Idaho National Engineering Laboratory

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January 1995

Avoidable Waste Management Costs

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Lockheed
Idaho Technologies Company

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Idaho Falls, Idaho 83415

MASTER

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AVOIDABLE WASTE MANAGEMENT COSTS

INEL-94/0205
January 1995

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EXECUTIVE SUMMARY

This report describes the activity based costing method used to acquire variable (volume dependent or avoidable) waste management cost data for routine operations at Department of Energy (DOE) facilities. Waste volumes from environmental restoration, facility stabilization activities, and legacy waste were specifically excluded from this effort. A core team consisting of Idaho National Engineering Laboratory, Los Alamos National Laboratory, Rocky Flats Environmental Technology Site, and Oak Ridge Reservation developed and piloted the methodology, which can be used to determine avoidable waste management costs.

The method developed to gather information was based on activity based costing, which is a common industrial engineering technique. Sites submitted separate flow diagrams that showed the progression of work from activity to activity for each waste type or treatability group. Each activity on a flow diagram was described in a narrative, which detailed the scope of the activity. Labor and material costs based on a unit quantity of waste being processed were then summed to generate a total cost for that flow diagram. Cross-complex values were calculated by determining a weighted average for each waste type or treatability group based on the volume generated.

This study will provide DOE and contractors with a better understanding of waste management processes and their associated costs. Other potential benefits include providing cost data for sites to perform consistent cost/benefit analyses of waste minimization and pollution prevention (WMIN/PP) options identified during pollution prevention opportunity assessments and providing a means for prioritizing and allocating limited resources for WMIN/PP.

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ACRONYMS

ABC	activity based costing
AWMC	Avoidable Waste Management Cost
CH	contact handled
D&D	decontamination and decommissioning
DOE	Department of Energy
EM	Environmental Restoration and Waste Management Program
EPA	Environmental Protection Agency
ETEC	Energy Technology Engineering Center
G&A	General and Administrative
HANF	Hanford Reservation
HLW	high-level waste
ICPP	Idaho Chemical Processing Plant
INEL	Idaho National Engineering Laboratory
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
MLLW	mixed low-level waste
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PEIS	Programmatic Environmental Impact Statement
RH	remote handled
R&D	Research and Development

RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
ROI	return on investment
RTR	real-time radiography
SRS	Savannah River Site
TRU	transuranic waste
TRUM	transuranic mixed waste
TSCA	Toxic Substances Control Act
WAC	Waste Acceptance Criteria
WBS	work breakdown structure
WIPP	Waste Isolation Pilot Plant
WM	waste management
WMIN/PP	Waste Minimization and Pollution Prevention

1.0 INTRODUCTION

Waste management (WM) within the U.S. Department of Energy (DOE) involves the management of radiological and nonradiological wastes. These wastes are generated from:

- Normal facility operations
- Decontamination and decommissioning (D&D) of facilities
- Environmental restoration/remediation activities
- Management of transition and legacy wastes.

The Waste Minimization Division (EM-334) of the DOE has primary responsibility for initiating and developing programs to cost-effectively minimize the generation of wastes within the DOE Complex. A key component of an effective waste minimization/pollution prevention (WMIN/PP) program is to obtain a comprehensive understanding of the costs associated with waste management activities, and how those costs will vary as the generation of new wastes is reduced.

EM-334 initiated the Avoidable Waste Management Costs (AWMC) Project to develop a method to collect and analyze the avoidable costs associated with waste management activities across the complex. A team was formed of WMIN/PP representatives from:

- Idaho National Engineering Laboratory (INEL)
- Los Alamos National Laboratory (LANL)
- Oak Ridge Reservation (ORR)
- Rocky Flats Environmental Technology Site (RFETS).

This team collectively developed and piloted a methodology for determining avoidable waste management costs.

The method established by the team is based on determining the variable, or waste volume dependent costs associated with waste management activities. Variable or volume dependent costs are those that vary in direct relation with increases or decreases in the quantities of waste generated. It is these variable costs that potentially can be avoided through the implementation of WMIN/PP actions. To accomplish the task of collecting consistent waste management cost data across the DOE Complex, the AWMC team developed a preliminary reference manual. This reference manual identifies the appropriate cost data to be collected, and delineates a reporting protocol to facilitate site-specific and cross-complex analysis.

The method developed and reported in this document is the evolution of a previous method piloted in 1993. The previous method attempted to use existing work breakdown structure (WBS) cost estimating information to identify avoidable waste management costs. The data

received showed a wide cost range between sites and contained insufficient detail to assess the differences. This was largely attributed to the different methods used by each site to extract costs from their WBS. In an effort to reduce these differences, the team adopted a new method of obtaining costs. The new method, commonly used by industrial engineers, is referred to as activity based costing (ABC). This method is used to assess and improve productivity by identifying and costing sequential activities required to complete a task. Rigorously applied, it is in effect, a time and motion study.

1.1 Purpose of This Document

This document describes the ABC method used to acquire variable waste management cost data from participating sites, and presents the analysis and results of the cost data. The focus of the FY94 effort was to:

- Modify and improve the costing method
- Improve the accuracy of the data
- Develop a more accurate method for data analysis
- Develop software to facilitate the acquisition and consistency of new data.

A separate supplemental reference manual, *Reference Manual: Determination of Avoidable Waste Management Costs,* September 1994, has been prepared. This manual provides detailed instructions for DOE sites for developing avoidable waste management costs. In addition, a data acquisition software program has been developed to facilitate consistency in the data and data analysis.

2.0 CONTENTS OF AWMC REPORT

This report contains the following information:

- Benefits to DOE and DOE facilities

- Description of the approach taken during the FY94 data collection effort, including site selection, and a discussion of what data were requested

- Presentation of results of the FY94 data collection effort, including assumptions made in analyzing the data, summaries of the data gathered, and comparisons with the first round

- Appendices include detailed site WM activity narratives, corresponding activity based flow diagrams, and site-specific cost per waste unit for baseline activities (current practice).

3.0 BENEFITS OF AVOIDABLE WASTE MANAGEMENT COSTING

The AWMC project was initiated to collect volume dependent waste management costs from across the DOE Complex to estimate the potential cost savings based on WMIN/PP implementation actions. It is anticipated that both DOE and contractors will realize significant benefits from an improved understanding of waste management processes and associated costs. This understanding will be instrumental in achieving an effective WMIN/PP Program. Table 1 lists potential benefits identified by participating pilot sites.

Table 1. Benefits of avoidable waste management costing.

Potential benefit	Description
Means for resource prioritizing	Provides information to allow for the prioritization and allocation of limited resources for implementation of WMIN/PP opportunities.
Fundamental element for assessing the return on investment (ROI) for WMIN/PP actions	An understanding of the costs of waste management activities is required to perform ROI assessments. In addition, projected cost savings are required to assist in the establishment of WMIN/PP goals, as well as to ensure their ability to measure progress against those goals.
Provide cost data to complete options analysis for WMIN/PP actions	Reliable cost data can provide a basis for sites to perform cost/benefit analyses of WMIN/PP options identified during WMIN/PP Opportunity Assessments. Although WMIN/PP benefits cannot be measured solely in terms of economic impacts, such savings are a major consideration when prioritizing implementation options.
Promotes strong generator awareness to facilitate a cultural change towards WMIN/PP actions	An improved understanding of the costs of waste generation and management, promoted by the method outlined here, will help sites to identify economic incentives for the implementation of aggressive WMIN/PP programs.
Addresses an Environmental Protection Agency (EPA) defined fundamental requirement for an effective WMIN/PP program	In its interim guidance to waste generators, the EPA has established waste minimization as its highest national priority, and has described the basic elements required for a sound WMIN program. Two of those elements are: the proper characterization of waste generation and waste management costs, and the establishment of an accurate cost allocation system.

Table 1. (continued).

Potential benefit	Description
Assists in the realignment to an incentive-based award structure driven by DOE contract reform	Changes being implemented with each new contract the DOE negotiates for the management of the various sites clearly indicate an increased emphasis on sound economic principles and improved budgetary accountability. The activity based cost estimating techniques presented in this report can be used to understand all site budgetary requirements, and not just waste management costs. These guidelines can be incorporated by the sites into their financial procedures to assist them in formulating more precise and defensible budget requests.
Promotes stakeholder accountability	A major benefit to the DOE of the implementation of cost estimation techniques is the ability to reflect accurate, defensible costs when making budget requests. ABC accounting will promote the DOE as a reliable custodian of the public trust to such stakeholders as Congress and the public.

4.0 APPROACH

The following sections describe the approach used to collect the avoidable waste management baseline cost data from each of the participating sites. The fundamentals of activity based costing are discussed in Section 4.2. This section includes a discussion of direct, indirect, overhead, and General and Administrative (G&A) cost factors that are appropriate for inclusion to determine avoidable waste management costs.

The data collection and reporting activities implemented by participating sites are described in Section 4.3. This includes discussion on the identification and prioritization of waste types to be evaluated. Treatability groups and operational variances are also discussed in regards to costing and reporting. Narratives were developed for each activity based flow diagram to describe the discrete sequential tasks involved in a waste management activity.

A final discussion is presented on the cross-complex analysis. Detailed analyses on each waste management activity are performed to derive a unit cost by treatability group. These data are then used to determine a weighted average unit cost across the DOE Complex.

4.1 Selection of Facilities

There are over 200 sites within the DOE Complex, but many of these sites do not produce large quantities of wastes. To obtain a practical number of sites to test the methodology, the team focused on obtaining data from sites representing at least 80% of each waste type as reported in the *Annual Report on Waste Generation and Waste Minimization Progress, 1991–1992*, February 1994. The annual report presents data submitted by 57 sites for routine waste generated in 1991 and 1992. Data for environmental restoration and decontamination and decommissioning were excluded.

Because the project is focused on obtaining waste management costs, and the cost for radiological wastes are significantly higher than for nonradiological wastes, the data call was limited to those sites accounting for 80% of radiological waste. This was achieved by selecting the following six sites:

- Hanford Reservation (HANF)
- INEL
- LANL
- ORR
- RFETS
- Savannah River Site (SRS).

It should be noted that these six sites also account for 20 to 40% of the nonradiological wastes. Details of the site prioritization and selection is provided in Appendices A and B.

4.2 Activity Based Costing

Activity based costing is a common industrial engineering practice used to identify and assess opportunities to reduce cost. It is a tool that provides a systematic and straightforward method to fully document the avoidable costs of waste management activities for a particular site, and for summarizing those costs across the DOE Complex. A description of activity based costing is provided in the following sections. Because the accuracy of the cost data is dependent upon capturing all volume dependent cost elements, a detailed discussion of direct, indirect, overhead, and G&A cost elements is also presented.

4.2.1 Fundamentals of Activity Based Costing

Activity based costing is a method for preparing cost estimates, which breaks a work process into discrete, sequential activities. The sequence of tasks comprising the process for each waste type at a site is visually represented in a flow diagram. Flow diagrams show the progression of work from activity to activity. From the flow diagrams, descriptions of each activity, in terms of labor and materials can be prepared. The labor and material costs for each activity is expressed in on a per unit basis. This is determined by multiplying the number of labor hours of each labor type by the appropriate labor rates, and adding all nonlabor costs, such as material, equipment, and subcontracting costs. This can be expressed as:

$$C = HR + M$$

where

C = estimated activity cost

H = labor hours required to perform the activity once

R = fully burdened labor rate per labor hour

M = fully burdened nonlabor costs.

The basis for costing an activity is the amount of waste each activity is being performed on. For example, the basis could be a single 55-gal drum or a pallet of four 55-gal drums. With a cost per unit volume or weight for each activity, a total cost for the process is obtained by merely summing the costs for the individual activities. One of the most important aspects of activity based costing is that it cuts across organizational boundaries. By considering every activity that pertains to a task, all personnel involved in the task are accounted for regardless of what organization they are part of.

4.2.2 Direct vs. Indirect Costs

In order to obtain the total avoidable cost for waste management activities, it is important to know the fully burdened costs for labor and materials. The total cost of a waste management activity can be significantly underestimated if the fully burdened costs are not correctly captured. Fully burdened costs are composed of direct and indirect costs. They do not include costs for such things as buildings, storage bunkers, landfills, etc.

A fully burdened cost is usually composed of three general categories:

1. Direct: Labor and nonlabor costs that are attributable to a specific waste management activity and are incurred only during the performance of the activity.

2. Indirect: Costs that are not specifically related to the performance of the task, but must be allocated to perform the task.

3. G&A: General and administrative costs incurred to operate a business.

Table 2 displays examples of cost elements typically included in direct, indirect, and G&A costs for labor categories and material procurements.

It is important to understand that not all indirect waste management costs are captured using this approach. Some sites have activity data sheets that directly fund specific waste management activities such as databases, engineering services to WM, facility costs, etc. Since these activities are not necessarily assigned to a direct waste processing activity it is very difficult to determine the volume dependent fraction of such costs.

Table 2. Cost components of activity based costing.

Direct	Indirect	G&A
Labor	Labor burden	G&A labor
Engineer, supervisor, technicians	• Employee direct benefits	• Management
• Equipment operators, truck drivers	• Employee overhead	• Administration
• Chemists and other directly charged to activity		• Finance
Nonlabor	Material Burden	
• Materials purchase cost (drums, packing, etc.)	• Procurement overhead	
• Contract services (offsite treatment or disposal)	• Warehousing	

4.3 Data Collection and Reporting

The approach developed for collecting and reporting data from DOE's waste management activities consists of four steps:

1. Identifying and prioritizing waste types, treatability groups, and/or operational variances

2. Developing sequential work tasks for each waste type by treatability group and/or operational variance

3. Developing narrative descriptions of each activity

4. Developing unit costs for each activity.

4.3.1 Identify and Prioritize Waste Streams

The 11 waste types defined for inclusion in the AWMC project are shown in Table 3. The first nine of these waste types are defined in *Annual Report on Work Generation and Waste Minimization Progress*. The tenth waste type was established for liquid waste, and the last was intended to capture any unique wastes that might be present at a particular facility. Again, this effort was intended to capture the cost of waste management activities for routinely generated wastes; costs for environmental remediation/restoration, decontamination and decommissioning, and legacy wastes are not included in these costs.

4.3.2 Treatability Groups and Operational Variations

Waste treatment typically involves either a volume reduction such as incineration, or a volume increase such as grouting. Operational variations typically involve different methods of handling waste, such as packaging, analysis, characterization, etc. These different treatability groups or operational variations have different costs. While there are many different possible treatments and operational variances, there were relatively few common to more than one or two facilities. Only those treatability groups or operational variances that accounted for greater than 10% of the total volume, or 10% of the cost for that waste type, were reported. Each treatment

Table 3. Waste types.

Waste type (radiological)	Waste type (nonradiological)
High-level waste (HLW)	RCRA hazardous
Low-level waste (LLW)	Toxic Substances Control Act (TSCA)
Mixed low-level waste (MLLW)	Non-RCRA hazardous (State Hazardous)
Transuranic (TRU)	Sanitary
Transuranic mixed (TRUM)	Liquid and other

method or operational variance was defined as a separate sequence of tasks, and reported with different costs. Table 4 shows examples of treatability groups and operational variances that were reported. Initial guidance was provided to the sites to break a few waste types into treatability groups that were thought to be common to all sites. These are shown in Figure 1.

Table 4. Examples of treatability groups and operational variations.

Treatability groups	Incineration Compaction Solidification Evaporation Encapsulation
Operational variations	Contact vs. remote handled Drum vs. box vs. crates Disposal vs. storage

4.3.3 WM Activity Flow Diagrams

A critical component to developing activity based costs was the development of activity flow diagrams. Activity flow diagrams are charts that identify sequential, discrete activities required to complete a waste management task. Each flow diagram began with the generators' declaration that a material is waste and ended with the final disposition of the waste material. This included actions that were required, even if they currently are not occurring, [e.g., Waste Isolation Pilot Plant (WIPP) disposal of TRU/TRUM]. Each block represented a single activity. A separate flow diagram was developed for each significant waste stream. The discrete activities were defined in a way that costs for labor and material could be assigned to each activity. Site-specific flow diagrams are displayed by waste type in Appendices C through H.

4.3.4 Activity Narratives and Costs

A narrative was developed for each activity based flow diagram. These narratives are important to understand and evaluate the scope of the submitted cost data. Costs were provided for each activity based on a unit quantity of generated waste.

Costs were reported on the common volume unit used in handling the waste. Radioactive waste was typically reported on the basis of volume, e.g., cubic meters, a drum, a B-42 box, etc. Nonradioactive waste were handled in 5-gal cans, drums, etc. Offsite processing costs for hazardous wastes were generally reported on a weight basis, such as kilograms. Density conversions were provided by the sites to allow for weight to volume conversions.

Volume change ratios were provided for wastes that undergo a volume change during an activity. For example, compaction may change the density from 8 lb/ft^3 to 32 lb/ft^3, which is a volume change ratio of 4:1. In addition, packing inefficiencies were accounted for if waste is overpacked after compaction, e.g., 10% void volume. All handling and treatment activities were described in sufficient detail to allow the investigator to assess completeness of the data. For example, if a survey was performed, who performed the survey? What tasks were involved? What was the purpose of the characterization and what method was used? Table 5 lists examples of discrete activities.

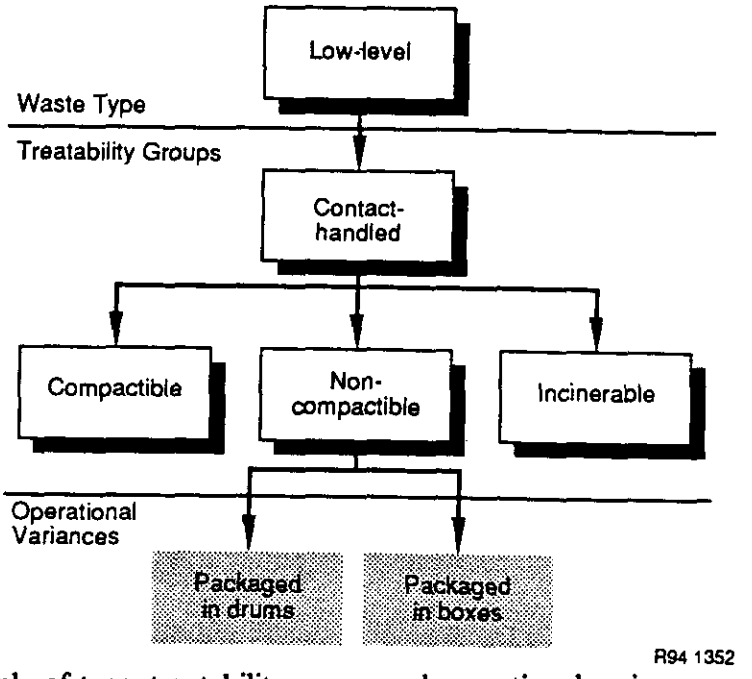


Figure 1. Example of type, treatability group, and operational variance.

Table 5. Reference activity descriptions.

Characterization activities	Treatment	Front-end handling	Documentation/data base management	Disposal
X-Ray or real-time radiography (RTR)	Low density compaction	Sorting for thermal treatment	Tracking waste movement	Waste Acceptance Criteria (WAC) compliance verification
Automated package assay	High density compaction	Segregation for recycle	Regulatory compliance	Repackaging for disposal
Weight	Incineration	Clean waste segregation	WAC compliance documentation	Grouting
Dose rate	Metal melting for recycle	Size reduction	DOE reporting	
Visual container inspection	Chemical decontamination		State reporting	
Surface contamination survey	$C0_2$ decontamination		Transportation manifesting	
RCRA compliance sampling & analysis	Soil washing			
GeLi isotope assay	Vitrification			
Truck survey	Grouting			
Vehicle release survey				
Other physical/chemical/ visual				

Cost data provided for each activity included the number of hours for each labor category and hourly rates. This will be discussed in more detail in the results section of this document. Sites were asked to provide only the time required to complete the task. Consequently, an evaluation of efficiency or productivity cannot be performed.

All direct material, such as containers, packing, grouting, etc. used in a task were reported for each activity. Where possible, the cost of one unit and the number of units consumed in the activity were included. Again, both raw and fully burdened costs were reported. However, if the material burden is already included in the burden on labor, it was not counted again in the material burden.

4.4 Cross-Complex Analysis

Data received from participating sites were analyzed to determine the range of unit cost for each waste type. Unit costs by waste type and/or treatability group were derived using the cost data provided by each participating sites. In addition, a unit cost per activity within a treatability group was determined. If costs were provided for a treatability group that differs in operational practice, an activity unit cost was derived based on that difference. For example, sites use both barrels and B-25 boxes for packaging low-level waste-contact handled (LLW-CH). The unit costs can potentially differ significantly between the operational practice of using barrels or boxes.

5.0 RESULTS

Avoidable waste management cost data were received from six sites. These sites are shown in Appendices C through H. Each site provided activity based flow diagrams, a corresponding narrative describing each discrete sequential activity, and the associated labor and materials costs.

A site-specific unit cost was determined for each waste type or treatability group. The unit cost data, with the annual volume were used to calculate the weighted average unit cost. The weighted average represents a reasonable cross-complex value by waste type. These data were compared to the FY93 data to assess improvement in the overall consistency and quality of the cost data. The following sections discuss the results of these analyses. Results are presented by waste type in the following order:

1. LLW
2. MLLW
3. TRU
4. TRUM
5. Resource Conservation and Recovery Act (RCRA) Hazardous
6. State Hazardous
7. TSCA
8. Sanitary.

5.1 AWMC Site Participation

There are over 200 sites within the DOE Complex that generate one or more of the nine major waste types. Because of this large number, the data call in support of the *Annual Report on Waste Generation and Waste Minimization Progress,* 1991-1992 implemented a threshold reporting criteria. The AWMC group adopted a similar approach for selection of AWMC sites. They focused on collecting cost data from sites representing a significant fraction of the largest generators of each waste type, with the radiological waste types as the priority. The following sites agreed to support the AWMC data collection.

- HANF
- INEL
- LANL
- ORR

- RFETS
- SRS.

Each site was provided a copy of the draft reference manual describing the activity based costing approach.

Waste type volumes from the 1992 Annual Report were used as a basis to estimate the percentage captured in the FY 94 AWMC data collection effort. This is shown in Figure 2 for radioactive wastes including: LLW, MLLW, TRU, and TRUM. Figure 3 shows similar information for the nonradiological waste types including RCRA, State Hazardous, TSCA, and sanitary.

Typically, radioactive waste types have substantially higher unit costs when including costs for MLLW and TRU/TRUM disposal. The relative waste type ranking by unit cost (highest to lowest) is as follows:

- TRU/TRUM > MLLW > LLW >> RCRA Hazardous > TSCA > State Hazardous > Sanitary.

The goal of capturing at least 80% of the high unit cost waste types was met in all radiological waste except for MLLW. The results show that an increased focus on MLLW and the nonradioactive waste types is needed for FY95.

5.2 Site Response

Participating sites were asked to provide data for the highest unit cost and highest volume waste types at their individual site. Data were obtained from six pilot sites for seven different waste types. Five of the waste types were further broken into treatability groups or operational variations yielding a total of 10 waste streams. Table 6 shows the waste types and which sites presented data for them. All site references have been omitted to address concerns expressed by site participants regarding disclosure of business sensitive information.

5.3 Low-Level Waste

Low-level waste is the only waste type for which treatability groups and operational variations were identified. For the FY93 data only three groups could be distinguished: contact handled, remote handled, and liquid. Because the data received in FY94 is much more detailed, three operational variations were identified, one of which has three different treatment types, as shown in Table 7.

Figure 4 shows the range of costs for FY93 (1,137 to $5,829 per cubic meter) and for FY94 (367 to $3,166 per cubic meter). This represents a 48% reduction in the range of costs. One reason for this reduction is that activity based costing requires a site to first delineate every activity required to accomplish a particular task and then to assign costs to those activities.

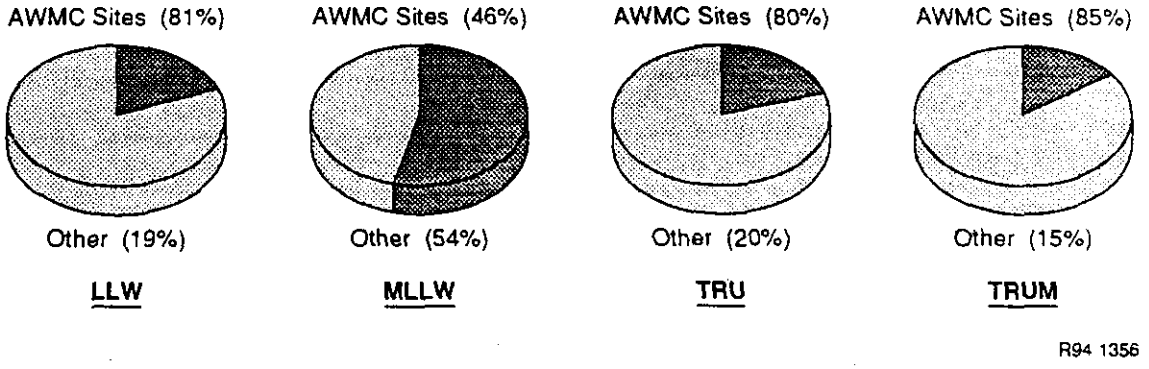


Figure 2. Captured cost data for radiological waste types.

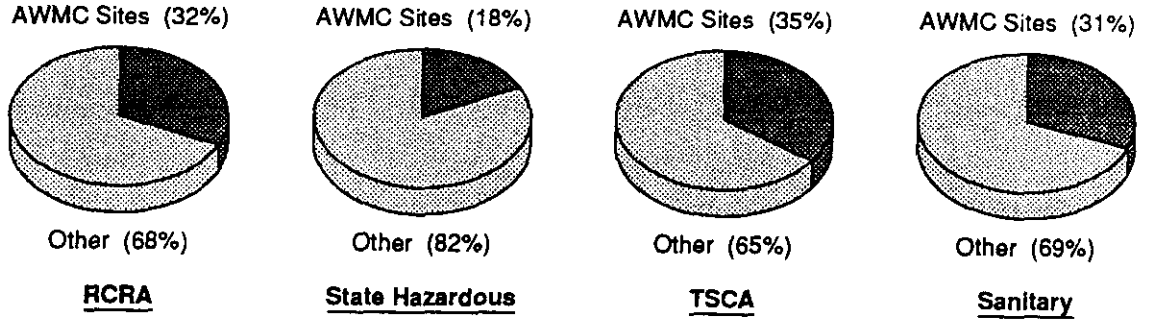


Figure 3. Captured cost data for nonradiological waste types.

R94 1355

Table 6. Waste types for which cost data were received.

Waste stream	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total
LLW-CH	X	X	X	X	X		5
LLW-RH			X		X		2
LLW-Liquid	X				X		2
MLLW		X			X		2
TRU		X	X			X	3
TRUM	X	X			X		3
RCRA Haz			X		X		2
State Haz					X		1
TSCA	X	X			X		3
Sanitary	X	X			X		3

Table 7. Number of sites reporting LLW treatability groups.

Low-level waste treatability groups	Number of sites
Contact handled, untreated	4 sites
Contact handled, compacted	3 sites
Contact handled, incinerated	2 sites
Remote handled, untreated	2 sites
Radioactive wastewater	2 sites

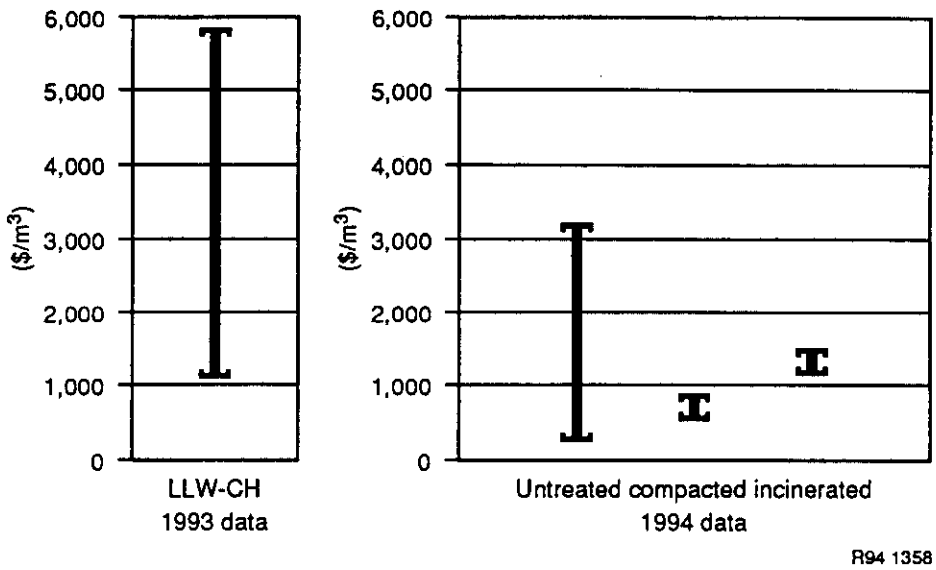


Figure 4. Comparison between LLW-CH solid waste data FY93 and FY94.

Another advantage of the improved approach to gathering and reporting cost data is the ability to estimate equivalent treatment costs. An example of this is Site 1, which treats all low-level waste. However, because they provided costs for each treatment type, it is possible to estimate what an untreated low-level waste would cost. This is done by subtracting the treatment costs and adjusting subsequent storage and disposal costs for the different volumes that would be present for untreated waste. It is important to remember that this is only an estimate and does not represent actual operation at Site 1. It does however, provide an additional point of comparison with the other four sites that do have untreated waste. These data were used with the other LLW-CH untreated cost data to compare FY93 and FY94 results. Table 8 shows the cost data by site for LLW-CH.

Table 8. Low-level contact handled untreated cost data by site.

LLW-CH untreated	Unit cost	Volume [m^3]
Site 1 (calculated)	1,742	3,570
Site 2	3,040	691
Site 3	709	6,690
Site 4	367	1,080
Site 5	3,166	2,644
Weighted Average	1,569	

The cross-complex data analysis for untreated LLW-CH yields a weighted average of $1,479 per cubic meter. Among the reasons for differences in waste management costs for similar wastes are:

- Differences in what comprises an activity. For instance, does an assay consist merely of a swipe, or is a full radiological analysis required? Is waste disposed of in a simple trench or is engineered storage or grouting required?
- Different labor mixes and hours for similar activities.
- Different burden rates.
- Economy of scale, i.e., large generators typically have lower per unit costs than small generators.

