1 of 6

STA #2

7/20/95

Page 1 of 1

ENGINEERING DATA TRANSMITTAL

1. EDT 605310

2. To: (Receiving Organization) Westinghouse Hanford Company	3. From: (Originating Organization) Site System Integration	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: System Integration	6. Cog. Engr.: A. B. Carlson	7. Purchase Order No.: N/A
8. Originator Remarks: The attached study provides alternative analysis in support of Tri-Party Agreement milestone M-33-00.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: June 22, 1995

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-ES-341 VOLUME 1-6	N/A	0	Solid Waste and Materials System Alternatives Study	NA	1	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
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BD-7400-172-2 (04/94) GEF097

BD-7400-172-1 (07/91)

1753

SUPPORTING DOCUMENT

1. Total Pages ~~715~~

2. Title	3. Number	4. Rev No.
Solid Waste and Materials System Alternatives Study	WHC-SD-WM-ES-341 VOL1-6	0

5. Key Words	6. Author
Tri-Party Agreement milestone M-33-00, alternative analysis, systems engineering	Name: Alan B Carlson Alan B Carlson Signature Organization/Charge Code 87320/A9E40

7. Abstract

This study presents alternatives defined to provide the necessary facilities satisfying the statement of TPA milestone M-33-00. Alternatives were arrived at using a systems engineering approach. The alternatives represent the use of existing facilities and construction of new facilities. The current planning baseline is also presented for comparison to the alternatives examined.

8. RELEASE STAMP

A-6400-073 (08/94) WEF124

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-ES-341, Rev. 0, Vol. 1 - 6
Document Title:	Solid Waste and Materials System Alternatives Study
Release Date:	June 30, 1995

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

T.L. Ontiveros   June 30, 1995

9513382.0506

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1 of 6

WHC-SD-WM-ES-341
Revision 0

Solid Waste and Materials Systems Alternatives Study

JUL 1995
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Prepared for the U. S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

WHC-SD-WM-ES-341
Revision 0

Solid Waste and Materials Systems Alternatives Study

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SOLID WASTE AND MATERIALS SYSTEMS ALTERNATIVES STUDY

VOLUME I

EXECUTIVE SUMMARY

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CONTENTS

ATTACHMENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

CH	Contact-Handled
Cs	Cesium
CTTF	Commercial Thermal Treatment Facility
CWC	Central Waste Complex
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DST	Double-shell tank
DU	Depleted Uranium
ERDF	Environmental Restoration Disposal Facility
FFTF	Fast Flux Test Facility
FMEF	Fuels and Materials Examination Facility
GSB	General Services Building
GTC3	Greater Than Category 3
HLW	High Level Waste
HMP	Hanford Mission Plan
HNPF	Hallam Nuclear Power Facility
HSP	Hanford Strategic Plan
LLMW	Low-Level Mixed Waste
LLW	Low-Level Waste
NRC	Nuclear Regulatory Commission
PNL	Pacific Northwest Laboratories
RCB	Reactor Containment Building
RH	Remote-Handled
SE	Systems Engineering
SNF	Special Nuclear Fuels
Sr	Strontium
SRE	Sodium Reactor Experiment
TGB	Turbine Generator Building
TPA	Hanford Federal Facilities Agreement and Consent Order
TRU	Transuranic
TRUM	Transuranic Mixed
UU	Unirradiated Uranium
WESF	Waste Encapsulation and Storage Facility
WNP-1	Washington Nuclear Plant 1
WRAP-1	Waste Receiving and Processing Facility Module 1
WRAP-2A	Waste Receiving and Processing Facility Module 2A
WRAP-2B	Waste Receiving and Processing Facility Module 2B

LIST OF UNITS

cm	centimeter
ft	feet
ft^3	cubic feet
g	gram
gal	gallon
kg	kilogram
km	kilometer
L	liter
m	meter
m^3	cubic meter
MCi	Megacurie
mi	mile
nCi	nanocurie

1.0 INTRODUCTION

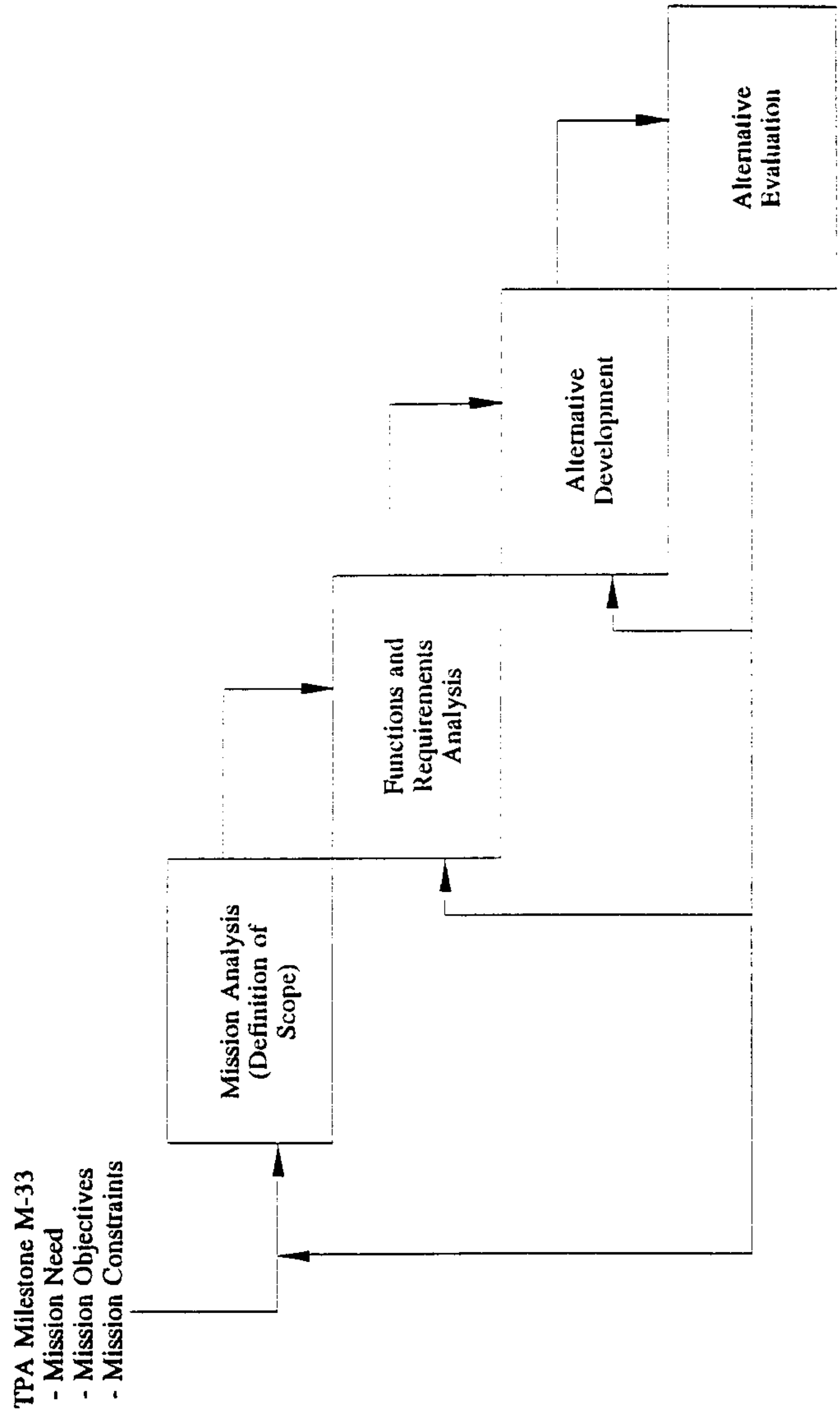
Past operations at the Hanford site have generated a wide range of radioactive solid waste and materials to be processed and stored prior to final disposition. In addition, current and planned retrieval of buried wastes and decontamination and decommissioning (D&D) of transition facilities will generate new wastes and materials over the next 30 years. These wastes will also require processing and storage prior to final disposal. The Hanford Federal Facilities Agreement and Consent Order (Tri-Party Agreement or TPA) milestone M-33-00-T04 requires the U.S. Department of Energy (DOE) to submit a change package by June 30, 1995, that would specify additional milestones for the acquisition of new facilities, modification of existing or planned facilities for storage, processing and/or disposal of solid waste and materials based on the results of the "Site-Wide Systems Analysis" effort.

This study presents alternatives defined to provide the necessary facilities satisfying the statement of TPA milestone M-33-00. Figure 1-1 shows the systems engineering approach that was taken to arrive at the analysis presented within this document. The initial step is the mission analysis which consists of determining the scope of materials and functions to be included within the study. The second step is the functions and requirements analysis. The functional analysis is taken from the site-wide systems engineering effort. Details of the site-wide systems engineering functions and requirements can be found elsewhere (Holmes 1994). Based on the definition of scope and functional analysis a set of alternatives was developed. Engineering information for each of these alternatives was compiled. This information coupled with public values (decision criteria) was used to provide alternative analysis and evaluation for the purpose of decision making.

The Systems Engineering (SE) approach to defining work content and organization is being introduced to the Hanford Site cleanup effort as an initiative to substantially improve mission performance. Systems Engineering methodology evolved mainly from the U.S. Department of Defense where its application to weapons system development, procurement, and verification is well known. This approach also has been used for planning and conducting the National Aeronautics and Space Administration activities which stretched the envelope of human experience to the moon and beyond. During the last few years, SE has been extended to applications beyond its original base such as improvements to business systems; the design and production of complex computer equipment; and advances in the nuclear industry, at the Yucca Mountain repository, and in the Nuclear Regulatory Commission regulatory process.

The formalized methodology of Systems Engineering is being applied to the Hanford Cleanup effort. Systems Engineering is a prescriptive process consisting of steps that span the entirety of the cleanup effort including program strategy development, system design, acquisition and verification, and deployment of the system to achieve the desired mission objectives. The initial steps in application of Systems Engineering to the cleanup effort include top-level mission analysis, functional breakdown, requirements analysis, and measures of effectiveness development for the selection of specific designs or functional architectures. This has been documented (Holmes 1994) for top-level SE mission analysis, functions analysis, and requirements analysis for the Hanford Site cleanup mission. Because SE is an iterative process, results are continuously updated as the mission evolves.

Figure 1-1. Summary of Approach for this Engineering Study Supporting TPA Milestone M-33-00-T04.



2.0 DEFINITION OF SCOPE

2.1 INVENTORY OF WASTES AND MATERIALS

The waste and materials identified in the TPA milestone M-33-00 change package are listed in Table 2-1. The commonly used classifications for these waste and material types are also identified in the table. The waste and materials included in the scope of the study are as follows:

- High-Level Waste (HLW) canisters;
- Transuranic Waste (including transuranic mixed waste)
  - Remote-handled wastes
  - Large container contact-handled wastes
  - Contact-handled special wastes not destined for Waste Receiving and Processing Module 1 (WRAP-1);
- Low-Level Mixed Waste
  - Remote-handled wastes
  - Large container contact-handled wastes not destined for the Waste Receiving and Processing Module 2A (WRAP-2A) or Commercial Thermal Treatment Facility (CTTF);
- Greater Than Category 3 (GTC3) Low-Level Waste (including CH and RH Low-Level Waste (LLW) and LLMW);
- Miscellaneous materials
  - Contaminated sodium from the Hallam Reactor and the Sodium Reactor Experiment (SRE),
  - Unirradiated Uranium (UU),
  - Miscellaneous Sources including Special Case Waste and Special Case Mixed Waste; and
- Cesium (Cs) and Strontium (Sr) Capsules.

Wastes and materials with well-defined paths established for storage, processing and/or disposal (i.e., LLW), and waste and materials being managed under other TPA milestones (i.e., TRU destined for WRAP-1, LLMW destined for WRAP-2A and CTTF, vitrified LLMW from Double-Shell Tank [DST] processing, Environmental Restoration Disposal Facility [ERDF] disposed LLMW, Fast Flux Test Facility [FFTF] sodium, Spent Nuclear Fuel [SNF]), are not included in the scope of this study. Other wastes and materials with significant uncertainties regarding their disposition (i.e., TRU contaminated waste buried prior to 1970, and TRU contaminated soil, special nuclear material) were also excluded from the scope of the M-33-00-T04 milestone. Listed below are the waste and material classifications not included in the scope of the study:

- Transuranic Waste (including transuranic mixed waste)
  - Drums and small boxes of contact-handled waste destined for the WRAP-1;
  - TRU contaminated waste buried prior to 1970;
  - TRU contaminated soil sites;

- Low-Level Mixed Waste
  - LLMW Destined for the WRAP-2A and the CTTF,
  - Vitrified Low-Level (Mixed) Waste from DST Processing,
  - ERDF disposed low-level mixed waste;
- Miscellaneous Materials
  - FFTF Sodium;
- Low-Level Waste;
- Special nuclear material; and
- SNF.

The following sections provide information about the inventory of waste and materials that are included in the scope of this study. A graphic representation of the inventory of waste and materials summary is provided in Figure 2-1. An overview of the waste and materials characteristics are provided in Table 2-2.

2.1.1 High-Level Waste

The high-level waste portion of double-shell tank waste is processed into an immobilized borosilicate glass product. The glass is poured into metal canisters for disposal in the geologic repository. Assuming a specific gravity of 2.66 and a level production rate during the 19 years of operation as stated in the TPA (Ecology et al. 1990), the volume of HLW glass to be generated and which will require storage prior to shipment to the geologic repository is approximately 8,600 m^3 (Orme 1994).

2.1.2 Transuranic Waste

Since May 1970, solid waste classed as, or suspected of being TRU waste has been packaged, labeled, and stored to be retrievable for at least 20 years. This inventory can be classified as either contact-handled (less than 200 mrem/hr at the container surface) or remote-handled (greater than 200 mrem/hr at the container surface). The inventory of retrievable stored RH TRU waste is approximately 380 m^3 (Anderson 1991). This RH TRU waste is stored in trenches or caissons within the 200 Area burial grounds and a single burial ground outside the 200 Area known as the 618-11 burial ground. The forecasted volume of remote-handled TRU waste during the next 30 years is 41,000 m^3 (Valero 1994a, 1994b; Templeton 1994).

The stored CH-TRU and TRUM large container waste (Anderson 1991) is located in four main burial ground sites in the 200 Areas, namely burial grounds 218-W-3A, 218-W-4B, 218-W-4C, and 218-E-12B. Also buildings 212-N and 212-P in the 200 North Area have been used to store large container TRU waste. The stored CH-TRU and TRUM inventory of retrievable stored solid TRU waste is approximately 7,300 m^3. The forecasted volume of CH-TRU and TRUM in large containers for the next 30 years is approximately 22,000 m^3 (Valero 1994a, 1994b; Templeton 1994).

The special contact-handled transuranic waste category includes waste items that will require unique and special considerations during processing. The stored CH special case waste items that constitute this category are classified waste (Venetz 1993), drums containing more than 200 g of ^{238}Pu (Anderson 1991), drums of dirt form the Z-9 crib, drums weighing over 1,000 lbs (454 kg) (Weidert 1993), and plutonium nitrate shipping containers adding up to approximately 490 m^3 of special stored CH TRU and TRUM waste. The forecast CH special case waste inventory would include the waste items rejected from WRAP-1. This includes: CH-TRUM with a hazard classification of "reactive" (RCRA code D003); and CH-TRU and CH-TRUM waste with a physical waste form consisting of soil or particulate. The projected volume of special forecasted CH Waste for the next 30 years is approximately 1,900 m^3 (Valero 1994a, 1994b; Templeton 1994).

2.1.3 Low-Level Mixed Waste

The stored RH-LLMW waste category consists of RH-LLMW stored in the Central Waste Complex or 200 Area burial grounds. This is waste generated between 1987-1995 that is both a remote-handled low-level radioactive waste and a state-regulated dangerous waste. Twelve items were identified in the 218E10 and 218W4C burial grounds. The total volume of RH-LLMW is 280 m^3 (9,800 ft^3). The projected volume of forecasted RH-LLMW for the next 30 years is approximately 96,000 m^3 (Valero 1994a, 1994b; Templeton 1994). Seven generators at the Hanford site (Project W-320 Tank 241-C Sluicing, 222-S Laboratory, Hanford Grout Facility [or its replacement], Surplus Facilities, T-Plant Building, PUREX Plant, and Long-Length Equipment from the Tank Farms) are expected to generate RH-LLMW during the next 30 years. Additional RH-LLMW may be expected to be generated from additional facilities after they become surplus facilities.

The stored CH-LLMW large containers (Anderson 1991) waste category consists of CH-LLMW stored in the Central Waste Complex or 200 Area burial grounds. This is waste generated between 1987-1995 that is both a remote-handled low-level radioactive waste and a state-regulated dangerous waste. Six items were identified in the 218E10 and 218W4C burial grounds. Items from Pacific Northwest Laboratory and Knolls Atomic Power Shipyards are being stored in the Hanford Central Waste Complex (CWC) Building 2403WD. The total volume of stored CH-LLMW large containers is 650 m^3. The projected volume of CH-LLMW in large containers for the next 30 years is approximately 980 m^3 (Valero 1994a, 1994b; Templeton 1994). Only four generators consisting of Bettis Atomic Power Laboratory, Knolls Atomic Power Shipyards, PUREX Plant, and Hanford Grout Facility [or its replacement] are expected to generate CH-LLMW in large containers during the next 30 years. Additional CH-LLMW in large containers could be generated from facilities after they become surplus facilities.

2.1.4 Greater Than Category III LLW and LLMW

Two generators consisting of Pacific Northwest Laboratories (PNL) and the Hanford Site Surplus Facilities Program are expected to generate GTC3 RH-LLW and LLMW during the next 30 years. Additional GTC3 RH-LLW could be generated from facilities after they become surplus facilities. The total projected waste volume of GTC3 RH-LLW over the next 30 years is approximately 42,600 m^3 (41,000 m^3 LLW and 1,600 m^3 LLMW).

