Crushed rock -		22,940 m^3 (30,000 yd^3)
Concrete/debris		*Estimated of quantities – TBD***
(LLW/mixed)		*Estimated of quantities – TBD***
Rails (300 F, 100 H&D)		32 metric tons (35 tons)
*Plastic over packs		(bio site north of T-Plant) 900-1000
Lead bricks (RCRA only)		1,000 Bricks
Used chain link fence		Check on inventory
*Check for well numbers		
GW/VZ		
Dowex21k	Regeneration	3.40 m^3 (120 ft^3) per month
	ERDF (mixed)	1.13 m^3 (40 ft^3) per month
Clino	Spent – ERDF	5.66 m^3 (200 ft^3) per month
GAC	Regeneration	34.00 m^3 (1200 ft^3) per year
Equipment		Four pieces of equipment
PPE		*Estimated of quantities – TBD***
Organic carbonaceous		*Estimated of quantities – TBD***
Drill cuttings		300 drums
Purge/decon water		567,810 L (150,000 gallons) per year
Excavations		*Estimated of quantities – TBD***
Abandoned wells		*Estimated of quantities – TBD***
D&D		
*Concrete rubble		1,912 m^3 – 2,676 m^3 (2,500 - 3,500 yd^3)
*Copper		*Estimated of quantities – TBD***
*Structural steel		*Estimated of quantities – TBD***
*Wood		1,134 kg (2500 lbs)
Aluminum		*Estimated of quantities – TBD***
Ductwork PPE		*Estimated of quantities – TBD***
Miscellaneous chemicals (paint)		*Estimated of quantities – TBD***
Electrical cable		*Estimated of quantities – TBD***
Piping		*Estimated of quantities – TBD***
Asbestos		15m^3 (20 yd^3)
*Roofing material		*Estimated of quantities – TBD***
Contaminated water		15m^3 (20 yd^3)
*Equipment decon water		*Estimated of quantities – TBD***
Contaminated construction equipment		Three pieces of equipment
Used D&D oils		22,716 – 3,785 L (600 – 1,000 gallons)
Batteries (alkaline)		14 – 18 kg (30 – 40 lbs)
Cal-Gas bottles		20 each
Flo-lite tubes		*Estimated of quantities – TBD***
Absorbents		150 – 10 lbs bags
Empty Containers		10 – 20/55 gallon drums
Plastics (over packs, M. T. container packaging)		20 each/85 gallon over pack
*Potential Rad		
SM&T		
Legacy hand tools from KE/KW Graphite blocks (105 KE)		*Estimated of quantities – TBD***
Legacy waste (105 KE/KW; 100 H&D) (miscellaneous materials)		*Estimated of quantities – TBD***
Roofing material (105 B)		*Estimated of quantities – TBD***
PPE		*Estimated of quantities – TBD***
Contaminated mulberry trees		*Estimated of quantities – TBD***
Lead bricks		*Estimated of quantities – TBD***
Ethylene glycol (183 KW)		3,785 L (1,000 gallons)
RARA contaminated area consists of underground radioactive materials		1.2 ha (3 acres)

**Although quantities of these waste streams were not readily available, it was determined by the team that they should be included in the pre-screening process and analyzed using other applicable criteria. If selected for further study, estimates of quantities for these waste streams could be generated for detail analysis.

Selected Waste Streams

1. Soil (low level) (excluding items 9 and 10)
2. Pipe (LLW) Packaging
3. Asbestos on Pipeline
4. (LLW/mixed) LDRL 300 (Variance)
5. Rails (300 F, 100 H &D) Recycle
6. Plastic over packs (Segregation)
7. Lead bricks (RCRA only)
8. Used chain link fence (Segregation)
9. Chrome – Mixed (soils)
10. Ash Pit (126-F-1)
11. N-Crib Cover Blocks (Segregation)
12. Contaminated construction equipment
13. Used D&D oils (Segregation)
14. Batteries (alkaline) (new process)
15. Cal-Gas bottles (return to mfg.)
16. Absorbents
17. Drill cutting drums (Segregation)
18. Legacy hand tools from KE/KW
19. Ethylene glycol (183 KW)
20. PUREX Filters – Shotcrete Reduce Infiltration

Criteria for Evaluation of Selected Waste Streams

The team members developed a set of five criteria that would be used to evaluate the selected waste streams. The criteria were weighed for relative importance using the VM paired comparison technique (see Table IB). The criteria are as follows:

1. *Potential Effective Volume*
   Strictly relative size of waste streams.

2. *Baseline Established (metrics/process)*
   Established metrics/process for a waste stream that would permit easy comparison with potential new metrics/processes for minimization.

3. *Potential for Success*
   The level of achievable waste minimization.

4. *Availability of Techniques*
   Availability of technologies, methods, and/or pathways for waste minimization.

5. *Can be initiated in FY 2000*
   Availability of waste stream and application of techniques for waste minimization within FY2000.

The criteria were weighed for relative importance using the VM paired comparison technique (see Table IB).

Evaluation and Ranking of Waste Streams

Team members were briefed on the VM process for evaluating and ranking waste streams. Using the VM technique, the team evaluated and ranked each of the 20 waste streams against each of the established evaluation criteria. The results are shown in Table IB.

The top 10 waste streams that achieved maximum total scores, as shown in Table IB, were recommended for further detail study, to identify and evaluate "options" for remediation.

Table IB. Evaluation and Ranking of Waste Streams from RAWD, GW/VZ, D&D, and SM&T.

A. Weighing Pre-Screening Criteria for Waste Streams Using Paired Comparisons.

How Important
1. Minor Preference
2. Medium Preference
3. Major Preference

	B	C	D	E	EVALUATION CRITERIA	Score	Percent
A	A3	C3	D2	E3	Potential Effective Volume	2	8
	B	C3	D3	E3	Baseline Established (metrics/process)	0	0
		C	C2	C2/E2	Potential for Success	10	34
			D	D2/E2	Availability of Techniques	9	24
				E	Can Be Initiated in FY 2000	10	34
					TOTALS	**29**	**100**

B. Evaluation of Waste Streams from RAWD, GW/VZ, D&D, and SM&T.

Category: **Waste Streams from RAWD, GW/VZ, D&D, and SM&T**

List the best ideas from the Suitability evaluation. Determine which one ranks best against desired criteria. Work down, not across.

