**Idaho
National
Engineering
Laboratory**

**INEL-94/0115
(Formerly EGG-WM-11352)
Revision 2**

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February 1996

**Waste Management Facilities
Cost Information:
System Cost Model
Product Description**

**K. M. Hsu
A. S. Lundeen
D. E. Shropshire**

Lockheed
Idaho Technologies Company

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Waste Management Facilities Cost Information: System Cost Model Product Description

A. S. Lundeen
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Published February 1996

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Waste Management Facilities Cost Information: System Cost Model Product Description

INEL-94/0115

Rev. 2

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SYSTEM COST MODEL DESCRIPTION

In May of 1994, Lockheed Idaho Technologies Company (LITCO) in Idaho Falls, Idaho and subcontractors developed the System Cost Model (SCM) application. The SCM estimates life-cycle costs of the entire U.S. Department of Energy (DOE) complex for designing; constructing; operating; and decommissioning treatment, storage, and disposal (TSD) facilities for mixed low-level, low-level, transuranic, and mixed transuranic waste. The SCM uses parametric cost functions to estimate life-cycle costs for various treatment, storage, and disposal modules which reflect planned and existing facilities at DOE installations. In addition, SCM can model new facilities based on capacity needs over the program life cycle. The SCM also provides transportation costs for DOE wastes. Transportation costs are provided for truck and rail and include transport of contact-handled, remote-handled, and alpha (transuranic) wastes. The user can provide input data (default data is included in the SCM) including the volume and nature of waste to be managed, the time period over which the waste is to be managed, and the configuration of the waste management complex (i.e., where each installation's generated waste will be treated, stored, and disposed). Then the SCM uses parametric cost equations to estimate the costs of pre-operations (designing), construction costs, operation management, and decommissioning these waste management facilities.

- *Pre-operations*—Pre-operations pertain to the studies and bench scale test costs, demonstration costs, and operations budget funded activities (conceptual design, safety assurance documentation, permitting, preparation for operation, and project management).
- *Construction costs*—Construction costs include title I and II design, inspection, project management, building construction (including indirect costs), equipment (including indirect costs), construction management, and contingency costs related to facility construction.
- *Operation Management (Operations and Maintenance)*—Operation management relates to operating labor, utilities, material, maintenance, and other costs including reserve and contingency costs.
- *Decommissioning*—Decommissioning pertains to manpower, surveillance and maintenance, assessment and characterization, environmental documentation review, operations, closure, and post-closure monitoring.

NEW FEATURES FOR THE SCM 1.3

With this release, a number of new features have been incorporated. The major new features of SCM version 1.3 are listed below:

- Treatment waste shedding allows a site to distribute the same waste matrix category to several sites including a commercial designation.
- For each waste generating site, the user will be able to select a disposal destination, transport mode, and post-treatment storage location. If commercial disposal is chosen, a unit rate will be required.
- Allows chargeback of treatment, storage, or disposal costs to waste generating sites.
- A new administrative support cost Work Breakdown Structure (WBS) 9.0 was created to reflect the fixed portion of the annual costs provided by the SCM user and variable support costs estimated from the administrative and maintenance modules.
- The SCM user can now vary the facility operating-hours per year from the standard 4,032 hours per year.
- The full-time equivalent (FTE) regression curves have also been modified to better model FTE results. Both the FTE curves and costs curves depend upon user-provided FTE labor rates.

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ACRONYMS

BEMR	Baseline Environmental Management Report
D&D	decontamination & decommissioning
DOE	U.S. Department of Energy
DOS	Disk Operating System
E&SA	Economic and Systems Analysis
FFCA	Federal Facility Compliance Act
FTE	full-time equivalent
GUI	graphical user interface
INEL	Idaho National Engineering Laboratory
LITCO	Lockheed Idaho Technologies Company
LLW	low-level waste
MLLW	mixed low-level waste
MTRU	mixed transuranic waste
MWIR	Mixed Waste Inventory Report
NEPA	National Environmental Policy Act of 1969
PC	personal computer
RAM	random access memory
RCRA	Resource Conservation and Recovery Act
SCM	System Cost Model
SQAP	Software Quality Assurance Programs
TRU	transuranic waste
TRUPACT II	transuranic package container
TSD	treatment, storage, and/or disposal
WAC	Waste Acceptance Criteria
WBS	work breakdown structure
WIPP	Waste Isolation Pilot Plant
WMFCI	Waste Management Facility Cost Information

Waste Management Facilities Cost Information: System Cost Model Product Description

1. SCOPE

Lockheed Idaho Technologies Company's (LITCO's) Technical Support Program and subcontractors developed the System Cost Model (SCM) at the request of the Department of Energy's (DOE's) Office of Waste Management. The SCM provides a life-cycle, cost-estimating system to manage and process the following waste types: low-level waste (LLW), mixed low-level waste (MLLW), transuranic waste (TRU), mixed transuranic waste (MTRU) throughout the DOE complex. The cost basis is derived from the *Waste Management Facilities Cost Information for Low-Level Waste*¹, *Waste Management Facilities Cost Information for Mixed Low-Level Waste*², *Waste Management Facilities Cost Information for Transuranic Waste*³ and *Waste Management Facilities Cost Information for Transportation of Radioactive and Hazardous Materials*⁴ manuals.