One generator, the Hanford Site Surplus Facilities Program, is expected to generate GTC3 CH-LLW during the next 30 years. Five generators consisting of Pacific Northwest Laboratories, Past Practice Remediation Projects, Portsmouth Gaseous Diffusion Plant, 222-S Analytical Laboratories, and the Hanford Site Surplus Facilities Program are expected to generate GTC3 CH-LLMW during the next 30 years. Additional GTC3 CH-LLW and LLMW may be generated from facilities after they become surplus facilities. The total projected waste volume of GTC3 CH-LLMW is approximately 4,400 m^3. The total projected waste volume of GTC3 CH-LLW over the next 30 years is approximately 42,000 m^3.

2.1.5 Miscellaneous Materials

This material category consists of three sources including contaminated metallic sodium, unirradiated uranium, and miscellaneous sources, briefly described below.

2.1.5.1 Contaminated Metallic Sodium. The contaminated metallic sodium inventory consists of quantities from Hallam Nuclear Power Facility (HNPF) and SRE (Jacobsen 1993). The sodium was originally planned for use at the Hanford site but no use has been identified to date. The sodium is currently being held in Sodium Storage Building 2727W and Alkali Metal Storage Modules at the CWC. The HNPF and SRE material was placed into storage April 1977 and December 1967, respectively. There is 140 m^3 HNPF sodium and 33 m^3 SRE sodium.

2.1.5.2 Unirradiated Uranium (Lini 1994). The estimated total volume of unirradiated uranium inventory is 140 m^3. Portions of the inventory of unirradiated depleted uranium (DU), normal, and low enriched uranium is proposed for sale, which may affect the inventory of uranium left in storage. The fuel assemblies, elements and metal billets are stored in wooden boxes in the 300 Area. The DU trioxide is stored in 55-gal (0.21 m^3) drums in the 200 West Area. The enriched uranium trioxide is stored in T-Hoppers in the 200 West Area. The DU metal slabs are stored in metal or wood boxes in the 400 Area, and the uranium dioxide powder and pellets are stored in cans, pins, assemblies, and drums in the 300 Area.

2.1.5.3 Miscellaneous Sources. The miscellaneous materials information was compiled from waste management records, and from the PNL unique materials listing. The estimated total volume of miscellaneous sources is 15 m^3. These sources are comprised of small quantities of borosilicate glass canisters, high dose rate LLW and LLMW (solid material), neptunium oxide powder, and non-fuel bearing reactor components.

2.1.6 Cesium and Strontium Capsules

There are 1577 cesium-137 capsules (or 2.38 m^3) that were fabricated at the Waste Encapsulation and Storage Facility (WESF). Once all offsite capsules are returned in FY 1996, the inventory in storage at WESF will be 1,295. Additionally, plans will be developed to receive approximately 33 capsules from PNL. The remaining original capsules have been cut or destroyed, and are outside the scope of this study.

A total of 640 strontium capsules (or 1.12 m^3) were fabricated at WESF. There are currently 601 strontium capsules (23.23 MCi decayed to October 15, 1994) stored in the WESF pool cells. There are four strontium capsules (0.32 MCi decayed to October 15, 1994) located offsite, five strontium capsules (0.17 MCi decayed to October 15, 1994) at PNL, and 30 strontium capsules (2.36 MCi decayed to October 15, 1994) that have been cut or destroyed.

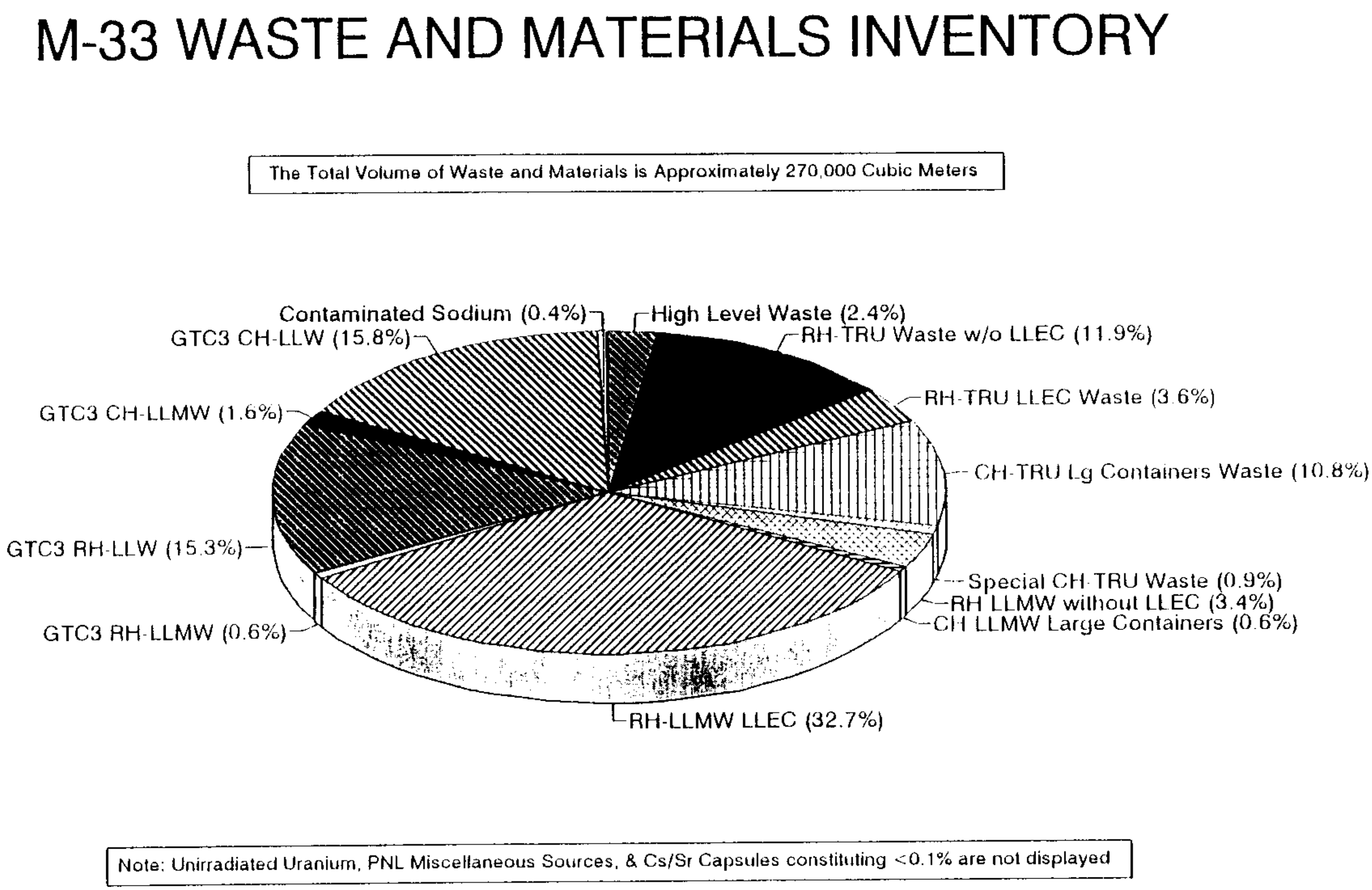


Figure 2-1. M-33-00-T04 Milestone Waste and Materials Inventory.

Table 2-1. TPA Milestone M-33-00-T04 Materials in Terms of Common Waste and Material Classifications.

Common Waste and Material Classifications	Materials Identified in TPA Milestone M-33-00-T04
Nuclear Materials	Unirradiated Uranium
Transuranic Waste Low-Level Mixed Waste Greater Than Category III Low Level Waste Low-Level Waste	D&D Generated Wastes
Cesium/Strontium Capsules	Cesium/Strontium Capsules
Transuranic Waste Low-Level Mixed Waste Greater Than Category III Low Level Waste Low-Level Waste	Contaminated Processing Equipment
High Level Waste	Vitrified HLW Canisters
Transuranic Waste Low-Level Mixed Waste Greater Than Category III Low Level Waste Low-Level Waste	Radioactive/Hazardous Solid Wastes

Table 2-2. Waste and Materials Characteristic Summary.

Waste or Material Category	Waste or Material Type	Container Type	Maximum Container Dimension	Maximum Container Weight	Maximum Radiation Field	Average Density (kg/L)	Notes
HLW	Vitrified Waste	Canister	27"OD x 15' (2.2m OD x 4.6m)	4 tons (3.6 MT)	Per Canister 359,000 Ci Cs-Ba 13,400 Ci Sr-Y	2.66	12K m^3 Canister 6800 Canisters
TRU Waste	Forecast RH	Ion Exchange Column	75 ft^3 (2.1 m^3) [nom. 4'OD x 6' or 1.2m OD x 1.8m]	2.5 tons (2.3 MT)	4,200 Ci/m^3 ^{137}Cs	0.34	1,000 Casks 18,000 m^3 Cask Exterior Volume
		Shipping Cask	9.5'OD x 9.1' (2.9m OD x 2.8m)	40 tons (36 MT)			
		Overpack	66"OD x 70' (1.7m OD x 21m)	15 tons (14 MT)	5,000 mrem/hr	0.34	22K m^3 Overpack
	Stored RH	Waste Overpack	26"OD x 10.1' (0.7m OD x 3.1m)	4 tons (3.6 MT)	7,000 Ci/m^3 Mixed Fission Products	0.34	35 Casks
		Cask	6.3'OD x 15.7' (1.9m OD x 4.8m)	25 tons (23 MT)			
		Box	4' x 4' x 4' (1.2m x 1.2m x 1.2m)	2 tons (1.8 MT)	1,300 mrem/hr (contact)	0.34	
	Forecast CH Large Container	Box	4' x 4' x 4' (1.2m x 1.2m x 1.2m)	Unknown	200 mrem/hr	0.40	
	Stored CH Large Container	Box	8' x 17' x 16' (2.4m x 5.2m x 4.9m)	30 tons (27 MT)	200 mrem/hr	0.40	
	Forecast Special CH Waste	Drum	2'OD x 3' (0.6m OD x 0.9m)	Unknown	200 mrem/hr	0.40	
	Stored Special CH Waste	Drum	2'OD x 3' (0.6m OD x 0.9m)	1,000 lb (454 kg)	200 mrem/hr	0.40	

Table 2-2. Waste and Materials Characteristic Summary.

Waste or Material Category	Waste or Material Type	Container Type	Maximum Container Dimension	Maximum Container Weight	Maximum Radiation Field	Average Density (kg/L)	Notes
LLMW	Forecast RH	Cask	4' x 4' x 4' (1.2m x 1.2m x 1.2m)	Unknown	Unknown	0.16	2,000 Casks
		Overpack	66"OD x 70' (1.7m OD x 21m)	15 tons (14 MT)	5,000 R/hr	0.16	93K m^3 Overpack
	Stored RH	Drum Box	2' OD x 3' (0.6m OD x 0.9m)	100 kg	500 mrem/hr	0.16	
	Forecast CH Large Container	Overpack	66"OD x 70' (1.7m OD x 21m)	15 tons (14 MT)	100 mrem/hr	0.40	
	Stored CH Large Container	Box Self-Contained	8.6' OD x 12.8' (2.6m OD x 3.9m)	78 MT	200 mrem/hr	0.40	
GTC3	Forecast RH LLW & LLMW	Box Drum	4' x 4' x 8' (1.2m x 1.2m x 2.4m) 2'OD x 3' (0.6m OD x 0.9m)	Unknown	Unknown	0.40	
	Forecast CH LLW & LLMW	Box Drum	4' x 4' x 8' (1.2m x 1.2m x 2.4m) 2'OD x 3' (0.6m OD x 0.9m)	Unknown	200 mrem/hr	0.40	
Misc. Materials	Contaminated Metallic Sodium	Tank Drum	15,000 gallon (57 m^3) 2'OD x 3' (0.6m OD x 0.9m)	47 MT	200 mrem/hr	1.00	
	Unirradiated Uranium	Box Drum	4' x 4' x 8' (1.2m x 1.2m x 2.4m) 2'OD x 3' (0.6m OD x 0.9m)	6 tons (5.4 MT)	10 mrem/hr	8.10	
	Misc. Sources	Canister Box Drum	0.32 m OD x 2.59 m 4.5 m x 22 cm^2 2'OD x 3' (0.6m OD x 0.9m)	Unknown	310,000 R/hr	0.40	
Cs/Sr	Cs/Sr Capsules	Capsule	2.6"OD x 20.8" (6.6cm x 5.3dm)	22 lb (10 kg)	300,000 R/hr 45K Ci/Cs Capsule 55K Ci/Sr Capsule	4.30	1,577 Cs Capsules 601 Sr Capsules
		Cask	54"OD x 49" (1.4m OD x 1.2m)	16.5 tons (15 MT)			

3.0 FUNCTIONAL ANALYSIS

The functions for each waste stream and material within the scope of this study are illustrated in Table 3-1. These functions were identified using the site-wide systems engineering functions and requirements. The numbers in the boxes correspond to the appropriate site-wide systems engineering functions that have been identified by the programs (Holmes 1994). The functions included in this study are based on the functional needs of the particular waste or material and vary according to the specific waste or material type.

Table 3-1. Addition of Potential Interfaces to the Site-Wide Functions Within the Scope of the M-33-00-T04 Milestone.

Material	Activity						
	Characterization	Retrieval	Storage Prior to Processing	Treat	Package	Storage Prior to Disposition	Disposition
High Level Waste							
Canisters						4.2.2.7	
TRU Waste							
Remote-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Contact-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Low Level Mixed Waste							
Remote-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	4.3.5.6
Contact-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	4.3.5.6
Greater Than Category 3 LLW							
Remote-Handled			4.3.2				
Contact-Handled			4.3.2				
Miscellaneous Materials							
Sodium (Hallam & SRE)						4.3.5.4&5	
Unirradiated Uranium			4.7.5.4		4.7.5.4	4.7.5.4	
Miscellaneous Sources			4.3.2 & 4.7.4.4		4.3.5.2&3 & 4.7.4.4	4.3.5.4&5 & 4.7.4.4	
Cesium & Strontium Capsules							
Cesium Capsules			4.7.3.4&5		4.2.2.6.2	4.2.2.5.3	
Strontium Capsules			4.7.3.4&5		4.2.2.6.2	4.2.2.5.3	

X.Y.Z	=In Scope	[shaded]	=Not In Scope

4.0 SOLID WASTE AND MATERIALS SYSTEM ALTERNATIVES

Development of the alternative system configurations was based on a matrix of three main factors: use of new or existing facilities, integration or segregation of waste and material stream storage and processing, and single or modular facilities. Table 4-1 illustrates this matrix. There were five feasible alternatives identified for evaluation. These alternatives are generic, and not facility or waste stream-specific. Because these alternatives are generic system configurations, they each create a solution that assigns a facility (facilities) to each function for each waste stream or material. Table 4-2 illustrates the facilities that have been developed for each waste and material by function for each alternative. Each of the five alternatives examined is described below.

4.1 ALTERNATIVE 1: SINGLE NEW FACILITY INTEGRATING STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS

The Alternative 1 evaluates a single new facility that provides storage, processing and disposal requirements for all the waste and materials within the scope of the study. Following evaluation of the design and functional differences between storage and processing facilities, a complex consisting of three contiguous facilities was identified. The complex is comprised of a processing facility, a remote-handled storage facility, and a contact-handled storage facility. Table 4-4 summarizes the facility sizes.

Facility sizes were determined by using existing size and throughput data (Feizollahi and Shropshire 1993 & 1994) on similar processing and storage facilities employed at other government locations. A method of scaling the data was employed to obtain the facility sizes. This data establishes the basis for the cost estimates.

The method of scaling the total throughput and storage capacity requirements is described in Volume II section 6.4.1. Engineering studies to select the equipment, size facilities, and apply accurate integration meeting the exact process requirements were not performed. The processing and storage references that were utilized are typical, however were not uniquely designed for the processes within this document scope. They are were sufficiently accurate, and representative, to obtain comparison cost estimates for the level of detail obtained.

A breakdown of the life cycle cost for Alternative 1 is provided in Table 4-5. Presented is the total estimated cost, total project cost, operations and maintenance cost, and decontamination and decommissioning cost. The total life cycle cost for Alternative 1 including escalation and contingency is $6,949,105,062. This is summarized in the following:

Total Estimated Cost	$2,055,725,480
Other Project Cost	$ 727,705,501
Operations and Maintenance	$2,783,430,981
Decontamination and Decommissioning	$1,382,243,100
Total Life Cycle Cost	$6,949,105,062

The details of the capital cost estimate are provided in Volume IV Appendix B. The personnel requirements and direct (no escalation, no contingency) operating and maintenance costs are presented in Volume VI Appendix D.

4.2 ALTERNATIVE 2: MULTIPLE NEW MODULAR FACILITIES INTEGRATING STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS

Alternative 2 evaluated multiple facilities that provide all storage, processing and disposal requirements for the waste and materials within the scope of this study. A complex consisting of two or three processing facilities, remote-handled storage facilities, and contact-handled storage facilities was identified following evaluation of the design and functional differences between storage and processing facilities. Table 4-6 summarizes the various facility sizes.

The facility sizes were determined using existing data (Feizollahi and Shropshire 1993 & 1994) from similar processing and storage facilities developed at other Federally operated sites. A method of scaling the data using facility size and waste throughput rates was employed to obtain the modular facility sizes. This data established the cost estimate basis.

The total throughput and storage capacities are described in Volume II Section 6.5.1. Engineering studies to select the equipment, size facilities, and integrate functions to meet the exact process requirements were not performed. The processing and storage references that were utilized are typical, however were not uniquely designed for the processes within this document scope. They are were sufficiently accurate, and representative, to obtain comparison cost estimates for the level of detail obtained.

A breakdown of the life cycle cost for Alternative 2 is provided in Table 4-7. Presented is the total estimated cost, total project cost, operations and maintenance cost, and decontamination and decommissioning cost. The total life cycle cost for Alternative 2 including escalation and contingency is $8,016,032,512. This is summarized below:

Total Estimated Cost	$2,762,232,739
Other Project Cost	$ 973,840,133
Operations and Maintenance	$3,006,164,057
Decontamination and Decommissioning	$1,273,795,583
Total Life Cycle Cost	$8,016,032,512

The details of the capital cost estimate are provided in Appendix B. The personnel requirements and direct (no escalation, no contingency) operating and maintenance costs are presented in Appendix D.