Rate from 10=Excellent to 1=Poor

(2) Waste Streams ↓ / (3) Weight →	(1) Objectives or Criteria: Potential For Success	Availability of Techniques	Potential Effective Volume	Can be initiated this FY	(4) Total	(5) Ranking	(6) Comments
	34%	24%	8%	34%			
[1]Soils (low level) (excluding Ash Pit and Chrome-Mixed Soils)	4 1.36	10 2.40	10 0.80	10 3.40	7.96	14	
[2]Pipe (LLW) Packaging	10 3.40	10 2.40	7 0.56	10 3.40	9.76	1	Recommended for Detail Study
[3]Asbestos on Pipeline (Cutting & Packaging	10 3.40	10 2.40	2 0.16	10 3.40	9.36	3	Recommended for Detail Study
[4](LLW/mixed) LDRL 300 (variance)	5 1.70	8 1.92	4 0.32	3 1.02	5.64	20	
[5]Rails (300 F, 100 H&D) Recycle	10 3.40	10 2.40	2 0.16	10 3.40	9.36	4	Recommended for Detail Study
[6]Plastic over packs* (Segregation)	10 3.40	10 2.40	3 0.24	10 3.40	9.44	2	Recommended for Detail Study
[7]Lead bricks (RCRA only)	8 2.72	10 2.40	1 0.08	8 2.72	7.92	15	
[8]Used chain link fence (Recycle)	8 1.70	10 2.40	10 0.80	10 3.40	8.30	12	
[9]Chrome – Mixed Soils (variance)	8 2.72	8 1.92	8 0.64	5 1.70	6.98	18	
[10]Ash Pit (126-F-1)	8 2.72	10 2.40	7 0.56	10 3.40	9.08	9	Recommended for Detail Study
[11]N-Cribs Cover Blocks (Segregation)	7 2.38	10 2.40	2 0.16	3 1.02	5.96	19	
[12]Contaminated construction equipment	8 2.72	10 2.40	4 0.32	10 3.40	8.84	10	Recommended for Detail Study
[13]Used D&D Oils (Segregation)	10 3.40	10 2.40	1 0.08	10 3.40	9.28	6	Recommended for Detail Study
[14]Batteries (alkaline) (new process)	5 1.70	8 1.92	1 0.08	10 3.40	7.10	17	
[15]Cal-Gas bottles (return to mfg.)	5 1.70	10 2.40	1 0.08	10 3.40	7.58	16	
[16]Absorbents	10 3.40	10 2.40	1 0.08	10 3.40	9.28	7	Recommended for Detail Study
[17]Drill cutting drums (Segregation)	10 3.40	10 2.40	1 0.08	10 3.40	9.28	8	Recommended for Detail Study
[18]Legacy hand tools from (KE/KW)	8 2.72	10 2.40	1 0.08	10 3.40	8.60	11	
[19]Ethylene glycol (183 KW)	7 2.38	10 2.40	1 0.08	10 3.40	8.26	13	
[20]PUREX Filters - Shotcrete Reduce Infiltration - Reduce Volume	10 3.40	10 2.40	2 0.16	10 3.40	9.36	5	Recommended for Detail Study

List of Top Ranking Waste Streams

1.	Pipe (low-level waste [LLW]) Packaging	9.76
2.	Plastic Over packs (Segregation)	9.44
3.	Asbestos on Pipeline (Cutting and Packaging)	9.36
4.	Rails (330 F, 100 H and D) Recycle	9.36
5.	PUREX Filters – Shotcrete –Reduce Infiltration – Reduce Volume	9.36
6.	Used D&D Oils (Segregation)	9.28
7.	Absorbents	9.28
8.	Drill Cutting Drums (Segregation)	9.28
9.	Ash Pit Remediation (126-F-1)	9.08
10.	Contaminated Construction Equipment	8.84

Final Selection of Waste Streams

Subsequent review of the above-mentioned waste streams determined that the current Hanford Site practices for remediation of "Pipe (LLW) Packaging," "Plastic Over Packs," "Used D&D Oils," and "Drill Cutting Drums" wastes are already at optimum levels; consequently, further improvements cannot be identified at this time. These were deleted from further detail study. Additionally, the team recommended that the "Used Chain-Link Fence" and "Chrome-Mixed (Soils)" waste streams be considered for detail studies. The revised list of selected eight waste streams were grouped into separate phases, as shown below, for detail studies.

1.	Ash Pit (126-F-1)	Phase IIA
2.	Asbestos on Pipeline (Cutting and Packaging)	Phase IIA
3.	Rails (300 F, 100 H&D) and Chain-Link Fence Materials	Phase IIA
4.	Chrome – Mixed (soils)	Phase IIA
5.	Contaminated construction equipment	Phase IIB
6.	Absorbents	Phase IIB
7.	PUREX Filters – Shotcrete Reduce Infiltration – Minimize Waste	Phase IIC

PHASE II: VALUE STUDY

In this phase, the Value Study team developed a FAST diagram (Fig. 2) to explore several "options" for waste minimization. As indicated earlier, the Phase II Study was subdivided into Phase IIA, IIB, and IIC studies, as follows:

PHASE IIA: RAWD CONTAMINATED WASTE STREAMS

Scope of the Phase IIA Study

The scope of the Phase IIA study was to perform detailed evaluation of the RAWD waste streams, for potential waste minimization. The Phase IIA study was carried out through the following steps:

Step 1: Verify if the waste streams recommended in Phase I Study are viable for detail study.

Step 2: Identify the current practice of operations (base) for the selected waste stream(s).

Step 3: Brainstorm and identify for consideration "options" that may lead to waste minimization.

Step 4: Develop and weigh criteria for evaluating the "options" identified in Step 3.

Step 5: Evaluate each "option" against the criteria developed in Step 4, and score each "option."

Step 6: Select the top scoring and most viable "options" as potential candidates for further detailed evaluation and cost estimation.