The requirements for the SCM were refined during the life cycle of SCM development and maintenance. To accommodate the dynamic requirements, this product description is continuously updated and maintained in accordance with LITCO's document control procedures. This report defines the high-level requirements and provides a description of the **SCM version 1.3**.

The SCM was developed using an iterative development methodology in conjunction with rapid prototyping techniques to develop the application. Rapid prototyping involves the "quick" implementation of a minimal set of requirements. The LITCO Technical Support Program and the Software and Electronics Department were responsible for providing the technical lead for integrating the design, developing the model, and documenting SCM. LITCO is responsible for the SCM project management, beta testing, and reviews of the SCM documentation.

2. GENERAL STANDARDS AND REQUIREMENTS

SCM was developed according to the guidelines and controlling procedures established for the Technical Support Program. The team followed applicable LITCO procedures for the engineering process. The SCM software product has been identified as a quality-level-2 product. To comply with the company direction for level-2 products, the project will continue to implement quality assurance measures specified in the SCM Software Quality Assurance Plan (SQAP).

The SQAP describes the configuration management procedures used for change control of the SCM and its associated documents. These procedures ensure that released versions of SCM software (programs and data), user documents, and product description documents are maintained in an identifiable and traceable manner. Version identification numbering is included in all documentation. Printed output, which is generated by the SCM, will include the appropriate version numbers to ensure traceable results. The SCM program and the default database have separate versions. A software change request system has been established for management control over adding new capabilities and resolving any identified software deficiencies. The SCM technical lead maintains a log of all requests for new capabilities and program fixes for the current released version of SCM. Previous program fixes are logged and kept for historical referencing. This log helps the SCM project team to decide what new features should be included into future version of the SCM.

3. FUNCTIONAL AND OPERATIONAL REQUIREMENTS

3.1 Overview

The SCM system architecture enables new features to be easily added as the product matures. A high-level, functional view of SCM architecture is shown in Figure 1.

User Interface (with Help Utilities)

Figure 1. System Cost Model Architecture.

The SCM architecture illustrates the partitioning of the model structure into three distinct components: Inputs, System, and Outputs. The Inputs define the model parameters that are required to execute calculations of the system. The System components consist of the calculation engines required to produce the desired outputs. The Output component provides the desired screens and reports that contain the results from the system calculations and provide a record of the input parameters

The model provides a default set of parameters that SCM users may use to select the site, facility, waste type, etc. In addition, the user may change the data elements provided. Modified data can be saved in scenarios called cases. An SCM user can access the saved cases in the future and perform additional modifications. The SCM cases can be copied to or from different personal computers (PCs) via floppy diskettes or a network media. The user can select different cases and merge these cases into a single case.

As the SCM evolves, rapid prototyping will continue to be used to facilitate the addition and deletion of requirements. SCM provides the following functions:

- Work breakdown cost structure (see Table 1, page 8)
- User-defined input parameters such as site-specific costs and facility capacities
- Support of cost and manpower profiles over time
- "User friendly" interface (e.g., online help screens)
- Report generator including graphical output
- Waste load inventory data for the sites (as defined in Appendix A) and waste type by waste matrix category (as defined in Appendix B)

SCM features for version 1.3 include the following options:

- Distributes waste for treatment to multiple designations by waste matrix category for treatment.
- Varies the waste generation on a yearly basis.
- Treatment waste shedding allows a site to distribute the same waste matrix category to several sites including a commercial designation.
- For each waste generating site, the user will be able to select a disposal destination, transport mode, and post-treatment storage location. If commercial disposal is chosen, a unit rate will be required.
- In past versions, the SCM automatically built a new facility that would be decontaminated and decommissioned. To more accurately provide full life cycle costs, a finite lifetime constraint is placed on all new facilities (default of 30 years which can be configured by the user up to 50 years).
- Automatically calculates pre-treatment storage based on user decisions of the earliest construction start date of new facilities and waste scheduling.
- Automatically calculates post-treatment storage based on availability of disposal facilities.