4.3 ALTERNATIVE 3: MULTIPLE EXISTING FACILITIES INTEGRATING STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS

Alternative 3 evaluates the feasibility of using existing DOE-owned facilities to perform the solid waste and material treatment and interim storage operations for the Hanford Site. The evaluation process used for Alternative 3 is shown in Figure 4-1.

Critical attributes for processing facilities include:

- Remote-handling capability;
- Confinement systems;
- Accessible by truck or rail; and
- Floor space and configuration to accommodate a processing line.

Critical attributes for interim storage facilities include:

- Radiologically clean;
- Secondary containment (leakage collection for RCRA wastes);
- Safeguards and security systems;
- Accessible by truck or rail;
- Heat removal capability (Sr/Cs capsules and HLW canisters only);
- Remote-handling capability (RH waste streams and miscellaneous sources);
- Shielded cells for high-activity waste (RH waste streams and Miscellaneous Sources); and
- Safety Class 2 structures and/or systems for high-activity wastes.

The facilities evaluated for any given treatment or storage function under Alternative 3 satisfied all of the critical attributes. The attributes were specific enough to ensure that the selected facilities could safely perform the identified function. It is possible that a number of facility options for storage of some of the smaller volume waste streams and materials, beyond those specifically selected for evaluation, could be viable. For the treatment and interim storage functions of the large-volume waste streams, there are few existing facilities that possess the critical attributes. Combinations of multiple facilities to provide individual functions were not considered because of the numerous scenarios possible, and the likelihood that the cost and programmatic complexities involved in modifying and operating several facilities for any given function would be prohibitive.

The facilities selected for each function are shown in Table 4-8. There were several facilities that are viable for the TRU and LLMW processing operations; whereas, the selection of facilities for interim storage was limited. Each of the processing facilities are technically viable and could be converted for use to perform the processing function(s). In the case of interim storage, the only viable facility/function options identified were Sr/Cs capsule storage at the Fuels and Materials Examination Facility (FMEF); and UU and Miscellaneous Radioactive Source storage also at the FMEF. Storage of the Sr/Cs capsules at the WESF and storage of the HLW canisters at the canyon facilities were also evaluated in some detail for Alternative 3, but may not be viable because the life cycle costs comparison with other options and alternatives do not appear favorable. Although FMEF was evaluated for storage of the RH TRU and LLMW waste streams, the required storage space exceeds the available space in the facility. There are no existing facilities capable of storing the projected volumes of RH and CH TRU, LLMW, and GTC-3 Wastes. Volume II Section 6.6.2 provides the technical assessment for each of the facility/function options evaluated under Alternative 3.

None of the processing or interim storage options evaluated involved any significant technical, safety, or regulatory uncertainties because most planned operations have previously been performed at, or had been part of the intended mission of, these same facilities. Processing facilities proposed in Alternative 3 (T Plant, MASF, and Grout Vaults) were specifically designed for waste handling functions and would require minimal incremental D&D costs. The T Plant facility was previously used for plutonium processing and this facility for processing TRU or LLMW would not appreciably affect the D&D liability that already exists.

Table 4-9 summarizes construction and life cycle costs for the processing and interim storage options for Alternative 3. For cost comparison purposes, the cost of future CWC expansion to store RH and CH TRU, LLMW and GTC3 LLW and LLMW are included in the Cost Summary Table. Details of capital and life cycle cost estimates for Alternative 3 are provided in Appendix B.

4.4 ALTERNATIVE 4: MAXIMIZING USE OF THE WASHINGTON NUCLEAR PLANT-1 FACILITY INTEGRATING STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS

Alternative 4 locates the required processing and storage capabilities within the essentially completed, but never fueled or operated Washington Nuclear Plant-1 (WNP-1) Facility on the Hanford Site. The facility would be converted to meet the needs of the scope of this study.

WNP-1 is a stand alone nuclear power plant designed to be licensed by the Nuclear Regulatory Commission (NRC) to generate, process, and store nuclear materials including waste products at the plant site. The WNP-1 is located 12 mi (19.3 km) north of Richland, WA and 2.4 mi (3.86 km) from the Columbia River. The plant, which is 65% complete, was designed to store 663 metric tons of uranium in the form of new and spent nuclear fuel, as well as annually process for disposal tens of millions of curies of radioactive waste streams. These storage and processing functions were to take place Reactor Containment Building and General Services Building (GSB). The study of plant conversion evaluated these two buildings for process and storage functions, plus the Turbine Generator Building (TGB) for waste storage and the Spray Pond structure for conversion to HLW canister storage.

Information on waste and materials characteristics and volumes was assessed to determine specific throughput before and after processing, unique storage requirements, and special handling or process needs which are required to store and process the waste in this facility option. Utilizing the results of this assessment the facility attributes were summarized based on historical data, existing processes, commercial experience and reference data. In parallel with this effort the WNP-1 plant capability related to systems, structures and components were tabulated for use in comparison to the waste and material storage and processing requirements. The alignment of the requirements with the existing capabilities yielded the subset of modifications needed to address the needs of the storage and processing.

The major modifications required to meet the scope of the study include the following conversions: WNP-1 spray pond to accommodate the high level waste canisters generated from tank waste processing; GSB for processing of contact-handled and remote-handled solid waste streams; Spent Fuel Storage Pool and its support systems to store the Cs and Sr capsules; GSB, TGB and warehouse space for the storage of contact-handled and remote-handled wastes and materials.

Use of WNP-1 for processing and storage of Hanford wastes and materials offers some unique advantages not found in any other alternative but also raises some issues requiring resolution to achieve those advantages. Conversion provides benefits by greatly reducing costs and time needed to establish solid waste processing facilities, and makes use of a quality Hanford structure that is otherwise subject to demolition at additional regional expense. The institutional issues involved with ownership of the plant, and occupying the leased Supply System property, are not addressed in detail by this study. However, the following information has bearing on resolution of this institutional issue:

1) The plant construction is 65% complete with in excess of $2 billion investment when the project was terminated;

2) The design and construction software (inspection records, material certifications, test reports, etc.) required to fully document the viability of the plant exists;

3) The plant is located on DOE leased property; access corridors to the Hanford rail and road infrastructure exist. Utilities at the site are operational;

4) Cost savings arise from several aspects:
   a. The facility is available at essentially no cost on an "as-is" basis.
   b. Much of the installed equipment such as turbine generators, emergency diesels, cooling water pumps and heat-exchangers, and piping could possibly be sold to offset the cost of conversion.
   c. Selected installed equipment and structures could be used for the waste processing and storage concept with little modification. These include radioactive waste processing, liquid volume reduction, grouting, decontamination, cask handling, operational cranes, extensive high efficiency particulate air-filtered HVAC systems, laboratory and counting rooms, maintenance rooms, receiving and handling areas, office and locker areas, and security and access control; and

5) The facility has been constructed to standards exceeding those needed for processing and storage functions with construction Quality Assurance/Quality Control records in site vault storage; and

The following issues require resolution to achieve the above benefits:

1) DOE must determine if transfer of the facility is acceptable per its procurement regulations.

2) Since modifications are required to perform the desired functions, agreement which allows a facility not designed for the specific purpose of solid waste processing and storage is in fact acceptable (e.g. layout may not be the most efficient); and

3) DOE must be willing to accept a facility built to meet NRC requirements rather than DOE design criteria. The NRC requirements are generally more restrictive. Agreement on criteria to be used for modification will need to be established.

A summary of the cost estimate for WNP-1 conversion is presented in Table 4-10. The details of the capital cost estimate are provided in Appendix B. The personnel requirements and direct (no escalation, no contingency) operating and maintenance costs are presented in Appendix D. A detailed description of this alternative is found in Volume II, Section 6.7.

4.5 ALTERNATIVE 5: CURRENT PLANNING BASELINE FOR EACH PROGRAM

The planning baseline for facilities and programs associated with each waste stream or material is described in this section. This baseline is provided as a reference point and basis for comparison for each of the alternatives previously discussed. The baseline is derived from the primary strategic documents for the Hanford Site.

The Hanford Strategic Plan (HSP) (DOE-RL, 1995) outlines broad, site-wide goals, with milestone dates and responsible parties. Goal #4 of the Plan is "Manage Cleanup as a Project." Project Management Plans for each cleanup activity and an integrated technical baseline are called for by the Hanford Strategic Plan. All solid waste and material options must be aligned with these Project Management Plans and the integrated technical baseline.

The Hanford Mission Plan (HMP) presents integrated guidance for Hanford Site programs, and was crafted to be consistent with the HSP. Important assumptions from the HMP are that the 200 Area Plateau is to be the central location for waste disposal and related activities, and that all radioactive and hazardous waste and materials eventually are to be converted to stable form and disposed onsite as waste or transferred off-site for reuse or disposal. Storage will be required indefinitely onsite for some waste or materials until offsite facilities or uses are available.

Alternative 5 represents the existing programmatic technical baseline for the storage, processing, and disposal of the various waste streams. In addition to the strategic planning documents discussed previously, existing programmatic planning and engineering documents were used as the basis for Alternative 5. The primary overall program baseline reference is the *Solid Waste Program Technical Baseline Description*.

The *Solid Waste Program Technical Baseline Description* is several years old, and consequently, does not represent the current path that is being followed for all waste streams and materials. As an example, the Waste

Receiving And Packaging Facility, WRAP-2A (Project W-100), which is described in the most recent technical baseline documents, was put on hold in December 1994. The current plan is to initiate procurement activities for commercial processing of the LLMW stream in fiscal year 1995. The current path that is being followed for each waste and material processing and storage function is described in Section 6.8 of Volume II.

Table 4-11, *Current Baseline Summary*, highlights the functions that are not currently a part of the baseline, or have been canceled subsequent to issuance of the baseline documentation. In this table, green background depicts functions that exist in the current baseline and are adequate for the management of the projected waste streams/materials; yellow background depicts functions of the current baseline that are undersized or are otherwise not adequate for the management of the projected waste streams/materials; red background depicts functions that the current baseline does not cover, or that are not currently funded; and blue background depicts functions that are outside of the scope of the M-33 Study.

Because only 24% of the functions within the scope of M-33 shown on Table 4-11 are shaded green, the current technical baseline does not provide a viable solution to the waste and material processing and storage requirements for the site. Another 24% of the functions within the scope of M-33 are shaded red, depicting processing and storage functions that are required, but not currently part of a funded technical baseline. The remaining 52% of the functions within the scope are shaded yellow. Most of the functions in yellow are associated with the storage of waste either prior to processing; or prior to disposal.

Functions shaded red include the following:

- High-Level Radioactive (HLW) Waste Canisters, Storage Prior to Disposal;
- Remote-Handled (RH) Transuranic (TRU) Waste, Processing;
- Large Container and Special-Case Contact-Handled (CH) TRU, Processing;
- RH Low Level Mixed Waste (LLMW), Processing;
- Large Container CH LLMW, Processing;
- RH Greater Than Category III (GTC-3) Low Level Radioactive Waste (LLW), Storage Prior to Processing;
- RH TRU and RH LLMW, Storage Prior to and after Processing;
- Hallam and Sodium Reactor Experiment Sodium, Processing;
- Strontium & Cesium Capsules, Processing & Storage Prior to Disposal; and
- Miscellaneous Sources, Storage Prior to Processing.

The most significant deficiencies in the existing baseline is the lack of a specific project or path forward for processing the large volume of RH and Large-Container CH TRU and LLMW. Additionally, there are no specific facilities that exist now or are planned for the future, to provide adequate storage for TRU, LLMW, and Greater Than Category III waste, except for the small quantities of Small-Container CH TRU and LLMW which will be stored in the Central Waste Complex (CWC), Phase V. It is because of these primary deficiencies in the existing baseline that the Tri-Party Agreement (TPA) M-33 Milestone was established. The information provided in the Alternatives 1 through 4 evaluations is intended to form the basis for making a decision on an integrated path forward for processing and storage functions which are not adequately addressed in the Current Technical Baseline.

Table 4-12 provides a cost comparison for projects included in the current Technical Baseline.

Figure 4-1. Alternative 3 Evaluation Process.

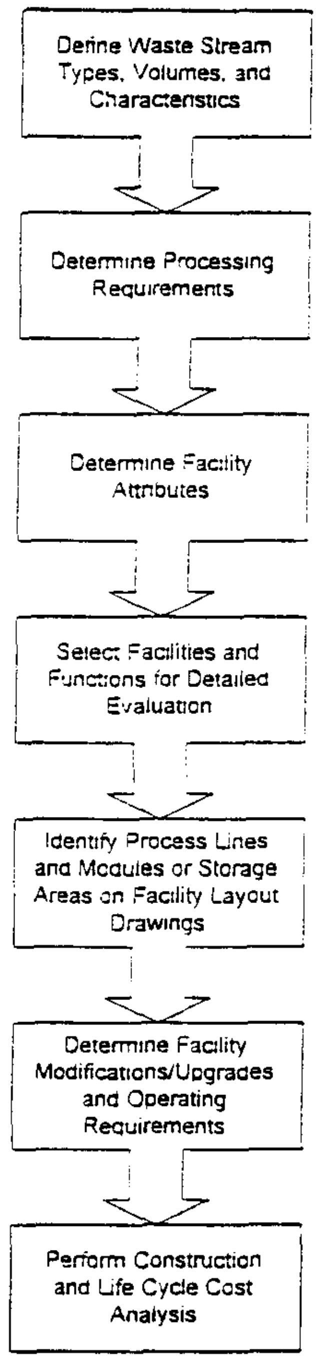


Table 4-1. Development of the Alternative System Configuration Set.

Alternate Feasibility	New/Existing Facility	Integrated/ Segregated Streams	Single/ Modular Facilities	Alternatives Considered
Yes	New	Integrated	Single	1
Yes	New	Integrated	Modular	2
No	New	Segregated	Single	Infeasible
Yes	New	Segregated	Modular	Not Included
Yes	Existing	Integrated	Single	4
Yes	Existing	Integrated	Modular	3
No	Existing	Segregated	Single	Infeasible
Yes	Existing	Segregated	Modular	Not Included
Yes	Program Planning Bases			5

Table 4-2. Overview of Facilities for Each Alternative.

	Alternative 1 Single New Processing Facility	**Alternative 2 Multiple New Modular Facilities**	**Alternative 3 Multiple Existing Facilities**	**Alternative 4 Conversion of Incomplete WNP-1**	**Alternative 5 Current Planning Baselines**
Treatment Facilities	New Processing Facility	RH TRU and LLMW Processing Facility	Cs/Sr Capsule Packaging at the FMEF	RH and CH Processing and Cs/Sr Capsule Packaging at WNP-1 General Services Building	Cs/Sr Capsule Overpack Facility - Not Provided
		CH TRU Processing Facility	RH and CH TRU Processing at T Plant or the MASF		RH and CH TRU and LLMW Processing at WRAP Module 2B (Cancelled)
			RH and CH LLMW Processing at T Plant, MASF, or the Grout Vaults		
Storage Facilities	New RH Storage Facility	HLW Canister Storage Facility	HLW Canister Storage in Canyon Facilities	HLW Canister Storage (WNP-1 Spray Pond)	HLW Canister Storage - Not Provided
		RH TRU Storage Facility	RH Storage at FMEF and New RH Storage Facility	RH and CH Storage at Turbine Generator Building and General Services Building (WNP-1)	Miscellaneous Source Storage from New Projects (W-272 and W-349)
		RH GTC3 Storage Facility			
		RH LLMW Storage Facility			TRU, LLMW, GTC3 Storage - Not Provided
		Miscellaneous RH Sources Storage Facility	Miscellaneous Source Storage at FMEF		
		Cs/Sr Capsule and Overpack Storage Facility	Cs/Sr Capsule Interim Storage at WESF or at the FMEF		Cs/Sr Capsule Storage at WESF
	New CH Storage Facility	New CH Waste Storage Facility	CH Storage at CWC		CH TRU and LLMW Storage at CWC
		UU Storage Facility	UU Storage at the FMEF		UU Storage at Existing Locations
		Contaminated Sodium Storage Facility	Hallam and SRE Sodium Storage at 2727-W Building and the CWC		Hallam and SRE Sodium Storage at 2727-W Building and CWC

CH	Contact-Handled
Cs	Cesium
CWC	Central Waste Complex
FMEF	Fuel and Materials Examination Facility
GTC3	Greater Than Category III Waste
HLW	High-Level Waste
LLMW	Low-Level Mixed Waste
LLW	Low-Level Waste
MASF	Maintenance and Storage Facility
RH	Remote-Handled
Sr	Strontium
SRE	Sodium Reactor Experiment
TRU	Transuranic
UU	Unirradiated Uranium
WESF	Waste Encapsulation and Storage Facility
WNP-1	Washington Nuclear Plant 1
WRAP	Waste Receiving and Processing

Table 4-3.

This table intentionally deleted.

Table 4-4. Alternative 1 Facility Summary.

FACILITY		SIZE m² (ft²)
PROCESSING		6,724 (72,349)
REMOTE-HANDLED STORAGE	Prior to Processing	28,133 (302,711)
	Prior to Disposal	15,836 (170,400)
	Total	43,969 (473,111)
CONTACT-HANDLED STORAGE	Prior to Processing	1,662 (17,884)
	Prior to Disposal	26,918 (289,638)
	Total	28,580 (307,522)

Table 4-5. Alternative 1 Cost Summary.

ALT. 2 TEC	(Costs per building category based on ALT and total SF/bldg in ALT 1)	% OF BLDG SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	2.06	2,015	35,404,756	11,725,946	47,130,702	17,444,277	64,574,979
2	CH TRU PROCESSING FACILITY	2.41	2,015	41,420,127	13,718,218	55,138,345	20,408,111	75,546,456
3	CH LLMW/LLW PROCESSING FACILITY	4.69	2,015	80,605,974	26,696,450	107,302,423	39,715,369	147,017,792
5	RLW CANISTER STORAGE	19.43	2,015	333,939,033	110,599,577	444,538,610	164,535,101	609,073,711
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	34.19	2,015	587,615,829	194,6166,548	782,232,377	289,524,195	1,071,756,571
9	CS/SR CAPSULE AND OVERPACK STORAGE	0.13	2,015	2,234,281	739,987	2,794,268	1,100,852	4,075,120
11	NEW CH WASTE STORAGE	34.36	145	42,491,000	14,072,888	56,563,888	20,935,741	77,499,629
12	UNIRRADIATED URANIUM STORAGE	2.74	145	3,389,000	1,122,426	4,511,426	1,669,795	6,181,221
	TOTAL	**852,864**	**1,322**	**1,127,100,000**	**373,292,040**	**1,500,392,040**	**555,333,440**	**2,055,725,480**

TEC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, AND WHC PM.