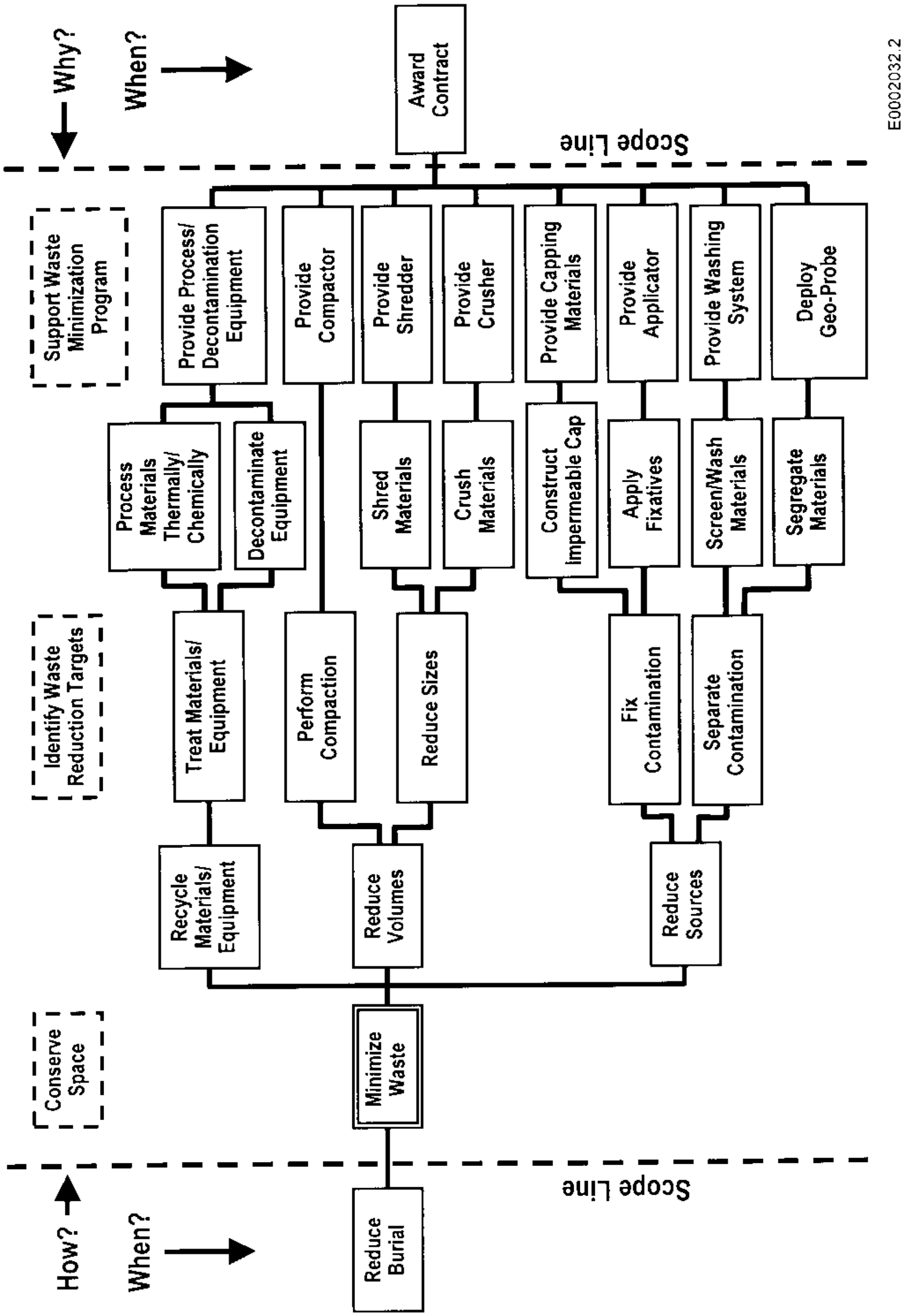

Fig. 2. FAST Diagram for Exploring "Options" for Waste Minimization

Deliverables for Phase IIA

A. Base case waste stream quantities, as defined in the *Detailed Work Plan* (DWP) for FY 2000.
B. Estimated cost of remediation for base case, as defined in the DWP.
C. Potential remediation "Option(s)" for each waste stream.
D. Estimated cost for implementing potential "Option(s)."
E. Target potential reduction in each waste stream.

Phase IIA Study Summary

Table IIA-1: Development of Deliverables for Phase IIA

Deliverable		1. Ash Pit (126-F-1)	2. Asbestos on Pipeline	3. Rails (300 F, 100 H and D) and Chain-link Fence Material	4. Chrome- Mixed (Soils)
A.	Base Case Waste Stream Quantities as Defined in DWP FY 2000.	167,514 metric tons (184,600 tons)	18 to 48 in.: 810 m > 48 in.: 1,420 m	Rails: 32 metric tons (35 tons) Fence Materials: Fabric = 76 rolls Gates = 4 each Barbed = 11 rolls	14,659 metric tons (16,154 tons)
B.	Estimated Cost of Remediation for Base Case as Defined in DWP.	$10,540,480	$452,000	TBD	$922,000
C.	Potential Remediation "Option(s)" for Each Waste Stream	Deploy GEO-probe to support lower cost in-situ characterization (source reduction)	Retain asbestos on pipeline, cut pipe to dispose.	To be excessed (recycle)	Leave it in place (source reduction)
D.	Estimated Cost for Implementing Potential "Option(s)"	TBD	TBD	TBD	TBD
E.	Target Potential Reduction in Each Waste Stream	5% or 8,376 metric tons (9,230 tons)	Potential large labor reduction	100%	100%

Development of "Options"

The team members identified current practices (bases) and developed the following "options" for the four waste streams identified for detail study.

Ash Pit (126-F-1)

Base: The basic process is to excavate, survey, and sample ash, then segregate ash into clean and contaminated components. Contaminated ash would go to the Environmental Restoration Disposal Facility (ERDF).

Option 1: Ash segregation (using a sophisticated scanning method).

Asbestos on Pipeline

Base: During the contaminated pipeline removal operations, contaminated asbestos has been removed from the pipeline for disposal at the ERDF. Asbestos removal operations add several steps in pipeline removal, increase waste volume, increase exposure/safety risk, and cost.

Option 1: This option would allow asbestos to be kept on the pipeline, and disposed with the pipeline. Benefits would be reduction in volume of waste stream, reduction in exposure to workers, and reduction in the cost of disposal.

Rails (300 F, 100 H & 100 D) and Chain-Link Fence Materials

Base: Surplus material is clean and stored at the site.

Option 1: Solid waste (such as rails, chain-link fence materials) that is clean can be excessed and possibly sold for re-use and through economic development.

Chrome-Mixed Soils

Base: Hexavalent chromium exceeding 100 Area remedial action cleanup requirements has been encountered at the bottom of 116-D-7 Basin. The base case is to over-excavate, to remove all chrome-mixed soil, and dispose it to the ERDF.

Option 1: A leach test was performed, showing that movement of chrome contamination is not impacting groundwater. A report was transmitted to the EPA Richland Field Office for approval of the leach test results. If this input is approved, over-excavation beyond the bottom of the 116-D-7 Basin will not have to be performed.

Criteria for Evaluation of "Options"

The team members developed a set of four criteria to evaluate the above-mentioned "Options." The criteria were weighed for relative importance using VM paired comparison techniques (see Table IIA-2). The criteria developed for evaluating "Options" were as follows:

1. *Potential for Effective Volume Reduction*
   Strictly how well can this "Option" reduce contaminated waste.

2. *Potential for Success*
   The level of achievable success in Waste Minimization using this "Option" (while complying with regulatory requirements).

3. *Availability of Techniques*
   The availability of technologies, methods, and/or pathways for potential Waste Minimization using this "Option".