Data gathered by activity based costing also allows for a comparative evaluation of waste management operations within a site. Costs for compaction and incineration at the relevant sites are summarized in Tables 9 and 10. The cost estimated for Site 1 for untreated waste ($1,742 per cubic meter is higher than for either compaction ($715 per cubic meter) or incineration ($1,016 per cubic meter). This is because the unit cost for disposal is high. Therefore, there is a cost savings for treatment by incineration or compaction.

Table 9. LLW-CH treated by compaction.

LLW-CH compaction	Unit cost [$/m^3]	Volume [m^3]
Site 1	715	535
Site 2	NR	
Site 3	713	4,361
Site 4	889	108
Site 5	NR	
Weighted average	717	

Table 10. LLW-CH treated by incineration.

LLW-CH incineration	Unit cost [$/m^3]	Volume [m^3]
Site 1	1,016	3,568
Site 2	NR	
Site 3	NR	
Site 4	1,410	862
Site 5	NR	
Weighted average	1,093	

In contrast, Site 4 shows a lower cost for their untreated waste than for either treatment process, because they use an existing onsite disposal facility, which is an inexpensive disposal method. So, despite the volume reductions for treatment, the cost of treatment overwhelms the savings in disposal costs. Site 3 shows a middle ground, where the costs for both untreated and compacted waste are nearly the same, implying that the increased cost for compaction is offset by the decreased cost of disposal.

LLW-RH

The 1994 costs for low-level waste-remote handled (LLW-RH) show a wider spread than the 1993 data ($1,973 vs. $212), as shown in Figure 5. Analyzing these differences is difficult since only two sites reported this type of waste. Site 3 cost data yields a unit cost of $1,280 based on the management of 850 m^3. Site 5 cost data yield $3,253 based on 3 m^3 of LLW-RH. There is insufficient information to explain the range for LLW-RH.

Liquid LLW

Cost data for liquid waste processing was provided by two sites. Costs were derived for treatment of the liquid including a cost per gallon for processing and a cost per cubic meter for the management of secondary sludge produced from the process. As seen in Figure 6, the costs show fairly good agreement between the two sites, which is supported by the fact that their wastes undergo similar sequences of activities. The difference in the unit cost per gallon is the volume

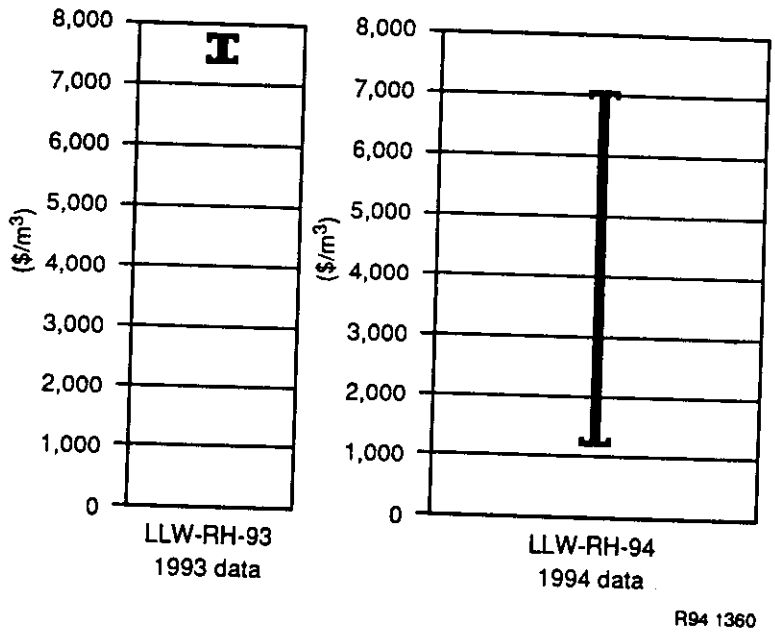


Figure 5. Comparison of LLW remote handled data FY93 and FY94.

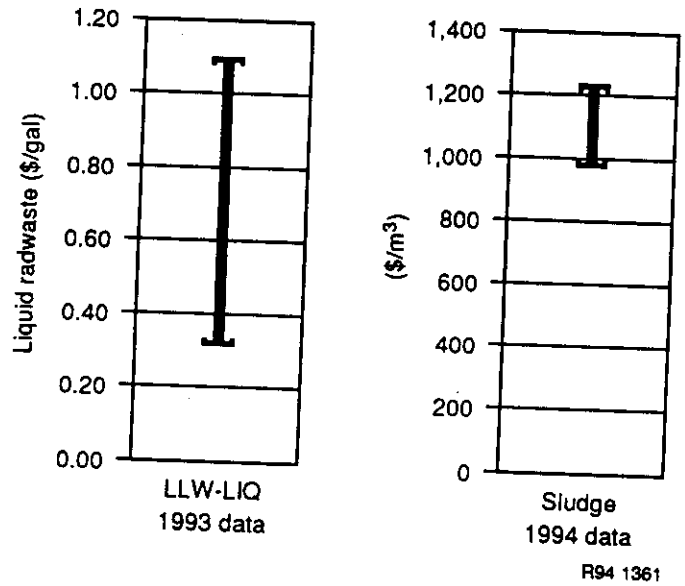


Figure 6. Low-level liquid radwaste costs for wastewater processing and secondary sludge disposal.

of radioactive wastewater processed is attributed to the volume and chemical nature of the wastewater. Site 1 processes a total of 70 million gallons a year, while Site 5 processes 5.6 million gallons per year, which is a factor of 12 difference. Even though Site 1 processes 12 times the volume of wastewater that Site 5 processes, the unit cost per gallon is only a factor of three greater. Site 1 generates 208 m^3 of sludge per year while Site 5 generates 45 m^3 of sludge per year. Since sludge is generated from the removal of dissolved ionic species, this would suggest that Site 1 processes a large volume of relatively pure (low ionic content) wastewater.

5.4 Mixed Low-Level Waste

Three sites provided data for mixed low-level waste (MLLW). The cost data provided did not include a cost for MLLW disposal, though clearly, the cost of MLLW disposal waste management activities is not zero. They are committed unavoidable expenditures to be incurred sometime in the near future. The challenge was to determine a basis for estimating associated costs. The best available data on the future costs for disposal of MLLW was found in work completed to support the Programmatic Environmental Impact Statement (PEIS).

The PEIS project has developed cost information for the DOE Office of Environmental Management regarding the cost of waste management facilities for LLW, MLLW, and TRU waste types. The following interim reports have been published for MLLW and TRU:

- EG&G-WM-11274, *Interim Report: Waste Management Facilities Cost Information for Transuranic Waste,* June 1994

- EG&G-WM-10962, *Interim Report: Waste Management Facilities Cost Information for Mixed Low-Level Waste,* March 1994.

These documents present the interim work on the planning level life cycle cost estimates for future waste management activities and facilities (accuracy of plus or minus 30%). The report covers treatment, storage, and disposal facilities that will be needed for the management of alpha and nonalpha mixed low-level radioactive waste streams. The waste management facility information has been divided into several distinct modules, which can be linked to evaluate different treatment, storage, and disposal alternatives. The AWMC team concluded that the available PEIS cost information would provide the best basis for estimating committed, but yet to be incurred, waste management costs.

5.4.1 Basis for MLLW Disposal Unit Cost

The PEIS cost information provided several disposal options for the final disposition of MLLW:

- Engineered disposal

- Shallow land disposal

- Silo disposal

- Bore hole disposal.

The core group chose engineered disposal as the basis for estimating MLLW disposal unit costs. Since the PEIS cost information is a function of capacity, a base assumption was required to estimate a unit cost for MLLW disposal for the AWMC method. The team selected a 20,000 m^3 capacity disposal site as a conservative cost basis. The total life cycle costs as a function of varying disposal capacity are shown in Appendices A and B. The waste volume dependent unit costs for MLLW engineered disposal is estimated to be $7,070 per cubic meter. This unit cost was used for site-specific MLLW analyses.

Table 11 shows the data used to determine the weighted average cost of $10,992 per cubic meter. The range of the data was reduced by 80% between FY93 data and FY94 data for MLLW. This substantial decrease in the data range is attributed to the fact that the sites providing more detailed information used the activity based flow diagraming and costing approach. The results are graphically shown in Figure 7.

Table 11. MLLW unit cost results.

AWMC site	Unit cost [$/$m^3$]	Annual quantity disposed [m^3]
Site 2	10,198	230
Site 5	15,023	45
Weighted average	12,099	

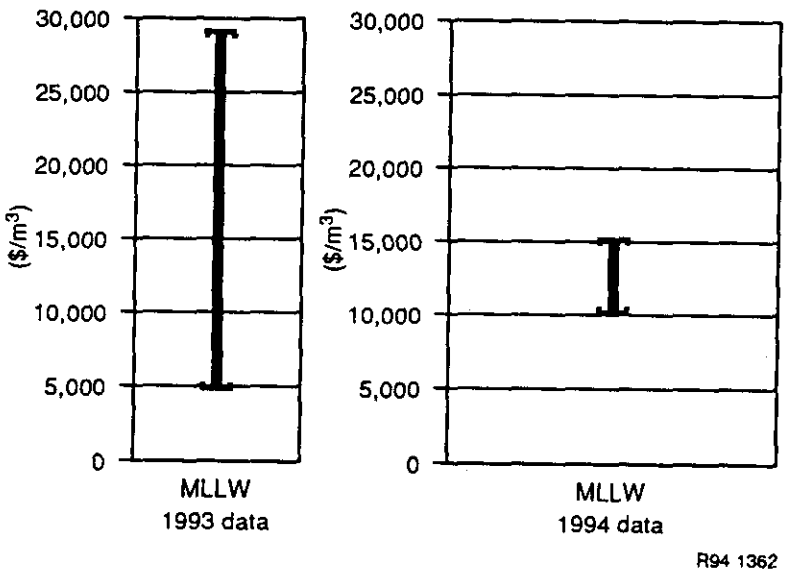


Figure 7. Comparison between MLLW data FY93 and FY94.

5.5 TRU

Many sites did not report projected WIPP disposal costs for TRU and TRUM costs. While there is great uncertainty regarding the potential unit cost for disposal at WIPP, it is certain that the unit cost will not be zero. Site 3 provides a unit cost of $35,000 per cubic meter for WIPP disposal. This unit cost was used in the site-specific determination of TRU and TRUM avoidable waste management costs. This cost does not include WIPP WAC compliance and transport to WIPP. Table 12 presents the unit cost data for the three sites submitting cost for TRU waste. The range of the cost data was reduced by 68% for all sites reporting in FY93. The results for TRU costs are graphically shown and compared to FY93 data in Figure 8. The higher unit cost is attributed to the inclusion of the WIPP disposal cost.

Table 12. TRU unit cost results.

AWMC Site	Unit Cost [$/m^3]	Annual Quantity Disposed [m^3]
Site 2	40,137	8.5
Site 3	47,992	425
Site 5	48,019	47
Site 6	49,695	140
Weighted Average	48,267	

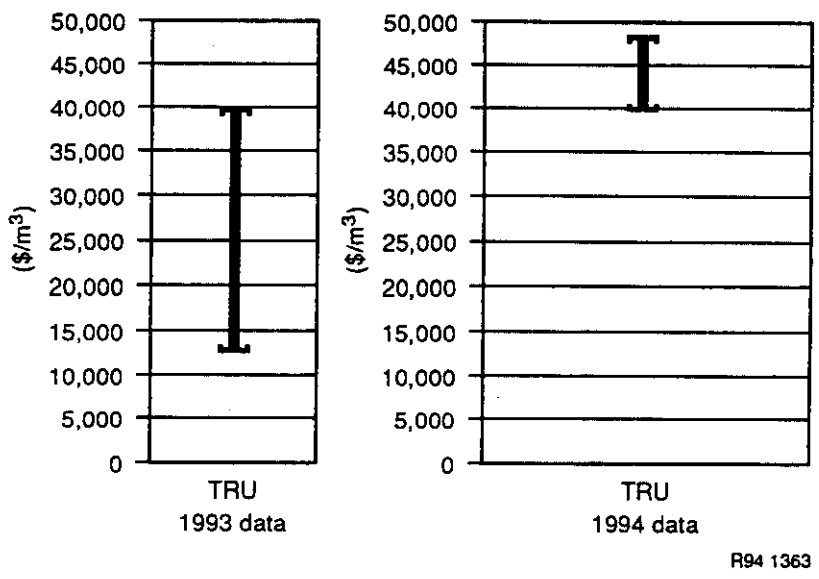


Figure 8. Comparison of TRU waste cost data FY93 and FY94.

For the TRU waste type, none of the sites reporting data indicated that TRU waste is being treated before storage. All sites currently package and store TRU waste. If TRU waste disposal at WIPP is valued at $35,000 per cubic meter and if WIPP closure will be based on volume and not total curies, then there may exist an avoidable cost by reducing the quantity of TRU waste using technically viable treatment options, recycling, or reusing.

5.6 TRUM Wastes

Three sites reported TRUM waste. None of these sites currently treat TRUM, which may be a requirement in the future to meet a WIPP disposal criteria after RCRA licensing of the facility. Table 13 shows a summary of the unit cost data for TRUM. The weighted average increased from $36,470 in FY93 to $45,386 in FY94. The range of cost data increased from $3,000 to $5,839, which is less than 10% of the weighted average unit cost.

Table 13. TRUM unit cost results.

AWMC site	Unit cost [$/m^3]	Annual quantity disposed [m^3]
Site 1	41,844	65
Site 2	40,620	6
Site 5	46,458	242
Weighted average	45,386	

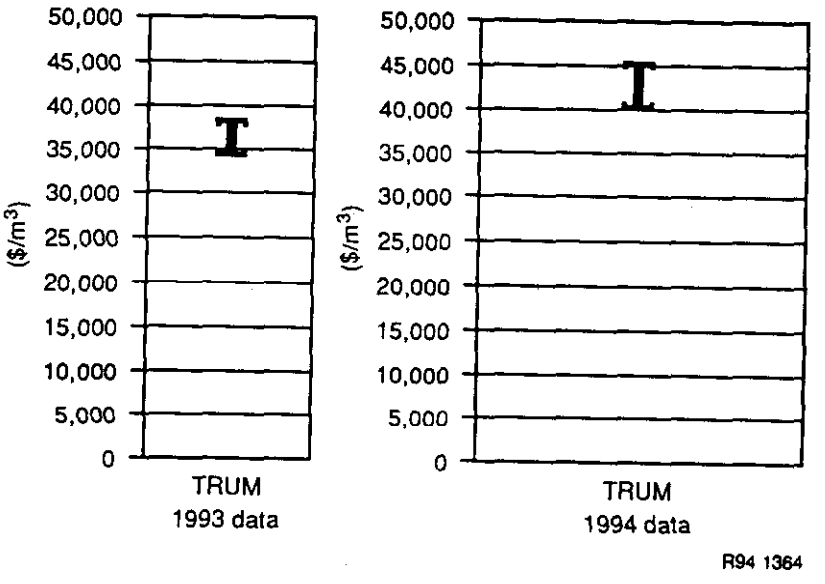


Figure 9. Comparison of TRUM cost data FY93 and FY94.

5.7 RCRA Wastes

Sites 2, 3 and 5 reported RCRA wastes. The unit cost for Site 2 was $16 per kilogram, for Site 3 was $48 per kilogram, and for Site 5 was $24 per kilogram. This was based on 36,514 kg for Site 2, 71,114 kg for Site 3, and 83,217 kg for Site 5. Figure 10 shows the comparison of cost data for FY93 and FY94. The results show a decrease in the range of cost data. However, since the number of participating sites is limited, the investigators do not consider this representative of a cross-complex unit cost range.

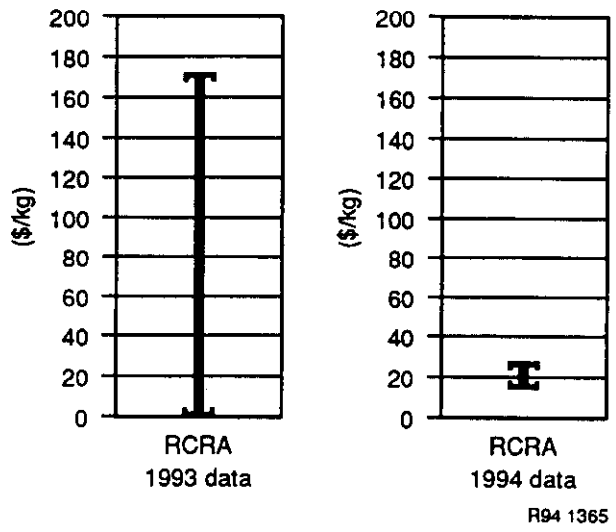


Figure 10. Comparison of RCRA cost data FY93 and FY94.

5.8 State Hazardous

Only Site 5 submitted cost data for State Hazardous waste. The unit cost was $10 per kilogram based on 402,438 kilograms of waste.

5.9 TSCA Wastes

TSCA wastes are those wastes defined under the Toxic Substances Control Act (TSCA). Sites 2 and 5 provided unit cost data of $11 per kilogram and $13 per kilogram, respectively. These two sites represent less than 35% of the total TSCA waste generated by DOE sites.

Figure 11 shows a decrease in the range of cost data between FY93 and FY94. The data shown for FY94 cannot be considered a representative cross-complex range for TSCA waste due to the small numbers of sites submitting data.

5.10 Sanitary Wastes

Even though all six sites generate sanitary wastes, costs were received from only three. It is interesting to note that the comparison between FY93 and FY94 cost data, while showing a

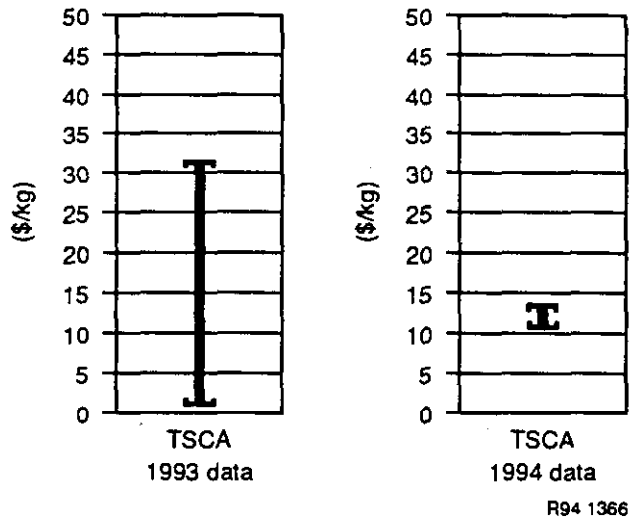


Figure 11. Comparison of TSCA cost data FY93 and FY94.

smaller range of data, shows a higher unit cost. This is attributed to more complete reporting of cost data using the activity based approach. Table 14 shows the unit cost data by site.

5.11 Summary of Results

A summary of the results from all waste types is shown in Table 15.

Table 14. Sanitary waste unit cost data.

Sanitary	Unit cost [$/metric tons]	Mass [metric tons]
Site 1	1,700	54,550
Site 2	1,521	3,223
Site 3	NR	
Site 4	NR	
Site 5	1,919	3,266
Weighted average	1,702	

Table 15. Summary of all waste type cost data.

Waste type/treatability group	Wgt avg [$]	Median [$/unit]	High [$/unit]	Low [$/unit]
Low level: [$/m^3]				
Contact handled—untreated	1,569	1,742	3,166	357
Contact handled compacted	717	715	889	713
Contact handled incinerated	1,093	1,213	1,410	1,016
Remote handled	1,287	2,267	3,253	1,280
Liquid treatment				
Wastewater [$/gal]			1.08	0.33
Sludge [$/m^3]			1,213	986
Mixed low level [$/m^3]	10,992	12,611	15,023	10,198
Transuranic, [$/m^3]	48,267	47,992	53,739	40,137
Mixed TRU, [$/m^3]	45,386	41,844	46,458	40,623
RCRA, [$/kg]	32	20	48	16
State hazardous, [$/kg]				
TSCA, [$/kg]	13	12	13	11
Sanitary, [$/metric ton]	1,702	1,700	1,919	1,521

6.0 CONCLUSIONS

As seen in the data received from the six sites, the range in costs was lower for all but one waste type. This held true for both radiological and nonradiological wastes, though the data provided by the six sites for nonradiological waste encompassed a smaller percentage of the total generated within DOE than did the radiological. The bottoms up approach used in activity based costing provides a more complete and systematic system for gathering cost data. The sites involved in providing costs for this FY94 effort were more confident in their data using this approach than the rather hit or miss method used in the FY93 effort.

Appendix A

Site Selection Criteria and Estimation of MLLW Disposal Costs

Appendix A:
Site Selection Criteria and Estimation of MLLW Disposal Costs

A-1.0 SITE PRIORITIZATION INFORMATION BY WASTE TYPE

The ranking of sites by waste type are shown for low-level waste (LLW), mixed low-level waste (MLLW), transuranic (TRU) waste, and transuranic mixed (TRUM) waste in Figures A-1 through A-4. Tables A-1 through A-4 show the total waste generated in 1992, a running total, and a percentage of the running total.

Table A-1. 1992 site prioritization data for low-level waste (LLW).

DOE facility	LLW volume [m^3]	Running total [m^3]	Percent of running total
SRS	12,442	12,442	37.1
Oak Ridge Y-12	5,711	18,153	54.2
Oak Ridge National Laboratory (ORNL)	2,687	20,840	62.2
LANL	2,336	23,176	69.2
Hanford Site	2,291	25,467	76.0
Oak Ridge K-25	2,151	27,618	82.4
Idaho Chemical Processing Plant	1,612	29,230	87.2
INEL	1,077	30,307	90.4

Figure A-1. Low-level waste site prioritization.

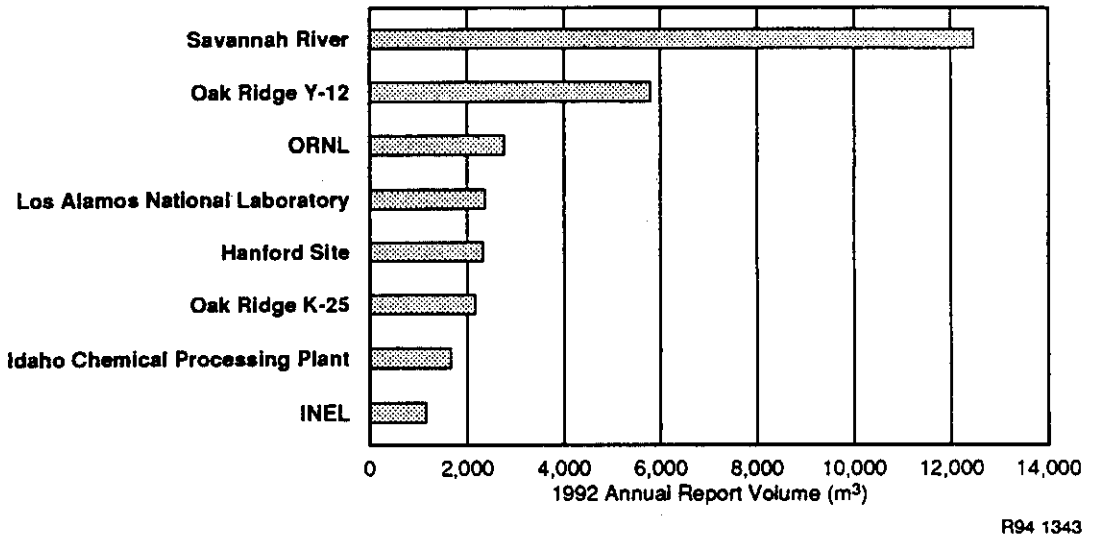


Table A-2. 1992 site prioritization data for mixed low-level waste (MLLW).

DOE facility	MLLW volume [m^3]	Running total [m^3]	Percent of running total
Energy Technology Engineering Center (ETEC)	645	645	26.8
Oak Ridge Y-12 Plant	481	1,126	46.8
Hanford Reservation	440	1,566	65.1
RFETS	440	2,006	83.4
INEL	93	2,099	87.3
LANL	81	2,180	90.7
Idaho Chemical Processing Plant (ICPP)	70	2,250	93.6

Figure A-2. Mixed low-level site prioritization.

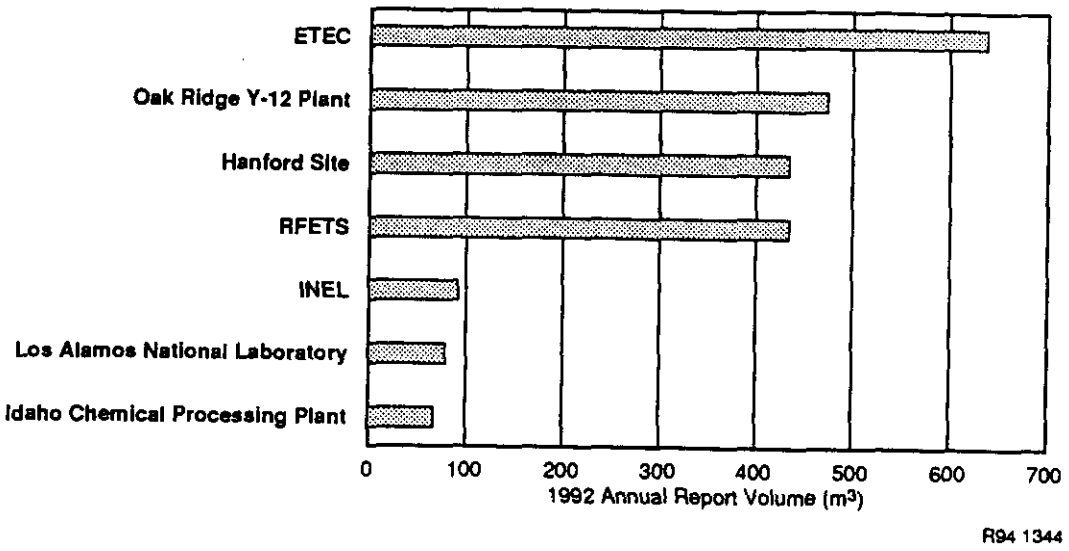


Table A-3. 1992 site prioritization data for TRU waste.

DOE facility	TRU volume [m^3]	Running total [m^3]	Percent of running total
SRS	564	564	76.2
Hanford Reservation	122	686	92.7
LLNL	19	705	95.3
ORNL	16	721	97.4
RFETS	10	731	98.8
ANL-East	5	736	99.5

Figure A-3. TRU waste site prioritization.

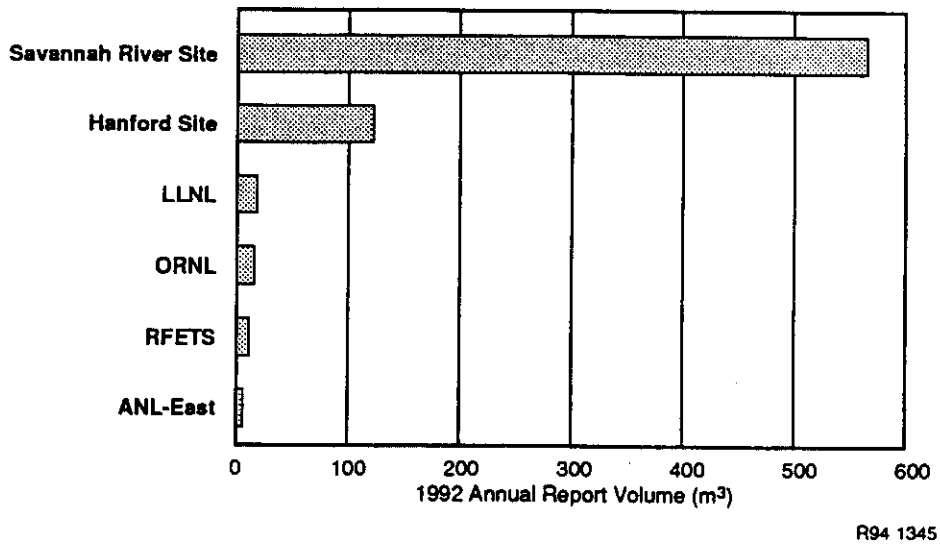
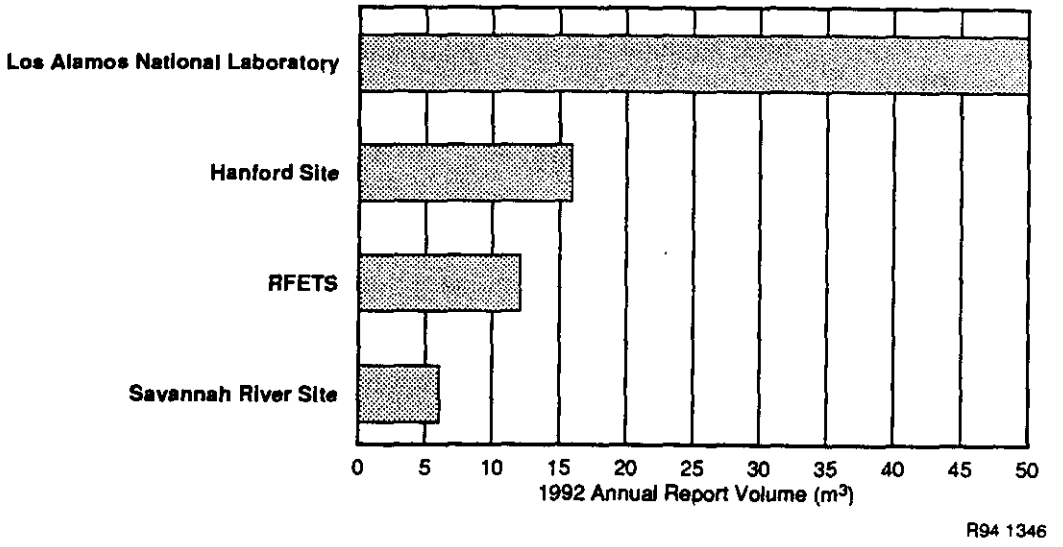


Table A-4. 1992 site prioritization data for TRUM waste.

DOE facility	TRUM volume [m^3]	Running total [m^3]	Percent of running total
LANL	50	50	58.1
Hanford Reservation	16	66	76.7
RFETS	12	78	90.7
SRS	6	84	97.7

Figure A-4. TRU mixed waste site prioritization.



Figures A-5 through A-8 provide information used for the prioritization of sites generating nonradiological waste streams. These data were extracted from the Annual Report for volumes generated during 1992. The waste streams included are:

- RCRA
- State hazardous
- TSCA
- Sanitary.

RCRA Waste

Table A-5 shows that the addition of Lawrence Livermore National Laboratory (LLNL), Pantex Plant, Kansas City Plant, ETEC, Pinellas, Sandia National Laboratory-NM and Nevada test site in the data collection effort would capture greater than 80% of the RCRA waste generated.