ALT. 2 TEC	(Costs per building category based on ALT and total SF/bldg in ALT 1)	% OF BLDG SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	2.06	2,821	49,566,691	15,147,802	64,714,493	22,719,417	87,433,910
2	CH TRU PROCESSING FACILITY	2.41	2,821	57,988,216	17,721,458	75,709,674	26,579,512	102,289,186
3	CH LLMW/LLW PROCESSING FACILITY	4.69	2,821	112,848,437	34,486,986	147,335,423	51,725,274	199,606,697
5	RLW CANISTER STORAGE	19.43	2,821	467,514,956	142,874,646	610,389,612	214,290,422	824,680,034
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	34.19	2,821	822,662,704	251,409,392	1,074,072,096	377,076,746	1,451,148,243
9	CS/SR CAPSULE AND OVERPACK STORAGE	0.13	2,821	3,127,995	955,929	4,083,924	1,433,750	5,517,674
11	NEW CH WASTE STORAGE	34.36	203	59,487,000	18,179,493	77,666,493	27,266,495	104,932,988
12	UNIRRADIATED URANIUM STORAGE	2.74	203	4,744,000	1,449,788	6,193,788	2,174,463	8,368,250
	TOTAL	**852,864**	**1,850**	**1,577,940,000**	**482,225,502**	**2,060,165,502**	**723,265,478**	**2,783,430,981**

TPC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, WHC PM, AND OPC

ALT 1 COSTS NOT INCLUDED IN ABOVE FIGURES

OM&R LCC		839,630,000	729,503,222	1,569,133,222	470,739,967	2,039,873,189
D & D		282,809,000	699,073,104	981,882,104	400,360,995	1,382,243,100

Table 4-6. Alternative 2 Facility Summary.

FUNCTION	FACILITY	SIZE m^2 (ft^2)
Processing	Remote-Handled	1,346 (14,481)
	Contact-Handled TRU	1,569 (16,879)
	Remote- and Contact-Handled LLMW/LLW	3,055 (32,868)
	TOTAL	5,970 (64,228)
Remote-Handled Storage	HLW Canisters	15,836 (170,400)
	TRU, LLMW, GTC3 LLW, and Miscellaneous	39,478 (424,783)
	Cs/Sr Capsule plus Overpack	105 (1,128)
	TOTAL	55,419 (596,311)
Contact-Handled Storage	CH Waste Storage	28,000 (301,280)
	Unirradiated Uranium	2,230 (24,000)
	TOTAL	30,230 (325,280)
TOTAL STORAGE		85,649 (921,591)
GRAND TOTAL		91,619 (985,819)

Table 4-7. Alternative 2 Cost Summary.

ALT. 2 TEC	BUILDING NAME	SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	18,101	2,492	45,101,000	15,829,721	60,930,721	22,529,142	83,459,864
2	CH TRU PROCESSING FACILITY	21,099	2,444	51,557,000	13,264,327	64,821,327	23,962,053	88,783,380
3	CH LLMW/LLW PROCESSING FACILITY	41,085	2,302	94,565,000	24,320,664	118,885,664	324,995,431	1,203,947,423
5	RLW CANISTER STORAGE	170,400	3,344	569,866,000	309,085,992	878,951,992	324,995,431	1,203,947,423
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	299,830	2,202	660,102,000	169,443,486	829,545,486	306,639,299	1,136,184,785
9	CS/SR CAPSULE AND OVERPACK STORAGE	1,128	3,095	3,491,000	837,137	4,328,137	1,600,181	5,928,317
11	NEW CH WASTE STORAGE	301,280	145	43,686,000	11,215,388	54,901,388	20,299,436	75,200,823
12	UNIRRADIATED URANIUM STORAGE	24,000	145	3,480,000	825,644	4,605,644	1,591,749	5,897,393
	TOTAL	876,923	1,678	1,471,848,000	544,822,359	2,016,670,359	745,562,380	2,762,232,739

TEC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, AND WHC PM

ALT. 2 TPC	BUILDING NAME	SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	18,101	3,488	63,142,000	20,691,300	83,833,300	29,399,916	113,233,216
2	CH TRU PROCESSING FACILITY	21,099	3,421	72,179,000	16,926,493	89,105,493	31,247,303	120,352,797
3	CH LLMW/LLW PROCESSING FACILITY	41,085	3,222	132,391,000	31,104,953	163,495,953	57,328,176	220,824,129
5	RLW CANISTER STORAGE	170,400	4,682	797,812,000	402,747,161	1,200,559,161	421,477,581	1,622,036,743
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	299,830	3,082	924,143,000	217,255,246	1,141,398,246	400,195,127	1,541,593,373
9	CS/SR CAPSULE AND OVERPACK STORAGE	1,128	4,333	4,888,000	1,061,030	5,949,030	2,086,449	8,035,478
11	NEW CH WASTE STORAGE	301,280	203	61,160,000	14,354,120	75,514,120	26,483,255	101,997,375
12	UNIRRADIATED URANIUM STORAGE	24,000	203	4,872,000	1,050,850	5,922,850	2,076,911	7,999,761
	TOTAL	876,923	2,350	2,060,587,000	705,191,153	2,765,778,153	970,294,718	3,736,072,872

TPC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, WHC PM AND OPC

Table 4-8. Existing Facilities and Functions Evaluated for Alternative 3.

WASTE TYPE	EXISTING FACILITY
HLW Canister Interim Storage	• Canyon Facilities
TRU Processing	• T Plant • Maintenance and Storage Facility (MASF)
LLMW Processing	• T Plant • Maintenance and Storage Facility (MASF) • Grout Vaults
TRU, LLMW, and Greater than Category 3 Interim Storage	• Fuel Materials Examination Facility (FMEF) • Central Waste Complex
Hallam and SRE Sodium Interim Storage	• 2727-W • Central Waste Complex
Strontium/Cesium Capsule Interim Storage	• FMEF • Waste Encapsulation Storage Facility (WESF)
Unirradiated Uranium and Miscellaneous Source Interim Storage	• FMEF • Existing Storage Locations

Table 4-9. Alternative 3 Cost Summary.

PROCESSING (Costs in $ Millions)		
Facility	**Construction[1]**	**Life Cycle[2]**
RH TRU		
T Plant	77	342
MASF	52	313
RH LLMW		
Grout, Scenario 1	41	218
Grout, Scenario 2	43	308
MASF	47	306
T Plant	73	337
STORAGE (Cost in $ Millions)		
Facility	**Construction[1]**	**Life Cycle[2]**
HLW Canisters		
Canyon Facilities	255	326
RH TRU		
FMEF	7[3]	187
Central Waste Complex (CWC) Expansion	--[4]	Not Available
RH LLMW		
FMEF	7[3]	187
CWC Expansion	--[4]	Not Available
CH TRU and LLMW		
CWC Phase V (Project W-112)	26[3]	Not Available
RH Greater Than Category III		
CWC Expansion	272[4]	Not Available
CH Greater Than Category III		
CWC Expansion	55	Not Available
Cs/Sr		
FMEF	7	77
WESF	30	671
UU and Miscellaneous Source		
FMEF	5	73
Existing Locations	0.4	32

1. Construction Cost with contingency.
2. Life Cycle Costs in Current dollars.
3. Provides only partial storage requirement.
4. RH Greater Than Category III Storage Costs Include cost of RH TRU and RH LLMW Storage. Construction Estimates obtained from projected waste volumes and average cost per square foot for storage space.

Table 4-10. Alternative 4 Capital Cost Summary.

Waste Stream Description	Construction/Modification Cost in Million $ (Escalated with Contingency)
HLW Canister Storage	271.3
TRU Process & Storage	42.0
LLMW/GTC III Process & Storage	113.0
Uranium Storage	2.0
Cs/Sr Capsule Storage	3.6
Common Usage Area Construction/Modification	1.8
Sub-Total, Capital Cost	433.7
Cost Line Item Description	**Other Cost in Million $ (Escalated with Contingency**
Construction/Modification	433.7
Engineering Title I	21.9
Engineering Title II	54.7
Engineering Inspection Title III	36.1
Construction Management	40.1
Project Management & Integration	54.4
Other Project Costs	66.8
Grand Total Cost	707.7

Table 4-11. Current Baseline Summary. 1 of 2

WASTE STREAMS AND MATERIALS	STORAGE PRIOR TO PROCESSING	PROCESSING	STORAGE PRIOR TO DISPOSAL	DISPOSAL/ USE
HIGH-LEVEL WASTE				
High-Level Waste Canisters	[redacted]			
Low-Level Vitrified Waste				
TRU WASTE				
Remote-Handled	[redacted]			
Large Container and Special Case Contact-Handled	Central Waste Complex[1]	[redacted]	Central Waste Complex[1]	[redacted]
Small Container Contact-Handled	[redacted]			
LLMW				
Remote-Handled	[redacted]			
Large Container Contact-Handled	Central Waste Complex[1]	[redacted]	Central Waste Complex[1]	[redacted]
Small Container Contact-Handled	[redacted]			

[redacted]

Yellow background depicts functions of the current baseline that are undersized or otherwise not adequate for the management of the projected waste streams.

[redacted]

[1] Central Waste Complex Phases I through V will provide 280,000 ft^2 of storage space. An additional 476,600 ft^2 will be required by 2023. Remote-Handled waste must be shielded to Contract-Handled levels to allow storage in existing and planned CWC facilities.

[2] WRAP-2B is not currently funded

Table 4-11. Current Baseline Summary. 2 of 2

WASTE STREAMS AND MATERIALS	STORAGE PRIOR TO PROCESSING	PROCESSING	STORAGE PRIOR TO DISPOSAL	DISPOSAL/ USE
GREATER THAN CATEGORY 3 LLW				
Remote-Handled	[redacted]	[redacted]	[redacted]	[redacted]
Contact-Handled	Central Waste Complex (Phase V)[1]	[redacted]	[redacted]	[redacted]
SODIUM				
FFTF Sodium	[redacted]	[redacted]	[redacted]	[redacted]
Hallam & Sodium Reactor Experiment (SRE) Sodium	[redacted]	[redacted]	[redacted]	[redacted]
OTHER MATERIALS				
Unirradiated Uranium[3]	UO3 Plant, 303-K South Bldg., 4713 Bldg.	Repackage As Required	Existing Locations or Consolidated Storage	[redacted]
Miscellaneous Sources	[redacted]	Treatment Requirements Not Specified[3,4]	[redacted]	[redacted]
Strontium & Cesium Capsules	[redacted]	[redacted]	[redacted]	[redacted]
SPENT NUCLEAR FUEL				
K Basins	[redacted]	[redacted]	[redacted]	[redacted]
T Plant	[redacted]	[redacted]	[redacted]	[redacted]
300 Area Laboratories	[redacted]	[redacted]	[redacted]	[redacted]
200 Area (Buried)	[redacted]	[redacted]	[redacted]	[redacted]

[3] Storage, treatment, or disposal options have not been selected for these waste streams and materials.

[4] TRU and TRUM will be shipped to CWC. Irradiated fuel and vitrified waste will be managed by the SNF Program.

Table 4-12. Alternative 5 Cost Comparison.

WASTE STREAM/FUNCTION	FACILITY	CONSTRUCTION COST	OPERATING COST	LIFE-CYCLE COST	SOURCE
HLW Canister Storage	New Modular Storage Facility	\$320 M	Not Available	Not Available	Kaiser Estimate for Alternative 2
RH and Large-Container CH TRU and LLMW Processing	WRAP-2B	\$202 M	\$48 M/YR	Not Available	Total Waste Receiving and Processing Module 2 CDR estimate, less WRAP-2A cost.
RH and Large-Container CH TRU and LLMW Storage	CWC Expansion	(1)			
GTC3, RH Waste Storage	CWC Expansion	\$272 M (1)	Not Available	Not Available	Estimate based on projected storage required and average cost per square foot.
GTC3, CH Waste Storage	CWC Expansion	\$55 M (1)	Not Available	Not Available	Estimate based on projected storage required and average cost per square foot.
Hallam and SRE Sodium Processing	FFTF Sodium Reaction Facility	\$30 M	Not Available	Not Available	Obtained from cost estimates for 2002 start date, converted to 1995 dollars.
Hallam and SRE Sodium Storage	2727 W Building and CWC	Not Applicable	Not Available	Not Available	
Unirradiated Uranium Storage	Existing 200 and 300 Area Facilities	Not Available	Not Available	Not Available	
Miscellaneous Source Storage	Interim Storage Facility (W-272)	\$6 M	Not Available	Not Available	Project W-272 documentation.
	Interim Storage Facility (W-349)	\$5 M	\$1 M/YR	Not Available	Project W-349 documentation.
Cesium and Strontium Capsule Storage	WESF	\$30 M	\$17 M/YR	\$671 M	Construction estimate from WESF staff. Operating cost from ADS documents.

(1)Cost of GTC III storage includes cost of RH and Large Container CH TRU and LLMW storage.

5.0 ALTERNATIVE COMPARISON, ANALYSIS, AND EVALUATION

5.1 DECISION CRITERIA

The five alternatives evaluated in this study were compared against decision criteria developed by the DOE's Pacific Northwest Laboratories (PNL). These decision criteria identified seven major assessment categories and a number of objective indicators for each category. The assessment categories were as follows:

- Safety;
- Cost;
- Socio/Economic Impact;
- Environmental Impact;
- Schedule;
- Program Integration; and
- System Manageability.

Objective indicators were chosen to provide a quantitative measure of the degree to which the function/facility combinations proposed in each of the five alternatives would compare against each other in the seven assessment categories. Weighting factors were also assigned to the indicators to reflect their relative importance in the assessment categories. Priorities and weighting factors were assigned to each assessment category by WHC Level 2 management representatives in a facilitated, consensus decision-making session. A detailed discussion of the assessment criteria, the weighting factors, and the methods used to grade each alternative is provided in Attachment 1 of this summary.

The most important assessment category was Safety, followed in order of priority by: Cost, Socio/Economic Impact, Environmental Impact, Schedule, Program Integration, and System Manageability. Near-term construction cost was thought to be the most important consideration and life cycle cost was assigned a lower weighting. Safety was viewed as an essential requirement for any alternative or alternative combination under consideration. Because all of the proposed facilities for the five alternatives would satisfy the appropriate Hazard (Safety) Class requirements for the intended functions and waste/material types and inventories (i.e., Class 3 for processing facilities and Class 2 for RH and other high-activity waste and material storage facilities), safety was not a relevant discriminator for selecting the preferred facility and function combinations.

5.2 ALTERNATIVE EVALUATION

An evaluation of the five alternatives shows that those alternatives that propose construction of significant new capital assets (Alternatives 1, 2, and 5) do not compare favorably to those alternatives that utilize existing facilities (Alternatives 3 and 4) in any of the high-priority assessment categories. The construction cost for Alternatives 1, 2, and 5 were significantly higher than Alternatives 3 and 4. Additionally, the overall construction schedules for Alternatives 1, 2, and 5 were significantly longer and would not support an objective for initiating waste processing operations within the next 5 years.

Construction costs for all of the facilities proposed for the five alternatives are compared in Table 5-1. The total construction, operating, and D&D costs for the five alternatives are provided in Table 5-2. The WNP-1 option is clearly the most cost-effective on the basis of near-term and long-term construction costs. The operating costs for WNP-1 were also significantly less than the other alternatives.

The socio/economic impact for Alternatives 1, 2, 4, and 5 are higher compared to Alternative 3 because of the long-term D&D costs and risks. The D&D risks pertain to the uncertainties associated with the future regulatory requirements and the potential for unforeseen cost escalation. The costs for restoration of the site (sites) proposed under Alternatives 1, 2, 4, and 5 are not known and represent a large potential cost liability. Aside from some additional decontamination costs as a result of the new processing operations, Alternative 3 (utilization of existing DOE-owned facilities) does not add any additional D&D cost liabilities that would not otherwise already exist.

Construction of new large facilities, as proposed in Alternatives 1, 2, and 5, also involve higher environmental impact because of the impact to the land. Construction of these facilities would require clearing large tracts of land. This would result in an adverse impact to old-growth sagebrush and wildlife habitat.

A detailed discussion of the performance of each alternative against the various assessment categories is provided in Attachment 2. An analysis of the benefits (total score on all public values or assessment categories) versus cost is also included in Attachment 2.

5.3 DETAILED ANALYSIS OF ALTERNATIVES 3 AND 4

The alternatives that best satisfied all high-priority assessment criteria were Alternatives 3 and 4. These alternatives also had cost/benefit profiles that were significantly better than Alternatives 1, 2, and 5, when capital cost and life cycle costs are considered (See Figures 8 and 10 of Attachment 2). Because Alternatives 3 and 4 scored well in the high-priority assessment categories and because the costs were substantially lower, these alternatives were examined in more detail to better define the positive and negative attributes of each.

5.3.1 Alternative 3 (Existing DOE-Owned Facilities)

Table 5-3 identifies the facilities to be utilized for each waste stream and material function for Alternative 3. Shaded areas in Table 5-3 indicate waste stream and material functions that are outside the scope of the M-33 Milestone.

Alternative 3 involves minimal programmatic or regulatory uncertainties and risks. Existing facilities in the 200 Areas, such as the MASF, the Grout

Vaults, and T Plant, could be readily converted to waste treatment facilities. The T Plant facilities are already permitted for waste treatment under an Interim Status Permit. Obtaining an exemption under Interim Status for waste processing at the MASF should not pose any difficulty. Permitting of the Grout Vaults for LLMW treatment and disposal would also require approval from the Washington State Department of Ecology (Ecology). This may be a more complicated process because the vaults would be used for disposal, as well as for processing/treatment. However, because the vaults were designed for disposal of higher activity wastes, the technical issues should be easily resolved. Under Alternative 3, additional waste storage capacity would be provided by constructing new storage facilities at the Central Waste Complex. There are no programmatic or regulatory obstacles involved with construction and operation of these storage facilities.