- Provides a new work breakdown structure (WBS) element, allowing for the addition of fixed administrative costs by facility module.
- Allows the chargeback of storage or disposal cost to generating sites. The chargeback cost is defined as waste sent to another site from a specific activity or generating site for a service (such as treatment or disposal). This charge is based on the quantity of waste and either a calculated unit rate or a user provided unit rate.
- Modifies existing reports to reflect the above changes (i.e. reports by waste type and subtype, new chargeback reports, etc.)

3.2 Mandatory System Capabilities

3.2.1 General Capabilities

The SCM provides the following general capabilities:

- Calculates the total life-cycle costs by module for the following three waste types:
 - LLW (alpha, non-alpha, and remote handle)
 - MLLW (alpha, non-alpha, and remote handle)
 - TRU/MTRU (contact and remote handle)
- The SCM user can chose between different treatment options (see Appendix C).
- Full-time equivalent (FTE) manpower estimates for each module by WBS
- Cost and FTE profiles for the three selected waste types (LLW, MLLW, TRU waste/MTRU)
- Transportation costs (rail or road)
- The administrative and support modules are automatically sized based on the calculated capacity of the TSD module.
- Cost by general module/facility type (pre-treatment storage, treatment, storage, and disposal)
- Cost by new facilities versus existing facilities
- Online help

- Capability to use portable treatment or commercial treatment options versus existing DOE facilities
- Capability to use a fixed minimum cost of facility modules for waste loads less than the defined module capacity range
- Allowance of DOE complex cost roll-ups of all DOE sites
- The total life-cycle costs for each module are organized based on the work breakdown structure (WBS) outlined in Table 1.

Table 1. SCM summary level work breakdown structure.

1.0	Pre-operations—Pre-operations pertain to the studies and bench scale test costs, demonstration costs, and operations budget funded activities (conceptual design, safety assurance documentation, permitting, preparation for operation, and project management).
2.0	Facility Construction Costs—Construction costs include design (title I and II), inspection, project management, building construction (including indirect costs), equipment (including indirect costs), construction management, and contingency costs related to facility construction.
3.0	Operations and Maintenance—Operation management refers to operating labor, utilities, material, maintenance, and other costs including reserve and contingency costs.
4.0	Decontamination and Decommissioning (D&D)—Decontamination and decommissioning pertains to facility D&D, closure, post-closure, and monitoring.
5.0	Contracted Services (Commercial)—Contracted services refers to commercial vendor for treatment or disposal.
6.0	Offsite Treatment, Storage, or Disposal—Offsite TSD relates to costs incurred from other DOE sites performing TSD for the generating site.
7.0	Transportation—Transportation costs associated with shipment either by rail or truck.
8.0	Special Site Costs—User defined, known costs for large homogenous waste matrix categories with unique processing requirements. This is used when the SCM provided treatment options are not appropriate and known costs exist.
9.0	TSD Support Administration Costs—TSD support administrative costs reflect the variable support costs estimated from the administrative and maintenance modules and the fixed portion of the annual costs provided by the SCM user.

3.2.2 Reporting Capabilities

The SCM provides the following reporting capabilities:

- Prints user-selected case summary or site detail reports; case summary, site detail, or case comparison graphs; and case Gantt charts.
- Preview option for viewing reports on the screen before printing reports.
- Data exports into text database, spreadsheet, and word processing format.
- Present data in tabular (Figure 2) and graphical formats (Figure 3).

System Cost Model [TESTCASE.SCM - MLLW]

Case Edit Run! Report Help

Detailed Work Breakdown Structure PLCC by Site

All Waste Types All costs in thousands of dollars (baseline year dollars)

WORK BREAKDOWN STRUCTURE						
Code	Name of Site	1.0	2.0	3.0	4.0	Total PLCC
AE	Argonne National Laboratory East	0	0	0	8,319	8,319
AW	Argonne National Laboratory West	280	1,065	6,709	59	8,077
ET	Energy Technology Engineering Center	0	0	0	2,769	2,769
FM	Fernald Environmental Management Project	0	0	0	23,173	23,173
HA	Hanford	655,718	5,410,763	15,465,930	3,672,552	25,504,955
ID	Idaho National Engineering Laboratory	94,133	441,063	412,984	268,530	1,214,701
LA	Los Alamos National Laboratory	195,372	767,373	267,504	234,512	1,464,762
LB	Lawrence Berkeley Laboratory	3,308	33,710	367	13,683	51,170
LL	Lawrence Livermore National Laboratory	24,335	126,740	260,842	118,282	560,210
NV	Nevada Test Site	28,469	4,182	0	84,604	117,255
OK	Oak Ridge K-25 Site	0	0	0	41,796	41,796
OR	Oak Ridge National Laboratory (K-10 Site)	659,236	2,732,349	0	968,703	4,359,290
OY	Oak Ridge Y-12 Plant	0	0	0	44,998	44,998
PO	Paducah Gaseous Diffusion Plant	0	0	0	5,319	5,319
PO	Portsmouth Gaseous Diffusion Plant	55,120	298,842	0	794,614	1,146,577
PX	Panlex Plant	0	0	0	2,262	2,262
RF	Rocky Flats Plant	393,739	1,333,454	0	1,429,042	3,129,235
SL	Sandia National Laboratory - Albuquerque	1,174	4,789	942	2,400	9,306
SR	Savannah River Site	225,726	710,579	0	331,794	1,268,099
WP	Waste Isolation Pilot Plant	180,408	50,721	144,495	100,000	475,674
		2,789,156	11,913,615	16,619,739	9,145,447	39,467,959