4. *Can be initiated in FY 2000*
   The availability of the waste stream, and the application of techniques for this "Option" for waste minimization within FY 2000.

Evaluation and Ranking of Options

For Ash Pit (126-F-1): Using the VM technique, the team evaluated and ranked the "Base" and "Option 1" for the Ash Pit against each of the Evaluation Criteria." The results are shown in Table IIA-2. The Base Case and "Option 1" (using the Geo-Probe) were selected for further study.

For Asbestos on Pipeline: The team evaluated and ranked the "Base" and "Option 1" for Asbestos on Pipeline against each of the "Evaluation Criteria." The results are shown in Table IIA-2. The Base Case and "Option 1" for leaving asbestos on the pipeline were selected for further study.

For Rails (300 F, 100 H and D) and Chain-link Fence Materials: The team also evaluated and ranked the "Base" and "Option 1" for Rails and Chain Link Fence against each of the "Evaluation Criteria." The results are shown in Table IIA-2. The Base Case and "Option 1" for recycling the materials were selected for further study.

For Chrome-Mixed Soil: Similarly, the team evaluated and ranked the "Base" and "Option 1" for Chrome-Mixed Soils against each of the "Evaluation Criteria." The results are shown in Table IIA-2. The Base Case and "Option 1" for not excavating chrome-mixed soil were selected for further study.

Table IIA-2. Evaluation and Ranking of Options for RAWD Waste Streams

A. Weighting Criteria for Evaluating Options Using Paired Comparison

How Important
1. Minor Preference
2. Medium Preference
3. Major Preference

	B	**C**	**D**	**EVALUATION CRITERIA**	**Score**	**Percent**
A	A2 B3	C2	D3	Potential for Effective Volume Reduction	2	8
	B	C3 B3	D3 B3	Potential for Success	9	33
		C	C2 D3	Availability of Techniques	7	26
			D	Can be Initiated in FY 2000	9	33
				TOTALS	**27**	**100**

B. Evaluation of Options for RAWD Waste Streams.

VALUE METHODOLOGY WORKSHEET

List the best ideas from the suitability evaluation. Determine which one ranks best against desired criteria. Work down, not across.

Rate from 10=Excellent to 1=Poor

(2) Options ↓ / (3) Weight →	(1) Objectives or Criteria: Potential for Success	Available Technologies	Potential for Effective Volume Reduction	Can Be Initiated in FY 2000	(4) Total	(5) Ranking	(6) Comments
	33%	26%	8%	33%			
Category: **RAWD – Ash Pit (126-F-1)**	MATRIX ANALYSIS						
Base: Remove ash and dispose in its entirety	0	10	10	10			Estimate from DWP
	0	2.60	0.80	3.30	6.70	2	
Option 1: Characterize/segregate ash for waste reduction	8	10	10	10			Recommended for detailed study
	2.64	2.60	0.80	3.30	9.34	1	
Category: **RAWD – Asbestos on Pipeline**	MATRIX ANALYSIS						
Base: Remove asbestos from pipe and dispose after bagging	0	10	10	10			From in place contract
	0	2.60	0.80	3.30	6.70	2	
Option 1: Leave asbestos on pipe, split pipe and dispose	9	10	10	10			Recommended for detailed study
	2.97	2.60	0.80	3.30	9.67	1	
Category: **RAWD – Rails and Chain-Link Fence Materials**	MATRIX ANALYSIS						
Base: Store rails and chain-link fence @ site	0	10	10	10			-
	0	2.60	0.80	3.30	6.70	2	
Option 1: Characterize/segregate ash for waste reduction	7	10	10	10			Recommended for detailed study
	2.31	2.60	0.80	3.30	9.01	1	
Category: **RAWD – Chrome-Mixed (Soils)**	MATRIX ANALYSIS						
Base: Excavate & dispose chrome-mixed exceeding ground water protection requirements	0	10	10	10			Estimate from DWP
	0	2.60	0.80	3.30	6.70	2	
Option 1: Obtain regulatory relief (chg. WAC) and leave it in place	7	10	10	10			Recommended for detailed study
	2.31	2.60	0.80	3.30	9.01	1	

Life Cycle Cost Estimates for Phase IIA

Life cycle cost estimates for four different waste streams are provided in Table IIA-3.

Table IIA-3: Life Cycle Costs for RAWD Waste Streams.

Ash Pit (126-F-1)			
	Basecase	Option 1	Savings
Mob & Prep Work	$ 361,000	$ 361,000	$ -
Project & Construction Management	$ 1,353,100	$ 1,285,445	$ 67,655
Sampling Management	$ 312,200	$ 296,590	$ 15,610
126-F-1 Remediation of Ash Pit	$ 1,315,000	$ 1,249,250	$ 65,750
Subtotal	$ 3,341,300	$ 3,192,285	$ 149,015
Transportation and ERDF Costs	$ 7,199,180	$ 6,839,430	$ 359,750
Total	**$ 10,540,480**	**$ 10,031,715**	**$ 509,000**
Basecase – The estimated amount in the DWP for the FY 2000 for the remediation of the 126-F-1 Ash Pit. Option 1 - The estimated cost to remediate the 126-F-1 Ash Pit with a 5% reduction in volume. Savings – The estimated cost savings by reducing the 126-F-1 Ash Pit volume by % is Option 1 subtracted from the Base Case.			
Asbestos on Pipeline			
	Basecase	Option 1	Savings
Asbestos Subcontractor	$ 353,000	$ 99,000	$ 254,000
Project & Construction Management	$ 39,000	$ 11,000	$ 28,000
ERC Support	$ 60,000	$ 17,000	$ 43,000
Subtotal	$ 452,000	$ 127,000	$ 325,000
	Cost to remove all asbestos circularly & longitudinally from the pipe	Cost to remove asbestos circularly from the pipe only where it is to be cut	Savings for not removing asbestos longitudinally along the pipe
Basecase – The estimated amount in the 2000-2002 DWP and Exhibit C of the remediation sub-contracts for the FY20 to remove all asbestos from the pipelines in 100-D, F & H Areas. Option 1 – The estimated cost to remove asbestos only around the pipe where it is to be cut in the trench. Savings – The estimated cost savings for not removing the remainder to the asbestos longitudinally along the pipe after the pipe is cut & removed from the trench.			
Rail and Chain-Link Fence Materials			
	Basecase	Option 1	Savings
Labor	$ 0	$ (550)	$ (550)
Subcontract	$ 0	$ 4,935	$ 4,935
Equipment	$ 0	$ 0	$ 0
Material	$ 0	$ 0	$ 0
Total	**$ 0**	**$ 4,385**	**$ 4,385**
Basecase – Leave items where they are now at no cost. Option 1 – Surplus and sell the items for scrap and the rail for reuse. Receiving agency will load & transport. Savings – This is the total revenue generated by surplusing the items and is equal to Option 1 since the Base Case is zero.			
Chrome Mixed Soils			
	Basecase	Option 1	Savings
Project & Construction Management	$ 118,022	$ 42,000	$ 76,022
Sampling Management	$ 27,300	$ 0	$ 27,300
116-D-9 Basin Over-excavation	$ 146,678	$ 0	$ 146,678
PNNL Costs	$ -	$ 60,000	$ (60,000)
Subtotal	$ 292,000	$ 102,000	$ 190,000
Transportation and ERDF Costs	$ 630,000	$ 0	$ 630,000
Total	**$ 922,000**	**$ 102,000**	**$ 820,000**
Basecase – The estimated cost to remediation the chrome contaminated material found at the bottom of 116-D-7 Basin Option 1 – The cost to prepare the site specific leachability test at bottom of the excavation to show there is no adverse groundwater impacts to leave the contaminated material in place. Savings – The estimated cost savings is equal to the base case excavation costs minus the costs of the Leach Test.			