Alternative 3 would utilize the Grout Vaults for LLMW treatment and disposal, and would not pose any additional D&D liabilities. The TRU processing would be performed at the MASF or T Plant. The MASF is only partially contaminated at present, and some additional D&D would be incurred if the facility were used for full-scale waste processing. These costs are estimated at $1 Million in 1995 dollars. The T Plant was previously used for plutonium processing and represents a D&D liability at present. Additional waste processing operations would not appreciably increase this liability.

5.3.2 Alternative 4 (WNP-1)

The WNP-1 option utilizes the WNP-1 facilities for all processing and storage functions. Table 5-4 indicates the facilities to be utilized for each of the processing and storage functions for Alternative 4. Shaded areas in Table 5-4 indicate waste stream and material functions that are outside the scope of the M-33 Milestone.

Alternative 4 requires the lowest capital investment and is attractive because of the capability to provide a full range of treatment and storage functions. The programmatic risks associated with the WNP-1 plant and site are significant, however. These programmatic risks include future liabilities and the potential for encountering unanticipated difficulties in obtaining the necessary regulatory approvals. Utilization of the WNP-1 facilities for any purpose would involve a complete acceptance of all future liability for D&D of the facilities and the site grounds. Because of the site D&D liabilities, it would not be reasonable to select WNP-1 for a limited mission.

The WNP-1 site is within the contiguous Hanford Site boundaries, and could be approved for a RCRA treatment and storage mission under an Interim Status exemption, in accordance with WAC 173-303 Section 281. Additional Clean Air Act and NEPA approvals would also be required. Approvals for an Interim Status exemption, air emission permits, and the NEPA documentation (most probably an Environmental Impact Statement) should be supportable from a technical perspective, but could be challenged in a political forum. These challenges could be based on the site's proximity to the Columbia River (approximately 3 miles) and a bias toward maintaining the Hanford Site waste treatment and storage functions in the 200 Areas.

Use of the WNP-1 facilities would require an immediate commitment (within the next six months) by DOE to assume responsibility for the site.

Given the legal arrangements that would be required, it may not be possible to conclude the necessary agreements within this time frame. Use of the WNP-1 facilities for waste treatment would result in contamination of buildings and equipment that are currently clean. Given the proximity of the site to the Columbia River, D&D would likely involve cleanup to "green field" conditions. Demolition of the WNP-1 facilities has been estimated to cost approximately $40 Million in 1995 dollars. The costs associated with decontamination and waste disposal are uncertain but are expected to be much higher.

5.3.3 Cost Comparison

Table 5-2 provides a comparison of all costs (construction, operation, and D&D), for Alternatives 3 and 4. Alternative 4 is clearly the most cost-effective option.

Table 5-1. Construction Cost Comparison--In Millions of Dollars (No Contingency and No Escalation).

Materials/Function			ALTERNATIVES		
	1 Single New Facility	2 Multiple New Facilities	3 Existing Facilities	4 WNP-1	5 Program Baseline
PROCESSING					
TRU--Remote-Handled		125	35		
TRU--Contact-Handled		95	[a]		
LLMW--Remote-Handled	315	151	27	42	>202[j]
LLMW--Contact-Handled		[a]	[a]		
Processing Subtotals	315	371	62	42	>202[j]
STORAGE					
HLW Canisters	370	370	171	270	370[b]
TRU--Remote-Handled	396[f]	139	[c]		[c]
TRU--Contact-Handled	91[g]	78[g]	[d]		[d]
LLMW--Remote-Handled	[f]	81	[c]		[c]
LLMW--Contact-Handled	[g]	[g]	[d]	251	[d]
GTC3--Remote-Handled	[f]	311	221[c]		221[c]
GTC3--Contact-Handled	[g]	[g]	44[d]		44[d]
Unirradiated Uranium	27[h]	27[h]	N/A	2	N/A
Miscellaneous Sources	[h]	[h]	11	[e]	11
Cs/Sr Capsules	[h]	[h]	5[i]	3	20[i]
Storage Subtotals	884	1,006	441	526	666
Total Estimated Cost	1,199	1,377	603	568	>868

[a] Cost of CH waste processing included with cost of RH waste processing.
[b] Cost of new HLW Canister Storage Facility taken from Alternative D.
[c] Cost of RH GTC3 storage includes all other RH storage costs.
[d] Cost of CH GTC3 storage includes all other CH storage costs.
[e] Cost of miscellaneous source storage is included in the cost for TRU and LLMW storage.
[f] Cost of RH TRU storage includes all other RH storage costs.
[g] Cost of CH TRU storage includes all other CH storage costs.
[h] Cost of miscellaneous sources and Cs/Sr Capsule storage included with cost of Unirradiated Uranium storage.
[i] Cost of WESF upgrades necessary for safe storage and packaging.
[j] Based on estimated cost of WRAP-2B as originally planned. The WRAP-2B facility would be capable of processing only a small fraction of the RH TRU and RH LLMW volume.

Table 5-2. Cost Comparison (Contingency and Escalation Not Reflected)

ALTERNATIVE	CONSTRUCTION COST ($ MILLION)	OPERATING COST ($ MILLION)	D&D COST ($ MILLION)	TOTAL COST ($ MILLION)
1	1,200	840	380	2,400
2	1,400	1,280	400	3,100
3	600	1,280	3	1,900
4	570	840	200	1,600
5	1,000	960	380	2,300

Table 5-3. Alternative 3: Maximum Utilization of Existing DOE-Owned Facilities

WASTE STREAMS AND MATERIALS	STORAGE PRIOR TO PROCESSING	PROCESSING (TREATMENT)	STORAGE PRIOR TO DISPOSAL	DISPOSAL/USE
HIGH-LEVEL WASTE				
High-Level Waste Canisters	Double-Shell Tanks	High-Level Waste Vitrification	Modular Storage Facility (New)	Off-Site Repository
TRANSURANIC WASTE (TRU)				
Remote-Handled (RH)	RH and Large Container Storage Facility (New)	Materials and Storage Facility (MASF) or T Plant	RH and Large Container Storage Facility (New)	Waste Isolation Pilot Plant (WIPP)
Large Container and Special Case Contact-Handled	RH and Large Container Storage Facility (New)	MASF or T Plant	RH and Large Container Storage Facility (New)	WIPP
LOW-LEVEL MIXED WASTE (LLMW)				
Remote-Handled	RH and Large Container Storage Facility (New)	Grout Vaults	RH and Large Container Storage Facility (New)	Grout Vaults
Large Container Contact-Handled	RH and Large Container Storage Facility (New)	Grout Vaults	RH and Large Container Storage Facility (New)	Mixed Waste Disposal Trench
GREATER THAN CATEGORY 3 LLW				
Remote-Handled	RH and Large Container Storage Facility (New)	Treatment Requirements Not Identified	No Immediate Action Required	Disposal Requirements Not Identified
Contact-Handled	Central Waste Complex Phase V (Under Construction)	Treatment Requirements Not Identified	No Immediate Action Required	Disposal Requirements Not Identified
SODIUM				
Hallam and Sodium Reactor Experiment (SRE Sodium	2727-W Building and Central Waste Complex	Commercial Treatment or 400 Area Sodium Reaction Facility	Commercial Use or HWVP	Commercial Use or HWVP
OTHER MATERIALS				
Unirradiated Uranium	UO3 Plant, 303-K South Building, 4713 Building	Existing Locations or 2706-T Building	No Immediate Action Required	Commercial Sale or LLW Burial Grounds
Miscellaneous Sources (Special-Case Waste)	Projects W-272 and W-349 (New), and Canister Storage Building (New)	Treatment Requirements Not Specified	Not Required	Final Disposal Requirements Not Specified
Strontium and Cesium Capsules	Fuels and Materials Examination Facility (FMEF)	FMEF	FMEF	Off-Site Repository

Table 5-4. Alternative 4 WNP-1

WASTE STREAMS AND MATERIALS	STORAGE PRIOR TO PROCESSING	PROCESSING (TREATMENT)	STORAGE PRIOR TO DISPOSAL	DISPOSAL/USE
HIGH-LEVEL WASTE				
High-Level Waste Canisters	Double-Shell Tanks	High-Level Waste Vitrification	WNP-1	Off-Site Repository
TRANSURANIC WASTE (TRU)				
Remote-Handled (RH)	WNP-1	WNP-1	WNP-1	Waste Isolation Pilot Plant (WIPP)
Large Container Contact-Handled	WNP-1	WNP-1	WNP-1	WIPP
LOW-LEVEL MIXED WASTE (LLMW)				
Remote-Handled	WNP-1	WNP-1	WNP-1	Grout Vaults
Large Container Contact-Handled	WNP-1	WNP-1	WNP-1	Mixed Waste Disposal Trench
GREATER THAN CATEGORY 3 LLW				
Remote-Handled	WNP-1	WNP-1 (Size Reduction Only)	WNP-1	Disposal Requirements Not Identified
Contact-Handled	WNP-1	WNP-1 (Size Reduction Only)	WNP-1	Disposal Requirements Not Identified
SODIUM				
Hallam and Sodium Reactor Experiment (SRE Sodium	2727-W and Central Waste Complex	Commercial Treatment or WNP-1	Commercial Use or WNP-1	Commercial Use or HWVP
OTHER MATERIALS				
Unirradiated Uranium	WNP-1	WNP-1	WNP-1	Commercial Sale or LLW Burial Grounds
Miscellaneous Sources (Special-Case Waste)	WNP-1	Treatment Requirements Not Specified	Not Required	Final Disposal Requirements Not Specified
Strontium and Cesium Capsules	WNP-1	WNP-1	WNP-1	Off-Site Repository

Table 5-5. Alternative 3 Cost Summary

PROCESSING (costs in $ millions)		
Facility	Construction[1]	Life Cycle[2]
RH TRU		
T Plant	77	342
MASF	52	313
RH LLMW		
Grout, Scenario 1	41	218
Grout, Scenario 2	43	308
MASF	47	306
T Plant	73	337

STORAGE (cost in $ millions)		
Facility	Construction[1]	Life Cycle[2]
HLW Canisters		
Canyon Facilities	255	326
RH TRU		
FMEF	7[3]	187
Central Waste Complex (CWC) Expansion	--[4]	Not Available
RH LLMW		
FMEF	7[3]	187
CWC Expansion	--[4]	Not Available
CH TRU and LLMW		
CWC Phase V (Project W-112)	26[3]	Not Available
RH Greater Than Category III		
CWC Expansion	272[4]	Not Available
CH Greater Than Category III		
CWC Expansion	55	Not Available
Cs/Sr		
FMEF	7	77
WESF	30	671
UU and Miscellaneous Source		
FMEF	5	73
Existing Locations	0.4	32

1. Construction Cost with contingency.
2. Life Cycle Costs in Current dollars.
3. Provides only partial storage requirement.
4. RH Greater Than Category III Storage Costs Include cost of RH TRU and RH LLMW Storage. Construction Estimates obtained from projected waste volumes and average cost per square foot for storage space.

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SOLID WASTE AND MATERIALS SYSTEMS ALTERNATIVES STUDY

EXECUTIVE SUMMARY

ATTACHMENT 1
ASSESSMENT CRITERIA

1.0 BASIS OF ANALYSIS

This section describes the various components that formed the basis of the analysis presented in Volume I, Section 5, of this document.

1.1 ALTERNATIVES

The alternatives chosen for this initial analysis are ones that bound the solution sets available within the most salient constraints or dimensions. This initial selection of alternatives is designed to analyze strengths and weaknesses of alternatives and thus to exemplify the major tradeoffs. Alternatives interior to this space that are combinations of these can be evaluated in more detail at a later time.

The two major dimensions that this initial analysis focuses on are whether to emphasize the use of existing facilities or build new facilities, and whether the various processes should be combined in a common facility or whether to use a modular approach in which the different processes are located in different buildings. Also included in the analysis is the Current Technical Baseline.

1.2 PUBLIC VALUES

Public values are the statements of desirable outcomes. Figure 1 shows the public values or objectives that, in part, form the basis for this analysis. These values were developed from a literature review (Armacost, et al., 1994), a series of workshops with technical personnel, and a review by program management. The objectives are intended to be an inclusive set that captures all the concerns of the public stakeholders, the Department of Energy, and WHC. The values have been tailored for the specific application of the solid waste and materials facility alternatives, and have measurable scales that clearly define the degree to which the objectives are achieved. The degree to which a technical option achieves these values is a measure of the extent to which the solid waste and materials facility's performance is maximized for all areas of public concern.

The identified areas of public concern, as shown in Figure 1, consist of maximizing public and worker health and safety, minimizing impacts to the environment, minimizing costs, expediting cleanup and meeting TPA milestones, as well as a consideration of socioeconomic impacts. Additional considerations are the manageability of the system and the integration of programs so as to promote overall efficiency and cost savings.

1.3 CRITERIA/SCALES

The criteria or scales are the end points in the value hierarchy and make possible well-defined measurement of the degree to which the objectives are achieved. The scales used in the analysis are shown in Table 1.

1.4 VALUE FUNCTIONS

Value functions were assessed to measure the relative importance of different levels of performance on each of the criteria. Value functions take as their domain the various levels of performance as measured by the scales and map it onto either the unit interval or a 0-to-100 range. Value functions capture the fact that the importance of achieving different levels on an objective may not be linear with its scale. Value functions were developed based upon discussions among the engineers and the analyst. For criteria having constructed scales, each level of performance, as described by a scenario was assigned a number from 0 to 100 representing the relative importance of achieving that level of performance. These numbers are shown in Table 1. For criteria having natural scales; the value functions were judged to be linear with the measure. These were either increasing or decreasing functions depending on whether more was better or worse than less. Typical value functions are shown in Figure 2.

1.5 UNCERTAINTIES

For some objectives, alternative performance on objectives depends not only on the choice of the alternative, but on uncertainties that can not be directly controlled. Uncertainty is an important consideration in evaluating programmatic risk. Of particular interest initially, are the uncertainties in which the outcome probabilities are not independent of the alternatives, and the uncertainties are thought to have a significant impact on the objectives or public values being considered in the decision.

Three such uncertainties have been identified. They are the regulatory outcome, the resolution of issues surrounding waste processing, and the feasibility of capital funding.

- Regulatory outcome refers to permitting issues, and has the potential of significant impacts on schedule and costs.

- Waste processing has unresolved issues concerning container requirements, cask requirements, and other handling criteria. The potential impact of a delay in resolving these issues is judged to be greater for a common facility than for a modular facility.

- Capital funding has a longer project cycle for larger projects and is more uncertain; consequently, alternatives using a common facility have a greater likelihood for delays in funding or not being funded at all.

1.6 WEIGHTS

Whereas value functions capture the importance of different levels of performance on a single objective, weights capture the relative importance of the different objectives or values. Weights logically depend on the potential ranges over which the alternatives can vary. The method used to develop the weights in this study tied the importance of objectives to their ranges in a "bottom up" assessment process.

The methodology used for determining the relative weights is a standard decision analysis procedure known as "swing weighting." The resulting weights reflect the tradeoffs among the objectives in their respective units.

No attempt was made in the weight elicitation to trade off public values against dollar costs. The analysis used the elicited weights to arrive at an overall public value score for each technical option and then directly compare performance on public value with cost. This method of analysis makes it possible to identify dominating alternatives; that is, technical alternatives that provide more value for less cost. It also keeps visible the cost-performance tradeoffs among the dominating alternatives.

The weights resulting from the elicitation are shown in Table 2. The first column in the table shows the major public values, in bold, along with the sub-criteria. The next four columns show the weights obtained from each of the four experts. Each column shows the weights for the major public values, in bold, as well as weights for the specific sub-criteria. Both the bold numbers and the non-bold numbers sum to one. Thus, the bold numbers capture the relative importance of the major criteria, and the non-bold numbers give the relative importance of specific criteria across all categories.

The last three columns in Table 2 are averages. Column six displays a consensus average, which is the average of the three individuals with similar weights. Column seven presents average weights for all four individuals. The last column, "Grp/Avg," shows a group average obtained at a solid waste management meeting. The weights elicited in that meeting were at the level of the major categories only--subcategories were not considered. Consequently, the weights shown are those obtained at the meeting for major categories, with the relative importance within categories being taken from the consensus average.

2.0 DATA

The data used to evaluate the performance of solid waste technical alternatives are in all cases based upon best engineering judgment. For some objectives detailed analysis was carried out to generate the data, and in other cases performance estimates were based upon direct engineering judgment. The performance of alternatives on the objectives is shown in Table 3.

Potential for Public Exposure is based upon facility location and safety class. Public Transportation Safety is based upon the number of miles materials would be transported on public roads.

Potential for Chronic Worker Exposure is based upon the total number of workers and the safety class. Acute exposures are based upon the number of workers located in a single facility; consequently, modular facilities score better on these measures.

Worker Transportation Accidents--At Work is based upon the total number of miles for transporting materials. Worker Transportation Accidents--Commuter is based upon the number of commuter miles per year from the Site boundary. Worker Industrial Accidents is the number of reportable incidents.

The immediate risk to the environment is based upon the additional accumulated risk that would occur by delaying the start of operations. Short-term risk to the environment is measured by the perceived risk resulting from facilities' proximity to the Columbia River. Long-term risk to the environment is captured by number of new acres and/or sites requiring D&D.

System Manageability and Demonstrate Integration of Programs is based upon engineering judgment, except for Minimize Cost to Interfacing Programs, which is based upon actual D&D dollars saved.

Socioeconomic Impacts to the land and making available areas of High Future Use Value are based upon actual land needs and locations. Future Facility Use is based on engineering judgment of which facilities would have potential for commercial use at the end of project life. Economic Stability is based on planned times for construction and production estimates. Capture Economic Opportunities Locally is based upon engineering judgment.