State Hazardous Waste

The data provided in Table A-6 show that the addition of Pantex Plant, Sandia National Laboratory-NM, and Kansas City Plant would capture 80% of the data for State Hazardous waste. These sites will be recommended for inclusion in the FY95 effort.

TSCA Waste

Table A-7 shows that the addition of Kansas City Plant, Brookhaven National Laboratory, Sandia National Laboratory-NM, Stanford Linear Accelerator Center (SLAC) and Hanford site would capture greater than 80% of the TSCA waste generated throughout the DOE Complex.

Sanitary Waste

Table A-5. 1992 site prioritization data RCRA waste.

DOE facility	RCRA (kg)	Running total	Percent of total
Oak Ridge Y-12 Plant	840	840	20.9
LLNL	653	1,493	37.2
Pantex Plant	423	1,916	47.8
Kansas City Plant	396	2,312	57.6
ETEC	205	2,517	62.7
Pinellas Plant	160	2,677	66.7
Los Alamos National Laboratory	153	2,830	70.5
SNL-New Mexico	147	2,977	74.2
INEL	139	3,116	77.7
Nevada Test Site	96	3,212	80.1

Figure A-5. RCRA hazardous waste site prioritization.

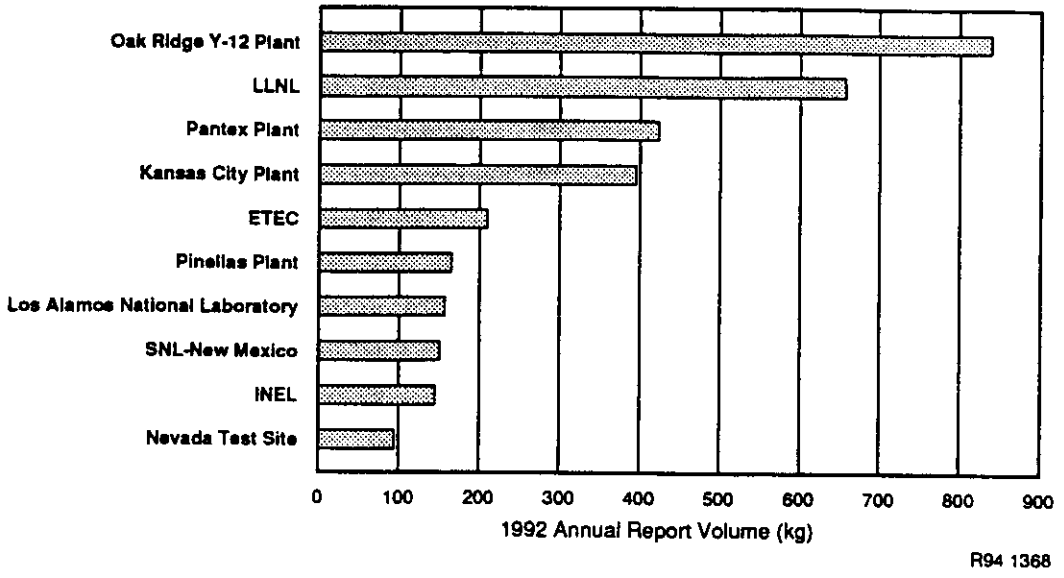


Table A-6. 1992 prioritization data for state hazardous waste.

DOE facility	State Haz. (kg)	Running total	Percent of total
Pantex Plant	3,617	3,617	48.0
Los Alamos National Laboratory	1,284	4,901	65.0
Hanford Site	541	5,442	72.2
SNL—New Mexico	346	5,788	76.8
Kansas City Plant	304	6,433	85.4
LLNL	269	6,702	88.9
ETEC	246	6,948	92.2

Figure A-6. State Hazardous site prioritization.

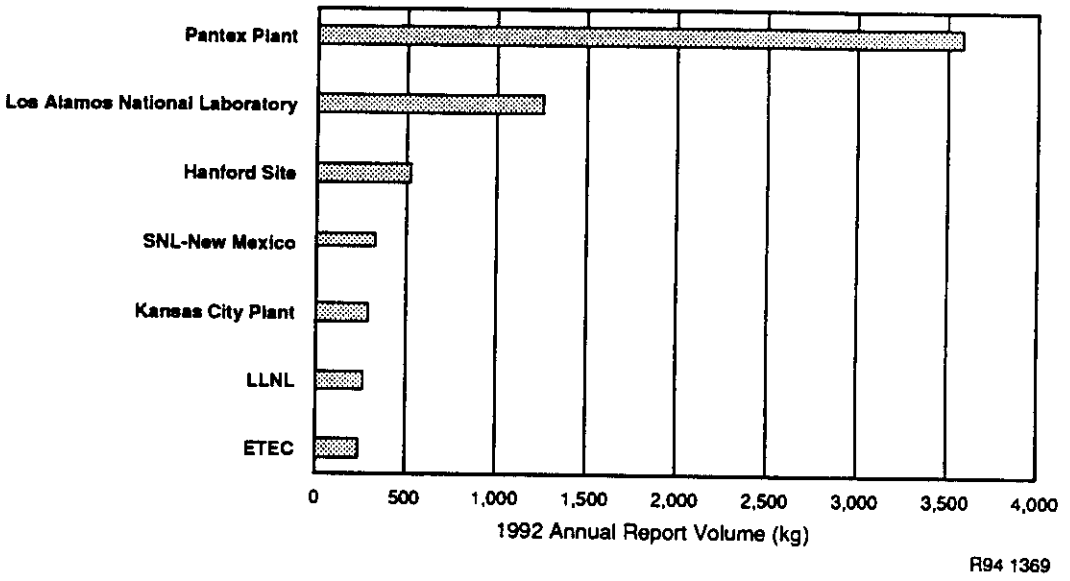


Table A-7. 1992 site prioritization for TSCA waste.

DOE facility	TSCA (kg)	Running total	Percent of total
Kansas City Plant	531	531	26.1
Oak Ridge K-25 Site	334	865	42.5
Los Alamos National Laboratory	276	1,141	56.0
Brookhaven National Laboratory	167	1,308	64.2
Sandia National Laboratories—NM	128	1,436	70.5
Stanford Linear Accelerator Center	110	1,546	75.9
Hanford Site	110	1,656	81.3

Figure A-7. TSCA waste site prioritization.

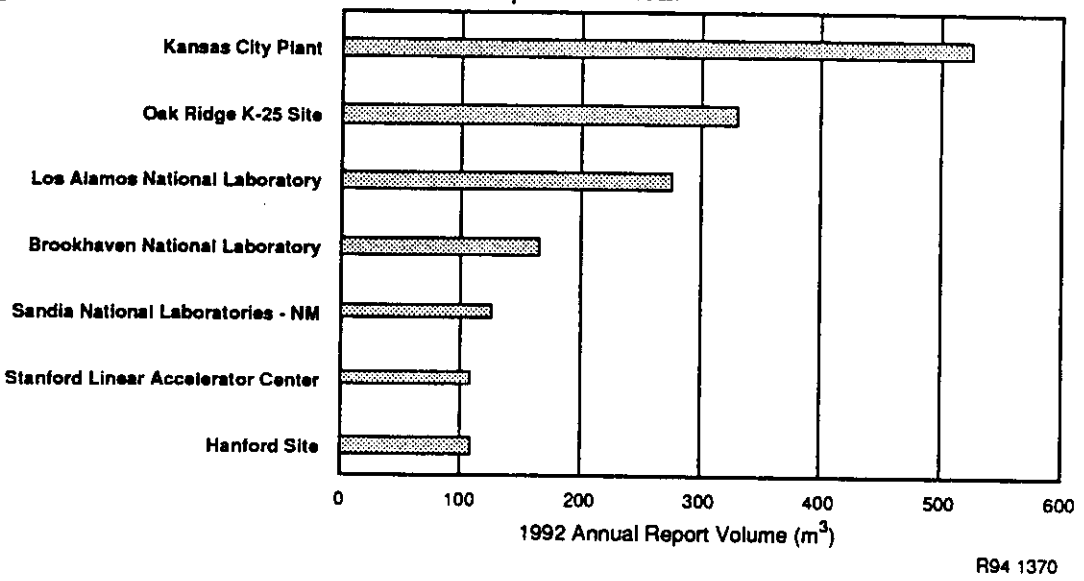
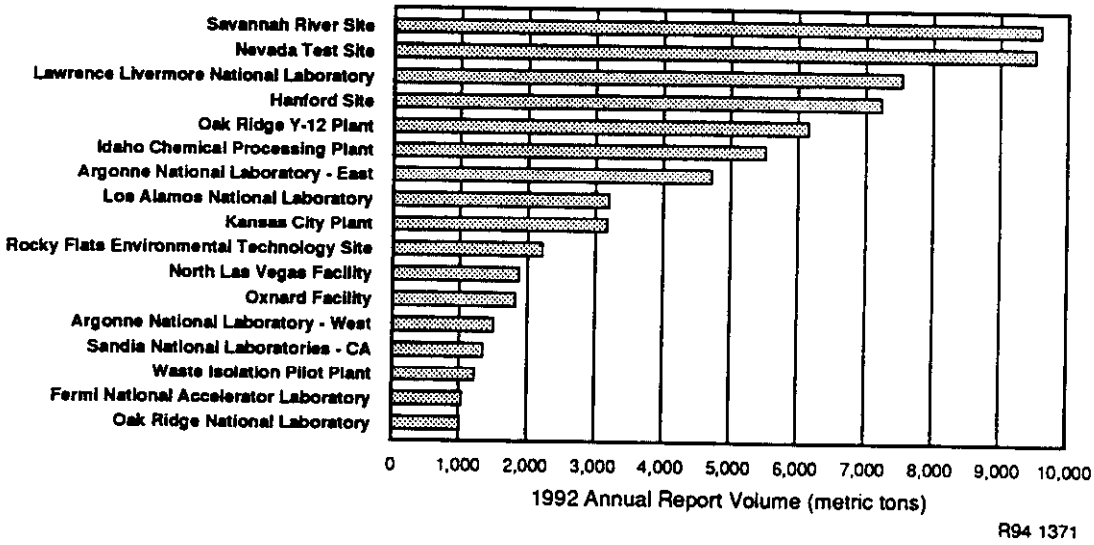


Table A-8. 1992 site prioritization data for sanitary waste.

DOE facility	Sanitary [metric tons]	Running total [metric tons]	Percent of total
Savannah River Site	9,612	9,612	12.5
Nevada Test Site	9,551	19,163	25.0
LLNL	7,570	26,733	34.8
Hanford Site	7,263	33,996	44.3
Oak Ridge Y-12 Plant	6,188	40,184	52.4
Idaho Chemical Processing Plant	5,536	45,720	59.6
Argonne National Laboratory—East	4,746	50,466	65.8
Los Alamos National Laboratory	3,232	53,698	70.0
Kansas City Plant	3,199	56,897	74.2
Rocky Flats Plant	2,254	59,151	77.1
North Las Vegas Facility	1,890	61,041	79.6
Oxnard Facility	1,832	62,873	82.0
Argonne National Laboratory—West	1,522	64,395	83.9
Sandia National Laboratories—CA	1,347	65,742	85.7
Waste Isolation Pilot Plant	1,225	66,967	87.3
Fermi National Accelerator Laboratory	1,013	67,980	88.6
Oak Ridge National Laboratory	1,002	68,982	89.9

Figure A-8. Sanitary waste site prioritization.



Appendix B

Estimate of MLLW Disposal Costs Using PEIS Cost Information

Appendix B:
Estimate of MLLW Disposal Costs Using PEIS Cost Information

The PEIS cost information provided several disposal options for the final disposition of MLLW:

- Engineered disposal
- Shallow land disposal
- Silo disposal
- Borehole disposal.

The core group chose engineered disposal as the basis for estimating MLLW disposal unit costs. The module consists of engineered disposal units that are based on the Illinois LLW disposal module design. This design uses earthened concrete engineered barriers. The unit operations include receiving inspected drums, placing the drums into concrete canisters, and constructing the disposal units that will house incoming concrete waste canisters. Disposal unit construction includes foundation, leachate collection system, concrete vaults, and earth covers. Disposal modules are constructed as disposal capacity is required.

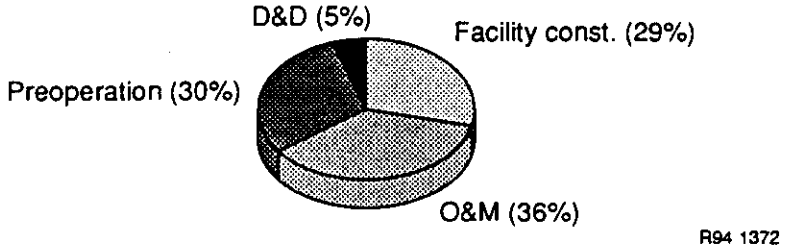
Cost information for an engineered disposal facility was developed for the following as a function of disposal capacity:

- Preoperation full-time equivalent (FTE) labor

- Decommissioning & Decontamination (D&D) FTE labor
- Facility construction labor
- Operations and Maintenance (O&M) FTE labor (1 year)
- Facility construction capital costs (10 years)
- O&M costs (10 years)
- Preoperations costs
- D&D costs.

Figure B-1 shows the distribution of all preoperation costs, O&M costs, D&D costs, and facility construction costs.

Figure B-1. Distribution of MLLW disposal facility costs with total capacity of 40,000 m^3.



It was assumed that the Preoperation and D&D labor costs are not waste volume dependent costs. These costs would be incurred and relatively insensitive to the capacity of the MLLW disposal facility. The only costs that the AWMC team considered volume dependent are the O&M costs and facility construction costs. This seems reasonable since the disposal modules are constructed on an as needed basis during the

operating life of the facility. The base assumption is that when waste is reduced, the number of required modules is reduced, and therefore, the facility construction and O&M costs are reduced and concluded to be volume dependent.

Since the PEIS cost information is a function of capacity, a base assumption was required to estimate a unit cost for MLLW disposal for the AWMC method. The team selected a 20,000 cubic meter capacity disposal site as a conservative cost basis. Table B-1 shows the total life cycle costs as a function of varying disposal capacity. The waste volume dependent unit costs for MLLW engineered disposal is estimated to be $7,070 per cubic meter.

Table B-1. MLLW engineered disposal facility life cycle costs.

Total capacity (m^3)	20,000	40,000	100,000
Facility construction ($M)	62.38	112.51	262.88
O&M (10 years) ($M)	79.02	101.09	167.27
Preoperation ($M)	65.31	71.74	91.04
D&D ($M)	10.94	14.61	25.60
Total ($M)	217.66	299.94	546.79
Total life cycle ($M)	222	305	554
Unit life cycle ($/$m^3$)	11,123	7,635	5,543
AWMC estimate ($M)	141	214	430
Unit variable cost ($/$m^3$)	7,070	5,340	4,302

Appendix C

Site 1 WM Activity Narratives and Flow Diagrams

Appendix C:
WM Activity Narratives and Flow Diagrams

SITE 1
LOW-LEVEL WASTE: CONTACT HANDLED: COMPACTED AND INCINERATED

Note: Site 1 treats all LLW. Approximately 15% of its solid LLW is compacted, and approximately 90% of the waste returned from offsite incineration to storage. Because these splits in processing were not treated as separate flow diagrams, an additional table, Table C-2, had to be developed to determine the average avoidable cost. The waste in storage will have a disposal cost sometime in the future. To accommodate this, a disposal cost equal to the current disposal cost at Site 1 was added to the unit cost of the waste that is currently being stored.

Activity 0. Generator Declares Material Waste

This waste stream comprises typical solid LLW; both untreated and treated wastes may go to either long-term storage for ultimate disposal offsite or for disposal at the solid waste storage tumulus (decision is a function of radionuclide content and concentration).

Activity 1. Waste Packaging

Low-level waste (LLW) is placed into various containers. Generators, radiation technicians, sampling technicians, and chemical analysts all spend some time during the filling of the container. The costs for this activity are based on the equivalent amount of waste that would fill 90% of a B-25 bin.

Activity 2. Documentation Management

The generator prepares the documentation to have the box picked up.

Activity 3. Verify Characterization and Labeling

The operator ensures that the container is properly closed and affixes the appropriate labels.

Activity 4. Transport to Compactor

An operator and truck driver working together each spend an average of 1 hour per box, transporting it to the compactor. (Only 15% of the waste stream is compacted.)

Activity 5. Compact Waste and Repackage

Only 15% of the waste is compacted. The waste is compacted into a B-25 box. The equivalent of five B-25 boxes is compacted to fit into one B-25 box, which has an interior capacity of 82 cubic feet. Boxes cost $450/each. A radiation technician performs monitoring as part of the compaction process.

Activity 6. Radiological Survey

Some boxes receive additional radiological monitoring from a nondestructive analysis technician (NDA tech.) with assistance from an operator. Although not every box is done, the effort averages 1 hour of operator time and 3 hours of NDA technician time per box.

Activity 7. Storage

All boxes, whether or not they were compacted, are placed in interim storage until a shipment is prepared. Placing each box in storage takes the operator an average of 1 hour.

Activity 8. Stage for Offsite Transportation

Removing boxes from interim storage and loading them on the truck for offsite shipment takes an operator an average of 2 hours per box.

Activity 9. Prepare Shipping Papers

Shipping papers are prepared by a clerk and waste engineer.

Activity 10. Transport to Offsite Treatment

The boxes are then shipped offsite, requiring 1.5 hours of truck driver time and $10 in vehicle costs (shown as part of Activity 9).

Activity 11. Offsite incineration

The boxed waste is treated by an offsite contractor who charges $8,000 per box.

Activity 12. Transport to Storage

A truck driver transports, unloads, and places the waste in long-term storage.

Activity 13. Storage Inspection and Maintenance

The stored waste is inspected periodically by a radiation technician and an operator with assistance from a data clerk.

Activity 14. Disposal

Approximately 1,200 cubic feet per year of waste is placed in a tumulus vault, which costs $2,500. Radiation technicians, operators, truck drivers, data clerks, and riggers are all involved in placing the box in the vault for final disposal.

Figure C-1. Site 1: low-level waste: contact-handled: compacted and incinerated.

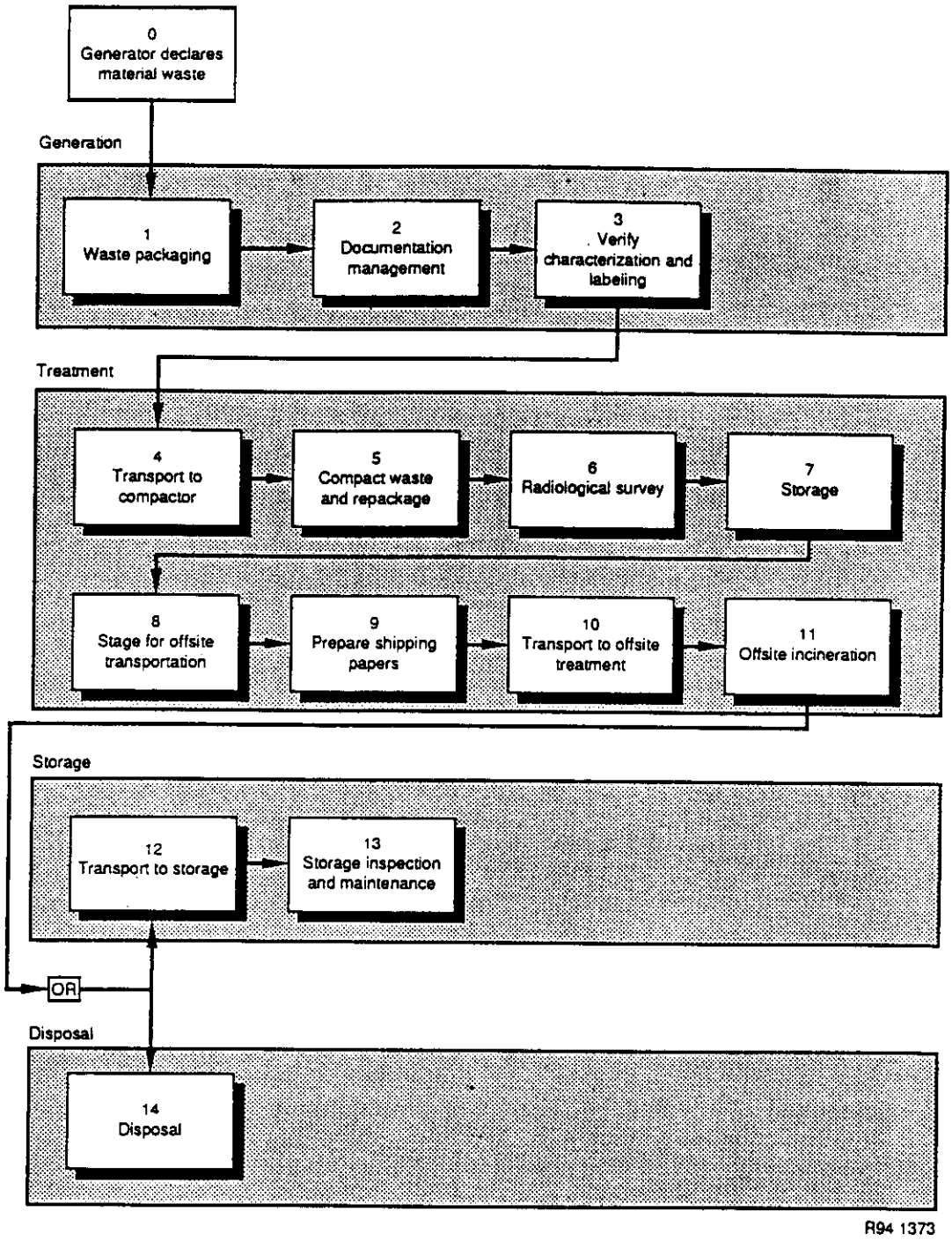


Table C-1. Site 1: low-level waste: contact handled: compacted and incinerated.

Annual Quantity Generated: 3568 m^3
Annual Quantity Disposed: 325.6 m^3

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Waste Packaging	B-25 Box	1:1	Generator	1	1	$28	$97	B-25 Box	1	$450			
				Rad Tech.	1	0.3	$23	$81						
				Sampling Tech.	1	0.1	$30	$105						
				Chem. Analyst	1	0.5	$30	$105				$634	$302	$302
2	Documentation Management	B-25 Box	1:1	Generator	1	0.3	$28	$97				$29	$14	$315
3	Verify Characterization and Labeling	B-25 Box	1:1	Operator	1	0.5	$19	$64	Micellaneous	1	$10	$42	$20	$336
4	Transport to Compactor	B-25 Box	1:1	Operator	1	1	$19	$64						
				Truck Driver	1	1	$19	$64				$129	$61	$397
5	Compact Waste and Repackage	B-25 Box	5:1	Rad Technician	1	0.5	$23	$81	Miscellaneous	1	$50			
				Operator	1	1.5	$19	$64				$187	$18	$415
6	Radiological Survey	B-25 Box	1:1	Operator	1	1	$19	$64						
				NDA Tech.	1	3	$26	$89				$330	$31	$446
7	Storage	B-25 Box	1:1	Operator	1	1	$19	$64				$64	$6	$452
8	Stage for Off-Site Transportation	B-25 Box	1:1	Operator	1	2	$19	$64				$129	$12	$465
9	Prepare Shipping Papers	B-25 Box	1:1	Waste Engineer	1	0.5	$28	$97	Shipping Costs	1	$10			
				Data Clerk	1	0.25	$14	$48				$70	$7	$471
10	Transport to Off-Site Treatment	B-25 Box	1:1	Operator	1	1.5	$19	$64				$97	$46	$517
11	Off-Site Incineration	B-25 Box	10:1				$0	$0	Contract Services	1	$8,000	$8,000	$76	$593
12	Transport to Storage	B-25 Box	1:1	Operator	1	2	$19	$64				$129	$6	$600

Table C-1. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
13	Storage Inspection and Maintenance	B-25 Box	1:1	Rad Tech.	1	0.5	$23	$81	Miscellaneous	1	$130			
				Operator	1	1	$19	$64						
				Data Clerk	1	0.5	$14	$48				$259	$2	$602
14	Disposal	B-25 Box	1:1	Rad Tech.	1	0.15	$23	$81	Tumulus Vault	1	$2,500			
				Operator	1	0.1	$19	$64						
				Truck Driver	1	0.1	$19	$64						
				Data Clerk	1	0.25	$14	$48						
				Rigger	1	0.4	$21	$72				$2,566	$24	$626

Site: 1
Waste Type: LLW
Treatablility Group: Solid Treatment for long-term storage

Annual Quantity Generated: 3568 m^3
Annual Quantity Disposed: 3143 m^3

		A		B		C		D	
ID	ACTIVITY DESCRIPTION	Activity Cost ($/m³)	Cumulative Total ($/m³)	Activity Cost ($/m³)	Cumulative Total ($/m³)	Activity Cost ($/m³)	Cumulative Total ($/m³)	Activity Cost ($/m³)	Cumulative Total ($/m³)
0	Generator Declares Material Waste	$0	$0	$0	$0	$0	$0	$0	$0
1	Waste Packaging	$302	$302	$302	$302	$302	$302	$302	$302
2	Documentation Management	$14	$315	$14	$315	$14	$315	$14	$315
3	Verify Characterization and Labeling	$20	$336	$20	$336	$20	$336	$20	$336
4	Transport to Compactor	$61	$397	$61	$397	$0	$336	$0	$336
5	Compact Waste and Repackage	$4	$400	$4	$400	$0	$336	$0	$336
6	Radiological Survey	$6	$407	$6	$407	$31	$367	$31	$367
7	Storage	$1	$408	$1	$408	$6	$373	$6	$373
8	Stage for Off-Site Transportation	$2	$410	$2	$410	$12	$385	$12	$385
9	Prepare Shipping Papers	$1	$412	$1	$412	$7	$392	$7	$392
10	Transport to Off-Site Treatment	$9	$421	$9	$421	$46	$438	$46	$438
11	Off-Site Incineration	$15	$436	$15	$436	$76	$514	$76	$514
12	Transport to Storage	$1	$437	$0	$436	$6	$520	$0	$514
13	Storage Inspection and Maintenance	$0	$438	$0	$436	$2	$523	$0	$514
14	Disposal-1	$0	$438	$5	$441	$0	$523	$24	$539
15	Disposal-2	$5	$443		$441	$24	$547	$0	$539
	Weighted Total =		$60		$7		$419		$46

Total = $531 /$m^3$

A Compaction, Storage, & Disposal-2 .15*.90 = 0.135
B Compaction & Disposal-1 .15*.10 = 0.015
C No Compaction, Storage, & Disposal-2 .85*.9 0.765
D No Compaction & Disposal-1 .85*.10 = 0.085

Table C-2. Site 1: low level waste: contact handled: waste stream split calc.

SITE 1

LOW-LEVEL WASTE: LIQUID

Activity 0. Generator Declares Material Waste

This waste stream comprises wastewaters slightly contaminated with various radionuclides that are typically treated at wastewater treatment facilities with the effluent released to surface streams through National Pollution Discharge Elimination System monitors. In this case, wastewaters are transported to and through the treatment facilities via piping, in a continuous process.

Activity 1. Characterize and Assay

The waste generator, a radiation technician, a sampling technician, and a chemical analyst are all involved in this process.

Activity 2. Prepare Disposal Documentation and Certification

The generator and radwaste engineer prepare the documentation for treatment and disposal of the waste.

Activity 3. Release to Transport System

Transfer through a piping system to a collection tank with essentially no volume dependent costs.

Activity 4. Receive at Treatment Feed Tank

Transfer through a piping system to a collection tank with essentially no volume dependent costs.

Activity 5. Treatment

Treatment involves precipitation/clarification, filtration, ion exchange, and a final pH adjustment. Treatment requires 728 hours of chemical operator per 4,000,000 gallons of waste. Assistance from radiation technicians, a radwaste engineer, and a chemical analyst is also required. The treated water is collected and sampled as part of this process.

Activity 6. Package/Characterize Secondary Waste

Secondary waste is the solids that result from treating the liquid waste. These solids are packed in 55-gal drums without treatment beyond dewatering. This requires the services of a chemical operator, radiation technician, and chemical analyst. These solids are then incorporated into the solid LLW stream.

Activity 7. Sample and Characterize Treated Effluent

Before release to surface water stream, the treated effluent is sampled and characterized. These costs are captured in Activity 6.

Activity 8. Release to surface stream

The treated effluent is released back to the river with no volume dependent costs.

Figure C-2. Site 1: low-level waste: liquid.

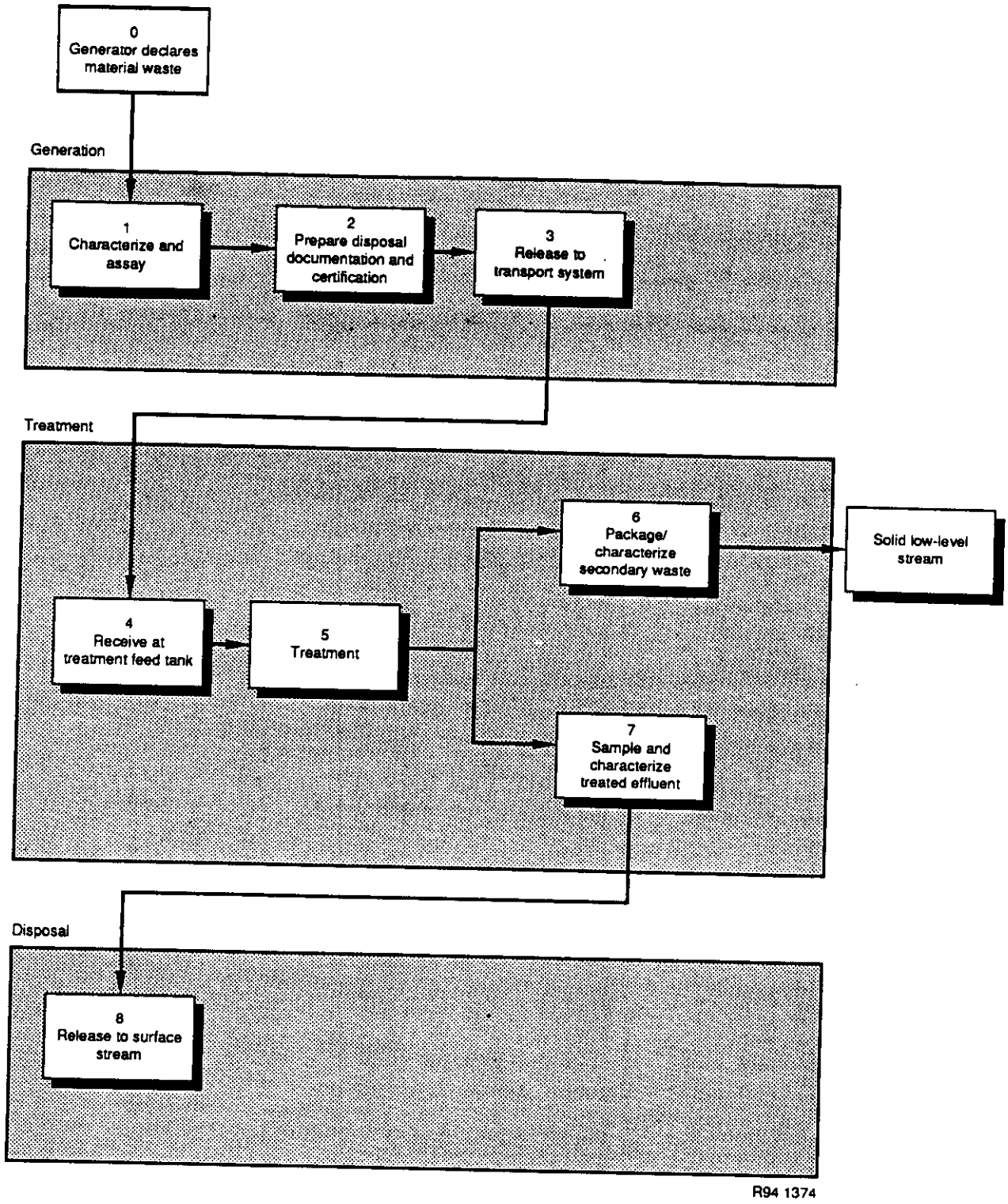


Table C-3. Site 1: low-level waste: liquid.