PHASE IIB: D&D AND CONTAMINATED CONSTRUCTION EQUIPMENT WASTE STREAMS SCOPE OF THE PHASE IIB STUDY

The scope of the Phase IIB study was to perform a detailed evaluation of the D&D waste streams, for potential waste minimization. The Phase IIB study was carried out through the following steps:

Step 1: Verify if the waste streams recommended in Phase I Study are viable for detail study.
Step 2-6: Same as Phase IIA study.

Deliverables for Phase IIB

A. Base case waste stream quantities, as defined in the DWP for FY 2000.
B. Estimated cost of remediation for base case, as defined in the DWP.
C. Potential remediation "Option(s)" for each waste stream.
D. Estimated cost for implementing potential "Option(s)."
E. Target potential reduction in each waste stream.

Phase IIB Study Summary

Table IIB-1: Development of Deliverables for Phase IIB

Deliverable	1. Contaminated Construction Equipment	2. Absorbents
A. Base Case Waste Stream Quantities as Defined in DWP FY 2000.	See list below	150: 10-lb Bags
B. Estimated Cost of Remediation for Base Case as Defined in DWP.	$161,077	$22,171
C. Potential Remediation "Option(s)" for Each Waste Stream	Wash, characterize and excess (recycle)	To be excessed (recycled)
D. Estimated Cost for Implementing Potential "Option(s)"	TBD	TBD
E. Target Potential Reduction in Each Waste Stream	100%	100%

Team members identified current practices (bases), and developed the following "options" for the three waste streams identified for detail study.

Contaminated Construction Equipment

Base: The base case includes long-term storage of seven large pieces of equipment, for a life cycle of 15 years (FY 2000 through FY 2014). The long-term storage involves property management, preventative maintenance (occasional oil cleanup), and winterization. The equipment identified for long-term storage is as follows:

- Equipment ready for excess
  - Man Lift, HO-34-3738 (JLG 60')
  - Mini Backhoe, HO-74-5840/Trailer, HO-64-5468
- Equipment requiring groundwater program concurrence for excess
  - Drill Rig, HO-22-5301/Truck, HO-68K-4552
  - Drill Rig, HO-22-5305/Truck, HO-68K-4569
  - Drill Rig, HO-22-5307/Truck, HO-68K-4571

- 400 Ton Casing Pullers (HO-29-05025)
- WRENTAIL/Trailer, HO-64-04286

Option 1: This option would include draining all fluids from the equipment, filling voids, and disposing to the ERDF.

Option 2: This option would require transferring title of equipment to the Tri-City Asset Reinvestment Company (TARC), which in turn would wash/ decontaminate and sell the equipment to general public.

Option 3: This option would include draining all fluids from the equipment, filling voids, and disposing to onsite low-level burial grounds.

Option 4: This option would require ERC to wash/ decontaminate and excess the equipment offsite.

Option 5: This option involves dismantling equipment, segregating contaminated and non-contaminated parts, and disposing accordingly.

Absorbents

Base: This base case involves long-term storage of absorbents at the site.

Option 1: This option entails excessing to DynCorp.

Option 2: This option would require sending it to pump and treat locations at the Hanford Site for reuse.

Option 3: This option would include direct offsite disposal.

Criteria for Evaluation of Options

The team developed a set of four criteria to evaluate the above-mentioned "Options." The criteria were weighted for relative importance using VM paired comparison techniques (see Table IIB-2)

1. *Potential for Effective Volume Reduction*
   How well can this "Option" reduce contaminated waste.

2. *Potential for Success*
   The level of achievable success in waste minimization using "Option" (while complying with regulatory requirements).

3. *Availability of Techniques*
   The availability of technologies, methods, and/or pathways for potential waste minimization using this "Option."

4. *Can Be Initiated in FY 2000*
   The availability of the waste stream and application of techniques for this "Options" for waste minimization within FY 2000.

Table IIB-2. Evaluation and Ranking of Options for D&D and Construction Equipment Waste Streams

A. Weighting Criteria for Evaluating Options Using Paired Comparison

How Important		B	C	D	EVALUATION CRITERIA	Score	Percent
1. Minor Preference	**A**	A2 B3	C2	D3	Potential for Effective Volume Reduction	2	8
2. Medium Preference		**B**	C3 B3	D3 B3	Potential for Success	9	33
3. Major Preference			**C**	C2 D3	Availability of Techniques	7	26
				D	Can be Initiated in FY 2000	9	33
					TOTALS	**27**	**100**

B. Evaluation of Options for D&D Waste Streams – Construction Equipment and Absorbents.

VALUE METHODOLOGY WORKSHEET

List the best ideas from the suitability evaluation. Determine which one ranks best against desired criteria. Work down, not across.