Preview Controls

458 of 458 Total: 458 100%

Next Cancel Print

Figure 2. Example of the SCM user-selected table report.

Figure 3. Example of the SCM user-selected graphical report.

The user can select from the following Report options:

- Case summary input reports for the following:
 - Waste loads and densities by waste type and site
 - Site treatment, storage, and/or disposal (TSD) schedule showing construction start dates, years of construction, and module extensions (WBS 2.0)
 - Facility names and code
 - Treatment option and storage disposal scenario(s) by generating site
 - Treatment option and storage disposal scenario(s) by treating site
 - Facility profiles showing module capacity, status, and availability
 - Sites which have disabled chargeback option (the user has to initiate the action to disable chargeback option for a site)
- Case summary output reports for the following:
 - Detailed WBS 1.0 - 4.0 planning level life-cycle costs by site
 - Detailed WBS 5.0 - 9.0 planning level life-cycle costs by site
 - Detailed WBS FTEs by site
 - Annual costs by site (all waste types)

- Site detailed input reports:
 - Site cost factors for construction, pre-operation, operating, and FTE (construction, engineering, operating)
 - Treatment scenarios by site showing the waste matrix category, priority, volume amount, treatment location, transportation mode, years, unit rate, and commercial volume
 - Waste loads and shipping per site by waste matrix category showing legacy volume, generation volume, and shipping for legacy and generation
 - A list of sites which are sending waste to be treated, stored, or disposed at a specified site
 - Scale factors and operating hours listed per site by module showing the TSD costs scale factors (WBS 1.0 - 4.0, 9.0), FTE scale factors (WBS 1.0 - 4.0, 9.0), and operating hours
- Case summary graphs:
 - Life cycle costs by TSD (includes WBS 1.0 - 4.0)
 - Total life cycle costs by WBS
 - TSD costs by timeline (includes WBS 1.0 - 4.0)
 - WBS cost timeline
- Site detail graphs:
 - TSD cost timeline by site
 - WBS cost timeline by site
- Case comparison graphs:
 - TSD case comparison by costs
 - Cumulative case costs comparison over time
 - WBS 1.0 - 4.0 case cost comparison
 - WBS 5.0 - 9.0 case cost comparison.

3.2.3 User Input Options

The SCM allows the user to select, enter, or change the following data:

- Waste type
- Waste loads (by waste matrix category)
- Destination of waste matrix categories to different sites (DOE or commercial)
- Offsite DOE treatment unit costs
- Treatment options for each waste type (e.g., Base Case, BEMR Calibrated, Nonflame, etc.)
- Transportation (rail/road)
- Commercial unit costs

- Site schedules for start and stop dates, durations of major cost elements (e.g., preoperation, construction, etc.)
- Existing or planned DOE facility cost information
- Facility Profiles (waste dedication, capacity, operation & maintenance, and existing/planned facilities)
- Site-specific cost factors
- Cost escalation factors
- SCM baseline defaults (see Section 3.2.4).

A detailed list of user-input data for SCM is included as Appendix A.

3.2.4 Internal Reference Data

The SCM contains and provides the following data:

- Cost data based on Waste Management Facility Cost Information reports
- Generic schedule data
- Existing and planned/approved facility capacity and operating parameters
- Existing and planned/approved facility costs
- Minimum and maximum scaling factors for parametric cost/capacity equations
- Transportation miles and costs/mile
- Standard operating parameters (such as years of operations and maintenance)
- Module flow factors.

3.3 Future Development

In future software versions, LITCO's Technical Support Program will develop and prototype new capabilities that will allow users to perform simplified health and safety risk evaluations (SCM-R). After successfully completing a risk prototype, the development team will integrate the subsystem into the current version of the SCM. This functionality will help to evaluate risk differences among waste management alternatives for the DOE complex.

All versions of the SCM use a traditional standard user interface; however Graphical User Interface (GUI) screens would improve user interaction. New software tools are being evaluated, including the next release of FoxPro (Visual FoxPro), which will allow specific functions, such as scheduling, to be incorporated using the GUI technology. A human factors expert has reviewed and provided recommendations for the SCM. These recommendations will be considered for future SCM releases.