Annual Quantity of Liquid: 75 M gal
Annual Quantity of Solids: 208 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Liquid Cost ($/gal)	Solid Cost ($/m3)
0	Generator Declares Material Waste													$0.00
1	Characterize and Assay	1.5 M gal	1:1	Generator	1	0.5	$28	$97						
				Rad Tech.	1	0.25	$23	$81						
				Sampling Tech.	1	0.5	$30	$105						
				Chem. Analyst	1	1	$30	$105				$225	$0.00	$0.00
2	Prepare Disposal Documentation and Certification	Per new stream	1:1	Generator	1	2	$28	$97						
				Rad Waste Eng.	1	1	$28	$97				$290	$0.00	$0.00
3	Release to Transport System		1:1	NO VARIABLE COSTS ASSOCIATED WITH THIS ACTIVITY									$0.00	$0.00
4	Receive at Treatment Feed Tank		1:1	NO VARIABLE COSTS ASSOCIATED WITH THIS ACTIVITY									$0.00	$0.00
5/6	Treatment Package/Characterize Secondary Waste	1.2 M gal	1:1	Rad Tech	1	70	$23	$81	Chemicals		Insig.			
				Operator	1	728	$19	$64						
				Chem. Analyst	1	35	$30	$105						
				Rad Waste Eng.	1	122	$28	$97				$67,966	$0.06	$0.00
7	Sample and Characterize Treated Effluent	4- 5 gal drums	1:1	Rad Technician	1	1	$23	$81						
				Operator	1	2	$19	$64						
				Chem. Analyst	1	0.5	$30	$105				$262	$1.19	$0.00
8	Release to Surface Stream		1:1	NO VARIABLE COSTS ASSOCIATED WITH THIS ACTIVITY									$0.00	$0.00
	Disposal of Solids as LLW													$539
												TOTAL	$1.25	$539

SITE 1

MIXED TRU: CONTACT HANDLED

Activity 0. Generator Declares Material Waste

This waste stream comprises typical solid process waste from cell and glove box operations that are contaminated with both transuranic radionuclides and RCRA/TSCA materials. These wastes are packaged and put in long-term storage pending shipment to the Waste Isolation Pilot Plant.

Activity 1. Characterize and Package Waste

The waste is containerized and characterized as it is removed from the cell. It is placed in a TRU drum. Each TRU drum has a drum vent filter so gas pressure doesn't build up inside the drum. The generator, radiological technicians, generator certification official, sampling technician, and a chemical analyst are involved in the initial drum filling and closure.

Activity 2. Prepare Disposal Documentation

The generator spends an average of 1 hour preparing the shipping documentation for each drum.

Activity 3. Verify Characterization and Labeling

A field technician spends an average of 1/2 hour per drum verifying the contents and affixing the labels.

Activity 4. Transport to Storage Facility

Drums are transported to an interim storage facility until they are taken to the waste examination and assay facility. In addition to the truck driver and laborer there are two different data technicians involved.

Activity 5. Palletize and Transport to Waste Assay Facility

At the interim storage facility the drums are placed on secondary containment pallets and taken to the waste assay facility. This requires a radiation technician, an operator, a truck driver, a laborer, and two different data entry clerks.

Activity 6. Assay

Individual drums are inspected by real-time-radiography and active and passive neutron techniques. A technician performs the assay requiring an average of 1.5 hours per drum.

Activity 7. Transport to Storage

Final storage documentation is then prepared and the drum is moved to a long-term storage facility. This requires the work of a truck driver, a waste operations field technician, two different data technicians, and a laborer.

Activity 8. Receive at Storage

The drum is then transported to the long-term storage facility where it is unloaded from the truck, requiring the work of both the truck driver and an operator.

Activity 9. Monitor Interim Storage

The containers will remain in storage until WIPP is able to accept them. The avoidable annual cost to maintain the storage is insignificant on a per container basis and is therefore not estimated. This is the final stage of the operation as it is now performed.

Activity 10. Repackage and Certify

It is anticipated that, for the material to be disposed of at WIPP, it will need to be repackaged into a WIPP-approved container to be acceptable. This is expected to require 1.5 person-hours per container.

Activity 11. Load Truck for WIPP

Once the WIPP-approved containers are loaded (in casks—rental is shown as part of Activity 13) they must be put on the truck for offsite transportation and the shipping papers must be prepared. These tasks are expected to take 2 person-hours per drum.

Activity 12. Prepare Shipping Documentation

Activity 13. Ship to WIPP

The waste is transported to WIPP. Costs for the cask and shipping contractor are estimated at $400/drum.

Activity 14. Receive at WIPP

It is estimated that WIPP will spend an average of 5 person hours per drum in receipt and documentation activities.

Activity 15. Emplace Waste

A charge of $3,500/drum is estimated to cover the cost of moving the drums into the caverns, and to recover the cost of facility construction, operation, closure, and long-term monitoring.

Activity 16. Survey & Release Waste Transport Vehicle

Release of the vehicle and transport casks is expected to require 0.75 person-hours per drum of waste shipped.

Figure C-3. Site 1: mixed TRU: contact handled.

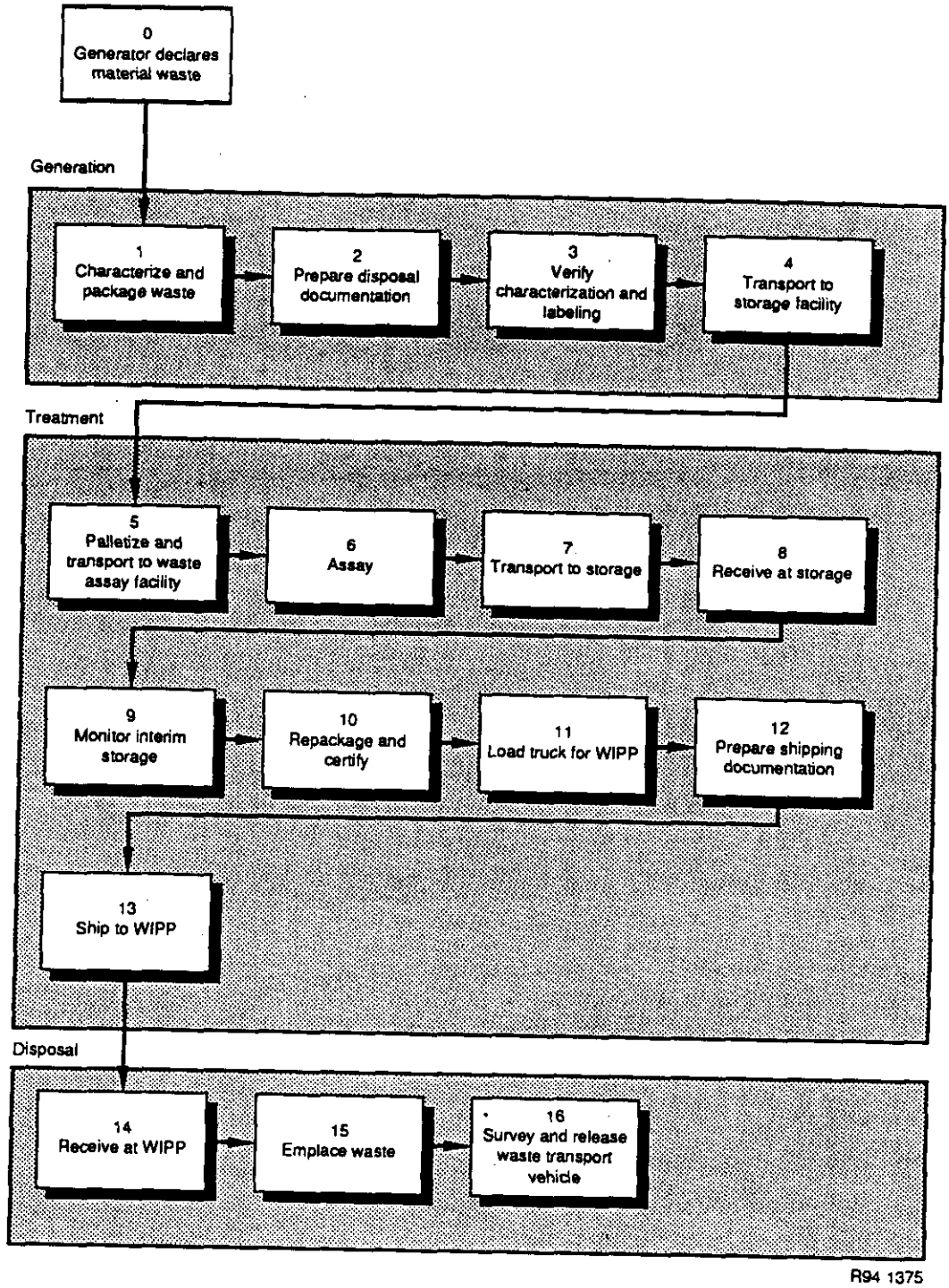


Table C-4. Site 1: mixed TRU: contact handled.

Annual Quantity Generated: 65 m^3
Annual Quantity Disposed: 65 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Characterize and Package Waste	1 55-gal drum	1:1	Generator	1	3	$28	$97	55-gal drum	1	$300			
				Rad Tech.	1	0.5	$23	$81	Filter	1	$50			
				GCO	1	0.5	$28	$97						
				Sampling Tech.	1	0.5	$30	$105						
				Chem. Analyst	1	1	$30	$105				$885	$4,216	$4,216
2	Prepare Disposal Documentation	1 55-gal drum	1:1	Generator	1	1	$28	$97				$97	$460	$4,676
3	Verify Characterization and Labeling	1 55-gal drum	1:1	RSWOG Field Tech.	1	0.5	$14	$48				$24	$115	$4,791
4	Transport to Storage Facility	1 55-gal drum	1:1	Truck Driver	1	0.5	$19	$64						
				Laborer	1	0.15	$21	$72						
				RSWOG Data Tech.	1	0.25	$14	$48						
				DMC Data Tech.	1	0.25	$14	$48				$67	$320	$5,111
5	Palletize and Transport to Waste Assay Facility	1 55-gal drum	1:1	Rad Tech.	1	0.15	$23	$81						
				Operator	1	0.25	$19	$64						
				Truck Driver	1	0.25	$19	$64						
				Laborer	1	0.25	$21	$72						
				RSWOG Data Tech.	1	0.1	$14	$48						
				DMC Data Tech.	1	0.1	$14	$48				$72	$343	$5,454
6	Assay	1 55-gal drum	1:1	WEAF Tech.	1	1.5	$14	$48				$72	$345	$5,799
7	Transport to Storage	1 55-gal drum	1:1	Truck Driver	1	0.25	$19	$64						
				RSWOG Field Tech.	1	0.25	$14	$48						
				RSWOG Data Tech.	1	0.25	$14	$48						
				DMC Data Tech.	1	0.25	$14	$48						
				Laborer	1	0.25	$21	$72				$70	$335	$6,134
8	Receive at Storage	1 55-gal drum	1:1	Operator	1	0.25	$19	$64						
				Truck Driver	1	0.25	$19	$64				$32	$153	$6,288

Table C-4. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
9	Monitor Interim Storage	1 55-gal drum	1:1	Insignificant Cost								$0	$0	$6,288
10	Repackage and Certify	1 55-gal drum	1:1	RSWOG Field Tech	1	1	$14	$48						
				RSWOG Data Tech	1	0.25	$14	$48						
				RSWOG Eng.	1	0.25	$28	$97				$85	$403	$6,690
11	Load Truck for WIPP	1 55-gal drum	1:1	Operator	1	0.25	$19	$64						
				Truck Driver	1	0.25	$19	$64				$32	$153	$6,844
12	Prepare Shipping Documentation	1 55-gal drum	1:1	GCO	1	0.25	$28	$97						
				RSWOG Field Tech.	1	0.25	$14	$48						
				RSWOG Data Tech.	1	0.25	$14	$48						
				DMC Data Tech.	1	0.25	$14	$48						
				Transporation	1	0.25	$28	$97						
				Shipping	1	0.25	$28	$97				$109	$518	$7,361
13	Ship to WIPP	1 55-gal drum	1:1						Transportation	1	$300			
									Cask Rental	1	$100	$400	$1,905	$9,266
14	Receive at WIPP	1 55-gal drum	1:1	Rad Tech.	1	0.5	$23	$81						
				WIPP Tech.	1	0.5	$14	$48						
				WIPP Operations Data	1	0.5	$14	$48				$89	$422	$9,688
15	Emplace Waste	1 55-gal drum	1:1	Rad Technician	1	0.5	$23	$81	WIPP	1	$3,500			
				Operator	1	0.5	$19	$64						
				Truck Driver	1	0.25	$19	$64						
				Laborer	1	0.5	$21	$72						
				WIPP Tech.	1	0.5	$14	$48						
				Data Storage	1	0.25	$14	$48				$3,661	$17,433	$27,121
16	Survey & Release Waste Transport Vehicle	1 55-gal drum	1:1	Rad Technician	1	0.5	$23	$81	Transportation	1	$150			
				WIPP Operations Data	1	0.25	$14	$48				$202	$963	$28,084

SITE 1

SANITARY WASTE

Activity 0. Generator Declares Material Waste

This waste stream is typical solid sanitary waste.

Activity 1. Characterize Waste

Responsibility to characterize sanitary waste to ensure that no hazardous or radiological components have been added falls primarily on the generator with periodic monitoring by a radiological technician. The generator spends an average of 2.6 hours and the radiological technician 1.7 hours per 100 cubic yards of waste.

Activity 2. Prepare Disposal Documentation

The generator spends an average of 2 hours per 100 cubic yards of waste preparing documentation for disposal.

Activity 3. Transport to Staging

Sanitary waste is transported to a staging area for QA verification. The truck driver spends approximately 7.8 hours per 100 cubic yards performing this transportation. Vehicle costs are considered a base operations cost.

Activity 4. Verify QA

A field engineer checks the waste for radiological contamination, they spend 0.9 person hours per 100 cubic yards of waste generated, even though 10% is checked.

Activity 5. Transport to Radiological Monitoring

For the final check the waste is transported to another area from the staging area. Like the previous transport, this requires 7.8 hours of truck driver time per 100 cubic yards of waste.

Activity 6. Radiological Monitoring of Sanitary Waste

The actual monitoring of the waste is done by a radiological technician who spends 0.9 hours on 100 cubic yards of waste.

Activity 7. Transport to Compactor

The waste is then transported by truck driver as before.

Activity 8. Compact Waste

Sanitary waste is baled into 10 cubic yard bales, with a 5 to 1 reduction in volume. This is done by laborers and waste technicians.

Activity 9. Transport to Landfill

It takes a truck driver 1/2 hour to transport each bale to the landfill.

Activity 10. Receive at Disposal

Each shipment is logged at the landfill, requiring 0.9 hours of technician time.

Activity 11. Document Returned Dumpsters

Dumpsters used in Activity 9 are returned.

Figure C-4. Site 1: sanitary waste.

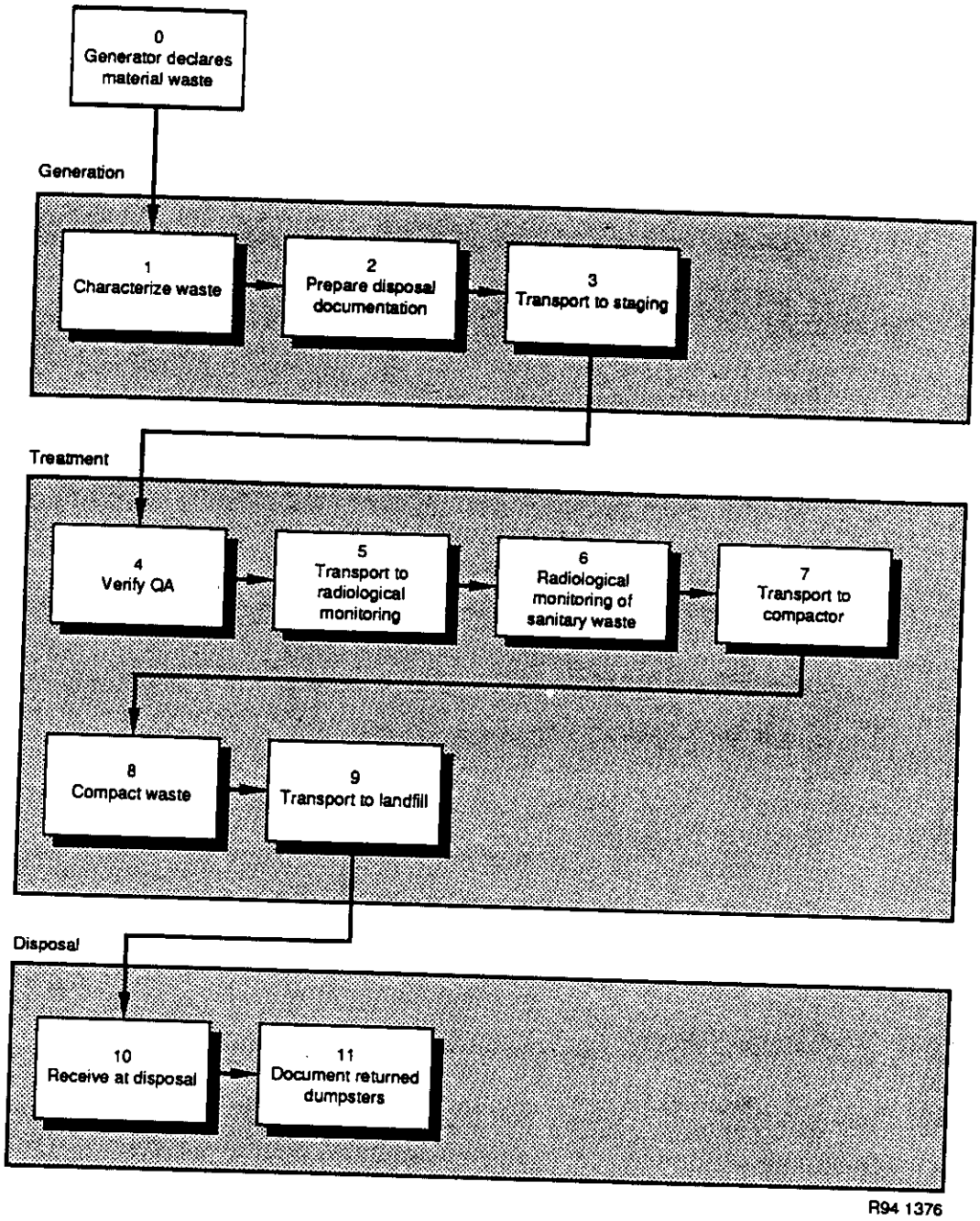


Table C-5. Site 1: sanitary waste.

Annual Quantity Generated: 54550 Metric Tons
Annual Quantity Disposed: 54550 Metric Tons

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/metric ton)	Cumulative Total ($/metric ton)
0	Generator Declares Material Waste											$0	$0	$0
1	Characterize Waste	100 cu. yds	1:1	Generator	1	2.6	$28	$97						
				Rad Technician	1	1.7	$23	$81				$388	$17	$17
2	Prepare Disposal Documentation	100 cu. yds	1:1	Generator	1	2	$28	$97				$193	$8	$26
3	Transport to Staging	100 cu. yds	1:1	Truck Driver	1	7.8	$19	$64				$502	$22	$48
4	Verify QA	100 cu. yds	1:1	Field Eng.	1	0.9	$28	$97				$87	$4	$51
5	Transport to Radiological Monitoring	100 cu. yds	1:1	Truck Driver	1	7.8	$19	$64				$502	$22	$74
6	Radiological Monitoring of Sanitary Waste	100 cu. yds	1:1	Rad Technician	1	0.9	$23	$81				$72	$3	$77
7	Transport to Compactor	100 cu. yds		Truck Driver	1	7.8	$19	$64				$502	$22	$99
8	Compact Waste	10 cu. yds	5:1	Laborer	1	1.8	$21	$72						
				Waste Technician	1	0.5	$14	$48				$155	$14	$112
9	Transport To Landfill	10 cu. yds	1:1	Truck Driver	1	0.5	$19	$64				$32	$3	$115
10	Receive at Disposal	10 cu. yds	1:1	Waste Technician	1	0.9	$14	$48				$43	$4	$119
11	Document Returned Dumpsters	10 cu. yds	1:1	Data Entry Clerk	1	0.5	$14	$48				$24	$2	$121

Appendix D

Site 2 WM Activity Narratives and Flow Diagrams

Appendix D: Site 2
WM Activity Narratives and Flow Diagrams

SITE 2

LOW-LEVEL WASTE: CONTACT HANDLED: UNTREATED

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouses. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number, which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of new waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste

coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Transport to Storage

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 3. Storage

Inspections by a waste technician and a waste coordinator must be conducted and documented. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 4. Transport to Assay

Movement of the container from storage requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the assay building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 5. Waste Assay

Each container is nondestructively assayed to determine the amount of radioactive materials within each drum. Different types of assay equipment are located in different buildings. Each drum is directed to assay equipment based upon its weight and contents. The assay or counting operation is conducted by a process specialist. A second process specialist is required to move the drum from the delivery area to the counting equipment and back. A health physics technician checks the drum at receipt and before the drum leaves the assay building for radiological contamination. The results of the assay and the location of the drum are entered into the waste tracking system and the Nuclear Materials Control system. The drum is then shipped to RTR.

Activity 6. Transport to RTR

Movement of the container from the assay building requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the RTR building, unloading the truck at the destination, followed by more data accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 7. Verify Characterization

This procedure is a nondestructive testing (NDT) technique for looking inside a drum to determine that it is in compliance with shipping requirements. The RTR of a drum requires participation by waste technicians, an NDT technician, and a waste coordinator. The procedure includes moving the drum in and out of the RTR machine, running the test, and documenting the results. Before the drum can leave the building it must again be radiologically monitored.

Activity 8. Transport to Storage

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 9. Storage

Inspections by a waste technician and a waste coordinator must be conducted and documented. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 10. Movement to Staging

Same as Activity 8 above.

Activity 11. Prepare for Shipment

Radioactive waste designated for offsite shipment and disposal is staged, where it undergoes final inspection and certification. The waste is accepted into the building by two waste technicians and a waste coordinator.

Activity 12. Stage Containers

Two waste technicians ready the containers for shipment by aligning them in a staging area.

Activity 13. Verify Characterization

Containers are inspected to confirm compliance with physical and documentation requirements.

Activity 14. Paint and Stencil

Containers are painted and stenciled with all required markings by a painter. Two waste technicians move the drums.

Activity 15. Container and Document Inspection

A waste coordinator inspects all containers and documentation for compliance with all criteria.

Activity 16. Certification Inspection

Certification personnel perform an inspection to ensure compliance with the applicable waste acceptance certification criteria. The inspection is conducted by a quality engineer assisted by two waste technicians.

Activity 17. Traffic Inspection

The quality engineer, two waste inspectors, and traffic personnel inspect the trailer and the waste load to ensure all Department of Transportation (DOT) requirements are satisfied.

Activity 18. Trailer Inspection

The trailer is inspected by two waste technicians and a health physics technician just before to loading.

Activity 19. Load Truck

Waste is again inspected by several personnel as it is loaded into the trailer. Container and radiation inspection is performed again. As the waste is loaded, paperwork is again verified. Traffic personnel coordinate all shipping aspects. When loading is complete the vehicle is closed by a waste technician.

Activity 20. Radiological Survey

The exterior of the truck is surveyed the vehicle's departure.

Activity 21. Shipment to Nevada Test Site (NTS)

This task includes costs associated with transport from Site 2 to the NTS.

Activity 22. Disposal at NTS

Costs associated with receipt, documentation, unloading, and emplacement.

Figure D-1. Site 2: low-level waste: contact handled: untreated.

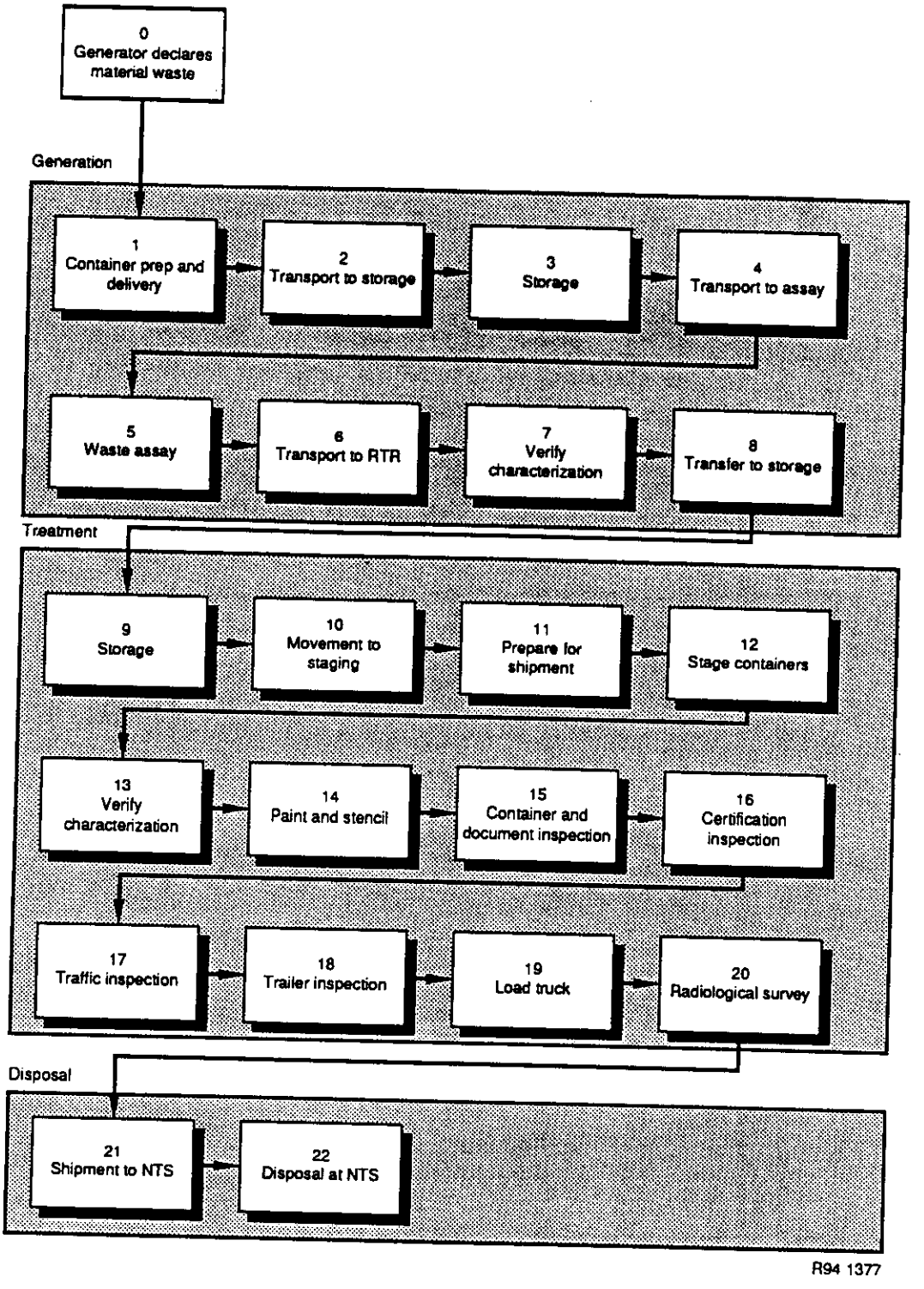


Table D-1. Site 2: low-level waste: contact handled: untreated.