Rate from 10=Excellent to 1=Poor

(2) Options ↓	(3) Weight →	(1) Objectives or Criteria: Potential for Success	Available Technologies	Potential for Effective Volume Reduction	Can Be Initiated in FY 2000	(4) Total	(5) Ranking	(6) Comments
		33%	26%	8%	33%			
Category: **D&D – Contaminated Construction Equipment**		MATRIX ANALYSIS						
Base: Long-term storage @ site (15 years)		0	10	10	10			Recommended for detailed study
		0	2.60	0.80	3.30	6.70	5	
Option 1: Drain all fluids, fill all voids, an dispose to the ERDF		3	10	10	10			Recommended for detailed study
		0.99	2.60	0.80	3.30	7.69	2	
Option 2: TARC would wash, decontaminate, and sell the equipment to the public		10	10	10	9			Recommended for detailed study
		3.30	2.60	0.80	2.97	9.67	1	
Option 3: Drain all fluids and fill all void; dispose to onsite low-level burial grounds		0	10	10	0			
		0	2.60	0.80	2.97	9.67	6	
Option 4: ERC would wash, decontaminate, and excess the equipment		7	7	10	6			
		2.31	1.82	0.80	1.98	6.91	4	
Option 5: Dismantle equipment; segregate between contaminated and non-contaminated and dispose accordingly		5	10	10	7			
		1.65	2.60	0.80	2.31	7.36	3	
Category: **D&D– Absorbents**		MATRIX ANALYSIS						
Base: Long-term storage of absorbents at the site		0	10	10	10			Recommended for detailed study
		0	2.60	0.80	3.30	6.70	4	
Option 1: Excess to DynCorp		10	10	10	10			Recommended for detailed study
		3.30	2.60	0.80	3.30	10	1	
Option 2: Transport to Pump & Treat at the Hanford site for reuse		5	10	10	10			Recommended for detailed study
		1.65	2.60	0.80	3.30	8.35	2	
Option 3: Off-site disposal		0	10	10	10			
		0	2.60	0.80	3.30	6.70	3	

Evaluation and Ranking of Options

For Contaminated Construction Equipment: ..Using the VM technique, the team evaluated and ranked "Base" and "Options 1 through 5" for Contaminated Construction Equipment against each of the established "Evaluation Criteria." The results are shown in Table IIB-2. The Base Case and "Options 1 & 2" were selected for further study.

For Absorbents: The team evaluated and ranked "Base" and "Options 1 through 3" for Absorbents against each of the established "Evaluation Criteria." The results are shown in Table IIB-2. The base case and "Options 1 & 2" were selected for further study.

Life Cycle Cost Estimates for Phase IIB

Life cycle cost estimates for three different waste streams are provided in the tables/cost data that are presented in Table IIB-3.

Table IIB-3: Life Cycle Costs for D&D Waste Streams – Construction Equipment and Absorbents.

Contaminated Construction Equipment				
	Basecase	Option 1	Option 2	Savings
Labor	$ -	$ 50,366	$ 19,491	$ (19,491)
Subcontracts	$ 161,077	$ 19,685	$ -	$ 161,077
Equipment	$ -	$ 6,468	$ 210	$ (210)
Total	**$ 161,077**	**$ 76,519**	**$ 19,701**	**$ 141,376**
	Life Cycle Costs for 15 years at an average 2.7% Escalation a Year	Cost to dispose of the equipment in ERDF	Cost to give the equipment to TARC and move it offsite	Estimated Life Cycle Savings is Option 2 less the Base Case
Note 1 Equipment includes: 3 truck mounted drill rigs, manlift, min backhoe & trailer, casing puller, and a wrentail trailer. Basecase – Long Term Storage on the Hanford Site. Option 1 – Package Equipment as is and Dispose at ERDF. Option 2 – Transfer Contaminated Equipment to TARC. Savings – Estimated Life Cycle Costs Savings is Option 2 subtracted from the Base Case.				
Absorbents				
	Basecase	Option 1	Option 2	Cost Avoidance
Labor	$ -	$ 1,235	$ (9,498)	$ 9,498
Subcontracts	$ 22,171	$ -	$ 137	$ 22,034
Equipment/Material	$ -	$ 70	$ -	$ -
Total	**$ 22,171**	**$ 1,305**	**$ (9,361)**	**$ 31,532**
	Life Cycle Costs for 15 years at an average 2.7% Escalation a Year	Cost to excess the absorbent offsite	Use the absorbent in the Pump & Treat burial boxes as a water absorbent	Estimated Cost Avoidance is the Base Case minus Option 2
Basecase – Long term storage of absorbent. Option 1 – Excess the absorbent and transport to DynCorp. Option 2 – Use the mineral base absorbent in the P&T used resin burial containers instead of the present resin absorbent. Cost Avoidance – The estimated cost to use this absorbent instead of the present resin absorbent in the Pump & Treat burial boxes is the Base Case minus Option 2.				

PHASE IIC: SELECTION OF WATER BARRIER FOR PUREX #2 FILTER

Scope of the Phase IIC Study

The scope of this Value Engineering Study was to develop criteria for screening, and subsequently evaluating and ranking identified "Options" for Water.

Barrier for PUREX #2 Filters. The Phase IIC study was carried out through the following steps:

Step 1: Identify the current practice of operations (base) for infiltrated rainwater.

Step 2: Develop and weight criteria for evaluating the "Options" for the Water Barrier System.

Step 3: Brainstorm and identify for consideration "Options" for the Water Barrier System that may lead to reduction in rainwater infiltration.

Step 4: Evaluate each "Option" against the criteria developed in Step 2, and score each "Option."

Step 5: Select the top scoring and most viable "Option" as potential candidate for further detailed evaluation and cost estimation.

Deliverables for Phase IIC

A. Waste stream volumes
B. Waste production rate and schedule
C. The cost of existing process for disposing waste
D. Potential technologies for each waste stream
E. Potential change(s), in terms of options
F. Estimated life cycle costs of potential change(s) (in terms of options).

Phase IIC Study Summary

Development of Deliverables for Phase IIC

Base: Currently, the rainwater accumulated into the underground PUREX V-11 Tank is pumped out, transported, and disposed at ETF as contaminated waste water approximately every three years. This is done to prevent backup of water into the filters, and subsequent potential release of highly radioactive particulate from the filter fibers to the environment. This is a very difficult and expensive option.

Criteria for Evaluation of Options

The team members developed a set of five criteria to evaluate the above-mentioned options. The criteria are described below and weighted using paired comparison techniques (Table IIC-1).

1. *Reduce Infiltration*
   This identifies how effective the Water Barrier System would be in reducing infiltration of rainwater.

2. *15-year Service Life*
   This includes the expected service life of the Water Barrier System.

3. *Ease of Application*
   This addresses the ease of construction and/or any physical limitations of installing the Water Barrier System.

4. *Low Maintenance*
   This includes the level and frequency of required maintenance for the Water Barrier System.

5. *Permit Walking on the Surface*
   This includes any limitations for walking on the completed surface of the Water Barrier System.

Evaluation and Ranking of Options

Using the VM technique, the team evaluated and ranked the Current (Base) Practice and other six "options" for the Water Barrier against each of the established "Evaluation Criteria." The results are shown in Table IIC-1.

Life Cycle Cost Estimates for Phase IIC

Detailed life cycle cost estimates for the Current Base Practice, and Options 1, 2, 3, and 4, are shown in Table IIC-2.