Figure 1. Public Values Used in the Analysis of Solid Waste Technical Alternatives.

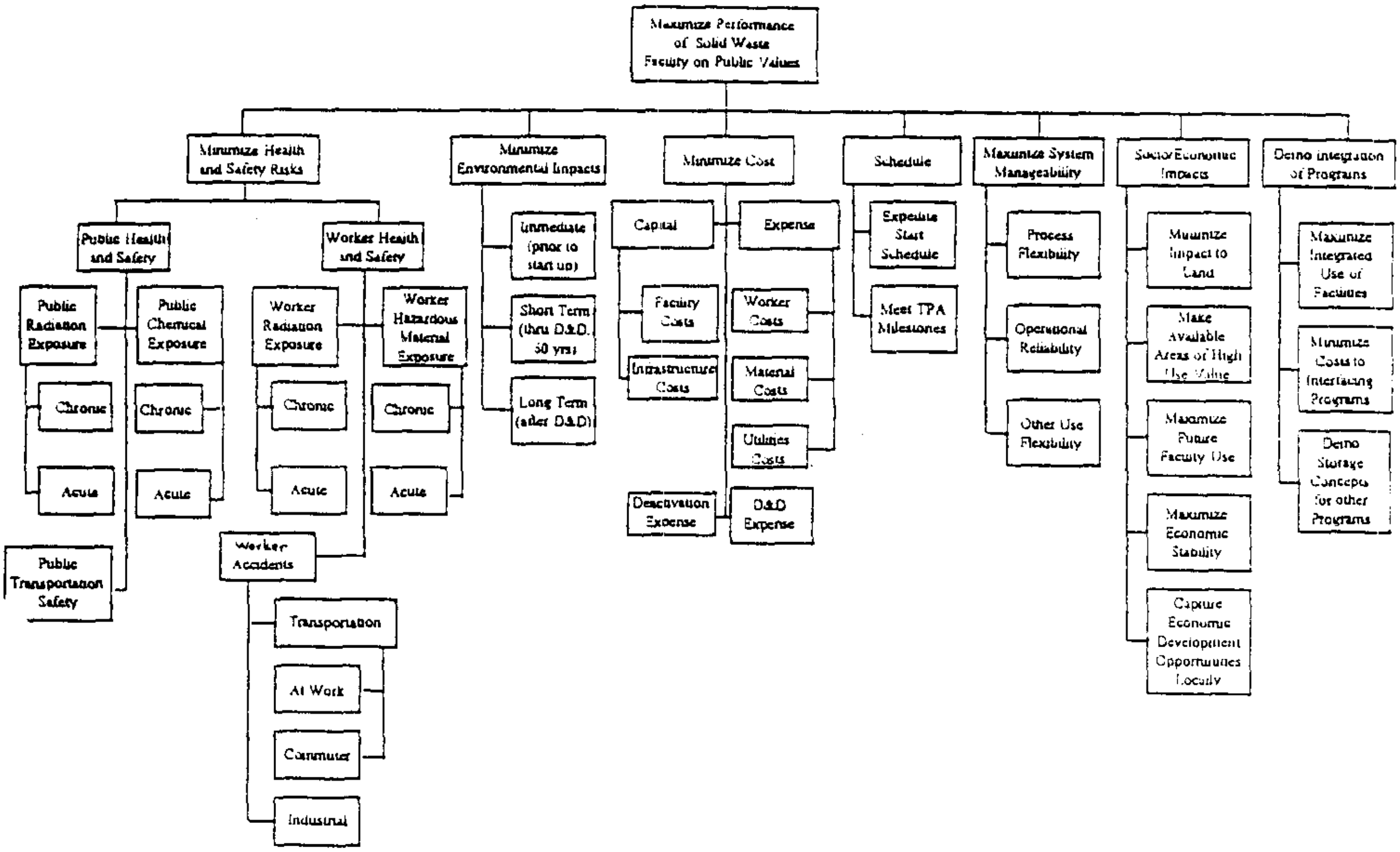


Figure 2. Example Value Functions Used in Solid Waste Technical Alternatives.

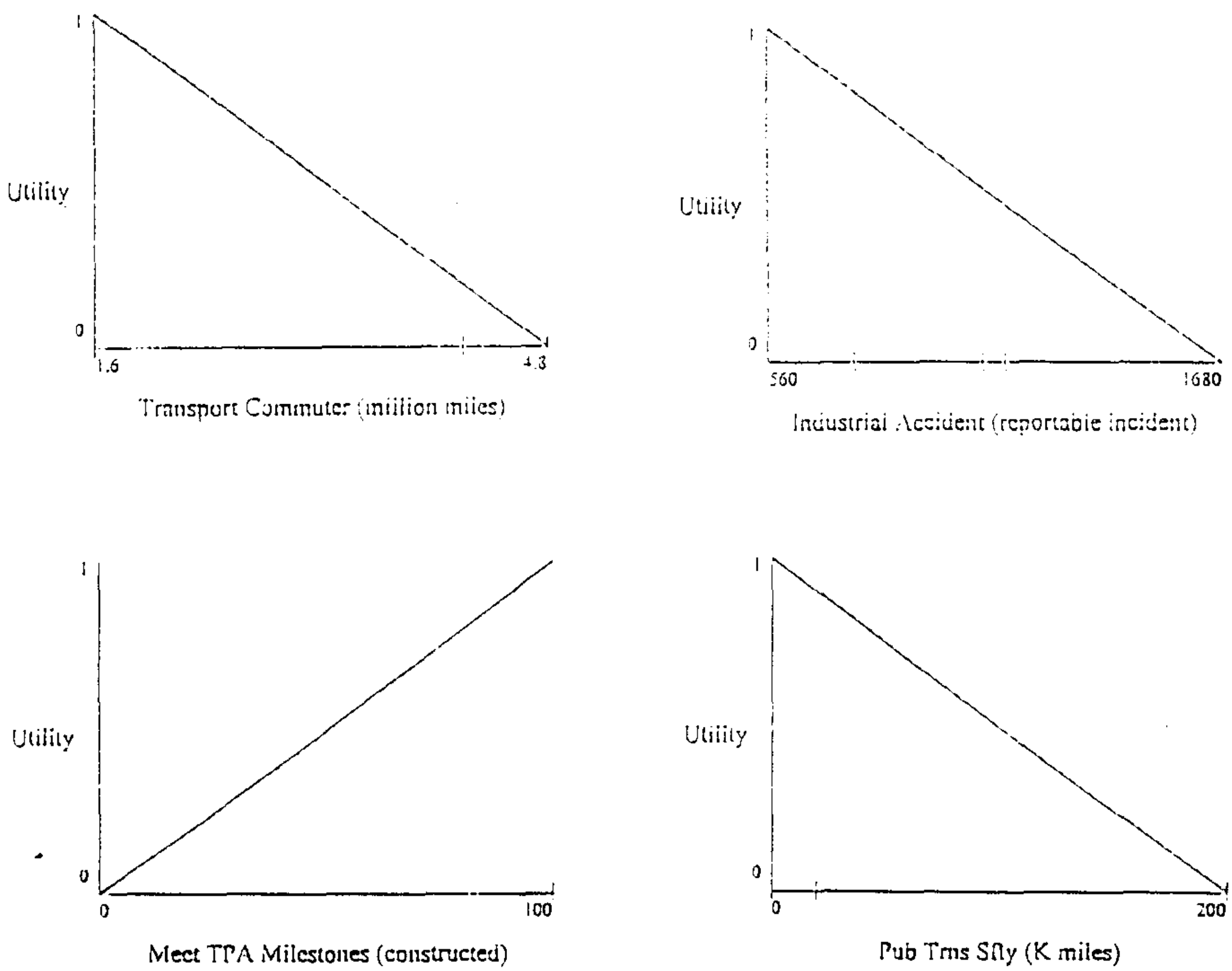


Table 1. Scales Used in the Analysis of Solid Waste Technical Alternatives (Page 1 of 4).

PUBLIC VALUES/CRITERIA	SCALE
Health and Safety	
Public Radiation Exposure	
Chronic	Distance in miles from major populaton center (10 to 25)
Acute	Distance in miles from major populaton center (10 to 25)/Safety Class (>3 to 1)
	100 25 miles and safety class 1
	90 25 miles and safety class2.
	80 25 miles and safety class 3 or 10 miles and safety class 1
	70 10 miles and safety class 2.
	60. 10 miles and safety class3.
	30 25 miles and safety class >3
	0 10 miles and safety class >3.
Public Chemical Exposure	
Chronic	Distance in miles from major populaton center (10 to 25)
Acute	Distance in miles from major populaton center (10 to 25)/Safety Class (>3 to 1)
	100 25 miles and safety class 1
	90 25 miles and safety class2.
	80 25 miles and safety class 3 or 10 miles and safety class 1
	70 10 miles and safety class 2.
	60. 10 miles and safety class3.
	30. 25 miles and safety class >3
	0 10 miles and safety class >3
Public Transportation Safety	Number of miles transporting solid waste on public roads (200K [Expected .048 accidents] to 0)
Worker Health and Safety	
Worker Radiation Exposure	
Chronic	Number of Radiation Workers
Acute	Maximum number of individuals that could be exposed in single incident (245 to 40)/ Safety Class (>3 to1)
	100 40 Workers and safety class 1
	90 40 workers and safety class2
	80 40 workers and safety class 3 or 245 workers and safety class 1
	70 245 workers and safety class 2
	60 245 workers and safety class3.
	30 40 workers and safety class >3
	0 245 workers and safety class >3

Table 1. Scales Used in the Analysis of Solid Waste Technical Alternatives (Page 2 of 4).

PUBLIC VALUES/CRITERIA	SCALE
Worker Hazardous Chemical Exposure	
Chronic	Estimated number of workers for life of project (400 to 150)
Acute	Max no. of individuals that could be exposed in single incident (245 to 40)/Safety Class (>3 to 1)
	100 40 Workers and safety class 1
	90 40 workers and safety class2
	80 40 workers and safety class 3 or 245 workers and safety class 1
	70 245 workers and safety class 2
	60 245 workers and safety class3
	30 40 workers and safety class >3
	0 245 workers and safety class >3
Worker Accidents	
Transportation	
At Work	Number miles solid waste materials are transported (600K to 200K) (145 to .048 Accidents)
Commuter	Worker commuter miles per year from site boundary 4 8M to 1 6M) (4 6 to 1 5 disabling injuries)
Industrial	Number of reportable incidents for life of project (1680 to 560) (15K to 5K person yrs for prj life)
Environmental Impact	
Immediate (prior to start up)	Risk to environment prior to start up (Add'l accum that must be managed if start in 11 yrs instd of 6)
Short term (thru D&D 60 yrs)	Proximity to Columbia River:
	100 All Facilities at least 6 miles from Columbia River in 200 Area
	60 One or more facilities within 4 5 mi of Columbia River; no facilities within 2 5 mi of River
	30 One or more facilities within 2 5 miles of Columbia River
	0 One or more facilities within 1 0 mile of Columbia River
Long term (after D&D)	Number of additional acres and/or sites requiring D&D:
	100 No additional acreage and/or sites requiring D&D
	65 One additional site and 10 additional acres requiring D&D
	0 Four additional sites and 20 additional acres requiring D&D
Cost	
Short-Term Capital (5 years)	Dollars (Millions)
Long-Term Capital	Dollars (Millions)
Maintenance and Operating Costs	Dollars (Millions)
D&D Costs	Dollars (Millions)
Total Costs	Dollars (Millions)

Table 1. Scales Used in the Analysis of Solid Waste Technical Alternatives (Page 3 of 4).

PUBLIC VALUES/CRITERIA	SCALE
Schedule	
Expedite Start Schedule	Amount and when processing capacities come on line:
	100 30% on line in 6 years, and the remaining 70% on line in 11 years
	75 30% on line in 8 yrs, and the remaining 70% on line in 14 yrs, or 100% on line in11 yrs
	25 30% on line in 15 years, and the ramaining 70% on line in 20years
	0 100% on line in 20 years
Meet TPA Milestones	Whether a significant delay in major and/or minor TPA milestones:
	100 Meets all TPA milestones
	50 Significant delays in one or more minor milestones but meets all major milestones
	0 Significant delay in a major TPA milestone
System Manageability	
Process Flexibility	Variety of material types and sizes and throughput combinations that can be processed
	100 Facility is easily modified to change relative throughput of waste stream types and can process a variety of waste and material sizes
	0 Physical restrictions of building provide for little or no ability to change relative throughput of waste stream types and is limited in the variety of sizes that can be processed
Operational Reliability	Operating efficiency (60 to 75%)
Other Use Flexibility	Facility potential for processing and storage besides intended campaign (yes or no)
	100 Facility has potential for processing and storage besides intended campaign
	0 No potential for processing and storage besides intended campaign
Socio/Economic Impacts	
Minimize Impact to Land	
Facilities on New Land	Acres required for buildings of undistrbed and/or previous sites:
	100 Buildings on 50 acres of previous site
	30 Buildings on 50 acres of undisturbed land
	20 Buildings on 50 acres of undisturbed land and 20 acres of previous sites
	0 Buildings on 70 acres of undisturbed land
Roads Needed	Miles of road constructed (3 to 0)
Make available areas of high use value	Extent of facilities located outside 200 Area.
	100 All facilities located In 200 Area
	20 Some facilities outside 200 Area
	0 All facilities outside 200 Area
	0 Four additional sites and 20 additional acres requiring D&D

Table 1. Scales Used in the Analysis of Solid Waste Technical Alternatives (Page 4 of 4).

PUBLIC VALUES/CRITERIA	SCALE
Economic Stability	
Construction Worker Demand Profile	Whether demand is even or consists of ups and downs:
	100. Construction demand is at nearly the same level over a period of 10 years
	50. All construction takes place over 2-3 years
	0. Construction demand peaks 2 or 3 times over 10 years, and little or no demand between cycles
Operator Work Demand Profile	Whether demand is even or consists of ups and downs:
	100. Operational worker demand is at nearly the same level for the life of the project
	0. Operational wkr demand requires periods of multiple shifts and periods below capacity
Capture Economic Oportunities Locally	Amount of economic opportunity for local business:
	100. Solid waste cleanup plan will most likely result in at least one large scale opportunity for a new or existing local business or several moderately sized opportunities
	80. Solid waste cleanup plan will most likely result in at least one moderate scale opportunity for a new or existing local business or several small sized opportunities
	20. Solid waste cleanup will most likely result in one small scale opportunity for a new or existing local business
	0. Solid waste cleanup will most likely result in no new opportunities for a new or existing business
Demo Integration of Programs	
integrated use of facilities	Extent same facilities are shared by multiple programs:
	100. Multiple programs using the same facilities
	0. All programs using Independent facilities
Minimum costs to interfacing programs	Dollars saved by other programs in D&D expenses (0 to TBD)
Demo storage concepts to other programs	Whether demonstrate can store and process other waste types
	100. Can store and process other waste types
	0. Can not store and process other waste types

Table 2. Weights Used in the Analysis of Solid Waste Tecnical Alternatives (Page 1 of 2).

Public Value/Criteria	SS	AC	JK	LD	Consensus Average	Average	Grp/Avg
Public Health and Safety	**0.25**	**0.28**	**0.12**	**0.23**	**0.25**	**0.22**	**0.15**
Public Radiation Exposure							
Chronic	0.040	0.017	0.027	0.042	0.033	0.031	0.020
Acute	0.081	0.111	0.045	0.065	0.085	0.075	0.051
Public Chemical Exposure							
Chronic	0.040	0.006	0.009	0.032	0.026	0.022	0.016
Acute	0.081	0.078	0.013	0.048	0.069	0.055	0.041
Public Transportation Safety	0.008	0.067	0.022	0.045	0.040	0.036	0.024
Worker Health and Safety	**0.18**	**0.21**	**0.12**	**0.19**	**0.19**	**0.17**	**0.15**
Worker Radiation Exposure							
Chronic	0.006	0.010	0.015	0.040	0.019	0.018	0.010
Acute	0.044	0.069	0.030	0.032	0.049	0.044	0.038
Worker Hazardous Chemical Exposure							
Chronic	0.002	0.003	0.012	0.024	0.010	0.010	0.008
Acute	0.044	0.049	0.024	0.024	0.039	0.035	0.030
Worker Accidents							
Transportation							
At Work	0.011	0.042	0.018	0.017	0.023	0.022	0.018
Commuter	0.033	0.021	0.003	0.034	0.029	0.023	0.022
Industrial	0.035	0.014	0.018	0.032	0.027	0.025	0.021
Environmental Impact	**0.08**	**0.14**	**0.23**	**0.17**	**0.13**	**0.16**	**0.18**
Immediate (prior to start up)	0.016	0.033	0.070	0.051	0.033	0.042	0.047
Short term (thru D&D,60 yrs)	0.033	0.066	0.046	0.073	0.057	0.054	0.080
Long term (after D&D)	0.026	0.040	0.116	0.051	0.039	0.058	0.055

Table 2. Weights Used in the Analysis of Solid Waste Tecnical Alternatives (Page 2 of 2).

Public Value/Criteria	SS	AC	JK	LD	Consensus Average	Average	Grp/Avg
Schedule	**0.20**	**0.13**	**0.29**	**0.12**	**0.15**	**0.18**	**0.15**
Expedite Start Schedule	0.111	0.104	0.193	0.089	0.102	0.124	0.104
Meet TPA Milestones	0.089	0.021	0.097	0.027	0.046	0.058	0.047
System Manageability	**0.08**	**0.04**	**0.03**	**0.07**	**0.06**	**0.05**	**0.05**
Process Flexibility	0.016	0.020	0.018	0.028	0.022	0.021	0.016
Operational Reliability	0.033	0.008	0.004	0.014	0.018	0.015	0.013
Other Use Flexibility	0.026	0.014	0.007	0.027	0.022	0.019	0.016
Socio/Economic Impacts	**0.13**	**0.18**	**0.17**	**0.17**	**0.16**	**0.16**	**0.23**
Minimize Impact to Land							
Facilities on New Land	0.025	0.040	0.064	0.034	0.033	0.041	0.047
Roads Needed	0.012	0.006	0.019	0.008	0.009	0.011	0.013
Available areas of high use value	0.025	0.057	0.013	0.032	0.038	0.032	0.054
	0.020	0.003	0.000	0.012	0.011	0.009	0.016
Economic Stability							
Construction Worker Demand Profile	0.020	0.011	0.013	0.014	0.015	0.014	0.021
Operator Worker Demand Profile	0.010	0.034	0.039	0.040	0.028	0.031	0.040
Capture Economic Oportunity Locally	0.015	0.029	0.026	0.036	0.026	0.026	0.037
Demo Integration of Programs	**0.10**	**0.03**	**0.04**	**0.05**	**0.06**	**0.05**	**0.09**
Integrated use of facilities	0.043	0.014	0.012	0.014	0.024	0.021	0.038
Minimum costs to interfacing progrms	0.035	0.003	0.024	0.019	0.019	0.020	0.030
Demo storage concepts to other programs	0.022	0.011	0.007	0.014	0.015	0.013	0.024

Table 3. Scores for Technical Alternatives on Public Values Criteria (Page 1 of 2).