Annual Quantity Generated: 691.2 m³
Annual Quantity Disposed: 691.2 m³

					LABOR					NONLABOR						
ID	ACTIVITY DESCRIPTION	Basis Drum	Basis Crate	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Nonlabor Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
0	**Generator Declares Material Waste**															
1	**Container Prep & Delivery**															
	Receive New Drums	3,000		1:1	Stock Clerk	6	80	$18	$83	55 Gallon Drum	1	$32.17	$40,041	$217	$217	
	Inspect & Prepare New Containers	25		1:1	NMC	1	0.5	$18	$83	Liner, PVC, Type V	1	$26.45	$68	$134	$351	
		25		1:1	Inspector	2	1.5	$18	$83	O-ring bag (22")	1	$17.72	$266	$132	$482	
		25		1:1	Stock Clerk	2	2	$17	$78	Plastic liner-10 mil	1	$0.66	$313	$63	$545	
	Load Truck, Deliver to Plant and Generator	25		1:1	Trucker	2	2.5	$15	$71	Filter	1	$25.47	$379	$189	$733	
		25		1:1	Coordinator	1	0.25	$18	$83	Fiberboard Disc	1	$1.74	$23	$12	$746	
		25		1:1	NMC	1	2.5	$18	$83				$207	$39	$785	
		25		1:1	WEMS	1	0.25	$17	$78				$20	$4	$789	
		1		1:1	NMC	1	0.5	$18	$83				$41	$197	$986	
1a	**Container Prep & Delivery**															
	Receive New Crates		12	1:1	Stock Clerk	2	3	$18	$83	Full Crate	1	$282.41	$783	$102		$102
	Inspect & Prepare New Containers		8	1:1	NMC	1	0.17	$18	$83	Fiberboard liner	1	$17.14	$31	$6		$108
			8	1:1	Inspector	2	1.5	$18	$83	Fiberboard sheet	1	$3.88	$252	$11		$119
			8	1:1	Waste Technician	2	1.25	$18	$83	PVC liner, size 2	1	$19.92	$227	$14		$134
			8	1:1	Painter	2	1.5	$19	$85	Banding, glue, nails	1	$3.65	$260	$11		$145
	Load & Deliver to Plant & Paint Shop		8	1:1	Trucker	2	2.5	$15	$71				$353	$14		$159
			8	1:1	Stock Clerk	4	1	$18	$83				$333	$13		$172
			8	1:1	NMC	1	2.5	$18	$83				$207	$8		$180
			8	1:1	WEMS	1	0.25	$17	$78				$20	$1		$181
	Paint Crate		1	1:1	Painter	1	0.33	$19	$85	Paint (.75 gallon)	1	$38.00	$66	$21		$202
	Move from Paint Shop to requesting building		8	1:1	Trucker	2	0.5	$15	$71				$71	$3		$205
	Deliver to Generator		1	1:1	NMC	1	0.5	$18	$83				$41	$13		$218
2	**Transport to Storage**															
	Staging from building to dock	30		1:1	WA&S	2	2	$18	$83				$332	$53	$1,038	
		30		1:1	NMC	1	1.13	$18	$83				$93	$15	$1,053	
		30		1:1	RCT	1	1.36	$18	$83				$113	$18	$1,071	
	Shipping from building to storage	30		1:1	WA&S	2	2	$18	$83				$332	$53	$1,124	
		30		1:1	RCT	1	2.72	$18	$83				$226	$36	$1,160	
		30		1:1	NMC	1	2.26	$18	$83				$187	$30	$1,190	
		30		1:1	Trucker	2	1.5	$15	$71				$212	$34	$1,223	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142	$1,365	

Table D-1. (continued).

ID	ACTIVITY DESCRIPTION	Basis Drum	Basis Crate	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Nonlabor Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
2a	**Transport to Storage**															
	Staging from building to dock		5	1:1	WA&S	2	2	$18	$83				$332	$21		$239
			5	1:1	NMC	1	1.13	$18	$83				$93	$6		$245
			5	1:1	RCT	1	1.36	$18	$83				$113	$7		$252
	Shipping from building to storage		5	1:1	WA&S	2	2	$18	$83				$332	$21		$273
			5	1:1	RCT	1	2.72	$18	$83				$226	$14		$287
			5	1:1	NMC	1	2.26	$18	$83				$187	$12		$299
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13		$312
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9		$321
3	**Storage**				NO VARIABLE COSTS ASSOCIATED WITH NON REGULATED WASTE STORAGE											
4	**Transport to Assay**	30		1:1	WA&S	2	2	$18	$83				$332	$53	$1,418	
		30		1:1	RCT	1	2.72	$18	$83				$226	$36	$1,454	
		30		1:1	NMC	1	2.26	$18	$83				$187	$30	$1,484	
		30		1:1	Trucker	2	1.5	$15	$71				$212	$34	$1,517	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142	$1,659	
4a	**Transport to Assay**		5	1:1	WA&S	2	2	$18	$83				$332	$21		$342
			5	1:1	RCT	1	2.72	$18	$83				$226	$14		$357
			5	1:1	NMC	1	2.26	$18	$83				$187	$12		$369
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13		$382
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9		$391
5	**Waste Assay**															
	Counting	1		1:1	Process Specialist	2	0.5	$18	$83				$83	$396	$2,055	
	Container Movement	40		1:1	Process Specialist	2	4	$18	$83				$665	$79	$2,134	
		40		1:1	RCT	1	4.08	$18	$83				$339	$40	$2,175	
		40		1:1	NMC	1	3.39	$18	$83				$280	$33	$2,208	
5a	**Waste Assay**		1	1:1	Process Specialist	2	0.5	$18	$83				$83	$26		$418
	Counting		5	1:1	Process Specialist	2	4	$18	$83				$665	$42		$459
	Container Movement		5	1:1	RCT	1	4.08	$18	$83				$339	$21		$481
			5	1:1	NMC	1	3.39	$18	$83				$280	$18		$499
6	**Transport to RTR**	30		1:1	WA&S	2	2	$18	$83				$332	$53	$2,261	
		30		1:1	RCT	1	2.72	$18	$83				$226	$36	$2,297	
		30		1:1	NMC	1	2.26	$18	$83				$187	$30	$2,326	
		30		1:1	Trucker	2	2.5	$15	$71				$353	$56	$2,382	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142	$2,524	
6a	**Transport to RTR**		5	1:1	WA&S	2	2	$18	$83				$332	$21		$520
			5	1:1	RCT	1	2.72	$18	$83				$226	$14		$534
			5	1:1	NMC	1	2.26	$18	$83				$187	$12		$546
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13		$559
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9		$568

Table D-1. (continued).

					LABOR					NONLABOR						
ID	ACTIVITY DESCRIPTION	Basis Drum	Basis Crate	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Nonlabor Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
7	Verify Characterization	30		1:1	Coordinator	1	1.5	$18	$83				$125	$20	$2,544	
		1		1:1	Waste Technician	2	0.17	$18	$83				$28	$135	$2,679	
		30		1:1	Waste Technician	2	1	$18	$83				$167	$26	$2,706	
		1		1:1	Waste Technician	2	0.05	$18	$83				$8	$40	$2,745	
		3		1:1	NDT Technician	2	0.5	$20	$91				$91	$144	$2,889	
		3		1:1	Waste Technician	2	0.17	$18	$83				$28	$45	$2,934	
7a	Verify Characterization		1	1:1	NDT Technician	2	0.33	$20	$91				$60	$19		$587
			1	1:1	Waste Technician	2	0.17	$18	$83				$28	$9		$596
			5	1:1	Coordinator	1	1.5	$18	$83				$125	$8		$604
			1	1:1	Waste Technician	2	0.17	$18	$83				$28	$9		$613
			5	1:1	Waste Technician	2	1	$18	$83				$167	$11		$624
			1	1:1	Waste Technician	2	0.05	$18	$83				$8	$3		$626
8	Transport to Storage	30		1:1	WA&S	2	2	$18	$83				$332	$53	$2,987	
		30		1:1	RCT	1	2.72	$18	$83				$226	$36	$3,023	
		30		1:1	NMC	1	2.26	$18	$83				$187	$30	$3,052	
		30		1:1	Trucker	2	2.5	$15	$71				$353	$56	$3,109	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142	$3,251	
8a	Transport to Storage		5	1:1	WA&S	2	2	$18	$83				$332	$21		$647
			5	1:1	RCT	1	2.72	$18	$83				$226	$14		$661
			5	1:1	NMC	1	2.26	$18	$83				$187	$12		$673
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13		$687
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9		$696
9	Storage				NO VARIABLE COSTS ASSOCIATED WITH NON REGULATED WASTE STORAGE											
10	Movement to Staging	30		1:1	WA&S	2	2	$18	$83				$332	$53	$3,303	
		30		1:1	RCT	1	2.72	$18	$83				$226	$36	$3,339	
		30		1:1	NMC	1	2.26	$18	$83				$187	$30	$3,369	
		30		1:1	Trucker	2	2.5	$15	$71				$353	$56	$3,425	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142	$3,567	
10a	Movement to Staging		5	1:1	WA&S	2	2	$18	$83				$332	$21		$717
			5	1:1	RCT	1	2.72	$18	$83				$226	$14		$731
			5	1:1	NMC	1	2.26	$18	$83				$187	$12		$743
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13		$756
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9		$766
11	Prepare for Shipment	1		1:1	Waste Technician	2	0.17	$18	$83				$28	$135	$3,702	$775
		1		1:1	Coordinator	1	0.05	$18	$83				$4	$20	$3,722	$776
12	Stage Containers	1		1:1	Waste Technician	2	0.03	$18	$83				$5	$24	$3,746	$778
13	Verify Characterization	1		1:1	Inspector	1	0.17	$18	$83				$14	$67	$3,813	$782
14	Paint & Stencil Containers	1		1:1	Waste Technician	2	0.08	$18	$83				$13	$64	$3,876	$786
		1		1:1	Painter	1	0.25	$19	$85				$21	$102	$3,978	$793
15	Container & Document Inspection	42		1:1	Coordinator	1	1	$18	$83				$83	$9	$3,987	
15a	Container & Document Inspection		10	1:1	Coordinator	1	0.5	$18	$83				$42	$1		$794
16	Certification Inspection	1		1:1	Quality Engineer	1	1	$21	$97				$97	$462	$4,449	
		104		1:1	Waste Technician	2	2	$18	$83				$333	$15	$4,464	
16a	Certification Inspection		1	1:1	Quality Engineer	1	1	$21	$97				$97	$31		$825
			10	1:1	Waste Technician	2	0.5	$18	$83				$83	$3		$828
17	Traffic Inspection	104		1:1	Inspector	2	1	$18	$83				$166	$8	$4,472	

Table D-1. (continued).

ID	ACTIVITY DESCRIPTION	Basis Drum	Basis Crate	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Nonlabor Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
		104		1:1	Quality Engineer	1	1	$21	$97				$97	$4	$4,476	
		104		1:1	Traffic	1	1	$17	$80				$80	$4	$4,480	
17a	**Traffic Inspection**		10	1:1	Inspector	2	0.5	$18	$83				$83	$3		$830
			10	1:1	Quality Engineer	1	1	$21	$97				$97	$3		$833
			10	1:1	Traffic	1	1	$17	$80				$80	$3		$836
18	**Trailer Inspection**	104		1:1	Waste Technician	2	0.25	$18	$83				$42	$2	$4,482	
		1		1:1	RCT	1	0.12	$18	$83				$10	$47	$4,530	
	Paperwork Verification	104		1:1	Waste Technician	2	0.17	$18	$83				$28	$1	$4,531	
18a	**Trailer Inspection (drums)**		10	1:1	Waste Technician	2	0.25	$18	$83				$42	$1		$837
			1	1:1	RCT	1	0.12	$18	$83				$10	$3		$840
	Paperwork Verification		10	1:1	Waste Technician	2	0.17	$18	$83				$28	$1		$841
19	**Load Truck**			1:1												
	Inspection	208		1:1	Quality Engineer	1	3.47	$21	$97				$337	$8	$4,539	
		208		1:1	Inspector	2	3.47	$18	$83				$575	$13	$4,552	
		208		1:1	Coordinator	1	3.47	$18	$83				$289	$7	$4,558	
		208		1:1	Waste Technician	4	3.47	$18	$83				$1,157	$26	$4,585	
	Move into vehicle	208		1:1	Waste Technician	4	2	$18	$83				$667	$15	$4,600	
	Loading inspection	208		1:1	Quality Engineer	1	2	$21	$97				$194	$4	$4,605	
		208		1:1	Inspector	2	2	$18	$83				$331	$8	$4,612	
		208		1:1	Coordinator	1	2	$18	$83				$167	$4	$4,616	
	Paperwork Verification	208		1:1	Quality Engineer	1	0.25	$21	$97				$24	$1	$4,616	
		208		1:1	Inspector	1	0.25	$18	$83				$21	$0	$4,617	
		208		1:1	Coordinator	1	0.25	$18	$83				$21	$0	$4,617	
		208		1:1	Coordinator	2	3	$18	$83				$500	$11	$4,629	
		208		1:1	Waste Operations	2	0.5	$18	$83				$83	$2	$4,631	
		208		1:1	RCT	1	0.25	$18	$83				$21	$0	$4,631	
	Traffic coordination	208		1:1	Coordinator	1	2	$18	$83				$167	$4	$4,635	
		208		1:1	Traffic	1	4	$17	$80				$319	$7	$4,642	
	Vehicle sealed	208		1:1	Waste Technician	1	0.33	$18	$83				$28	$1	$4,643	

Table D-1. (continued).

ID	ACTIVITY DESCRIPTION	Basis Drum	Basis Crate	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Nonlabor Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
19a	Load Truck								$0							
	Inspection		20	1:1	Quality Engineer	1	0.5	$21	$97				$49	$1		$842
			20	1:1	Inspector	2	0.5	$18	$83				$83	$1		$843
			20	1:1	Coordinator	1	0.5	$18	$83				$42	$1		$844
			20	1:1	Waste Technician	4	0.5	$18	$83				$167	$3		$846
	Move into vehicle		20	1:1	Waste Technician	4	0.5	$18	$83				$167	$3		$849
	Loading inspection		20	1:1	Quality Engineer	1	0.5	$21	$97				$49	$1		$850
			20	1:1	Inspector	2	0.5	$18	$83				$83	$1		$851
			20	1:1	Coordinator	1	0.5	$18	$83				$42	$1		$852
	Paperwork Verification		20	1:1	Quality Engineer	1	0.25	$21	$97				$24	$0		$852
			20	1:1	Inspector	1	0.25	$18	$83				$21	$0		$853
			20	1:1	Coordinator	1	0.25	$18	$83				$21	$0		$853
			20	1:1	Coordinator	2	3	$18	$83				$500	$8		$861
			20	1:1	Waste Operations	2	0.5	$18	$83				$83	$1		$862
			20	1:1	RCT	1	0.25	$18	$83				$21	$0		$863
	Traffic coordination		20	1:1	Coordinator	1	2	$18	$83				$167	$3		$865
			20	1:1	Traffic	1	4	$17	$80				$319	$5		$870
	Vehicle sealed		20	1:1	Waste Technician	1	0.33	$18	$83				$28	$0		$871
20	Radiological Survey	208		1:1	RCT	1	0.33	$18	$83				$27	$1	$4,644	
20a	Radiological Survey		20	1:1	RCT	1	0.33	$18	$83				$27	$0		$871
21	Shipment to NTS	104		1:1							1	$29.00	$29	$138	$4,782	
21a	Shipment to NTS		10	1:1							1	$299.00	$299	$94		$966
22	Disposal at NTS	104		1:1							1	$82.00	$82	$390	$5,172	
22a	Disposal at NTS		10								1	$1,240.00	$1,240	$391		$1,357

Total ($/m³) = $3,036

SITE 2

MIXED LOW-LEVEL WASTE

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouses. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Transport to Storage

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the

accumulation area to the dock area must be documented on the accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 3. Storage

RCRA inspections by a waste technician and a waste coordinator must be conducted and documented on a weekly basis. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 4. Transport to Assay

Movement of the container from storage requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the assay building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 5. Waste Assay

Each container is nondestructively assayed to determine the amount of radioactive materials within each drum. Different types of assay equipment are located in different buildings. Each drum is directed to assay equipment based upon its weight and contents. The assay or counting operation is conducted by a process specialist. A second process specialist is required to move the drum from the delivery area to the counting equipment and back. A health physics technician checks the drum at receipt and before the drum leaves the assay

building for radiological contamination. The results of the assay and the location of the drum are entered into the waste tracking system and the Nuclear Materials Control system. The drum is then shipped to RTR.

Activity 6. Transport to RTR

Movement of the container from the assay building requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the RTR building, unloading the truck at the destination, followed by more data accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 7. Verify Characterization

This procedure is a nondestructive testing (NDT) technique for looking inside a drum to determine that it is in compliance with shipping requirements. The RTR of a drum requires participation by waste technicians, an NDT technician, and a waste coordinator. The procedure includes moving the drum in and out of the RTR machine, running the test, and documenting the results. Before the drum can leave the building it must again be radiologically monitored.

Activity 8. Transport to Storage

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability

transactions. At the destination, the drums and documentation are again inspected.

Activity 9. Storage

RCRA inspections by a waste technician and a waste coordinator must be conducted and documented on a weekly basis. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 10. Movement to Staging

Same as Activity 8 above.

Activity 11. Prepare for Shipment

Radioactive waste designated for offsite shipment and disposal is staged, where it undergoes final inspection and certification. The waste is accepted into the building by two waste technicians and a waste coordinator.

Activity 12. Stage Containers

Two waste technicians ready the containers for shipment by aligning them in a staging area.

Activity 13. Verify Characterization

Containers are inspected to confirm compliance with physical and documentation requirements.

Activity 14. Paint and Stencil

Containers are painted and stenciled with all required markings by a painter. Two waste technicians move the drums.

Activity 15. Container and Document Inspection

A waste coordinator inspects all containers and documentation for compliance with all criteria.

Activity 16. Certification Inspection

Certification personnel perform an inspection to ensure compliance with the applicable waste acceptance certification criteria. The inspection is conducted by a quality engineer assisted by two waste technicians.

Activity 17. Traffic Inspection

The quality engineer, two waste inspectors, and traffic personnel inspect the trailer and the waste load to ensure all Department of Transportation (DOT) requirements are satisfied.

Activity 18. Trailer Inspection

The trailer is inspected by two waste technicians and a health physics technician just before to loading.

Activity 19. Load Truck

Waste is again inspected by several personnel as it is loaded into the trailer. Container and radiation inspection is performed again. As the waste is loaded,

paperwork is again verified. Traffic personnel coordinate all shipping aspects. When loading is complete the vehicle is closed by a waste technician.

Activity 20. Radiological Survey

The exterior of the truck is surveyed before to the vehicle's departure.

Figure D-2. Site 2: mixed low-level waste.

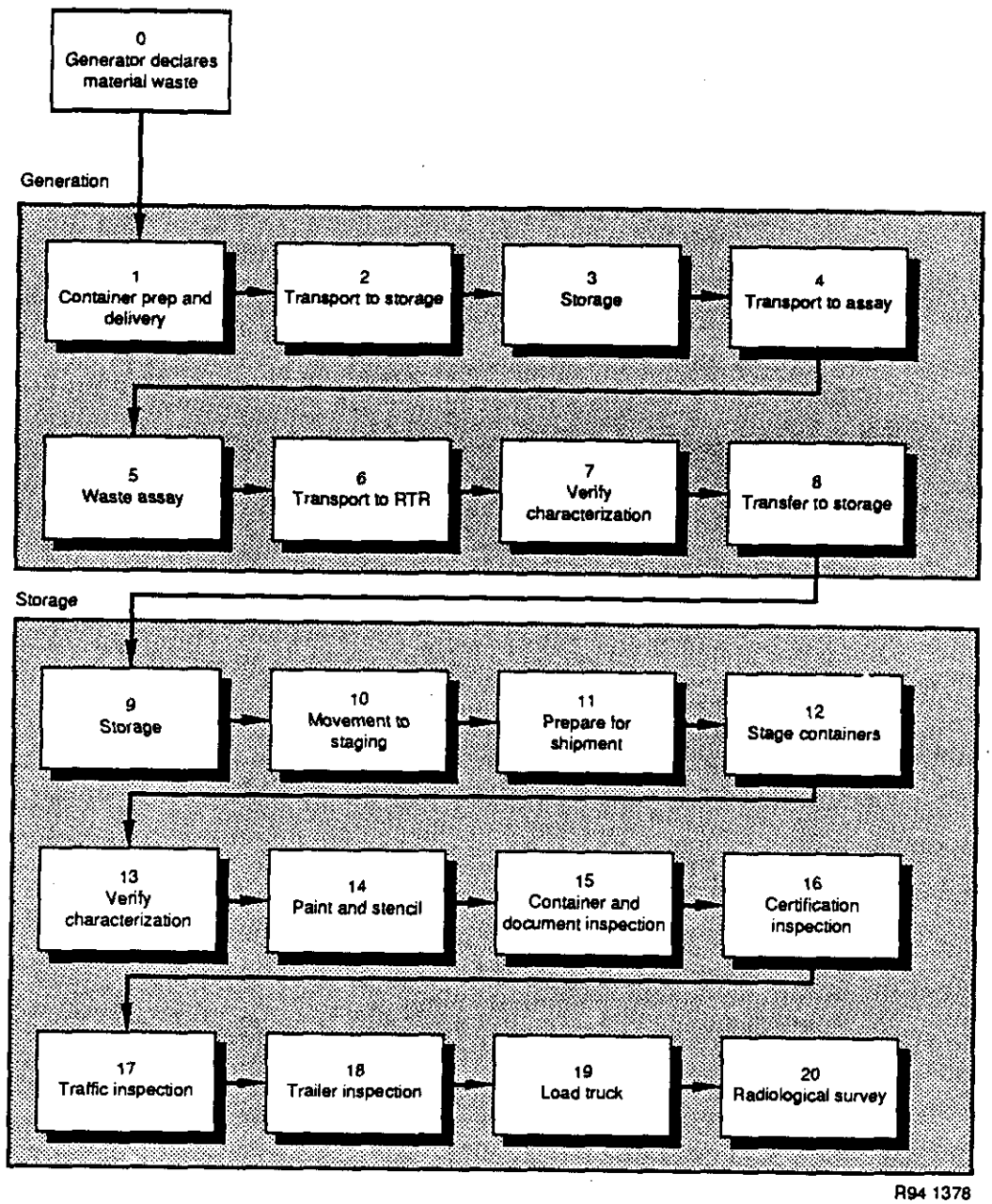


Table D-2. Site 2: mixed low-level waste.

Annual Quantity Generated: 229.6 m^3
Annual Quantity Disposed: 229.6 m^3

					LABOR					NONLABOR						
ID	ACTIVITY DESCRIPTION	Basis (Drums)	Basis Crate	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$) Drums	Cumulative Total ($/$m^3$) Crates
0	Generator Declares Material Waste														$0	$0
1	Container Prep & Delivery															
	Receive New Drums	3,000		1:1	Stock Clerk	6	80	$18	$83	55 Gallon Drum	1	$32.17	$40,041	$216.70	$217	
	Inspect & Prepare New Containers	25		1:1	NMC	1	0.5	$18	$83	Liner, PVC, Type V	1	$26.45	$68	$133.83	$351	
		25		1:1	Inspector	2	1.5	$18	$83	O-ring bag (22")	1	$17.72	$266	$131.72	$482	
		25		1:1	Stock Clerk	2	2	$17	$78	Plastic liner-10 mil	1	$0.66	$313	$62.55	$545	
	Load Truck, Deliver to Plant and Generator	25		1:1	Trucker	2	2.5	$15	$71	Filter	1	$25.47	$379	$188.58	$733	
		25		1:1	Coordinator	1	0.25	$18	$83	Fiberboard Disc	1	$1.74	$23	$12.25	$746	
		25		1:1	NMC	1	2.5	$18	$83				$207	$39.38	$785	
		25		1:1	WEMS	1	0.25	$17	$78				$20	$3.73	$789	
		1		1:1	NMC	1	0.5	$18	$83				$41	$196.92	$986	
1a	Container Prep & Delivery															
	Receive New Crates		12	1:1	Stock Clerk	2	3	$18	$83	Full Crate	1	$282.41	$783	$102.24		$102
	Inspect & Prepare New Containers		8	1:1	NMC	1	0.17	$18	$83	Fiberboard liner	1	$17.14	$31	$5.96		$108
			8	1:1	Inspector	2	1.5	$18	$83	Fiberboard sheet	1	$3.88	$252	$11.02		$119
			8	1:1	Waste Technician	2	1.25	$18	$83	PVC liner, size 2	1	$19.92	$227	$14.45		$134
			8	1:1	Painter	2	1.5	$19	$85	Banding, glue, nails	1	$3.65	$260	$11.26		$145
	Load & Deliver to Plant & Paint Shop		8	1:1	Trucker	2	2.5	$15	$71				$353	$13.93		$159
			8	1:1	Stock Clerk	4	1	$18	$83				$333	$13.15		$172
			8	1:1	NMC	1	2.5	$18	$83				$207	$8.15		$180
			8	1:1	WEMS	1	0.25	$17	$78				$20	$0.77		$181
	Paint Crate		1	1:1	Painter	1	0.33	$19	$85	Paint (.75 gallon)	1	$38.00	$66	$20.88		$202
	Move from Paint Shop to requesting building		8	1:1	Trucker	2	0.5	$15	$71				$71	$2.79		$205
	Deliver to Generator		1	1:1	NMC	1	0.5	$18	$83				$41	$13.05		$218
2	Transport to Storage															
	Staging from building to dock	30		1:1	WA&S	2	2	$18	$83				$332	$52.78	$1,038	
		30		1:1	NMC	1	1.13	$18	$83				$93	$14.83	$1,053	
		30		1:1	RCT	1	1.36	$18	$83				$113	$17.94	$1,071	
	Shipping from building to storage	30		1:1	WA&S	2	2	$18	$83				$332	$52.78	$1,124	
		30		1:1	RCT	1	2.72	$18	$83				$226	$35.89	$1,160	
		30		1:1	NMC	1	2.26	$18	$83				$187	$29.67	$1,190	
		30		1:1	Trucker	2	1.5	$15	$71				$212	$33.65	$1,223	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142.02	$1,365	

Table D-2. (continued)

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Basis Crate	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
2a	Transport to Storage															
	Staging from building to dock		5	1:1	WA&S	2	2	$18	$83				$332	$20.98		$239
			5	1:1	NMC	1	1.13	$18	$83				$93	$5.90		$245
			5	1:1	RCT	1	1.36	$18	$83				$113	$7.13		$252
	Shipping from building to storage		5	1:1	WA&S	2	2	$18	$83				$332	$20.98		$273
			5	1:1	RCT	1	2.72	$18	$83				$226	$14.26		$287
			5	1:1	NMC	1	2.26	$18	$83				$187	$11.79		$299
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13.37		$312
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9.41		$321
3	Storage									Annual Inspection Cost	1	$51.00	$51	$242.86	$1,608	
4	Transport to Assay	30		1:1	WA&S	2	2	$18	$83				$332	$52.78	$1,661	
		30		1:1	RCT	1	2.72	$18	$83				$226	$35.89	$1,697	
		30		1:1	NMC	1	2.26	$18	$83				$187	$29.67	$1,726	
		30		1:1	Trucker	2	1.5	$15	$71				$212	$33.65	$1,760	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142.02	$1,902	
4a	Transport to Assay		5	1:1	WA&S	2	2	$18	$83				$332	$20.98		$342
			5	1:1	RCT	1	2.72	$18	$83				$226	$14.26		$357
			5	1:1	NMC	1	2.26	$18	$83				$187	$11.79		$369
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13.37		$382
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9.41		$391
5	Waste Assay															
	Counting	1		1:1	Process Specialist	2	0.5	$18	$83				$83	$395.82	$2,298	
	Container Movement	40		1:1	Process Specialist	2	4	$18	$83				$665	$79.16	$2,377	
		40		1:1	RCT	1	4.08	$18	$83				$339	$40.37	$2,417	
		40		1:1	NMC	1	3.39	$18	$83				$280	$33.38	$2,451	
5a	Waste Assay		1	1:1	Process Specialist	2	0.5	$18	$83				$83	$26.22		$418
	Counting		5	1:1	Process Specialist	2	4	$18	$83				$665	$41.95		$459
	Container Movement		5	1:1	RCT	1	4.08	$18	$83				$339	$21.40		$481
			5	1:1	NMC	1	3.39	$18	$83				$280	$17.69		$499
6	Transport to RTR	30		1:1	WA&S	2	2	$18	$83				$332	$52.78	$2,504	
		30		1:1	RCT	1	2.72	$18	$83				$226	$35.89	$2,539	
		30		1:1	NMC	1	2.26	$18	$83				$187	$29.67	$2,569	
		30		1:1	Trucker	2	2.5	$15	$71				$353	$56.08	$2,625	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142.02	$2,767	
6a	Transport to RTR		5	1:1	WA&S	2	2	$18	$83				$332	$20.98		$520
			5	1:1	RCT	1	2.72	$18	$83				$226	$14.26		$534
			5	1:1	NMC	1	2.26	$18	$83				$187	$11.79		$546
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13.37		$559
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9.41		$568
7	Verify Characterization	30		1:1	Coordinator	1	1.5	$18	$83				$125	$19.85	$2,787	
		1		1:1	Waste Technician	2	0.17	$18	$83				$28	$134.95	$2,922	
		30		1:1	Waste Technician	2	1	$18	$83				$167	$26.46	$2,949	
		1		1:1	Waste Technician	2	0.05	$18	$83				$8	$39.69	$2,988	
		3		1:1	NDT Technician	2	0.5	$20	$91				$91	$143.77	$3,132	
		3		1:1	Waste Technician	2	0.17	$18	$83				$28	$44.98	$3,177	
7a	Verify Characterization		1	1:1	NDT Technician	2	0.33	$20	$91				$60	$18.86		$587
			1	1:1	Waste Technician	2	0.17	$18	$83				$28	$8.94		$596
			5	1:1	Coordinator	1	1.5	$18	$83				$125	$7.89		$604

Table D-2. (continued)