Table IIC-1. Evaluation and Ranking of Options for Water Barrier for PUREX #2 FILTER. (2 Pages)

A. Weighting Criteria for Evaluating Options Using Paired Comparison

How Important
1. Minor Preference
2. Medium Preference
3. Major Preference

	B	C	D	E	EVALUATION CRITERIA	Score	Percent
A	A3 B1	A3 C2	A3 D3	A3 E1	Reduce Infiltration	12	29
		B3 C1	B2 D2	B2 E2	15-Year Service Life	8	19
		C	D2 C1	E2 C1	Ease of Application	5	12
			D	D3 E2	Low Maintenance	10	24
				E	Permit Walking on Surface	7	16

Table IIC-1. Evaluation and Ranking of Options for Water Barrier for PUREX #2 FILTER. (2 Pages)

							TOTALS	**42**	**100**
B. Evaluation of Options for RAWD Waste Streams – Construction Equipment and Absorbents.									
VALUE METHODOLOGY WORKSHEET									
List the best ideas from the suitability evaluation. Determine which one ranks best against desired criteria. Work down, not across. *Rate from 10=Excellent to 1=Poor*		(1) Objectives or Criteria: Reduce Infiltration	15-Year Service Life	Ease of Application	Low Maintenance	Permit Walking on Surface			
(2) Options ↓	(3) Weight →	29%	19%	12%	24%	16%	(4) Total	(5) Ranking	(6) Comments
Category: **Water Barrier for PUREX #2 - Filter**		MATRIX ANALYSIS							
[1]Current (Base) Practice: Pump Tank Every 3 Years		0 / 0	10 / 1.9	10 / 1.2	2 / 0.48	10 / 1.6	5.18	7	Recommended for detailed study
[2]Option – 1: HDPE Material Cover with SHOTCRETE Ballast		10 / 2.9	10 / 1.9	7 / 0.84	10 / 2.4	8 / 1.28	9.32	3	Recommended for detailed study
[3]Option – 2: Polypropylene Material Cover with SHOTCRETE Ballast		10 / 2.9	10 / 1.9	8 / 0.96	10 / 2.4	8 / 1.28	9.44	2	Recommended for detailed study
[4]Option – 3: Special Polymer Material Cover with SHOTCRETE Ballast		10 / 2.9	10 / 1.9	10 / 1.2	10 / 2.4	20 / 1.6	10.00	1	Recommended for detailed study
[5]Option – 4: SHOTCRETE Material Cover – 100 cm (4 in.) Thick		8 / 2.32	6 / 1.14	10 / 1.2	7 / 1.68	10 / 1.6	7.94	4	Recommended for detailed study
[6]Option – 5: Asphalt Material Cover – 100 cm (4 in.) Thick		7 / 2.03	6 / 1.14	5 / 0.60	6 / 1.44	9 / 1.44	6.65	5	
[7]Option – 6: Light Metal Deck Installed over Steel Beams Supported on Concrete Pedestals		6 / 1.74	8 / 1.52	2 / 0.24	6 / 1.44	6 / 0.96	5.90	6	

Table IIC-2: Life Cycle Costs for Shotcrete Water Barrier for PUREX #2 Filter.

	Basecase	Option 1	Option 2	Option 3	Option 4	Cost Avoidance
Labor	$ 137,400	$ 7,494	$ 7,494	$ 7,312	$ 6,006	$ 131,394
Equipment	$ -	$ -	$ -	$ -	$ -	$ -
Material	$ -	$ -	$ -	$ -	$ -	$ -
Subcontracts	$ -	$ 79,924	$ 83,153	$ 137,289	$ 78,668	$ (78,668)
Total	**$ 137,400**	**$ 87,418**	**$ 90,648**	**$ 144,600**	**$ 84,674**	**$ 52,726**
	Actual cost to pump water from the filter in 1999 Repeat in 3 years	HDPE Material covered with Shotcrete	Polypropylene covered with Shotcrete	Special polymer covered with Shotcrete	The surface covered with 100 cm (4 in.) Shotcrete	The cost avoidance is the Base Case minus Option 4

Basecase – Pump, Transfer, and Dispose Contaminated Water from Tank V-11 at the Bottom of the Purex Filter Every Three Years.
Option 1 – Cover the Top of the Purex Filter with HDPE Material and Ballast with Shotcrete.
Option 2 – Cover the Top of the Purex Filter with Polypropylene Material and Ballast with Shotcrete.
Option 3 – Cover the Top of the Purex Filter with a Special Polymer Material and Ballast with Shotcrete.
Option 4 – Cover the Top of the Purex Filter with 100 cm (4 in.) of Shotcrete Material.
Cost Avoidance – It is the Base Case, pumping the water from the tank every three years minus Option 4, which is to cover the surface with 100 cm (4 in.) of Shotcrete to stop the infiltration of water.

RECOMMENDATION FOR IMPLEMENTATION

In the final analysis, the seven opportunities (listed below) were identified and recommended for implementation in support of ER Project waste minimization efforts. Each opportunity is a stand-alone item, and can be implemented with no impact on the others.

Opportunity #1: Ash Pit (126-F-1) Waste Stream

It is recommended that the contaminated **Fly Ash** waste stream from the Ash Pit (126-F-1) identified in "Phase IIA" of this report be effectively segregated (per Option #1) using a sophisticated scanning method. The scanning method would involve deploying a Geo-Probe configured with a sodium iodide detector to support lower cost in-situ characterization.

It is estimated that a 5% of ash would not have to be excavated during remediation if the Geo-Probe is deployed. This would result in a cost avoidance in the amount of **$509, 000**.

Opportunity #2: Asbestos on Pipeline Waste Stream

During contaminated pipeline removal operations, contaminated asbestos has been removed from the pipeline for disposal at the ERDF. It is recommended, under Option #1, to keep the contaminated asbestos on the pipeline and dispose it with the pipeline. Benefits would include reduction in volume of waste streams, reduction in exposure to workers, and reduction in the cost of disposal.

It is estimated that Option #1 would result in a cost savings in the amount of **$325, 000**.

Opportunity #3: Rail and Chain-Link Materials Waste Stream

It is recommended that the clean surplus solid waste (such as rails, and chain-link fence materials), should be excessed.

It is estimated that the sale of the above materials would generate revenue in the amount of **$4,000**.

Opportunity #4: Chrome -Mixed Soils

Soil containing chrome with a valence of plus six, exceeding 100 Area remedial action clean up requirements, has been encountered at the bottom of 116-D-7 Basin. The base case is to over-excavate to remove all chrome -mixed soil and dispose it at the ERDF.

A leach test was performed showing that movement of chrome contamination is not impacting groundwater. A report has been transmitted to the EPA Richland Field Office for approval of the leach test results. If this is approved, over-excavation beyond the bottom of the 116-D-7 Basin will not be required. This option will result in a cost avoidance in the amount of **$820, 000**.