3.4 System Requirements

The SCM runs as a stand-alone application on an IBM PC (or compatible) under the Microsoft Windows 3.1 environment. As a minimum, the following configuration is recommended for adequate performance:

- Pentium microprocessor, 70 MHz
- 16-megabytes of RAM
- 20-megabytes free hard-disk space (in addition to the disk space required by the windows virtual memory).
- VGA color monitor
- Mouse or equivalent pointing device.

Future versions of the SCM may require additional hardware to accommodate new software features as well as increase software performance. The SCM project leader is responsible for approving the software platform and defining new SCM features.

3.5 Software Requirements

The SCM will be distributed as a stand-alone executable program for use under Microsoft Windows 3.1. Each system requires the following software to run the SCM:

- DOS 5.0 or higher
- Microsoft Windows 3.1.

The development system consist of the following software:

- Microsoft FoxPro 2.6 Professional (database and user interface)
- Crystal Reports (output reports)
- Microsoft Delta (development software configuration management) or equivalent
- CaseWare (released software configuration management) or equivalent
- Graphics Server (graphical output reports)
- DynaZIP (for compressing case data).

3.6 Interface Requirements

The SCM will adhere to industrial standards for interfacing with peripherals on the hardware platform selected as optimal for the developmental effort.

3.6.1 Communications/Networking

The SCM is a stand-alone system that does not require any networking capabilities. If the system design for future versions requires a network environment, the network shall be compatible with network requirements for LITCO and the EM-30 office environment. Federal communications guidelines and LITCO networking standards will be met for any communications implemented in conjunction with the SCM.

3.6.2 External Data Interfaces

All SCM data is stored in FoxPro database tables. This design provides a mechanism for developing interfaces to the SCM from other programs, such as the BEMR Integration Model, and external uses of the data in spreadsheets or word processors. These tables will include the following types of data:

- Case-invariant data (such as module cost factors)
- Default values for user inputs (such as waste loads)
- Case-specific user inputs (such as TSD scenarios)
- Calculated output data (such as module capacities and costs).

4. PERFORMANCE EXPECTATIONS

The user-defined inputs, such as waste loads and the number of sites and combined with the size and speed of the computer hardware, will determine the performance expectations of SCM. For example, a medium-case scenario would consist of MLLW waste loads for approximately ten sites from the 1995 BEMR calibration effort. The calculation time for this case will take approximately five minutes using a 90-MHz Pentium processor. This calculation time does not include data entry or selection.

5. DOCUMENTATION

The following documentation for the SCM is maintained and available to external users of the model:

1. *Product Description*: The SCM Product Description (this document) will be maintained throughout the SCM development cycle to ensure that it is current and accurate. All changes to this document will be done in accordance with the change control procedures established by the Waste Management Facilities Cost Information project manager and Lockheed Idaho document control.
2. *User's Manual*: A user's manual will be developed to accompany initial and subsequent major releases of the SCM. The manual must provide a basic overview of the software and user instructions, but the user manual is not intended to be used as a training tool. User training and a training presentation may be developed to supplement the user's manual.

Internal project documentation will consist of the following:

3. *Software Quality Assurance Plan*: A Software Quality Assurance Plan (SQAP) has been developed and maintained. It will document the software risk assessment, verification & validation procedures, and software configuration management procedures. Periodic revisions will be made in conjunction with major additional SCM features or specified by the SQAP.
4. *Software Quality Product Evaluation*: This evaluation focuses on the current release of the SCM. This process helps to further validate that the new features and requirements are being met.

6. REFERENCES

1. D. Shropshire, M. Sherick, and C. Biagi, LITCO, *Waste Management Facilities Cost Information for Low-Level Waste*, INEL-95/0013, June 1995.
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3. D. Shropshire, M. Sherick, and C. Biagi, LITCO, *Waste Management Facilities Cost Information for Transuranic Waste*, INEL-95/0015, June 1995.
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Appendix A