					LABOR					NONLABOR						
ID	ACTIVITY DESCRIPTION	Basis (Drums)	Basis Crate	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
			1	1:1	Waste Technician	2	0.17	$18	$83				$28	$8.94		$613
			5	1:1	Waste Technician	2	1	$18	$83				$167	$10.52		$624
			1	1:1	Waste Technician	2	0.05	$18	$83				$8	$2.63		$626
8	Transport to Storage	30		1:1	WA&S	2	2	$18	$83				$332	$52.78	$3,230	
		30		1:1	RCT	1	2.72	$18	$83				$226	$35.89	$3,266	
		30		1:1	NMC	1	2.26	$18	$83				$187	$29.67	$3,295	
		30		1:1	Trucker	2	2.5	$15	$71				$353	$56.08	$3,351	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142.02	$3,493	
8a	Transport to Storage		5	1:1	WA&S	2	2	$18	$83				$332	$20.98		$647
			5	1:1	RCT	1	2.72	$18	$83				$226	$14.26		$661
			5	1:1	NMC	1	2.26	$18	$83				$187	$11.79		$673
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13.37		$687
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9.41		$696
9	Storage									Annual Inspection Cost	1	$51.00	$51	$242.86	$3,736	
10	Movement to Staging	30		1:1	WA&S	2	2	$18	$83				$332	$52.78	$3,789	
		30		1:1	RCT	1	2.72	$18	$83				$226	$35.89	$3,825	
		30		1:1	NMC	1	2.26	$18	$83				$187	$29.67	$3,855	
		30		1:1	Trucker	2	2.5	$15	$71				$353	$56.08	$3,911	
		1		1:1	Inspector	2	0.18	$18	$83				$30	$142.02	$4,053	
10a	Movement to Staging		5	1:1	WA&S	2	2	$18	$83				$332	$20.98		$717
			5	1:1	RCT	1	2.72	$18	$83				$226	$14.26		$731
			5	1:1	NMC	1	2.26	$18	$83				$187	$11.79		$743
			5	1:1	Trucker	2	1.5	$15	$71				$212	$13.37		$756
			1	1:1	Inspector	2	0.18	$18	$83				$30	$9.41		$766
11	Prepare for Shipment	1		1:1	Waste Technician	2	0.17	$18	$83				$28	$134.95	$4,188	$775
		1		1:1	Coordinator	1	0.05	$18	$83				$4	$19.85	$4,207	$776
12	Stage Containers	1		1:1	Waste Technician	2	0.03	$18	$83				$5	$23.81	$4,231	$778
13	Verify Characterization	1		1:1	Inspector	1	0.17	$18	$83				$14	$67.07	$4,298	$782
14	Paint and Stencil	1		1:1	Waste Technician	2	0.08	$18	$83				$13	$63.51	$4,362	$786
		1		1:1	Painter	1	0.25	$19	$85				$21	$101.64	$4,463	$793
15	Container & Document Inspection	42		1:1	Coordinator	1	1	$18	$83				$83	$9.45	$4,473	
15a	Container & Document Inspection		10	1:1	Coordinator	1	0.5	$18	$83				$42	$1.31		$794
16	Certification Inspection	1		1:1	Quality Engineer	1	1	$21	$97				$97	$461.97	$4,935	
		104		1:1	Waste Technician	2	2	$18	$83				$333	$15.27	$4,950	
16a	Certification Inspection		1	1:1	Quality Engineer	1	1	$21	$97				$97	$30.60		$825
			10	1:1	Waste Technician	2	0.5	$18	$83				$83	$2.63		$828
17	Traffic Inspection	104		1:1	Inspector	2	1	$18	$83				$166	$7.59	$4,958	
		104		1:1	Quality Engineer	1	1	$21	$97				$97	$4.44	$4,962	
		104		1:1	Traffic	1	1	$17	$80				$80	$3.65	$4,966	
17a	Traffic Inspection		10	1:1	Inspector	2	0.5	$18	$83				$83	$2.61		$830
			10	1:1	Quality Engineer	1	1	$21	$97				$97	$3.06		$833
			10	1:1	Traffic	1	1	$17	$80				$80	$2.52		$836
18	Trailer Inspection	104		1:1	Waste Technician	2	0.25	$18	$83				$42	$1.91	$4,968	
		1		1:1	RCT	1	0.12	$18	$83				$10	$47.50	$5,015	
	Paperwork Verification	104		1:1	Waste Technician	2	0.17	$18	$83				$28	$1.30	$5,017	
18a	Trailer Inspection		10	1:1	Waste Technician	2	0.25	$18	$83				$42	$1.31		$837
			1	1:1	RCT	1	0.12	$18	$83				$10	$3.15		$840

Table D-2. (continued)

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Basis Crate	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³) Drums	Cumulative Total ($/m³) Crates
	Paperwork Verification		10	1:1	Waste Technician	2	0.17	$18	$83				$28	$0.89		$841
19	Load Truck															
	Inspection	208		1:1	Quality Engineer	1	3.47	$21	$97				$337	$7.71	$5,024	
		208		1:1	Inspector	2	3.47	$18	$83				$575	$13.16	$5,037	
		208		1:1	Coordinator	1	3.47	$18	$83				$289	$6.62	$5,044	
		208		1:1	Waste Technician	4	3.47	$18	$83				$1,157	$26.49	$5,071	
	Move into vehicle	208		1:1	Waste Technician	4	2	$18	$83				$667	$15.27	$5,086	
	Loading inspection	208		1:1	Quality Engineer	1	2	$21	$97				$194	$4.44	$5,090	
		208		1:1	Inspector	2	2	$18	$83				$331	$7.59	$5,098	
		208		1:1	Coordinator	1	2	$18	$83				$167	$3.82	$5,102	
	Paperwork Verification	208		1:1	Quality Engineer	1	0.25	$21	$97				$24	$0.56	$5,102	
		208		1:1	Inspector	1	0.25	$18	$83				$21	$0.47	$5,103	
		208		1:1	Coordinator	1	0.25	$18	$83				$21	$0.48	$5,103	
		208		1:1	Coordinator	2	3	$18	$83				$500	$11.45	$5,115	
		208		1:1	Waste Operations	2	0.5	$18	$83				$83	$1.91	$5,117	
		208		1:1	RCT	1	0.25	$18	$83				$21	$0.48	$5,117	
	Traffic coordination	208		1:1	Coordinator	1	2	$18	$83				$167	$3.82	$5,121	
		208		1:1	Traffic	1	4	$17	$80				$319	$7.31	$5,128	
	Vehicle sealed	208		1:1	Waste Technician	1	0.33	$18	$83				$28	$0.63	$5,129	
19a	Load Truck															
	Inspection		20	1:1	Quality Engineer	1	0.5	$21	$97				$49	$0.77		$842
			20	1:1	Inspector	2	0.5	$18	$83				$83	$1.31		$843
			20	1:1	Coordinator	1	0.5	$18	$83				$42	$0.66		$844
			20	1:1	Waste Technician	4	0.5	$18	$83				$167	$2.63		$846
	Move into vehicle		20	1:1	Waste Technician	4	0.5	$18	$83				$167	$2.63		$849
	Loading inspection		20	1:1	Quality Engineer	1	0.5	$21	$97				$49	$0.77		$850
			20	1:1	Inspector	2	0.5	$18	$83				$83	$1.31		$851
			20	1:1	Coordinator	1	0.5	$18	$83				$42	$0.66		$852
	Paperwork Verification		20	1:1	Quality Engineer	1	0.25	$21	$97				$24	$0.38		$852
			20	1:1	Inspector	1	0.25	$18	$83				$21	$0.33		$853
			20	1:1	Coordinator	1	0.25	$18	$83				$21	$0.33		$853
			20	1:1	Coordinator	2	3	$18	$83				$500	$7.89		$861
			20	1:1	Waste Operations	2	0.5	$18	$83				$83	$1.31		$862
			20	1:1	RCT	1	0.25	$18	$83				$21	$0.33		$863
	Traffic coordination		20	1:1	Coordinator	1	2	$18	$83				$167	$2.63		$865
			20	1:1	Traffic	1	4	$17	$80				$319	$5.04		$870
	Vehicle sealed		20	1:1	Waste Technician	1	0.33	$18	$83				$28	$0.43		$871
20	Radiological Survey	208		1:1	RCT	1	0.33	$18	$83				$27	$0.63	$5,129	
20a	Radiological Survey		20	1:1	RCT	1	0.33	$18	$83				$27	$0.43		$871
														Total ($/m³)		$3,128

SITE 2

TRANSURANIC WASTE

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouse. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of new waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Transport to Storage

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the

accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 3. Storage

No variable, waste dependent costs are associated with non-RCRA storage.

Activity 4. Transport to Assay

Movement of the container from storage requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the assay building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 5. Waste Assay

Each container is nondestructively assayed to determine the amount of radioactive materials within each drum. Different types of assay equipment are located in different buildings. Each drum is directed to assay equipment based upon its weight and contents. The assay or counting operation is conducted by a process specialist. A second process specialist is required to move the drum from the delivery area to the counting equipment and back. A health physics technician checks the drum at receipt and before the drum leaves the assay building for radiological contamination. The results of the assay and the location of the drum are entered into the waste tracking system and the Nuclear Materials Control system. The drum is then shipped to RTR.

Activity 6. Shipment to RTR

Movement of the container from the assay building requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the RTR building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 7. Verify Characterization

This procedure is a nondestructive testing (NDT) technique for looking inside a drum to determine that it is in compliance with shipping requirements. The RTR of a drum requires participation by waste technicians, an NDT technician, and a waste coordinator. The procedure includes moving the drum in and out of the RTR machine, running the test, and documenting the results. Before the drum can leave the building it must again be radiologically monitored.

Activity 8. Transport to Storage

Before the drum is moved from a building the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 9. Storage

No variable, waste dependent costs are associated with non-RCRA storage.

Activity 10. Movement to Staging

Same as Activity 8 above.

Activity 11. Prepare for Shipment

Radioactive waste designated for offsite shipment and disposal is staged, where it undergoes final inspection and certification. The waste is accepted into the building by two waste technicians and a waste coordinator.

Activity 12. Stage Containers

Two waste technicians ready the containers for shipment by aligning them in a staging area.

Activity 13. Verify Characterization

Containers are inspected to confirm compliance with physical and documentation requirements.

Activity 14. Paint and Stencil

Containers are painted and stenciled with all required markings by a painter. Two waste technicians move the drums.

Activity 15. Container and Document Inspection

A waste coordinator inspects all containers and documentation for compliance with all criteria.

Activity 16. Certification Inspection

Certification personnel perform an inspection to ensure compliance with the applicable waste acceptance certification criteria. The inspection is conducted by a quality engineer assisted by two waste technicians.

Activity 17. Traffic Inspection

The quality engineer, two waste inspectors, and traffic personnel inspect the trailer and the waste load to ensure all Department of Transportation (DOT) requirements are satisfied.

Activity 18. Load Trupact

The TRUPACT-II Trailer is loaded by four waste technicians under the supervision of a quality engineer, an inspector, and a waste coordinator. A final inspection of each container takes place as it is loaded. The container movement is recorded in the Nuclear Materials Control system and the waste tracking system. When loaded, the trailer is sealed and an exterior radiological survey is performed.

Activity 19. Shipment to WIPP

Activity 20. WIPP Disposal

Figure D-3. Site 2: transuranic waste.

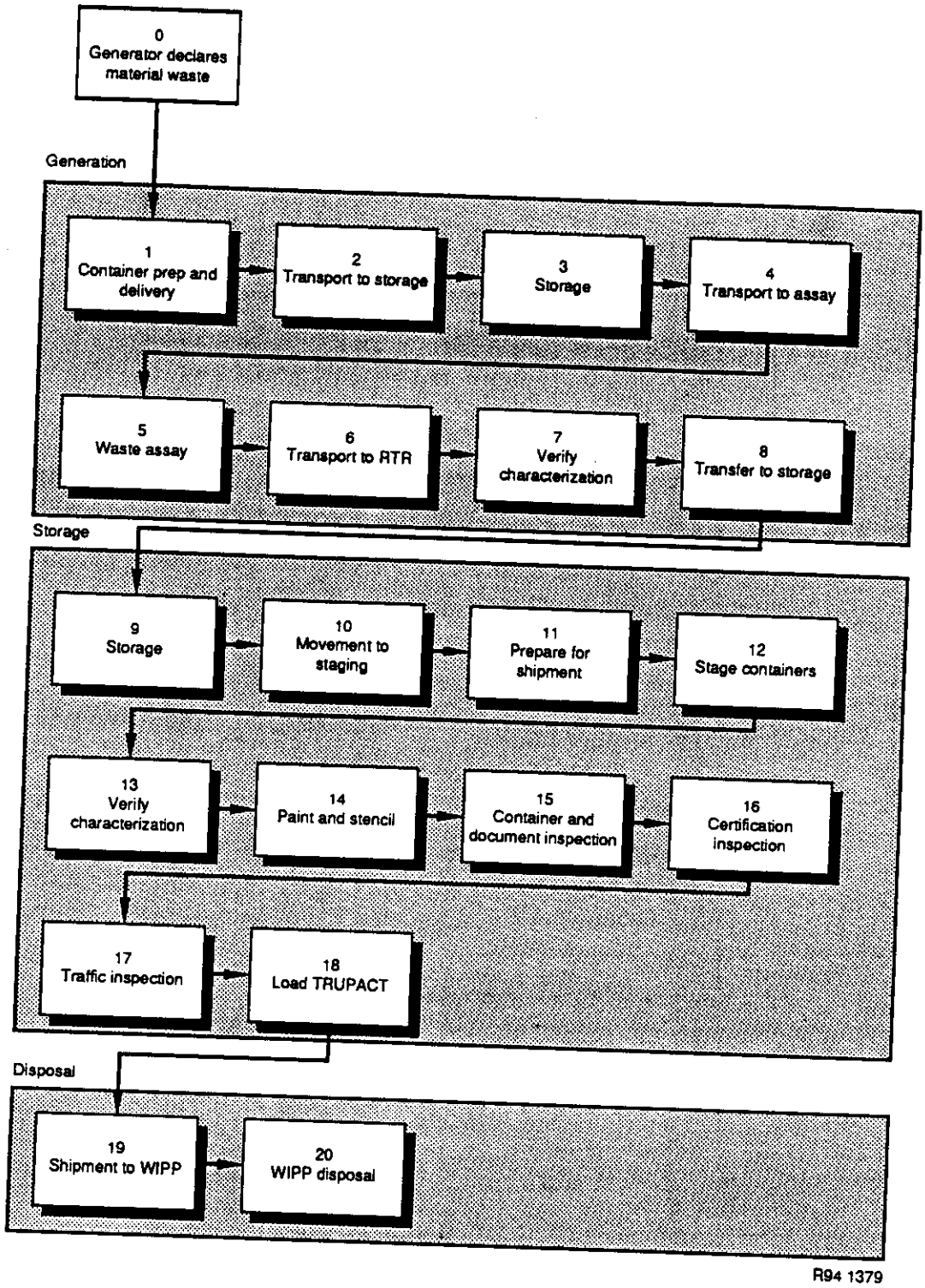


Table D-3. Site 2: transuranic waste.

Annual Quantity Generated: 8.41 m^3
Annual Quantity Disposed: 8.41 m^3

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Container Prep & Delivery													
	Receive New Drums	3,000	1:1	Stock Clerk	6	80	$18	$83	55 Gallon Drum	1	$32	$40,041	$217	$217
	Inspect & Prepare New Containers	25	1:1	NMC	1	0.5	$18	$83	Liner, PVC, Type V	1	$26	$68	$134	$351
		25	1:1	Inspector	2	1.5	$18	$83	O-ring bag (22")	1	$18	$266	$132	$482
		25	1:1	Stock Clerk	2	2	$17	$78	Plastic liner-10 mil	1	$1	$313	$63	$545
	Load Truck, Deliver to Plant and Generator	25	1:1	Trucker	2	2.5	$15	$71	Filter	1	$25	$379	$189	$733
		25	1:1	Coordinator	1	0.25	$18	$83	Fiberboard Disc	1	$2	$23	$12	$746
		25	1:1	NMC	1	2.5	$18	$83				$207	$39	$785
		25	1:1	WEMS	1	0.25	$17	$78				$20	$4	$789
		1	1:1	NMC	1	0.5	$18	$83				$41	$197	$986
2	Transport to Storage													
	Staging from building to dock	30	1:1	WA&S	2	2	$18	$83				$332	$53	$1,038
		30	1:1	NMC	1	1.13	$18	$83				$93	$15	$1,053
		30	1:1	RCT	1	1.36	$18	$83				$113	$18	$1,071
	Shipping from building to storage	30	1:1	WA&S	2	2	$18	$83				$332	$53	$1,124
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$1,160
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$1,190
		30	1:1	Trucker	2	1.5	$15	$71				$212	$34	$1,223
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$1,365
3	Storage			NO VARIABLE COSTS ASSOCIATED WITH NON REGULATED WASTE STORAGE										
4	Transport to Assay	30	1:1	WA&S	2	2	$18	$83				$332	$53	$1,418
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$1,454
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$1,484
		30	1:1	Trucker	2	1.5	$15	$71				$212	$34	$1,517
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$1,659
5	Waste Assay													
	Counting	1	1:1	Process Specialist	2	0.5	$18	$83				$83	$396	$2,055
	Container Movement	40	1:1	Process Specialist	2	4	$18	$83				$665	$79	$2,134
		40	1:1	RCT	1	4.08	$18	$83				$339	$40	$2,175
		40	1:1	NMC	1	3.39	$18	$83				$280	$33	$2,208

Table D-3. (continued).

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
6	Shipment to RTR	30	1:1	WA&S	2	2	$18	$83				$332	$53	$2,261
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$2,297
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$2,326
		30	1:1	Trucker	2	2.5	$15	$71				$353	$56	$2,382
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$2,524
7	Verify Characterization	30	1:1	Coordinator	1	1.5	$18	$83				$125	$20	$2,544
		1	1:1	Waste Technician	2	0.17	$18	$83				$28	$135	$2,679
		30	1:1	Waste Technician	2	1	$18	$83				$167	$26	$2,706
		1	1:1	Waste Technician	2	0.05	$18	$83				$8	$40	$2,745
		3	1:1	NDT Technician	2	0.5	$20	$91				$91	$144	$2,889
		3	1:1	Waste Technician	2	0.17	$18	$83				$28	$45	$2,934
8	Transport to Storage	30	1:1	WA&S	2	2	$18	$83				$332	$53	$2,987
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$3,023
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$3,052
		30	1:1	Trucker	2	2.5	$15	$71				$353	$56	$3,109
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$3,251
9	Storage			NO VARIABLE COSTS ASSOCIATED WITH NON REGULATED WASTE STORAGE										
10	Movement to Staging	30	1:1	WA&S	2	2	$18	$83				$332	$53	$3,303
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$3,339
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$3,369
		30	1:1	Trucker	2	2.5	$15	$71				$353	$56	$3,425
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$3,567
11	Prepare for Shipment	1	1:1	Waste Technician	2	0.17	$18	$83				$28	$135	$3,702
		1	1:1	Coordinator	1	0.05	$18	$83				$4	$20	$3,722
12	Stage Containers	1	1:1	Waste Technician	2	0.03	$18	$83				$5	$24	$3,746
13	Verify Characterization	1	1:1	Inspector	1	0.17	$18	$83				$14	$67	$3,813
14	Paint & Stencil	1	1:1	Waste Technician	2	0.08	$18	$83				$13	$64	$3,876
		1	1:1	Painter	1	0.25	$19	$85				$21	$102	$3,978
15	Container & Document Inspection	42	1:1	Coordinator	1	1	$18	$83				$83	$9	$3,987
16	Certification Inspection	1	1:1	Quality Engineer	1	1	$21	$97				$97	$462	$4,449
		42	1:1	Waste Technician	2	2	$18	$83				$333	$38	$4,487
17	Traffic Inspection	42	1:1	Inspector	2	1	$18	$83				$166	$19	$4,506
		42	1:1	Quality Engineer	1	1	$21	$97				$97	$11	$4,517
		42	1:1	Traffic	1	1	$17	$80				$80	$9	$4,526

Table D-3. (continued).

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
18	Load TRUPACT	42	1:1	Quality Engineer	1	7	$21	$97				$679	$77	$4,603
		42	1:1	Inspector	1	7	$18	$83				$580	$66	$4,669
		42	1:1	Coordinator	1	7	$18	$83				$583	$66	$4,735
		42	1:1	Waste Technician	4	7	$18	$83				$2,334	$265	$4,999
		42	1:1	NDT Technician	1	7	$20	$91				$634	$72	$5,071
		42	1:1	RCT	1	7	$18	$83				$582	$66	$5,137

SITE 2

TRANSURANIC MIXED WASTE

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouse. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of new waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Transport to Storage

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the

accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 3. Storage

RCRA inspections by a waste technician and a waste coordinator must be conducted and documented on a weekly basis. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 4. Transport to Assay

Movement of the container from storage requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the assay building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 5. Waste Assay

Each container is nondestructively assayed to determine the amount of radioactive materials within each drum. Different types of assay equipment are located in different buildings. Each drum is directed to assay equipment based upon its weight and contents. The assay or counting operation is conducted by a process specialist. A second process specialist is required to move the drum from the delivery area to the counting equipment and back. A health physics technician checks the drum at receipt and before the drum leaves the assay building for radiological contamination. The results of the assay and the location

of the drum are entered into the waste tracking system and the Nuclear Materials Control system. The drum is then shipped to RTR.

Activity 6. Shipment To RTR

Movement of the container from the assay building requires data entry on the accountability system, radiological monitoring, loading of the truck, driving the truck to the RTR building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 7. Verify Characterization

This procedure is a nondestructive testing (NDT) technique for looking inside a drum to determine that it is in compliance with shipping requirements. The RTR of a drum requires participation by waste technicians, an NDT technician, and a waste coordinator. The procedure includes moving the drum in and out of the RTR machine, running the test, and documenting the results. Before the drum can leave the building it must again be radiologically monitored.

Activity 8. Transport to Storage

Before the drum is moved from a building the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to storage, which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the storage building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 9. Storage

RCRA inspections by a waste technician and a waste coordinator must be conducted and documented on a weekly basis. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 10. Movement to Staging

Same as Activity 8 above.

Activity 11. Prepare for Shipment

Radioactive waste designated for offsite shipment and disposal is staged, where it undergoes final inspection and certification. The waste is accepted into the building by two waste technicians and a waste coordinator.

Activity 12. Stage Containers

Two waste technicians ready the containers for shipment by aligning them in a staging area.

Activity 13. Verify Characterization

Containers are inspected to confirm compliance with physical and documentation requirements.

Activity 14. Paint and Stencil

Containers are painted and stenciled with all required markings by a painter. Two waste technicians move the drums.

Activity 15. Container and Document Inspection

A waste coordinator inspects all containers and documentation for compliance with all criteria.

Activity 16. Certification Inspection

Certification personnel perform an inspection to ensure compliance with the applicable waste acceptance certification criteria. The inspection is conducted by a quality engineer assisted by two waste technicians.

Activity 17. Traffic Inspection

The quality engineer, two waste inspectors, and traffic personnel inspect the trailer and the waste load to ensure all Department of Transportation (DOT) requirements are satisfied.

Activity 18. Load Trupact

The TRUPACT-II Trailer is loaded by four waste technicians under the supervision of a quality engineer, an inspector, and a waste coordinator. A final inspection of each container takes place as it is loaded. The container movement is recorded in the Nuclear Materials Control system and the waste tracking system. When loaded, the trailer is sealed and an exterior radiological survey is performed.

Activity 19. Shipment to WIPP

Activity 20. WIPP Disposal

Figure D-4. Site 2: transuranic mixed waste.

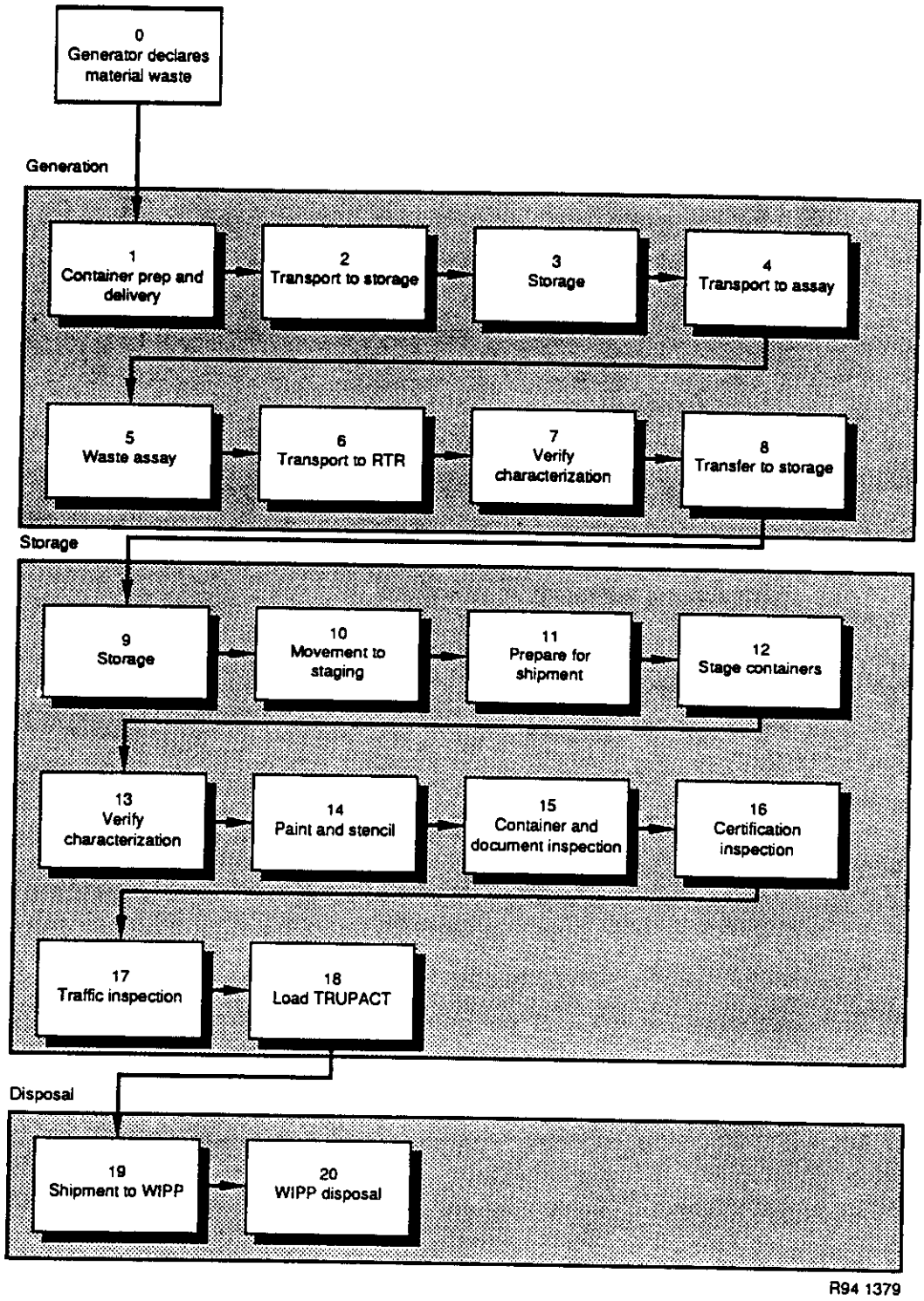


Table D-4. Site 2: transuranic mixed waste.

Annual Quantity Generated: 6.12 m³
Annual Quantity Disposed: 6.12 m³

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
0	**Generator Declares Material Waste**													$0
1	**Container Prep & Delivery**													
	Receive New Drums	3,000	1:1	Stock Clerk	6	80	$18	$83	55 Gallon Drum	1	$32	$40,041	$217	$217
	Inspect & Prepare New Containers	25	1:1	NMC	1	0.5	$18	$83	Liner, PVC, Type V	1	$26	$68	$134	$351
		25	1:1	Inspector	2	1.5	$18	$83	O-ring bag (22")	1	$18	$266	$132	$482
		25	1:1	Stock Clerk	2	2	$17	$78	Plastic liner-10 mil	1	$1	$313	$63	$545
	Load Truck, Deliver to Plant and Generator	25	1:1	Trucker	2	2.5	$15	$71	Filter	1	$25	$379	$189	$733
		25	1:1	Coordinator	1	0.25	$18	$83	Fiberboard Disc	1	$2	$23	$12	$746
		25	1:1	NMC	1	2.5	$18	$83				$207	$39	$785
		25	1:1	WEMS	1	0.25	$17	$78				$20	$4	$789
		1	1:1	NMC	1	0.5	$18	$83				$41	$197	$986
2	**Transport to Storage**		1:1											
	Staging from building to dock	30	1:1	WA&S	2	2	$18	$83				$332	$53	$1,038
		30	1:1	NMC	1	1.13	$18	$83				$93	$15	$1,053
		30	1:1	RCT	1	1.36	$18	$83				$113	$18	$1,071
	Shipping from building to storage	30	1:1	WA&S	2	2	$18	$83				$332	$53	$1,124
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$1,160
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$1,190
		30	1:1	Trucker	2	1.5	$15	$71				$212	$34	$1,223
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$1,365
3	**Storage**		1:1	Waste Technician					$/Container/year	1	$51	$51	$243	$1,608
4	**Transport to Assay**	30	1:1	WA&S	2	2	$18	$83				$332	$53	$1,661
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$1,697
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$1,726
		30	1:1	Trucker	2	1.5	$15	$71				$212	$34	$1,760
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$1,902
5	**Waste Assay**		1:1											
	Counting	1	1:1	Process Specialist	2	0.5	$18	$83				$83	$396	$2,298
	Container Movement	40	1:1	Process Specialist	2	4	$18	$83				$665	$79	$2,377
		40	1:1	RCT	1	4.08	$18	$83				$339	$40	$2,417
		40	1:1	NMC	1	3.39	$18	$83				$280	$33	$2,451
6	**Shipment to RTR**	30	1:1	WA&S	2	2	$18	$83				$332	$53	$2,504
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$2,539

Table D-4. (continued).

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$2,569
		30	1:1	Trucker	2	2.5	$15	$71				$353	$56	$2,625
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$2,767
7	Verify Characterization	30	1:1	Coordinator	1	1.5	$18	$83				$125	$20	$2,787
		1	1:1	Waste Technician	2	0.17	$18	$83				$28	$135	$2,922
		30	1:1	Waste Technician	2	1	$18	$83				$167	$26	$2,949
		1	1:1	Waste Technician	2	0.05	$18	$83				$8	$40	$2,988
		3	1:1	NDT Technician	2	0.5	$20	$91				$91	$144	$3,132
		3	1:1	Waste Technician	2	0.17	$18	$83				$28	$45	$3,177
8	Transport to Storage	30	1:1	WA&S	2	2	$18	$83				$332	$53	$3,230
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$3,266
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$3,295
		30	1:1	Trucker	2	2.5	$15	$71				$353	$56	$3,351
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$3,493
9	Storage		1:1						$/Container/year	1	$51	$51	$243	$3,736
10	Movement to Staging	30	1:1	WA&S	2	2	$18	$83				$332	$53	$3,789
		30	1:1	RCT	1	2.72	$18	$83				$226	$36	$3,825
		30	1:1	NMC	1	2.26	$18	$83				$187	$30	$3,855
		30	1:1	Trucker	2	2.5	$15	$71				$353	$56	$3,911
		1	1:1	Inspector	2	0.18	$18	$83				$30	$142	$4,053
11	Prepare for Shipment	1	1:1	Waste Technician	2	0.17	$18	$83				$28	$135	$4,188
		1	1:1	Coordinator	1	0.05	$18	$83				$4	$20	$4,207
12	Stage Containers	1	1:1	Waste Technician	2	0.03	$18	$83				$5	$24	$4,231
13	Verify Characterization	1	1:1	Inspector	1	0.17	$18	$83				$14	$67	$4,298
14	Paint and Stencil	1	1:1	Waste Technician	2	0.08	$18	$83				$13	$64	$4,362
		1	1:1	Painter	1	0.25	$19	$85				$21	$102	$4,463
15	Container & Document Inspection	42	1:1	Coordinator	1	1	$18	$83				$83	$9	$4,473
16	Certification Inspection	1	1:1	Quality Engineer	1	1	$21	$97				$97	$462	$4,935
		42	1:1	Waste Technician	2	2	$18	$83				$333	$38	$4,973
17	Traffic Inspection	42	1:1	Inspector	2	1	$18	$83				$166	$19	$4,992
		42	1:1	Quality Engineer	1	1	$21	$97				$97	$11	$5,003
		42	1:1	Traffic	1	1	$17	$80				$80	$9	$5,012

Table D-4. (continued).