PUBLIC VALUES/CRITERIA	UNITS	New Single	New Modular	Existing Modular	Existing Single (WNP-1)	Programs Baseline
Public Health and Safety						
Public Radiation Exposure						
Chronic	Miles (10-25)	25	25	22	10	25
Acute	Miles (10-25)/Safety Class (>3 to 1)	80 (25/3)	80 (25/3)	70 (22/3)	80 (10/1)	80 (25/3)
Public Chemical Exposure						
Chronic	Miles (10-25)	25	25	22	10	25
Acute	Miles (10-25)/Safety Class (>3 to 1)	80 (25/3)	80 (25/3)	70 (22/3)	80 (10/1)	80 (25/3)
Public Transportation Safety	Miles (0-200K)	0	0	20	200	0
Worker Health and Safety						
Worker Radiation Exposure						
Chronic	Rad Wrkrs	249	327	326	249	327
Acute	Wrkrs (245-40)/Safety Class (>3 to 1)	60 (245/3)	80 (116/3)	70 (154/3)	80 (245/1)	70 (154/3)
Worker Hazardous Chemical Exposure						
Chronic	Wrkrs (400 to 150)	249	327	326	249	327
Acute	Wrkrs (245-40)/Safety Class (>3 to 1)	60 (245/3)	80 (116/3)	70 (154/3)	80 (245/1)	70 (154/3)
Worker Accidents						
Transportation						
At Work	Miles (600K to 200K)	200	200	370	560	200
Commuter	Miles/yr 4 8M to 1 6M)	4 8	4 8	4 2	1 6	4 8
Industrial	Reportable incidents	776	1152	1094	776	1152
Environmental Impact						
Immediate (prior to start up)	Constructed (0-100)	0	80	100	100	40
Short term (thru D&D 60 yrs)	Constructed (0-100)	100	100	92	30	95
Long term (after D&D)	Constructed (0-100)	30	0	95	40	0

Table 3. Scores for Technical Alternatives on Public Values Criteria (Page 1 of 2).

PUBLIC VALUES/CRITERIA	UNITS	New Single	New Modular	Existing Modular	Existing Single (WNP-1)	Programs Baseline
Cost						
Short-Term Capital (5 years)	Dollars (Millions)	316	296	140	300	140
Long-Term Capital	Dollars (Millions)	1262	1765	700	230	1380
Maintenance and Operating Costs	Dollars (Millions)	840	1279	1230	800	920
D&D Costs	Dollars (Millions)	283	319	<30	200	200
Total Cost	Dollars (Millions)	2701	3659	2100	1530	2640
Schedule						
Expedite Start Schedule	Constructed (0-100)	75	100	100	100	35
Meet TPA Milestones	Constructed (0-100)	100	100	100	100	100
System Manageability						
Process Flexibility	Constructed (0-100)	75	100	50	90	0
Operational Reliability	Operating efficiency (60 to 75%)	70	70	70	70	70
Other Use Flexibility	Constructed (0-100)	75	100	50	70	0
Socio/Economic Impacts						
Minimize Impact to Land						
Facilities on New Land	Constructed (0-100)	0	0	75	100	0
Roads Needed	Miles (3 to 0)	2	3	1	2	3
Make available areas of high use value	Constructed (0-100)	100	100	80	0	100
Future Facility Use	Percentage (0 % 100)	5	5	0	0	0
Economic Stability						
Construction Worker Demand Profile	Constructed (0-100)	50	100	100	80	0
Operator Worker Demand Profile	Constructed (0-100)	100	100	100	100	100
Capture Economic Oportunities Locally	Constructed (0-100)	100	80	20	100	80
Demo Integr of Programs						
Integrated use of facilities	Constructed (0-100)	100	20	20	100	0
Minimum costs to interfacing programs	Dollars saved (0 to 600M)	0	0	600	0	0
Demo storage concepts to other programs	Constructed (0-100)	100	0	100	100	0

SOLID WASTE AND MATERIALS SYSTEMS ALTERNATIVES STUDY

EXECUTIVE SUMMARY

ATTACHMENT 2
COMPARATIVE ANALYSIS DATA

1.0 ANALYSIS

The data shown in Table 3 of Attachment 1 represent the information used in the analysis of the solid waste technical alternatives. No alternative scored best in all of the criteria; consequently, additional judgments considering costs and benefits and tradeoffs among values is necessary. The following subsections analyze the strengths and weaknesses of the technical alternatives.

1.1 OVERALL PERFORMANCE ON PUBLIC VALUES

Figure 1 shows the overall scores for Maximizing Public Value for each of the five technical alternatives. As can be seen in Figure 1, Existing Modular (Alternative 3) scored highest. New Modular (Alternative 2) ranked second, and New Common (Alternative 1) was a close third. Existing Singular (Alternative 4) ranked fourth, and the Program Baseline was last. The resulting weighted and transformed scores have a potential range from 0 to 1, where 1 would indicate scoring the highest possible on all criteria, and 0 would result from the lowest score on all criteria. As can be seen in Figure 1 the scores ranged from 0.567 to 0.737. These overall values do not consider cost. They are a weighted sum of all criteria with the exception of cost. Cost-benefit tradeoffs will be considered below. These values also do not consider risks to cost or schedule.

1.2 COST-BENEFIT ANALYSIS

The costs of the solid waste technical alternatives are shown in Table 3 of Attachment 1. Costs were estimated for short-term capital (next 5 years), long-term capital (remaining capital after 5 years), maintenance and operating cost, and D&D cost. Total cost is the summation of these four costs. This information is presented graphically in Figure 2. As seen in the figure, New Modular is the most costly overall and Existing Singular is the least costly. Maintenance and operating costs were estimated to be least for Existing Singular; however, it has the second highest short-term capital cost. Existing Modular, which had the highest overall performance, is the second least costly overall.

The relationship between costs and benefits is plotted on a two-dimensional graph of overall public value (benefit) versus total cost shown in Figure 3. As can be seen in Figure 3, Existing Modular outperforms New Common, New Modular, and the Program Baseline on both public value and total cost. That is Existing Modular provides more overall value at less cost than these other three alternatives. Existing Singular Existing Singular provides less value than Existing Modular, but it also costs less. Thus, when considering overall cost and overall public value, a decision must be made as to whether the additional benefits of Existing Modular are worth the additional cost.

Figures 4 through 6 show similar plots for short-term capital costs, long-term capital costs, and maintenance and operating costs. Figure 4 for short-term capital costs shows that Existing Modular dominates all the alternatives. It is important to note that the reason that the New Modular and New Common alternatives cost less than Existing Singular over a five-year period is somewhat of an anomaly. Construction for the Existing Singular alternative would be completed within this 5-year period; whereas construction for the New Singular and New Modular alternatives would have just started at the end of the 5-year period. The design and part of the construction costs for the New Singular and New Modular alternatives would be accrued in the first five years, whereas the entire design and construction costs for the Existing Singular alternative would be accumulated in this period. Additionally, it should be pointed out that the reason that the Program Baseline costs are low over the first five years is that this alternative does not address many of the near-term processing and storage requirements.

Figure 5 for long-term capital costs shows the same pattern as for total costs; that is, Existing Modular dominates all alternatives except Existing Singular. Figure 6 for maintenance and operating costs tells a different story. Existing Modular is still the best performer on public values, but New Common and Existing Singular perform better on the maintenance and operating costs.

The next section provides a more detailed analysis of what is driving the performance on overall public value for each of the technical alternatives.

1.3 DETAILED ANALYSIS OF PERFORMANCE ON PUBLIC VALUES

The overall values for the technical alternatives depend on how they scored on the major public value categories and the weights given to those categories. This is depicted graphically in Figure 7. Figure 7 shows the performance profile for each of the five technical alternatives. For each technical option, bars are shown for each of the major public value categories. (The ordering is such that socioeconomic impact is the third bar.) The weight given to a public value (which is the same for all the alternatives) is represented by the bar's width. The option's performance or score for the public value is represented by the bar's height. Thus, the total area of all bars is the option's overall value.

Performance profiles show the relative strengths and weaknesses of each technical option. A comparison of these two technical alternatives shows that Existing Modular scores better on Public Health and Safety, and worse on Worker Health and Safety. The scores are similar for Socioeconomic Impact and Schedule. Existing Modular does better on Environmental Impact and worse on System Manageability. Their scores were similar for Demonstrate Integration of Programs.

2.0 DISCUSSION/SUMMARY

Much of the analysis that has been described in the preceding sections is summarized in Figure 8. For each technical option this figure shows the overall public value and risk-based estimates of the option's costs. The horizontal lines show 90% confidence intervals for cost. These represent the range in costs such that there is only one chance in twenty that they would fall above the range and one chance in twenty that they would fall below the range. (Estimates for the Programs Baseline are not risk-based and no range is given.) The vertical lines show the ranges in overall public value based upon various value perspectives evaluated.

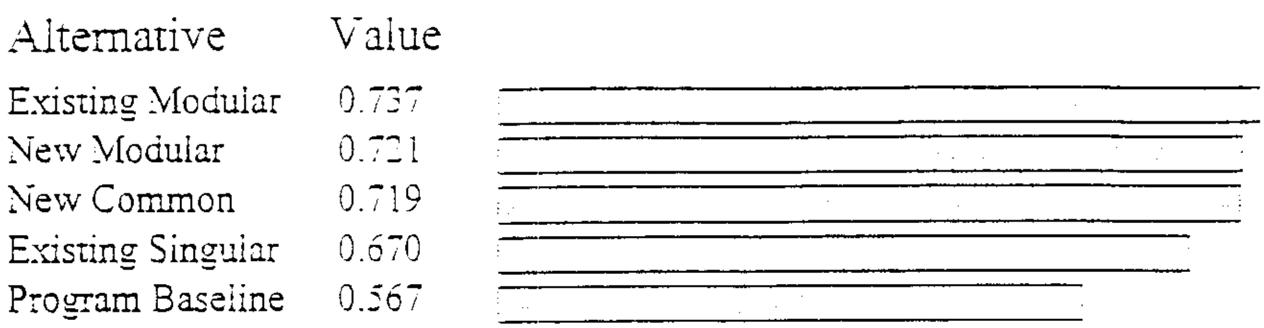
Figure 8 shows for each option the best estimates of its costs and overall value, as well as how far it may reasonably be thought to deviate from these estimates, given uncertainties in cost and value tradeoffs. As can be seen in the figure, there is no overlap of the alternatives, even when considering their regions of uncertainties. This allows one to conclude that the analysis shown on Figure 3, which was based on best estimates, still applies given uncertainties in cost and value tradeoffs. Consequently, we can be confident in the assertion that Existing Modular dominates all the technical alternatives except for Existing Singular, and the fundamental decision is whether the additional value offered by Existing Modular is worth the additional costs.

The additional value offered by Existing Modular over Existing Singular is due to Public Health and Safety, Environmental Impact, and D&D costs savings. The increase in value for Public Health and Safety is due to less potential for chronic exposure to either chemical or radiological contaminants, and increased Public Transportation Safety. The additional value for Environmental Impact is both short-term, as a result of being further from the Columbia River, and long-term, as a result of fewer acres and sites requiring D&D; thus, there would be less potential for residual contamination.

Existing Modular costs more overall than Existing Singular, however, the short-term capital costs and the D&D costs are lower. The greater costs are long-term capital and maintenance and operating which are spread out over the project's life, and therefore may be easier to bear. Also, the estimated schedule and the risk profile for the schedule are the same for both Existing Modular and Existing Singular. The expected start date for all alternatives doubles when risk is considered. This appears to indicate a benefit from working closely with regulators in the near-term to resolve regulatory issues and processing uncertainties.

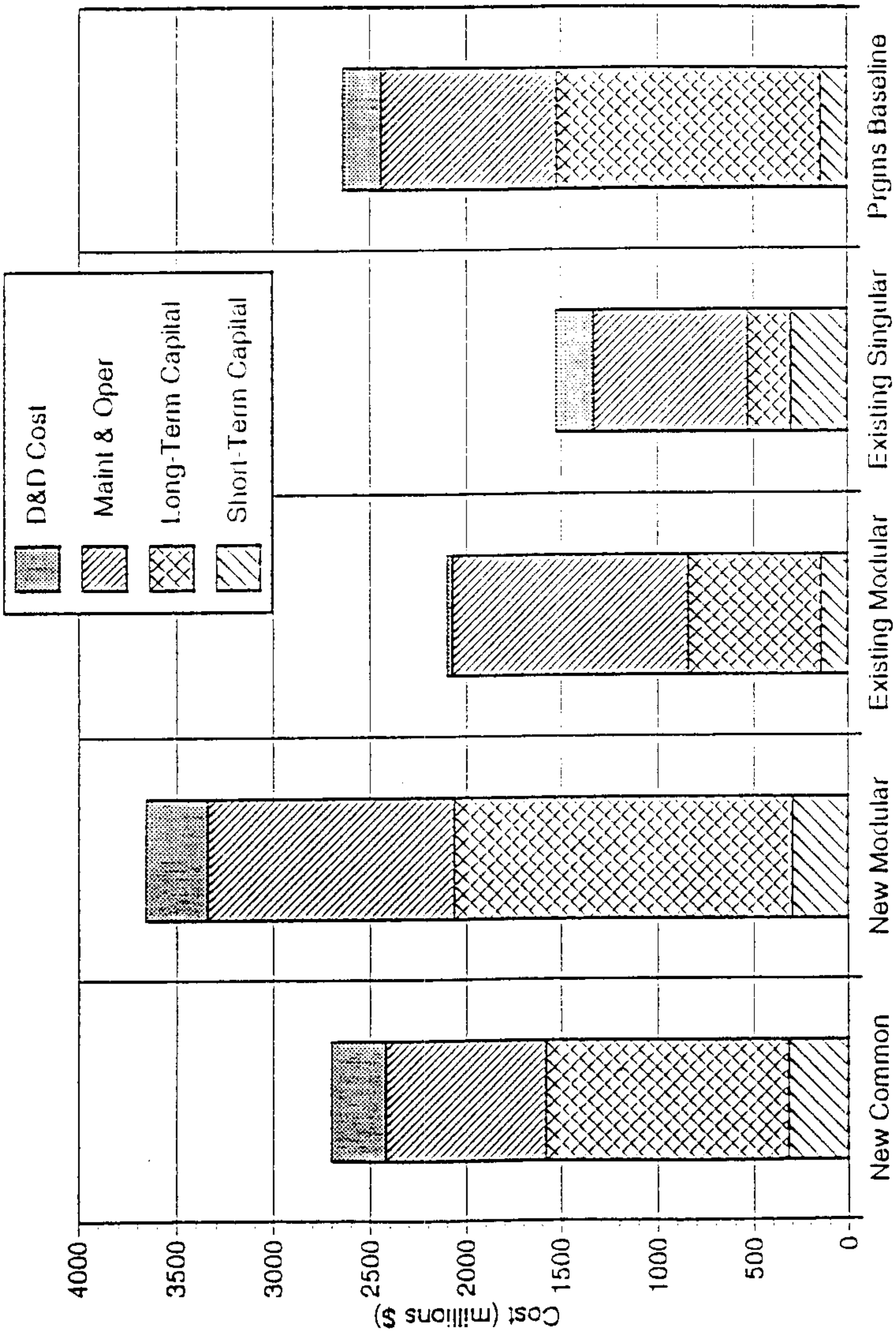
The cost risk does not appear to be as great for existing alternatives as for new construction alternatives -- especially New Common. However, the cost uncertainties are most likely underestimated. The estimates are from potential impacts of external events, that is, events to some extent outside the control of the Solid Waste Program. The impacts from these events are important to consider; however, they are not the only source of uncertainty in the cost estimates. Cost estimates come from the aggregation of many individual estimated cost parameters, each of which has associated uncertainties. An analysis including these parametric uncertainties would show greater overall uncertainties for costs.

Figure 1. Overall Performance on Public Values.



Preference Set = Consensus Average

Figure 2. Solid Waste Technical Alternatives Cost Comparison.