Input Data Elements for the System Cost Model

Appendix A

Input Data Elements for the System Cost Model

Waste Load by Site by Waste type	Units	Default Value
Legacy volume by waste category	m ³	see Appendix B
Annual generation rate by waste category	m ³	from Mixed Waste Inventory Report (MWIR) /BEMR data
Densities by waste category	kg/m ³	from MWIR data
Shipping schedule start year (by site for legacy & generated waste by waste type, by waste category)	years	baseline year
Shipping schedule number of years (by site for all legacy & generated waste streams)	years	1
Treatment Scenario for Waste Categories by Waste type		
	Units	Default Value
Treatment priority	sites	on site
Treatment transport mode (rail verse truck)		rail
Treatment transportation start year	years	1995
Treatment transportation end year	years	1995
Commercial or charge back rate	\$/m ³	\$0
Commercial volume change	factor	1.00
Commercial volume return percentage	percent	100%
Storage & Disposal Scenario by Waste Type		
	Units	Default Value
Treatment technology option by site		dependent upon the user chosen treatment option (i.e. BC, BEM, WIPP, ...)
Storage site location by site waste type	sites	on site
Storage transport mode (this is only for off-site storage)		rail
Disposal site location by site by waste type	sites	on site
Disposal transport mode		rail
Disposal unit rate	\$/m ³	\$0

TSD Site Schedules	Units	Default Value
Earliest time for beginning year of treatment facilities construction	1995 - n	1995
Number of years of TSD facilities construction	years	5
Number of years of treatment facilities operation	years	10
Number of years of module life	years	30
Annual WBS 2.0 extension cost	percentage	10%

Existing or Planned Approved Facilities	Units	Default Value
Facility name		from Federal Facility Compliance Act (FFCA) facility capacity analysis
Facility available start	1995 - n	1995
Facility end year	1995 - n	1995
Facility revised end year	1995 - n	1995

Existing Modules	Units	Default Value
Module name		
Capacity	kg/hr, m ³ /hr	0
Capacity allocation for LLW - alpha, non-alpha, rh; MLLW - alpha, nonalpha, rh; TRU - ch, rh, MTRU -ch, mtru-rh	percent	0
Waste dedication of unused capacity	percent	100%
Annual operating hours	hours	4032
Pre - operation cost	\$K/yr	Varies by Module Type
Pre - operation labor	FTE/yr	Varies by Module Type
Pre-operations start year	1995 - n	Limited by the start and end year of the associated facility
Pre-operations end year	1995 - n	Limited by the start and end year of the associated facility
Construction cost	\$K/yr	Varies by Module Type
Construction labor	FTE/yr	Varies by Module Type
Construction start year	1995 - n	Varies by Module Type
Construction end year	1995 - n	Varies by Module Type
Module Extension Costs	\$K/yr	Varies by Module Type
Module Extension Labor	FTE/yr	Varies by Module Type

Existing Modules	Units	Default Value
Module Extension start year	1995 - n	Start year equal to the original end year
Module Extension end year	1995 - n	End year equal to the revised end year
Operations & maintenance cost	\$K/yr	Varies by Module Type
Operations & maintenance labor	FTE/yr	Varies by Module Type
Operations & maintenance start year		Based on the facility life and cannot be edited
Operations & maintenance end year		Based on the facility life and cannot be edited
Decontamination & decommissioning cost	\$K/yr	Varies by Module Type
Decontamination & decommissioning labor	FTE/yr	Varies by Module Type
Decontamination & decommissioning start year	years	Start year is equal to the end year of the facility plus 1 year
Decontamination & decommissioning (D&D) end year	years	End year is equal to the D&D start year of the facility plus 3 years
<hr/>		
Site Specific Cost Factors	Units	Default Value
Construction Costs Percentages -	percent	
Design		12%
Inspection		7%
Project management		10%
Construction Indirect		29%
Construction Management		17.1%
Management Reserve		10%
Construction Contingency		25%
Pre-operation Cost Factors and Constants-	percent	
Conceptual Design		2.0%
Safety Assurance		1.0%
Prep. Operations		100%
PreOps. Management		10%
National Environmental Policy Act of 1969 (NEPA) Permit	K \$	0
Operating Cost Factors:		
Contingency		25%

Site Specific Cost Factors	Units	Default Value
FTE Costs per year		
Engineering	K \$/yr	150
Construction	K \$/yr	112
Operating	K \$/yr	140
Eng/Const	K \$/yr	125
Other Site Costs (WBS 8.0 and 9.0)		
Optional special site costs (WBS 8.0)		
Annual cost	\$K/yr	0
Beginning year of cost incurred	1995 - n	1995
End year of cost incurred	1995 - n	1995
Optional fixed support costs (WBS 9.0)		
Annual cost	\$K/yr	0
Beginning year of cost incurred	1995 - n	1995
End year of cost incurred	1995 - n	1995
Inflation		
Inflation factor by year or range of years	percent	4.5%
Inflation start	year	1995
Chargeback		
On/Off flag to determine if generations charged back for off-site TSD		On
WBS Scale Factors		
1.0 cost multiplier	0.00 - 9.99	1.0
2.0 cost multiplier	0.00 - 9.99	1.0
3.0 cost multiplier	0.00 - 9.99	1.0
4.0 cost multiplier	0.00 - 9.99	1.0
9.0 cost multiplier	0.00 - 9.99	1.0
1.0 FTE multiplier	0.00 - 9.99	1.0
2.0 FTE multiplier	0.00 - 9.99	1.0
3.0 FTE multiplier	0.00 - 9.99	1.0
4.0 FTE multiplier	0.00 - 9.99	1.0
9.0 FTE multiplier	0.00 - 9.99	1.0