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
18	Load TRUPACT	42	1:1	Quality Engineer	1	7	$21	$97				$679	$77	$5,089
		42	1:1	Inspector	1	7	$18	$83				$580	$66	$5,154
		42	1:1	Coordinator	1	7	$18	$83				$583	$66	$5,220
		42	1:1	Waste Technician	4	7	$18	$83				$2,334	$265	$5,485
		42	1:1	NDT Technician	1	7	$20	$91				$634	$72	$5,557
		42	1:1	RCT	1	7	$18	$83				$582	$66	$5,623

SITE 2

RCRA LIQUIDS

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouse. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of new waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Waste Sampling/Analysis

The fingerprint is an analysis of the waste to determine what RCRA constituents are present in the waste. The fingerprint sample is obtained by a waste

coordinator and two waste technicians and the laboratory sample is run at the plants general laboratory by a laboratory technician.

Activity 2a. Alpha Screen Loop

The laboratory also measures a sample to determine if any alpha contamination is present. This analysis involves one operations laboratory person.

Activity 3. Release Evaluation

Before the waste can be shipped and disposed of as nonradioactive it must be evaluated by a health physics technician and a radiological engineer. The waste is then shipped to interim storage, awaiting shipment and disposal.

Activity 4. Transport to Storage

Moving waste to temporary storage includes a waste coordinator, a waste technician, and a trucker, loading the waste into the truck and delivering it.

Activity 5. Storage

RCRA inspections by a waste technician and a waste coordinator must be conducted and documented on a weekly basis. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 6. Offsite Shipment for Treatment/Disposal

Charges shown are for a commercial company to pick up and dispose of the waste at an offsite treatment, storage, and disposal (TSD) facility.

Figure D-5. Site 2: RCRA liquids.

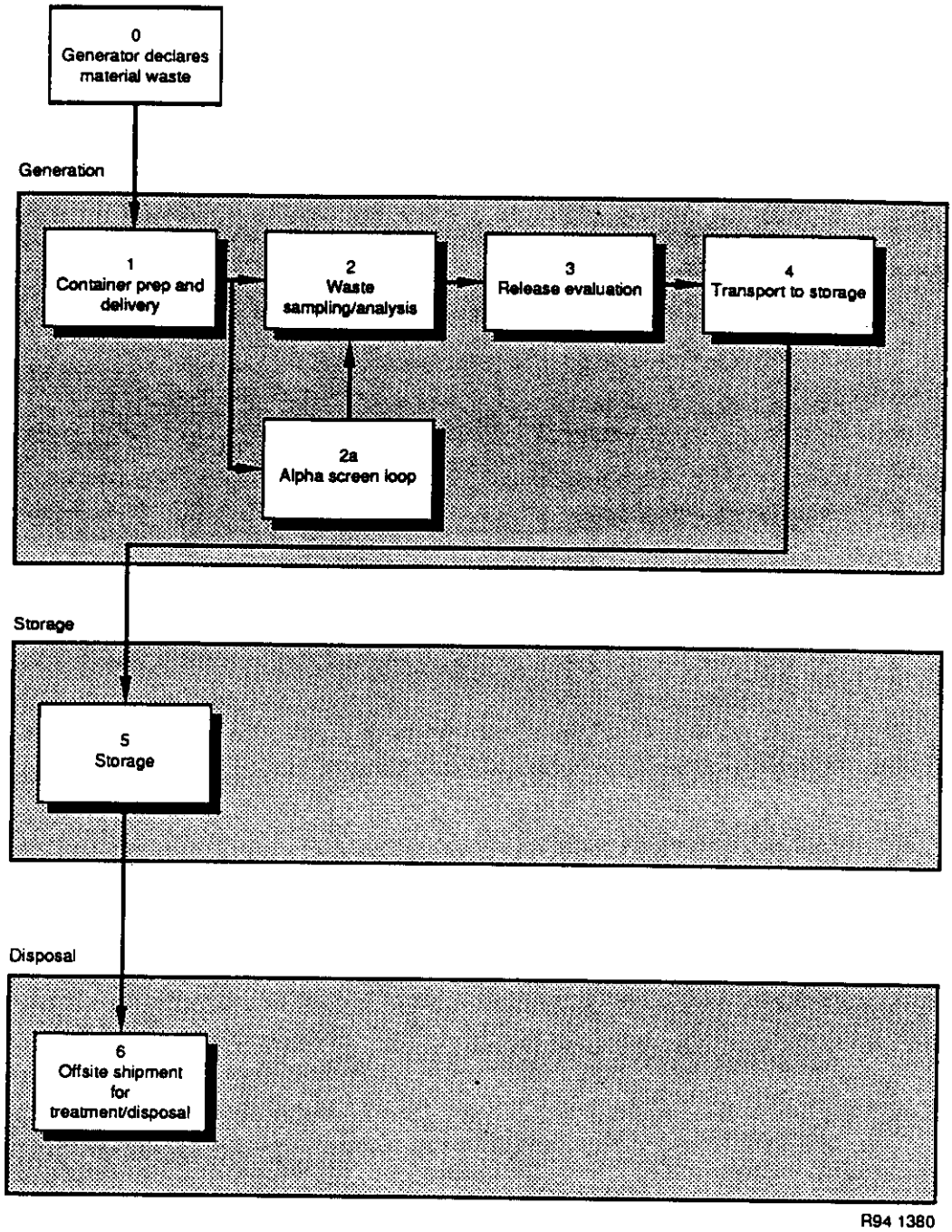


Table D-5. Site 2: RCRA liquids.

Annual Quantity Generated: 13145 kg
Annual Quantity Disposed: 13145 kg

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	**Generator Declares Material Waste**													$0.00
1	**Container Prep & Delivery**		1:1											
	Receive New Drums	3,000	1:1	Stock Clerk	6	80	$18	$83	55 Gallon Drum	1	$32	$40,041	$0.27	$0.27
	Inspect & Prepare New Containers	25	1:1	NMC	1	0.5	$18	$83	Plastic Liners	2	$1	$43	$0.02	$0.29
		25	1:1	Inspector	2	1.5	$18	$83	Filter	1	$25	$274	$0.21	$0.50
		25	1:1	Stock Clerk	2	2	$17	$78	Fiberboard Disk	1	$2	$314	$0.08	$0.58
	Load Truck, Deliver to Plant and Generator	25	1:1	Trucker	2	2.5	$15	$71				$353	$0.08	$0.66
		25	1:1	Coordinator	1	0.25	$18	$83				$21	$0.00	$0.67
		25	1:1	NMC	1	2.5	$18	$83				$207	$0.05	$0.72
		25	1:1	WEMS	1	0.25	$17	$78				$20	$0.00	$0.72
		1	1:1	NMC	1	0.5	$18	$83				$41	$0.24	$0.97
	Waste Processing Request	1	1:1	Coordinator	1	0.1	$18	$83				$8	$0.05	$1.02
	Drum Inspection & Sign-Off	1	1:1	Coordinator	1	0.75	$18	$83				$62	$0.37	$1.38
		1	1:1	Waste Technician	2	0.75	$18	$83				$124	$0.73	$2.12
		1	1:1	Coordinator	1	0.1	$18	$83				$8	$0.05	$2.17
	WEMS Input/Update	1	1:1	Coordinator	1	0.26	$18	$83				$21	$0.13	$2.29
2	**Waste Sampling/Analysis**	1	1:1	Coordinator	1	0.15	$18	$83	Lab Supplies	1	$4	$16	$0.10	$2.39
		1	1:1	Waste Technician	2	2.38	$18	$83				$393	$2.33	$4.72
		1	1:1	General Lab	1	6.25	$19	$87				$541	$3.20	$7.92
2a	**Alpha Screen Loop**	1	1:1	Operations Lab Suppo	1	6.25	$19	$87	Lab Supplies	1	$10	$551	$3.26	$8.90 *
3	**Release Evaluation**	1	1:1	RCT	1	2	$18	$83				$166	$0.98	$9.88
		1	1:1	Radiological Engineer	1	2	$22	$103				$206	$1.22	$11.10
4	**Transport to Storage**	1	1:1	Coordinator	1	1	$18	$83				$83	$0.49	$11.59
		1	1:1	Waste Technician	2	1	$18	$83				$165	$0.98	$12.57
		1	1:1	Trucker	2	1	$15	$71				$141	$0.84	$13.40
5	**Storage**		1:1											
	Weekly RCRA Inspection(annual cost)	920	1:1	Coordinator	1	312	$18	$83				$25,791	$0.17	$13.57
		920	1:1	Waste Technician	2	312	$18	$83				$51,581	$0.33	$13.90
	Weekly Physical Inspection	920	1:1	Waste Technician	2	78	$18	$83				$12,895	$0.08	$13.99
6	**Off-Site Shipment for Treatment/Disposal**	1	1:1	Commercial Disposal						1	$299	$299	$1.77	$15.75

* This cost only applies to 30% of the waste stream

SITE 2

RCRA SOLID WASTE

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouse. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of new waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Transport to RTR

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the

accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to real-time radiography (RTR), which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the RTR building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 3. Verify Characterization

This procedure is a nondestructive testing (NDT) technique for looking inside a drum to determine that it is in compliance with shipping requirements. The RTR of a drum requires participation by waste technicians, an NDT technician, and a waste coordinator. The procedure includes moving the drum in and out of the RTR machine, running the test, and documenting the results. Before the drum can leave the building it must again be radiologically monitored.

Activity 4. Release Evaluation

Before the waste can be shipped and disposed of as nonradioactive it must be evaluated by a health physics technician and a radiological engineer. The waste is then shipped to interim storage, awaiting shipment and disposal.

Activity 5. Transport to Storage

Moving waste from the RTR building to temporary storage includes a waste coordinator, a waste technician, and a trucker, loading the waste into the truck and delivering it.

Activity 6. Storage

RCRA inspections by a waste technician and a waste coordinator must be conducted and documented on a monthly basis. In addition, a weekly physical inspection of the storage area is conducted by a waste technician.

Activity 7. Off-Site Shipment for Treatment/Disposal

Charges shown are for a commercial company to pick up and dispose of the waste at an offsite treatment, storage, and disposal (TSD) facility.

Figure D-6. Site 2: RCRA solid waste.

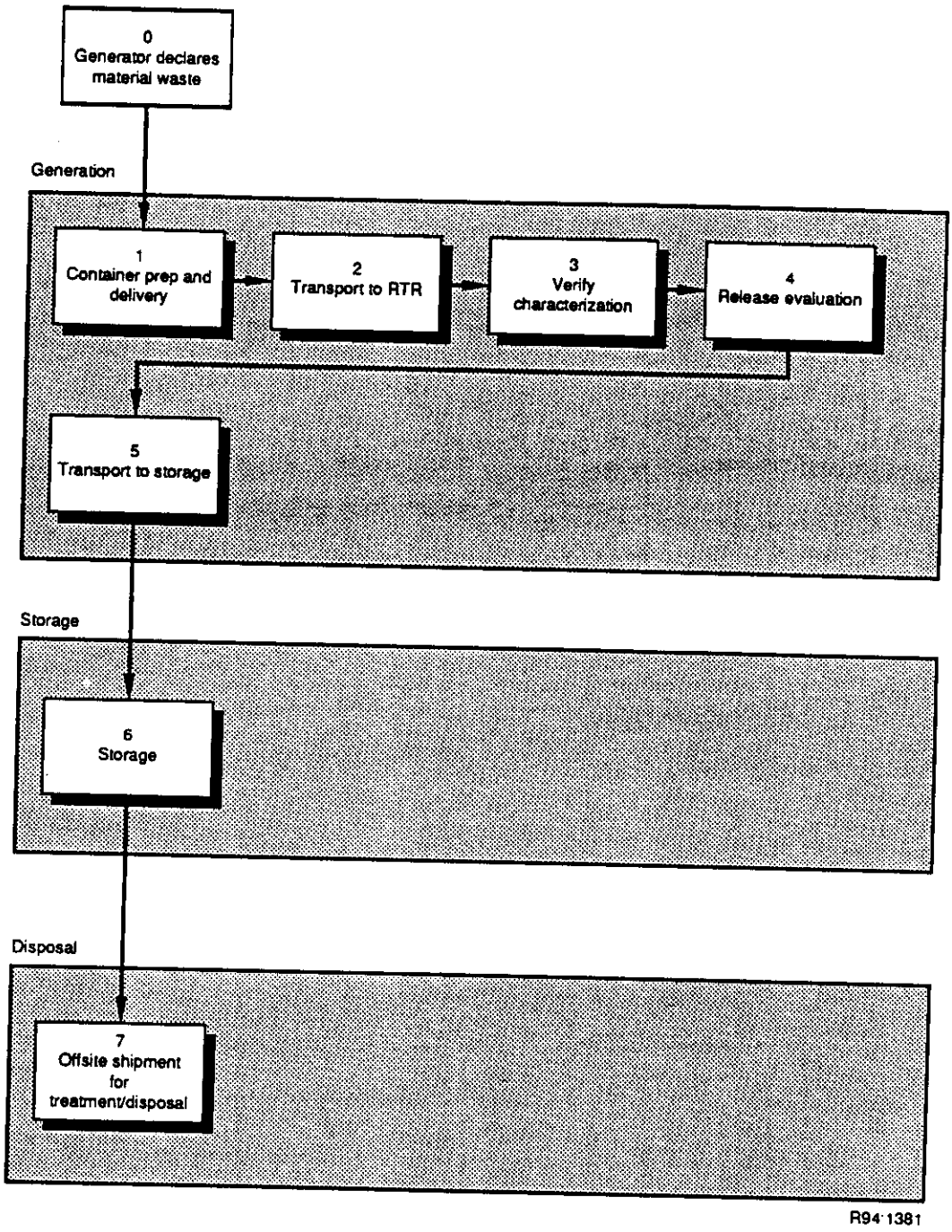


Table D-6. Site 2: RCRA solid waste.

Annual Quantity Generated: 23369 kg
Annual Quantity Disposed: 23369 kg

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	Generator Declares Material Waste													$0.00
1	Container Prep & Delivery		1:1											
	Receive New Drums	3,000	1:1	Stock Clerk	6	80	$18	$83	55 Gallon Drum	1	$32	$40,041	$0.34	$0.34
	Inspect & Prepare New Containers	25	1:1	NMC	1	0.5	$18	$83	Plastic Liners	2	$1	$43	$0.02	$0.37
		25	1:1	Inspector	2	1.5	$18	$83	Filter	1	$25	$274	$0.27	$0.63
		25	1:1	Stock Clerk	2	2	$17	$78	Fiberboard Disk	1	$2	$314	$0.11	$0.74
	Load Truck, Deliver to Plant and Generator	25	1:1	Trucker	2	2.5	$15	$71				$353	$0.11	$0.85
		25	1:1	Coordinator	1	0.25	$18	$83				$21	$0.01	$0.85
		25	1:1	NMC	1	2.5	$18	$83				$207	$0.06	$0.91
		25	1:1	WEMS	1	0.25	$17	$78				$20	$0.01	$0.92
		1	1:1	NMC	1	0.5	$18	$83				$41	$0.31	$1.23
	Waste Processing Request	1	1:1	Coordinator	1	0.1	$18	$83				$8	$0.06	$1.29
	Drum Inspection & Sign-Off	1	1:1	Coordinator	1	0.75	$18	$83				$62	$0.47	$1.76
		1	1:1	Waste Technician	2	0.75	$18	$83				$124	$0.93	$2.69
		1	1:1	Coordinator	1	0.1	$18	$83				$8	$0.06	$2.76
	WEMS Input/Update	1	1:1	Coordinator	1	0.26	$18	$83				$21	$0.16	$2.92
2	Transport to RTR		1:1											
	Staging from building to dock	30	1:1	WA&S	2	2	$18	$83				$332	$0.08	$3.00
		30	1:1	NMC	1	1.13	$18	$83				$93	$0.02	$3.02
		30	1:1	RCT	1	1.36	$18	$83				$113	$0.03	$3.05
	Shipping from building & receive at RTR	30	1:1	WA&S	2	2	$18	$83				$332	$0.08	$3.14
		30	1:1	RCT	1	2.72	$18	$83				$226	$0.06	$3.19
		30	1:1	NMC	1	2.26	$18	$83				$187	$0.05	$3.24
		30	1:1	Trucker	2	1.5	$15	$71				$212	$0.05	$3.29
		1	1:1	Inspector	2	0.18	$18	$83				$30	$0.22	$3.52
3	Verify Charaterization	30	1:1	Coordinator	1	1.5	$18	$83				$125	$0.03	$3.55
		1	1:1	Waste Technician	2	0.17	$18	$83				$28	$0.21	$3.76
		30	1:1	Waste Technician	2	1	$18	$83				$167	$0.04	$3.80
		1	1:1	Waste Technician	2	0.05	$18	$83				$8	$0.06	$3.87
		3	1:1	NDT Technician	2	0.5	$20	$91				$91	$0.23	$4.09
		3	1:1	Waste Technician	2	0.17	$18	$83				$28	$0.07	$4.17

Table D-6. (continued).

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
4	Release Evaluation	1	1:1	RCT	1	2	$18	$83				$166	$1.25	$5.42
		1	1:1	Radiological Engineer	1	2	$22	$103				$206	$1.55	$6.97
5	Transport to Storage	1	1:1	Coordinator	1	1	$18	$83				$83	$0.62	$7.59
		1	1:1	Waste Technician	2	1	$18	$83				$165	$1.24	$8.84
		1	1:1	Trucker	2	1	$15	$71				$141	$1.06	$9.90
6	Storage		1:1											
	Weekly RCRA Inspection(annual cost)	920	1:1	Coordinator	1	312	$18	$83				$25,791	$0.21	$10.11
		920	1:1	Waste Technician	2	312	$18	$83				$51,581	$0.42	$10.54
	Weekly Physical Inspection	920	1:1	Waste Technician	2	78	$18	$83				$12,895	$0.11	$10.64
7	Off-Site Shipment for Treatment/Disposal	1	1:1	Commercial Disposal						1	$720	$720	$5.42	$16.06

SITE 2

TSCA SOLID WASTE

Activity 0. Generator Declares Material Waste

Activity 1. Container Prep and Delivery

Receipt of new drums from the vendor is done by a stock clerk at the offsite warehouse. Receipt includes verifying the correct number and types of containers are delivered as per receiving documents. Inspection and preparation of the new containers is then conducted. Inspectors perform an inspection against inspection criteria. A truckload of 25 drums is inspected by two inspectors. Two stock clerks are also involved in the manual labor of moving the drums around for the inspectors. Each drum is assigned a unique tracking number which is bar coded on the container and entered into the tracking system by a data processing person. The stock clerks are involved in loading a truck for delivery of drums to generators. Two truckers are involved in the actual delivery of drums from the offsite warehouse to the waste generators. A waste coordinator is available for the acceptance of each delivery of drums to each generator. In addition, the container movement is entered in a tracking system each time the container location changes. The activity of delivering a drum to a generator is initiated by the generator processing a waste processing request form. The waste processing request form is filled out as a result of a newly-generated drum of waste. Before this drum of new waste can be moved, a preliminary drum inspection and sign off is conducted by two waste technicians and two waste coordinators. Status of the drummed waste is then entered into the tracking system by the waste coordinator.

Activity 2. Transport to RTR

Before the drum is moved from a building, the waste container documentation is inspected by Waste Acceptance and Shipping. Movement of the drum from the accumulation area to the dock area must be documented on the

accountability/tracking system and the drum must be surveyed by a health physics technician. Movement of the container to real-time radiography (RTR), which is located in another building, requires more data transactions on the accountability system, radiological monitoring, loading of the truck, driving the truck to the RTR building, unloading the truck at the destination, followed by more accountability transactions. At the destination, the drums and documentation are again inspected.

Activity 3. Verify Characterization

This procedure is a nondestructive testing (NDT) technique for looking inside a drum to determine that it is in compliance with shipping requirements. The RTR of a drum requires participation by waste technicians, an NDT technician, and a waste coordinator. The procedure includes moving the drum in and out of the RTR machine, running the test, and documenting the results. Before the drum can leave the building it must again be radiologically monitored.

Activity 4. Release Evaluation

Before the waste can be shipped and disposed of as nonradioactive it must be evaluated by a health physics technician and a radiological engineer. The waste is then shipped to interim storage, awaiting shipment and disposal.

Activity 5. Transport to Storage

Moving waste from the RTR building to temporary storage includes a waste coordinator, a waste technician, and a trucker, loading the waste into the truck and delivering it.

Activity 6. Storage

TSCA inspections by a waste technician and a waste coordinator must be conducted and documented on a monthly basis.

Activity 7. Off-Site Shipment for Treatment/Disposal

Charges shown are for a commercial company to pick up and dispose of the waste at an offsite treatment, storage, and disposal (TSD) facility.

Figure D-7. Site 2: TSCA solid waste.

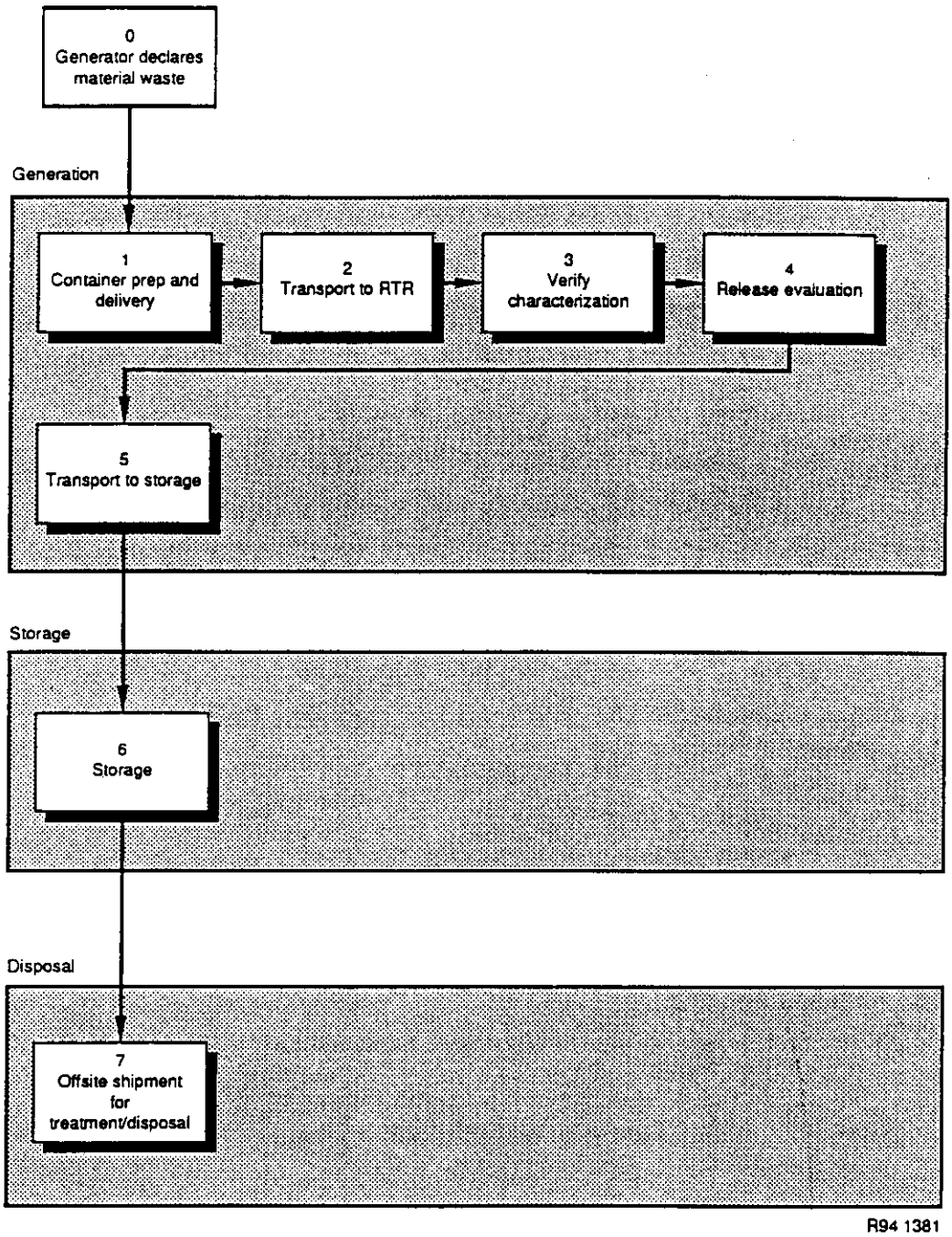


Table D-7. Site 2: TSCA solid waste.

Annual Quantity Generated: 10904 kg
Annual Quantity Disposed: 10904 kg

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	**Generator Declares Material Waste**													$0.00
1	**Container Prep & Delivery**		1:1											
	Receive New Drums	3,000	1:1	Stock Clerk	6	80	$18.12	$83	55 Gallon Drum	1	$32	$40,041	$0.32	$0.32
	Inspect & Prepare New Containers	25	1:1	NMC	1	0.5	$17.98	$83	Plastic Liners	2	$1	$43	$0.02	$0.34
		25	1:1	Inspector	2	1.5	$18.01	$83	Filter	1	$25	$274	$0.25	$0.58
		25	1:1	Stock Clerk	2	2	$16.95	$78	Fiberboard Disk	1	$2	$314	$0.10	$0.68
	Load Truck, Deliver to Plant and Generator	25	1:1	Trucker	2	2.5	$15.36	$71				$353	$0.10	$0.78
		25	1:1	Coordinator	1	0.25	$18.12	$83				$21	$0.01	$0.79
		25	1:1	NMC	1	2.5	$17.98	$83				$207	$0.06	$0.84
		25	1:1	WEMS	1	0.25	$17.05	$78				$20	$0.01	$0.85
		1	1:1	NMC	1	0.5	$17.98	$83				$41	$0.29	$1.14
	Waste Processing Request	1	1:1	Coordinator	1	0.1	$17.97	$83				$8	$0.06	$1.19
	Drum Inspection & Sign-Off	1	1:1	Coordinator	1	0.75	$17.97	$83				$62	$0.43	$1.63
		1	1:1	Waste Technician	2	0.75	$17.97	$83				$124	$0.86	$2.49
		1	1:1	Coordinator	1	0.1	$17.97	$83				$8	$0.06	$2.55
	WEMS Input/Update	1	1:1	Coordinator	1	0.26	$17.97	$83				$21	$0.15	$2.70
2	**Transport to RTR**		1:1											
	Staging from building to dock	30	1:1	WA&S	2	2	$18.07	$83				$332	$0.08	$2.77
		30	1:1	NMC	1	1.13	$17.98	$83				$93	$0.02	$2.79
		30	1:1	RCT	1	1.36	$18.07	$83				$113	$0.03	$2.82
	Shipping from building & receive at RTR	30	1:1	WA&S	2	2	$18.07	$83				$332	$0.08	$2.90
		30	1:1	RCT	1	2.72	$18.07	$83				$226	$0.05	$2.95
		30	1:1	NMC	1	2.26	$17.98	$83				$187	$0.04	$2.99
		30	1:1	Trucker	2	1.5	$15.36	$71				$212	$0.05	$3.04
		1	1:1	Inspector	2	0.18	$18.01	$83				$30	$0.21	$3.25
3	**Verify Characterization**	30	1:1	Coordinator	1	1.5	$18.12	$83				$125	$0.03	$3.28
		1	1:1	Waste Technician	2	0.17	$18.12	$83				$28	$0.20	$3.48
		30	1:1	Waste Technician	2	1	$18.12	$83				$167	$0.04	$3.51
		1	1:1	Waste Technician	2	0.05	$18.12	$83				$8	$0.06	$3.57
		3	1:1	NDT Technician	2	0.5	$19.69	$91				$91	$0.21	$3.78
		3	1:1	Waste Technician	2	0.17	$18.12	$83				$28	$0.07	$3.85

Table D-7. (continued).

ID	ACTIVITY DESCRIPTION	Basis (Drums)	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
4	Release Evaluation	1	1:1	RCT	1	2	$18.07	$83				$166	$1.16	$4.63
		1	1:1	Radiological Engineer	1	2	$22.43	$103				$206	$1.44	$6.07
5	Transport to Storage		1:1											
		1	1:1	Coordinator	1	1	$17.97	$83				$83	$0.58	$6.64
		1	1:1	Waste Technician	2	1	$17.97	$83				$165	$1.15	$7.79
		1	1:1	Trucker	2	1	$15.36	$71				$141	$0.98	$8.78
6	Storage		1:1											
	Monthly TSCA Inspection	132	1:1	Coordinator	1	48	$17.97	$83				$3,968	$0.21	$8.99
		132	1:1	Waste Technician	2	48	$17.97	$83				$7,936	$0.42	$9.40
7	Off-Site Shipment for Treatment/Disposal	1	1:1	Commercial Disposal					Transport & Disposal	1	$266	$266	$1.85	$11.25

SITE 2

SANITARY WASTES

Activity 0. Generator Declares Material Waste

Activity 1. Waste Collection

Sanitary solid wastes consists primarily of office and cafeteria waste generated throughout the site. Other significant waste streams include nonrecyclable construction wastes generated outside protected areas and cardboard packaging materials. White paper waste generated in offices is collected and stored for pickup by a commercial recycling facility. Collection and screening is done by custodial and cafeteria personnel. The waste is deposited in dumpsters that are picked up by a compactor truck and dumped at the landfill before burial.

Activity 2. Disposal

Waste dumped at the landfill is screened for inappropriate content, i.e., hazardous waste, recyclables, etc., by a waste technician. It also is checked by a health physics technician before burial. The waste is then compacted and buried by a heavy equipment operator.

Figure D-8. Site 2: sanitary wastes.