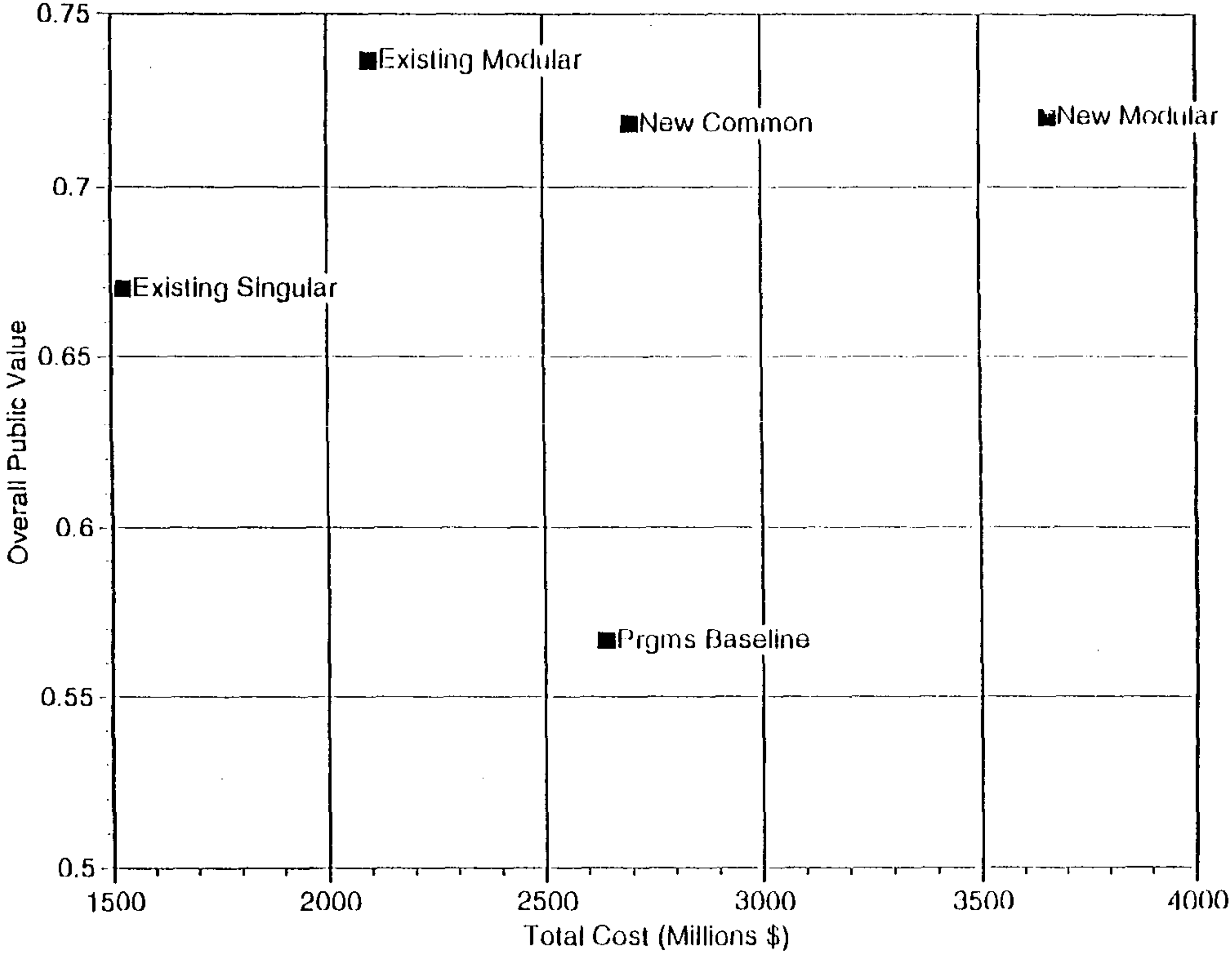
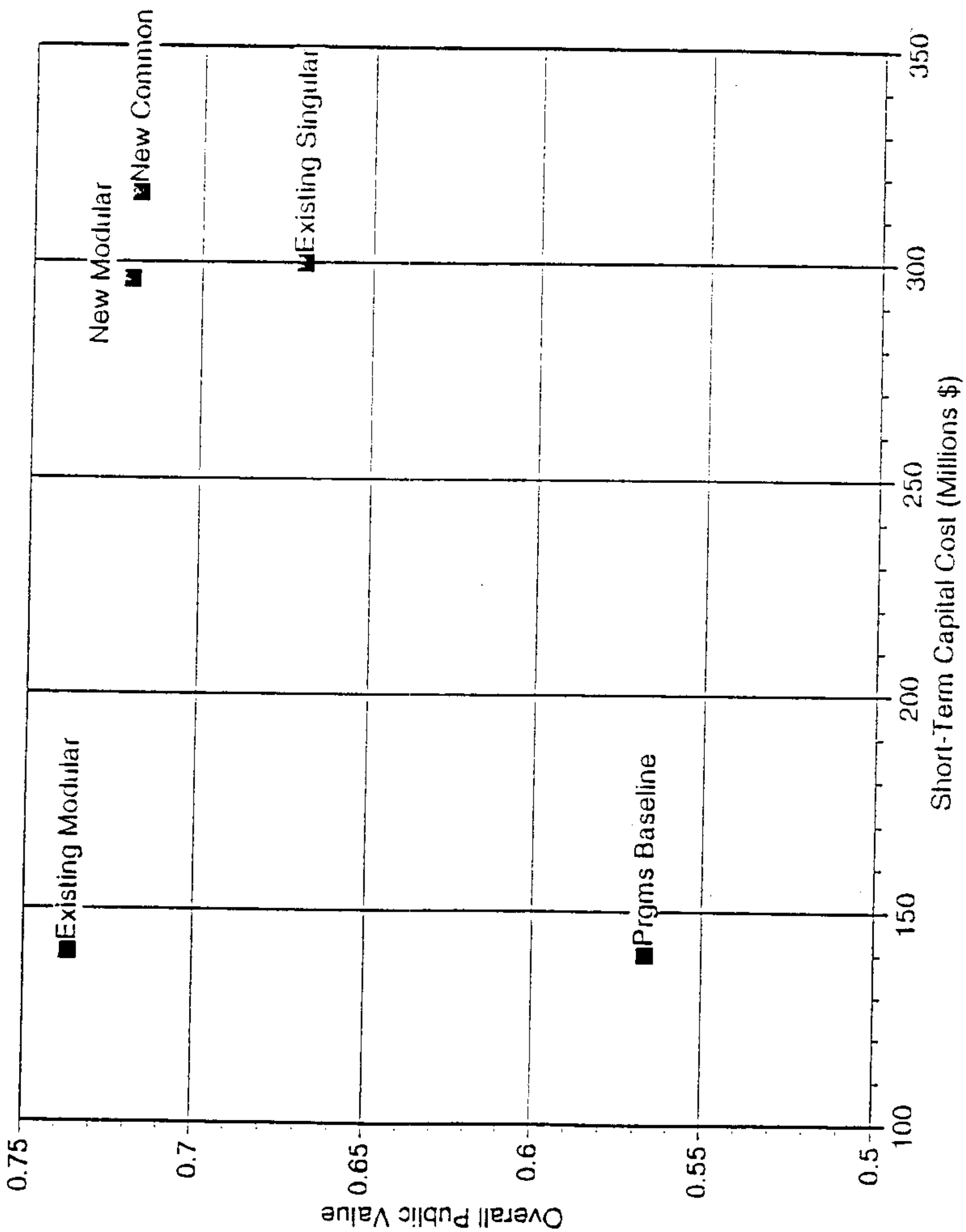


Figure 3. Composite Public Value versus Total Cost.

Figure 4. Composite Public Value Versus Short-Term Capital Cost.



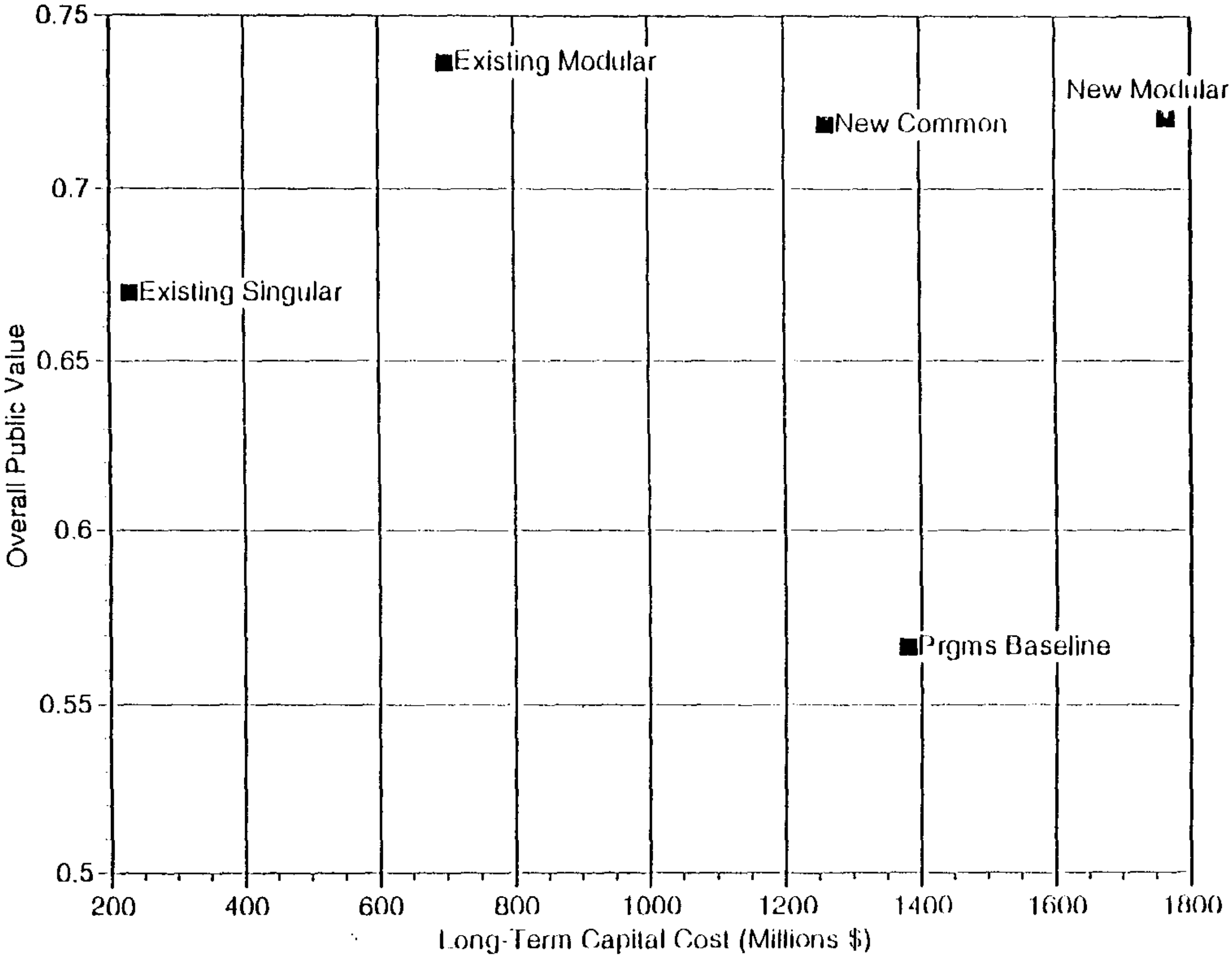


Figure 5. Composite Public Value Versus Long-Term Capital Cost.

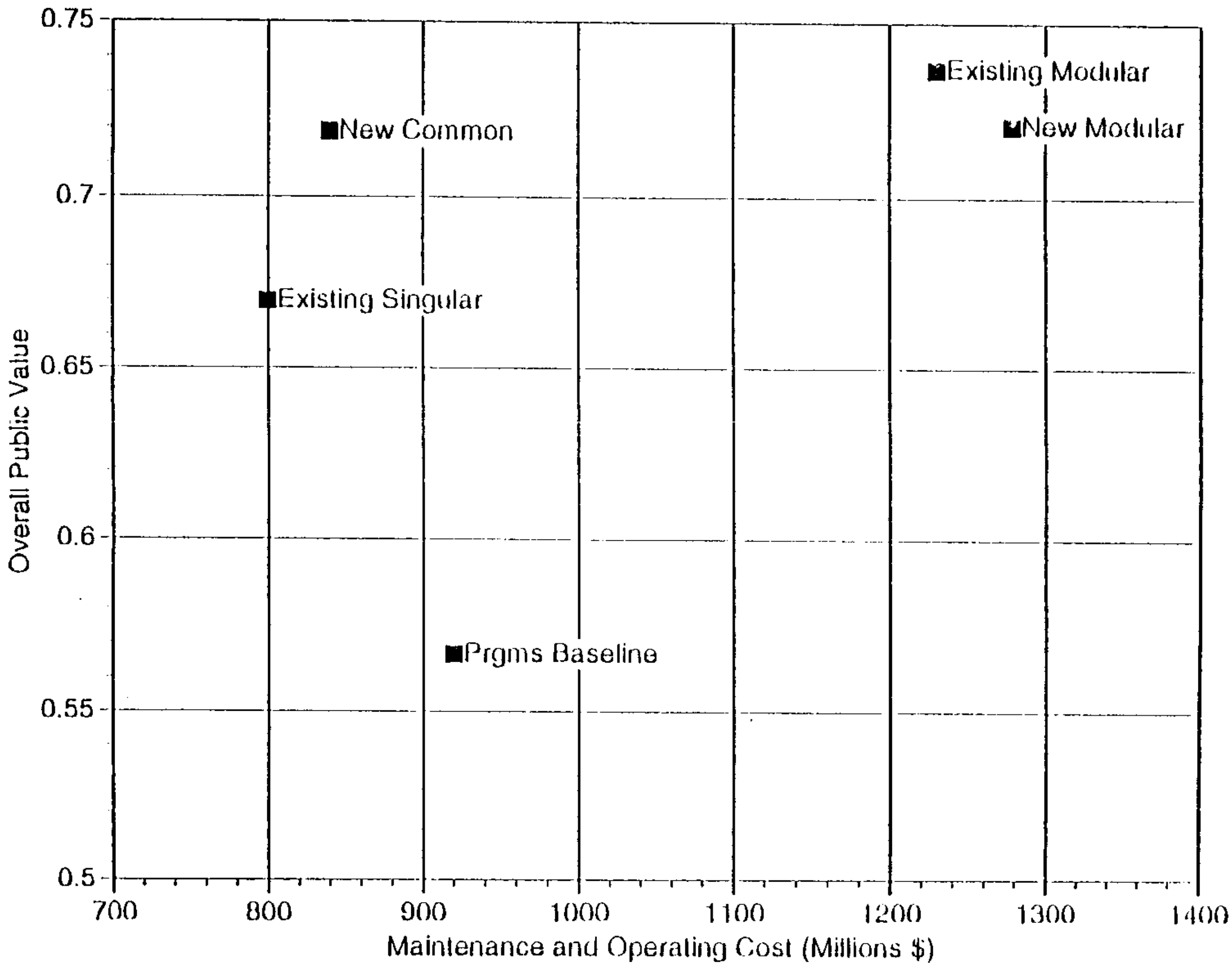


Figure 6. Composite Public Value Versus Maintenance and Operating Cost.

Figure 7. Performance Profile for Solid Waste Technical Alternatives.

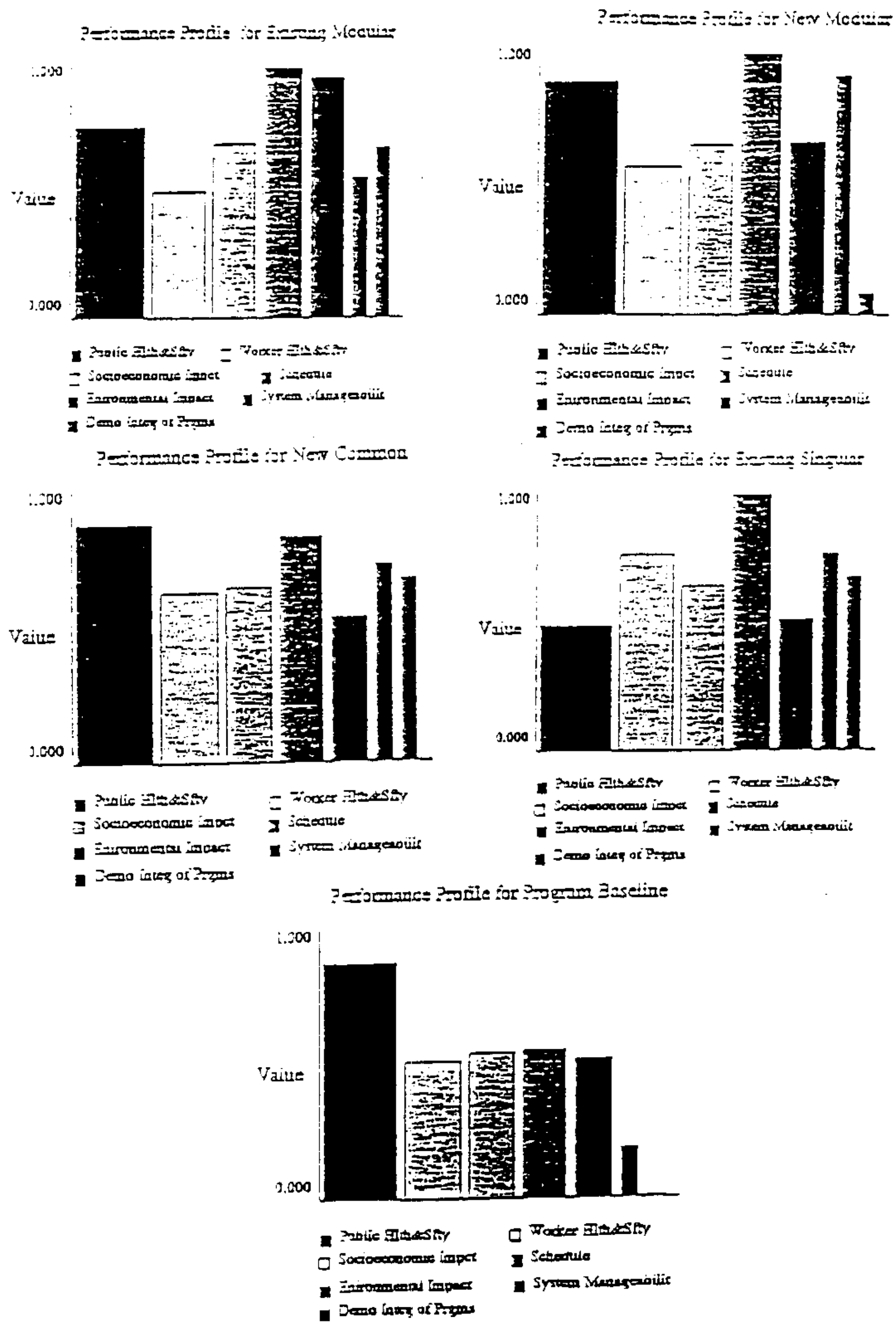


Figure 8. Composite Public Value Versus Total Cost Using Risk Analysis Data and Value Perspective Ranges.