Appendix B

Waste Matrix Categories for the System Cost Model

Appendix B

Waste Matrix Categories for the System Cost Model

Waste Group	No. Waste Category	MLLW Applicable	LLW Applicable	MTRU Applicable	TRU Applicable
1000 Aqueous Liquids/Slurries	1 L1100 WASTEWATERS	Y	Y	Y	Y
	2 L1200 AQUEOUS SLURRIES	Y	Y	Y	Y
2000 Organic Liquids	3 L2110 AQUEOUS/HOC ^a ORGANIC LIQUIDS	Y	Y	Y	Y
	4 L2120 AQUEOUS/NONHOC ^b ORGANIC LIQUIDS	Y	Y	Y	Y
	5 L2210 HOC ^a PURE ORGANIC LIQUIDS	Y	Y	Y	Y
	6 L2220 NONHOC ^b ORGANIC LIQUIDS	Y	Y	Y	Y
3000 Solid Process Residue	7 S3110 INORGANIC PARTICULATES	Y	Y	Y	Y
	8 S3120 INORGANIC SLUDGES	Y	Y	Y	Y
	9 S3130 PAINT WASTE	Y	Y	Y	Y
	10 S3140 SALT WASTE	Y	Y	Y	Y
	11 S3150 SOLIDIFIED HOMOGENEOUS SOLIDS	Y	Y	Y	Y
	12 S3160 INORGANIC CHEMICALS	Y	Y	Y	Y
	13 S3210 ORGANIC PARTICULATES	Y	Y	Y	Y
	14 S3220 ORGANIC SLUDGES	Y	Y	Y	Y
	15 S3230 ORGANIC CHEMICALS	Y	Y	Y	Y
	16 S4100 SOIL	Y	Y	Y	Y
	17 S4200 SOIL/DEBRIS	Y	Y	Y	Y
	18 S4300 ROCK/GRAVEL	Y	Y	Y	Y
	19 S5110 METAL DEBRIS	Y	Y	Y	Y
	20 S5120 INORGANIC NONMETAL DEBRIS	Y	Y	Y	Y
	21 S5125 ASBESTOS DEBRIS	Y	Y	Y	Y
4000 Soils	22 S5300 ORGANIC DEBRIS	Y	Y	Y	Y
	23 S5400 HETEROGENEOUS DEBRIS	Y	Y	Y	Y
	24 X6000 LAB PACKS	Y	N	Y	N
	25 X7100 ELEMENTAL MERCURY	Y	N	Y	N
	26 X7200 ELEMENTAL HAZARDOUS METALS	Y	N	Y	N
	27 X7300 BERYLLIUM DUST	Y	N	Y	N
	28 X7400 BATTERIES	Y	N	Y	N
	29 X7500 REACTIVE METALS	Y	N	Y	N
	30 X7600 EXPLOSIVES/PROPELLANTS	Y	N	Y	N
	31 X7700 COMPRESSED GASES/AEROSOLS	Y	N	Y	N
5000 Debris Waste	32 Z0000 FINAL WASTE FORMS	Y	Y	Y	Y
6000 Special Waste					
7000 Inherently Haz. Wastes					
9000 Waste Suitable for Disposal					

a. Halogenated Organic Compounds.

b. Non Halogenated Organic Compounds.

Appendix C

Treatment Technology Options in the System Cost Model

Appendix C

Treatment Technology Options in the System Cost Model

- Low-level waste (Alpha, Non-alpha, Remote Handle)
 - BASE CASE Minimum Treatment:
This treatment option is defined as the least amount of treatment required prior to either on site disposal or transport to another site for disposal. Minimum treatment includes solidification of liquids and residues (grouting), and packaging. This is a generic treatment option applied to all sites.
 - BASE CASE Regional Treatment:
This option uses volume reduction through incineration and shredding compaction of non-incinerables. Liquids and residues are grouted.
 - BEMR Calibrated:
Site specific LLW process flow schemes are calibrated for the 6 large sites (Hanford, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Oak Ridge, Rocky Flats Plant, and Savannah River Site). The rest of the sites default to the LLW BASE CASE Minimum treatment option.
 - Vitrification:
This treatment option is the same as the LLW BASE CASE Regional treatment option except that liquids and residues are vitrified.
- Mixed low-level waste (Alpha, Non-alpha, Remote Handle)
 - BASE CASE:
This option treats to RCRA standards using incineration for destruction of organics. The debris and residue waste are grouted.
 - BEMR Calibrated:
Site specific MLLW process flow schemes are calibrated for the 6 large sites (Hanford, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Oak Ridge, Rocky Flats Plant, and Savannah River Site). The rest of the sites default to the MLLW BASE CASE option.
 - Nonflame:
This option treats to RCRA standards using washing, thermal desorption and aqueous phase oxidation for the removal and destruction of organics. The debris and residue waste are grouted.
 - Vitrification:
Same as the MLLW BASE CASE treatment option except that the debris and residue waste are vitrified.