Opportunity #5: Contaminant Construction Equipment Waste Stream

It is recommended that all seven pieces of equipment identified in "Phase IIB" of this report be transferred (per Option #2) to the TARC in order to realize 100% of waste minimization and corresponding estimated life cycle savings in the amount of **$141,000**.

Opportunity #6: Absorbent Waste Stream

The base case includes long-term warehouse storage of about 150 bags of a mineral-based absorbent, for a life cycle of 15 years. The long-term storage costs include quarterly inspections and warehouse rental.

It is recommended that the mineral based absorbent be used in the spent 100 N Pump & Treat burial boxes to absorb the excess water, instead of the present resin absorbent. This will result in a cost avoidance in the amount of **31,000**.

Opportunity #7: Prevention of Infiltration of Water into Purex#2 Filters

Currently, infiltration of rainwater on the 291-A Deep Bed PUREX #2 Filter area drains to the underground PUREX V-11 tank. Approximately 18,927 L (5,000 gallons) of rainwater, equal to the capacity of the tank, accumulates in three years. As such, every three years, the water from the tank needs to be pumped out, transported, and disposed to ETF as contaminated wastewater. Otherwise, the water would overflow and back up to the filters and potentially release highly radioactive particulate from the filter fibers to the environment. Presently, there are no means to prevent infiltration of rainwater into the filter.

It is recommended that a water barrier (per Option #4) using 100 cm (4 in.)-thick Shotcrete be installed over the entire PUREX #2 Filter area to prevent infiltration of water into the filters. This will result in cost avoidance in the amount of **$52.000**.

Summary of Estimates of Potential Waste Minimization and Savings

The following Table III summarizes the estimates of potential waste minimization and corresponding 15-year life cycle cost savings that resulted from the VE studies:

Table III. Summary of Estimates of Potential Waste Minimization and Cost Savings

Waste Category and Type	15-Year Life Cycle[1]					
	Base Case (Current Practice)		Recommended Options		Estimated Potential Savings	
	$ Costs[2]	Quantities to ERDF	$ Costs[2]	Quantities to ERDF	$ Savings[2]	Quantities Saved
1. Ash Pit (126-F-1) (LLW)	$10,540,480	167,514 metric tons (184,600 tons)	$10,031,715 (Option-1)[3]	159,138 metric tons (175,370 tons)	$509,000	8,376 metric tons (9,230 tons)
2. Asbestos on Pipeline (LLW)	$452,000	2,225 meters (7,300 L ft) of pipe and 850 bags of asbestos	$127,000 (Option-1)[4]	2,225 meters (7,300 L ft) of pipe	$325,000	Savings due to retention of asbestos on pipe
3. Rail & Chain Link Fence Materials (LLW)	$0.00	Rails: 32 metric tons (35 tons) Fence Materials: Fabric: 76 rolls Posts: 300 each Gates: 4 each Barbed: 11 rolls	($4,000) (Option-1)[5]	None	$4,000	100% Rails: 32 metric tons (35 tons) Fence Materials: Fabric: 76 rolls Gates: 4 each Barbed: 11 rolls
4. Chrome-mixed Soils (MLW)	$922,000	14,659 metric tons (16,154 tons)	$102,000 (Option-1)[6]	None	$820,000	14,659 metric tons (16,154 tons)
5. Contaminated Heavy Equipment (LLW)	$161,000	For list, see Phase IIB Study	$20,000 (Option-2)[7]	None	$141,000	For list, see Phase IIB Study
6. Absorbents (Non-Regulated)	$22,000	150-ten-lb bags	($9,000) (Option-2)[8]	None	$31,000	100% (Recycled)
7. Water Barrier for PUREX #2 Filter (LLW)	$137,000	Require pumping of water every 3 years to ETF as contaminated waste water	$85,000 (Option-4)[9]	None to ETF	$52,000	Eliminate pumping
				Total	$1,882,000 in FY 2000	

Notes:
[1]15-year life cycle was applied on only certain waste streams.
[2]The cost figures indicated in this table have been rounded.
[3]Characterize/segregate ash for waste reduction.
[4]Leave contaminated asbestos on pipe, split pipe, and dispose.
[5]Excess rail and chain-link fence materials.
[6]Obtain regulatory relief (change WAC) and leave it in place.
[7]TARC would wash, decontaminate, and sell the equipment to the public.
[8]Transport to Pump & Treat at Hanford site for reuse.
[9]Water barrier using SHOTCRETE material cover – 100 cm (4 in.) thick.

RESULTS OF ACTUAL IMPLEMENTATION OF WASTE MINIMIZATION EFFORTS

The following Table IV summarizes actual waste reduction and corresponding 15-year life cycle cost savings that resulted from the implementation of waste minimization efforts identified in the VE studies and carried out by BHI at the Hanford site.

Table IV: Summary of Actual Waste Minimization and Cost Savings.

No.	Waste Category and Type	Baseline Quantity	Target Reduction	Actual Reduction	Cost Savings
1	Ash Pit Soil (Initial) Ash Pit Soil (Revised)	167,514 metric tons 597,823 metric tons**	8,391 metric tons 29,891 metric tons**	---- 307,317 metric tons	 $20,325,540
2	Asbestos on Pipeline	2,225 meters (7,300 ft) of pipe 850 bags asbestos ($71m^3$)	--- 850 bags asbestos ($71\ m^3$)	--- 850 bags asbestos ($71\ m^3$)	$ 200,000
3	Rail	32 metric tons	32 metric tons	32 metric tons	$ 1,000
4	Chrome mixed soil (Initial) Chrome mixed soil (Revised)	14,659 metric tons 24,918 metric tons**	14,659 metric tons 24,918 metric tons**	---- 24,918 metric tons	 $1,648,000
5	Contaminated Heavy Equipment and Containers (LLW) Concrete Crusher Drum Overpacks Flatbed Trailer/Generator	 1 ea. 1,100 ea. 1 ea.	 1 ea. 1,100 ea. 1 ea.	 1 ea. 1,100 ea. 1 ea.	 $ 750,000 $ 348,900 $ 76,000
6	Absorbents (Initial) Absorbents (Revised)	.7 metric ton 1.0 metric ton**	.7 metric ton 1.0 metric ton**	 1.0 metric ton	 $ 3,500
				Total Actual Cost Savings for FY 2000	**$23,352,940**

CONCLUSION

Based on the results of the actual waste minimization efforts at the Hanford Site, it can be concluded that BHI's innovative approach of adopting Value Methodology for the assessment of Waste Minimization/Pollution Prevention Opportunities has proven to be a grand success. We were able to save U. S. Department of energy over $23 million in FY 2000.

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