- Transuranic waste (Non-Mixed Contact Handle, Mixed Contact Handle, Mixed Remote Handle, Non-mixed contact Handle, Mixed Remote Handle)
 - BEMR Calibrated:
Site specific TRU/MTRU process flow schemes are calibrated for the large 6 sites (Hanford, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Oak Ridge, Rocky Flats Plant, and Savannah River Site). The rest of the sites default to the TRU Waste Isolation Pilot Plant (WIPP) - Waste Acceptance Criteria (WAC) option.
 - Resource Conservation and Recovery Act (RCRA):
This alternative is designed to provide compliance with RCRA treatment requirements, compliance with the WIPP WAC, and compliance with reduced gas WIPP WAC treatment options. In this alternative, all secondary wastes are sent to be grouted, with the exception of secondary waste from shredding and compaction, mercury separation, lead recovery, reactive metal recovery, and special waste treatment. These excluded wastes are packaged, certified, and shipped for disposal.
 - Reduced Gas:
In this alternative, except for waste stream 5000, waste routing and treatment trains are identical to the TRU WIPP WAC alternative. For waste stream 5000, the addition of the shredding and compaction treatment module provides an increased level of treatment by releasing organic gases present in organic and heterogeneous debris during shredding.
 - WIPP-WAC:
This alternative provides for treatment of TRU wastes to meet current WIPP WAC requirements. All incoming solid TRU wastes are examined for compliance with WIPP certification requirements. Wastes that exceed WIPP WAC plutonium-239 fissile gram equivalent limit and, or exceed the wattage limit for the transuranic package containers (TRUPACT-II) are redistributed until it meets the WIPP-WAC requirements. Then the waste is sent directly to WIPP.

Appendix D

Treatment, Storage, and Disposal Site Codes in the System Cost Model

Appendix D

Treatment, Storage, and Disposal Site Codes in the System Cost Model

Each of the following sites are identified by a site number and a two-letter site code. These codes are listed in alphabetical order by site name.

Site Name	Abbreviation
Ames Laboratory	AM
Argonne National Laboratory East	AE
Argonne National Laboratory West	AW
Battelle Columbus Laboratory	BC
Bettis Atomic Power Laboratory	BA
Brookhaven National Laboratory	BN
Charleston Naval Station	CN
Colonie Interim Storage Site	CI
Energy Technology Engineering Center	ET
Fermi National Atomic Laboratory	FE
Fernald Environmental Management Project	FM
General Atomics	GA
General Electric Vallecitos	GE
Grand Junction Project Office	GJ
Hanford	HA
Idaho National Engineering Laboratory	ID
Inhalation Toxicology Research	IT
Kansas City Plant	KC
Knolls - Kesselring	KK
Knolls - Schenectady	KS
Knolls - Windsor	KW
Laboratory for Energy-Related Health Research	EH
Los Alamos National Laboratory	LA
Lawrence Berkeley Laboratory	LB
Lawrence Livermore National Laboratory	LL
Mare Island Naval Station	MI
Middlesex Sampling Plant	MS
Mound Plant	MD
Nevada Test Site	NV
Norfolk Naval Station	NN
Naval Reactor Facility	NR
Oak Ridge K-25 Site	OK
Oak Ridge National Laboratory (X-10 Site)	OR
Oak Ridge Y-12 Plant	OY
Paducah Gaseous Diffusion Plant	PG
Pantex Plant	PX

Site Name	Abbreviation
Pearl Harbor Naval Station	PH
Pinellas Plant	PI
Portsmouth Gaseous Diffusion Plant	PO
Portsmouth Naval Station	PN
Princeton Plasma Physics Lab	PP
Puget Sound Naval Station	PS
RMI Titanium, Inc.	RM
Rocky Flats Plant	RF
Sandia National Laboratory - Albuquerque	SL
Sandia National Laboratory - Livermore	SC
Savannah River Site	SR
Site A/Plot M, Palos Forest Preservation	SM
Stanford Linear Accelerator Complex	ST
University of Missouri	UM
Waste Isolation Pilot Plant	WP
Weldon Spring Site	WS
West Valley Demonstration Project	WV