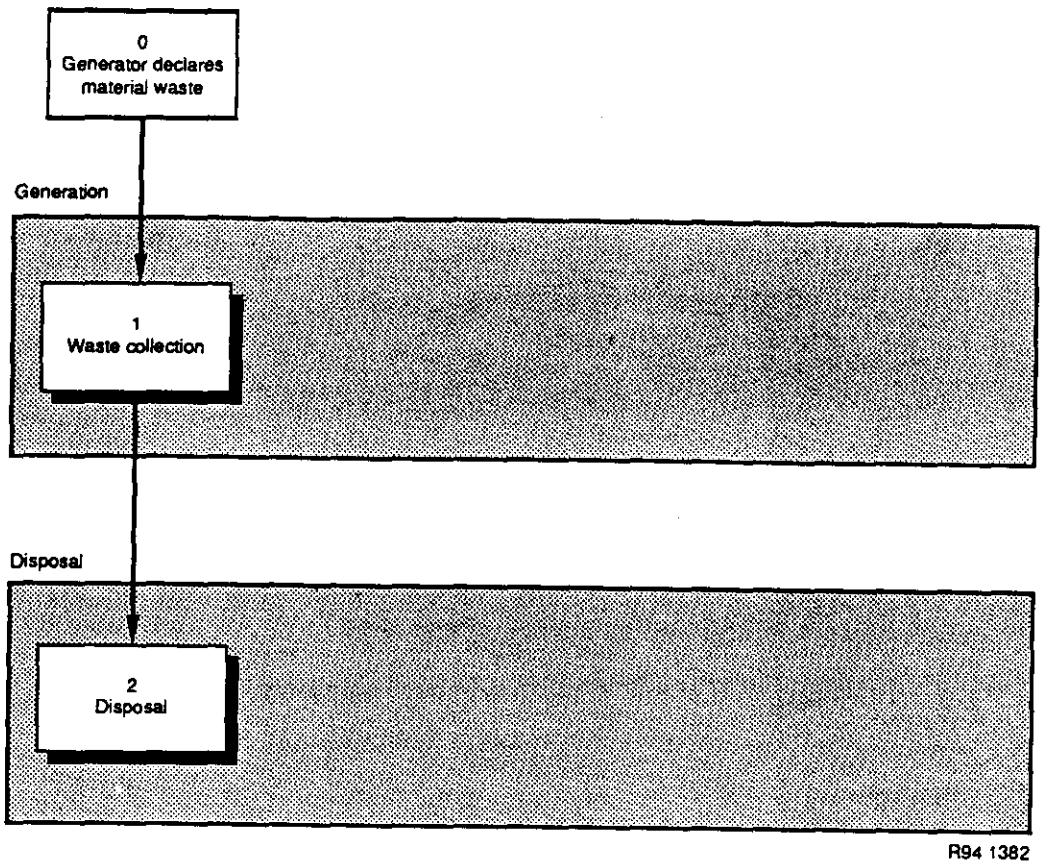


Table D-8. Site 2: sanitary wastes.

Annual Quantity Generated: **3223 metric tons**
Annual Quantity Disposed: **3223 metric tons**

ID	ACTIVITY DESCRIPTION	Basis (yd3)	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/metric ton)	Cumulative Total ($/metric ton)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
0	Generator Declares Material Waste													$0
1	Waste Collection	230 cu. yds	1:1	Utility Worker	50	20	$14	$66	Compact Truck/yr	1	$1.08	$65,597	$1,261	$1,261
		230 cu. yds	1:1	Trucker	2	40	$15	$71	Supplies	1	$0.67	$5,653	$111	$1,372
2	Disposal	230 cu. yds	1:1	Waste Tech	1	40	$20	$94	Equipment	1	$0.88	$3,758	$76	$1,448
		230 cu. yds	1:1	RCT	1	12	$18	$83				$997	$19	$1,467
		230 cu. yds	1:1	Heavy Equipment	1	40	$15	$71				$2,826	$54	$1,521

Appendix E

Site 3 WM Activity Narratives and Flow Diagrams

Appendix E:
Site 3 WM Activity Narratives and Flow Diagrams

SITE 3
LOW-LEVEL WASTE: CONTACT HANDLED: COMPACTED, CONTAINERIZED

In CY93, approximately 154,000 ft^3 of contact-handled, low-level waste that was generated and transported to the compactor for treatment. The following activity descriptions define the task-level basis assumptions used in activity cost development.

Activity 0. Generator Declares Material Waste

Activity 1. Waste Collection

Waste is collected into 21-inch cardboard boxes lined with a plastic bag. The outside of the waste package is surveyed by health physics to determine dose rate and contamination level, the waste box is tagged, and the waste is carried to a waste accumulation area for temporary storage by an operator. It takes 0.25 hours to survey the package and 0.5 hours to seal the waste package, get the survey results, carry the box to the accumulation area, and log it in. Waste package is based on 5.36 ft^3 of waste each. Packaging material costs (box, plastic bags, tags, tape, etc.) are valued at $2.50 per package.

Activity 2. Prepare Shipping Documentation

It takes a clerk/operator 2 hours to complete the shipping documentation and manifest for an average shipment of 50 boxes of waste to the compactor.

Activity 3. Transport to Treatment

Waste is loaded on a truck and transported to the compactor site. An operator takes 1 hour to load the truck, a health physics technician takes 0.75 hours to complete a final survey of the load (survey required within 24 hours before shipment), and the truck driver takes 2.5 hours to pick up, deliver waste, unload, and return to base. A vehicle use fee of $15 per trip was assumed, based on $0.75 per mile for an average 20-mile round trip. This activity is based on a 50-box waste stream to provide an average cost.

Activity 4. Purchase Burial Box

A compactor burial box costs $484. Compaction ratio is 4:1, i.e., a compacted burial box contains 360 ft^3 of precompacted waste volume. Set up and movement of boxes is included in Activity 5.

Activity 5. Compact Waste

Costing for this activity is based on operating cost divided by system capacity. Operating cost based on two full-time operators, 0.25 professional/supervisor, 0.33 health physics technician, and an average of $2K in maintenance cost per month. One man-month equals 173 man-hours (2,080 hours/yr/12 months). System capacity is 3,500 21-inch, compactor boxes per month. Operation at the compactor includes: waste receipt, temporary storage, compaction into a heavy duty compactor burial box, completion of documentation, loading truck with 10 burial boxes for shipment to the disposal facility, and routine upkeep and maintenance support for the compactor.

Activity 6. Transport to Disposal

A truck driver takes 2.5 hours to pick up, deliver waste to the disposal facility, unload, and return to base. A vehicle use fee of $15 per trip was assumed, based on $0.75 per mile for an average 20- mile round trip.

Activity 7. Receive at Disposal

This activity includes receipt inspection of shipment for container integrity, labeling, verification of shipment versus shipment documentation, and a health physics check of shipment before directing the driver to the disposal trench. This activity takes an operator 0.25 hours to complete the inspection; health physics technician takes 0.25 hours to complete shipment radiation check; an operator/clerk 1 hour to check paperwork and to log in shipment and complete records management entry and review; and a supervisor/professional 1 hour cumulative for coordination of activities. This activity is based on a ten compactor burial box shipment.

Activity 8. Emplace Waste

A heavy equipment operator takes 0.5 hours to unload the truck and stack the boxes. An operator is present, 0.5 hours, to record placement, complete burial record, and to direct waste placement. A health physics technician performs exit survey and releases truck, which takes 0.25 hours.

Activity 9. Waste Burial

It takes three heavy equipment operators (two truck drivers to transport dirt and one tractor/dozer operator equivalent) 8 hours to move and emplace a 3-foot cover of dirt over an average of 400 boxes stacked four high. Monitoring and facility maintenance costs are not volume incremental dependent over the projected scope of this activity and not included.

Activity 10. Final Closure

The final closure cost is based on the actual total cost to close a part of the burial ground under a RCRA closure. Closure involves dynamic compaction, site grading, followed by a clay overlay, top soil overlay, and grass cover. The 1 square foot of site closure covers 15 ft^3 of LLW due to stacking and waste placement inefficiencies. Therefore, an incremental cost of \$0.92/ft^3 of waste disposal volume is calculated. Based on 4:1 compaction ratio closure cost is \$0.13/ft^3 of precompacted waste. Postclosure monitoring and surveillance is not waste volume dependent over the projected scope of activities and are not included.

Figure E-1. Site 3: low-level waste: contact handled: compacted, containerized.

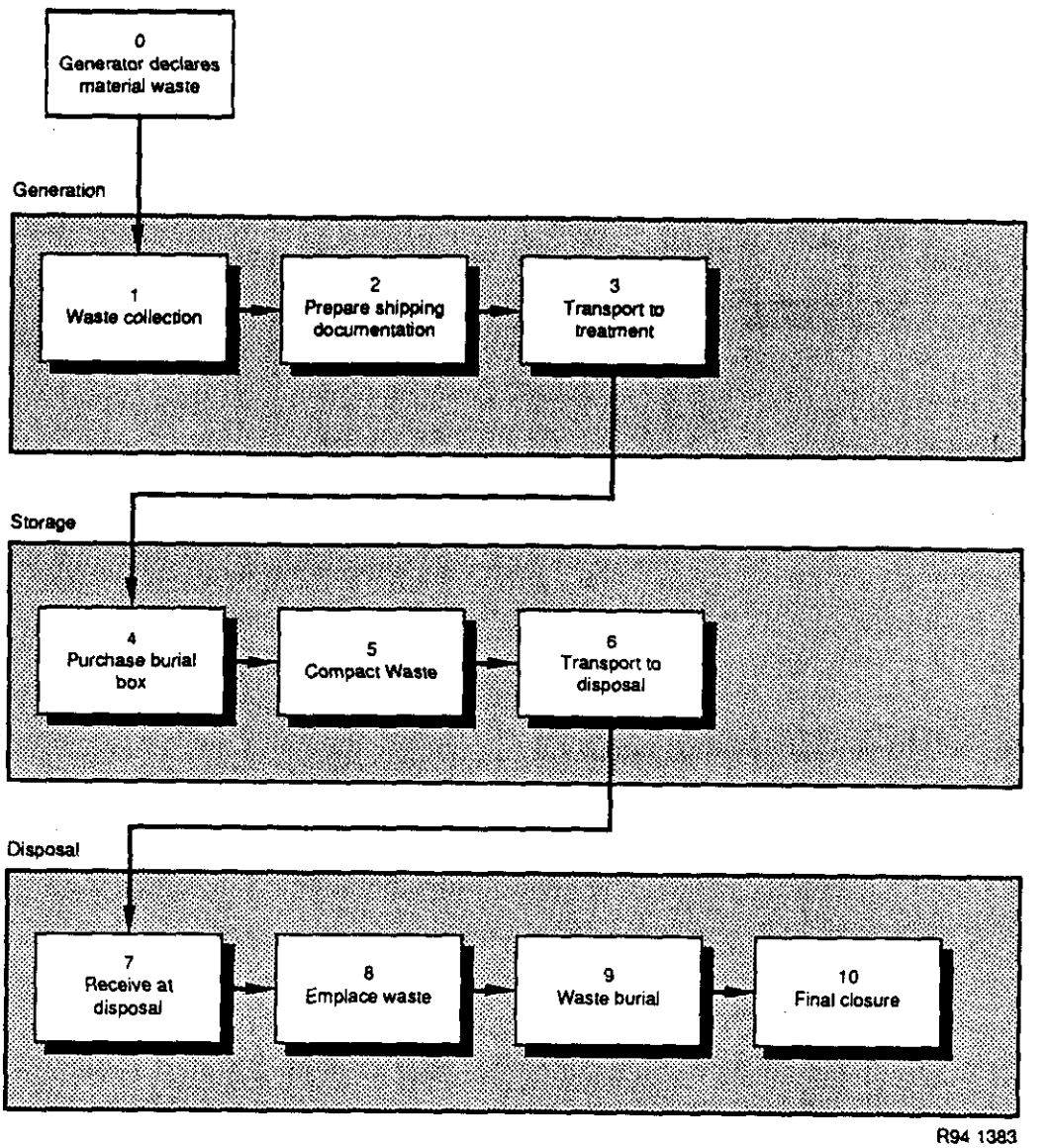


Table E-1. Site 3: low-level waste: contact handled: compacted, containerized.

Annual Quantity Generated: 4361 m^3
Annual Quantity Disposed: 1090 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													
1	Waste Collection	21" compactor box = 5.36 ft3	1:1	Operater/Clerk	1	0.5	$24	$91	21" box, liner	1	$3			
				HP Inspector	1	0.25	$17	$64				$64	$424	$424
2	Prepare Shipping Documentation	50 - 21" boxes	1:1	Operater/Clerk	1	2	$24	$91				$181	$24	$448
3	Transport to Treatment	50 - 21" boxes	1:1	Operater/Clerk	1	1	$24	$91	Vehicle fee	1	$15			
				CSWE Driver	1	2.5	$17	$62						
				HP Inspector	1	0.75	$17	$64				$310	$41	$489
4	Purchase Burial Box	Burial box (90 ft^3)	1:1						Burial Box	1	$484	$484	$190	$678
5	Compact Waste	3500 21" boxes	4:1	Operater/Clerk	2	173	$24	$91	253-H	1	$2,000			
				Supervisor	1	43.25	$39	$145	Maintenance					
				HP Inspector	1	57.09	$17	$64	Cost			$43,292	$20	$699
6	Transport to Disposal	10 burial	1:1	Truck Driver	1	2.5	$17	$62	Vehicle fee	1	$15	$171	$2	$701
7	Receive at Disposal	10 burial boxes	1:1	Operater/Clerk	1	1.25	$24	$91						
				Supervisor	1	1	$39	$145						
				HP Inspector	1	0.25	$17	$64				$275	$3	$703
8	Emplace Waste	10 burial boxes	1:1	Operator/Clerk	1	0.5	$24	$91						
				Truck Driver	1	0.5	$17	$62						
				HP Inspector	1	0.25	$17	$64				$93	$1	$704
9	Waste Burial	400 burial Boxes	1:1	Truck Driver	3	8	$17	$62				$1,497	$0	$705
10	Final Closure	1 ft3 of trench spac.	1:1						Final closure		$1	$1	$9	$713

SITE 3

LOW-LEVEL WASTE: CONTACT-HANDLED: UNTREATED, CONTAINERIZED

In CY93, approximately 235,000 ft^3 of containerized, contact-handled, untreated, low-level waste was generated and transported to a shallow land burial facility for disposal. The following activity descriptions define the task-level basis assumptions used in activity cost development.

Activity 0. Generator Declares Material Waste

Activity 1. Box Acquisition and Set Up

Burial boxes are purchased for $290 each. An operator takes 1 hour preparing the box to accept waste. This includes receipt, inspection, labeling, and placing the box at the waste accumulation area. A burial box is assumed to contain 90 ft^3 of waste.

Activity 2. Waste Collection

Waste is collected into plastic bags or wrapped in plastic. The outside of the waste bag/package is surveyed by a health physics technician to set dose rate and contamination level, the waste is tagged, and the waste is carried to a waste accumulation area for temporary storage by an operator. It takes 0.25 hours for the health physics technician to survey the package and 0.5 hours to seal the waste package, get the survey, carry the waste to the accumulation area, and log it in. Waste package is based on 5 ft^3 of waste each. Packaging material costs (plastic bags, tags, plastic wrap, etc.) are not significant.

Activity 3. Waste Packaging

Accumulated LLW packages are listed and loaded into burial boxes. The burial boxes are labeled, dose rate determined, and moved to a staging area until there are enough to constitute a shipment to the disposal facility. Eighteen units of waste are placed into each box. It takes two operators working together 0.75 hours each to load a burial box and get it to the staging area. It takes a health physics technician 0.25 hours to survey the box and complete the labeling.

Activity 4. Prepare Shipping Documentation

It takes a clerk/operator 0.25 hours to complete the waste manifest for a box of waste.

Activity 5. Transport to Disposal

Waste is loaded on a truck and transported to the disposal facility. An operator takes 1 hour to load the truck, a health physics technician takes 0.75 hours to complete a final survey of the load (survey required within 24 hours before shipment), and the truck driver takes 3 hours to pick up, deliver waste, unload, and return to base. A vehicle use fee of $15 per trip was assumed, based on $0.75 per mile for an average 20-mile round trip. This activity is based on a ten box waste stream to provide an average cost.

Activity 6. Receive at Disposal

This activity includes receipt inspection of shipment for container integrity, labeling, verification of shipment documentation, and a health physics check of shipment before directing the driver to the disposal trench. This activity takes an operator 0.25 hours to complete the inspection; health physics technician takes 0.25 hours to complete shipment radiation check; an operator/clerk 1 hour to check paperwork and to log in shipment and complete records management entry

and review; and a supervisor/professional 1 hour cumulative for coordination of activities. This activity is based on a ten box shipment.

Activity 7. Emplace Waste

A heavy equipment operator takes 0.5 hours to unload the truck and stack the boxes. An operator is present 0.5 hours, to record placement, complete burial record, and to direct waste placement. Health physics technician performs exit survey and release of truck, which takes 0.25 hours.

NOTE: If waste contains fissile isotopes in significant quantities, additional supervisor tasks are required. These are not included for this study.

Activity 8. Waste Burial

It takes three heavy equipment operators (two truck drivers to transport dirt and one tractor/dozer operator equivalent) 8 hours to move and emplace a 3-foot cover of dirt over an average of 400 boxes stacked four high. Monitoring and facility maintenance costs are not volume incremental dependent over the projected scope of this activity and not included.

Activity 9. Final Closure

The final closure cost is based on the actual total cost to close a part of the burial ground under a RCRA closure. Closure involves dynamic compaction, site grading, followed by a clay overlay, top soil overlay, and grass cover. The 1 square foot of site closure covers 15 ft^3 of LLW due to stacking and waste placement inefficiencies. Therefore, an incremental cost of \$0.92/ft^3 of waste is calculated. Postclosure monitoring and surveillance is not waste volume dependent over the projected scope of activities and not included.

Figure E-2. Site 3: low-level waste: contact handled: untreated, containerized.

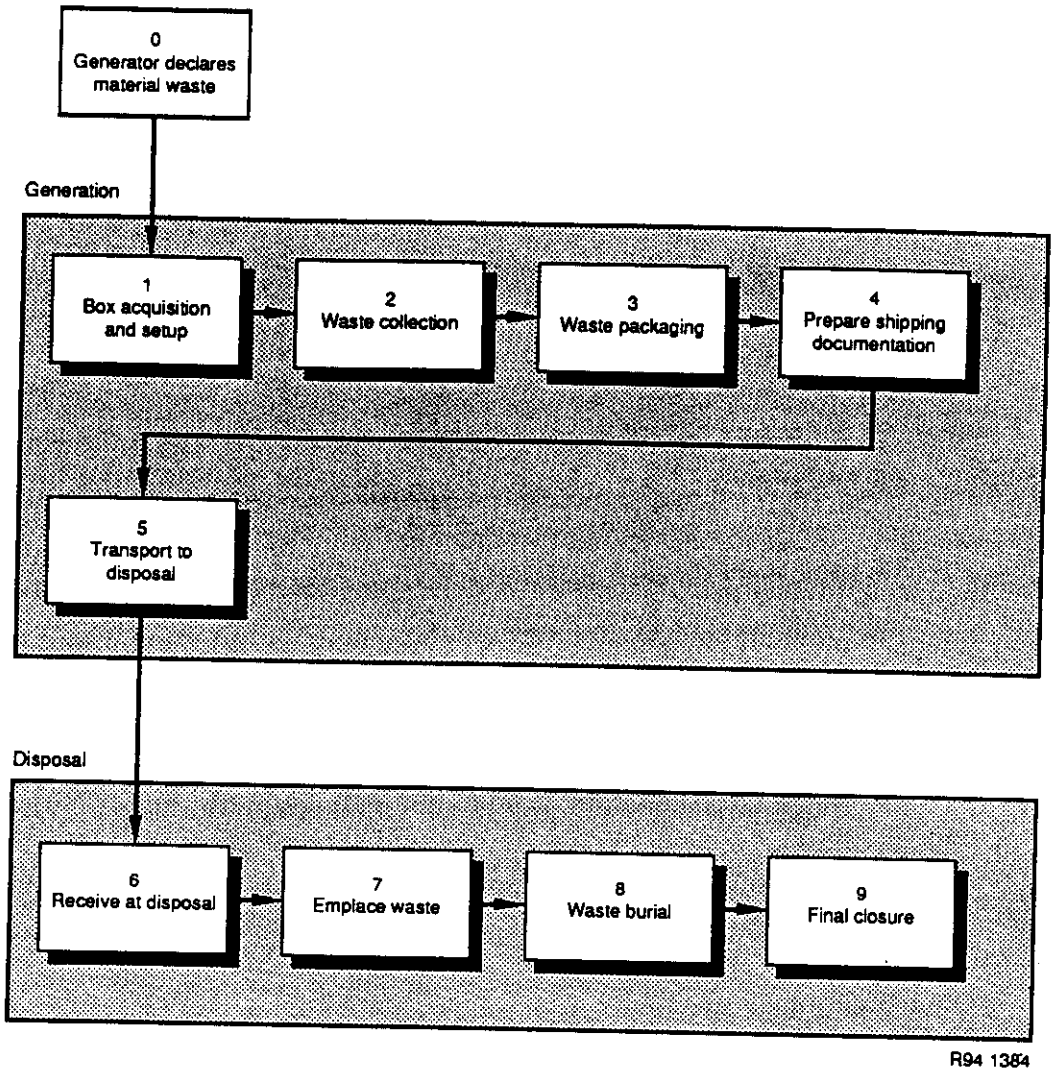


Table E-2. Site 3: low-level waste: contact handled: untreated, containerized.

Annual Quantity Generated: 6654 m^3
Annual Quantity Disposed: 6654 m^3

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													
1	Box Acquisition & Set Up	Box	1:1	Non-exempt, Operator/clerk	1	1	$24	$91	Burial Box	1	$290	$381	$149	$149
2	Waste Collection	Bag	1:1	Non-exempt, Operator/clerk	1	0.5	$24	$91						
				HP Inspector	1	0.25	$17	$64				$61	$433	$583
3	Waste Packaging	Box	1:1	Non-exempt, Operator/clerk	1	1.5	$24	$91						
				HP Inspector	1		$17	$64				$136	$53	$636
4	Prepare Shipping Documentation	Box	1:1	Non-exempt, Operator/clerk	1	0.25	$24	$91				$23	$9	$645
5	Transport to Disposal	10 Boxes	1:1	Non-exempt, Operator/clerk	1	1	$24	$91	Vehicle Fee	1	$15			
				CSWE Drive/Operator	1	3	$17	$62						
				HP Inspector	1	0.75	$17	$64				$341	$13	$658
6	Receive at Disposal	10 Boxes	1:1	Non-exempt, Operator/clerk	1	1.25	$24	$91						
				Exempt, Suprv/Professional	1	1	$39	$145						
				HP Inspector	1	0.25	$17	$64				$275	$11	$669
7	Emplace Waste	10 Boxes	1:1	Non-exempt, Operator/clerk	1	0.5	$24	$91						
				Truck Driver	1	0.5	$17	$62						
				HP Inspector	1	0.25	$17	$64				$93	$4	$673
8	Waste Burial	400 Boxes	1:1	Truck Driver	1	24	$17	$62				$1,497	$1	$674

Table E-2. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR					
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m^3)	Cumulative Total ($/m^3)
9	Final Closure	1 ft^3 of waste	1:1						Final Closure Costs	1	$1	$1	$35	$709

SITE 3

LOW-LEVEL WASTE: REMOTE-HANDLED: REQUIRING CRANE

In CY93, approximately 30,000 ft^3 of remote-handled (>200 mrem/hr at 30 cm), low-level waste, called intermediate level waste (ILW), was generated and transported to the disposal facility. The following activity descriptions define the task-level basis assumptions used in activity cost development. Each ILW form is somewhat unique and requires special handling. Cost development is based on averaging tasks and requirements.

Activity 0. Generator Declares Material Waste

Activity 1. Package Acquisition and Set Up

ILW packaging varies from a standard burial box as used for contact-handled LLW to specially designed, shielded shipping casks. Setup and placement of the package varies accordingly. For the purposes of this report, a large (1,000 ft^3), carbon-steel burial box with sacrificial rigging will be used. Cost to manufacture is $30K. It takes two operators 2 hours each to get the package in place and prepared to accept waste.

Activity 2. Waste Packaging

Accumulated waste or waste as-generated is placed into the burial box. Because of the high radiation fields, special job planning, including an ALARA review, is conducted before beginning the job. This preplan includes: a professional (ALARA coordinator), a supervisor, a health physics technician, three operators, and a health physics supervisor. The preplan lasts 0.5 hours. The waste placement job, involving a health physics technician, operations supervisor, and three operators, takes 3 hours to complete and get the waste loaded for shipment to the waste management facility.

Activity 3. Prepare Shipping Documentation

It takes a clerk/operator working with the waste packaging team 1 hour to complete the paperwork required for shipment.

Activity 4. Transport to Disposal

A driver's time is based on dropping a trailer off before the job and returning when the load is ready for transport. Waste loading and associated activities is included in Activity 2. Waste transport is coordinated with the disposal facility to allow preparation time to accept waste. It takes the driver 1.5 hours to drop the trailer and return to base. It takes 4 hours to pick up the load, transport it to the disposal site, and drop the load and return to base. A vehicle use fee of $15 per trip for two trips was assumed, based on $0.75 per mile for an average 20-mile round trip. It is assumed that special transport coverage is not required, e.g., site road closure.

Activity 5. Receive at Disposal

This activity includes receipt inspection of shipment for container integrity, labeling, verification of shipment versus shipment documentation, and a health physics check of shipment before directing the driver to the disposal trench. This activity takes an operator 0.25 hours to complete the inspection, the health physics technician takes 0.25 hours to complete shipment radiation check, an operator/clerk 1 hour to check paperwork and to log in shipment and complete records management entry and review, and a supervisor/professional 1 hour cumulative for coordination of activities.

Activity 6. Emplace Waste

A crane operator, two riggers, an operator, and a health physics technician take 2 hours to get the waste placed in the trench and the truck released. This

includes job planning and ALARA reviews. Job oversight by a supervisor takes 1 hour. Radiation sky shine is assumed to be within limits and immediate waste coverage not required.

Activity 7. Waste Burial

It takes a heavy, tractor/dozer, equipment operator 2 hours to push stockpiled dirt over the trench volume occupied by the box. Monitoring and facility maintenance costs are not volume dependent over the projected scope of this activity and not included.

Activity 8. Final Closure

The final closure cost is based on the actual total cost to close a part of the burial ground under a RCRA closure. Closure involves dynamic compaction, site grading, followed by a clay overlay, top soil overlay, and grass cover. The 1 square foot of site closure covers 6 ft^3 of ILW due to waste packaging and placement inefficiencies. Therefore, an incremental cost of $2.31/$ft^3$ of waste disposal volume is calculated. Postclosure monitoring and surveillance is not waste volume dependent over the projected scope of activities and not included.

Figure E-3. Site 3: low-level waste: remote handled: requiring crane.

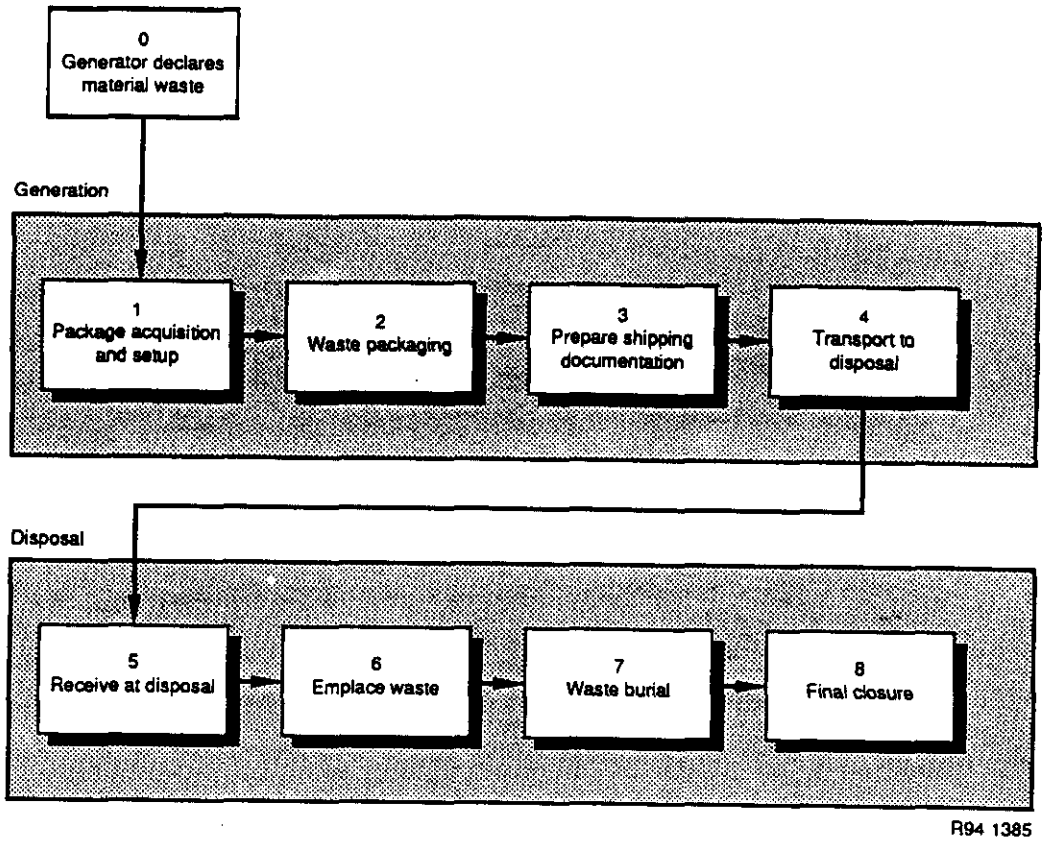


Table E-3. Site 3: low-level waste: remote handled: requiring crane.

Annual Quantity Generated: 850 m^3
Annual Quantity Disposed: 850 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													
1	Package Acquisition & Set Up	ILW Burial Box	1:1	Non-exempt, operator/clerk	1	4	$24	$91	ILW Burial Box	$1	$30,000	$30,362	$1,072	$1,072
2	Waste Packaging	ILW Burial Box	1:1	Non-exempt, operator/clerk	1	10.50	$24	$91						
				Exempt, Suprv/Professional	1	4.50	$39	$145						
				HP Inspector	1	3.50	$17	$64				$1,830	$65	$1,137
3	Prepare Shipping Documentation	ILW Burial Box	1:1	Non-exempt, operator/clerk	1	1.00	$24	$91				$91	$3	$1,140
4	Transport to Disposal	ILW Burial Box	1:1	CSWE Driver/Operator	1	5.50	$24	$91				$498	$18	$1,158
5	Receive at Disposal	ILW Burial Box	1:1	Non-exempt, operator/clerk	1	1.25	$24	$91						
				Exempt, Suprv/Professional	1	1.00	$39	$145						
				HP Inspector	1	0.25	$17	$64				$275	$10	$1,167
6	Emplace Waste	ILW Burial Box	1:1	Non-exempt, operator/clerk	1	2.00	$24	$91						
				Exempt, Suprv/Professional	1	1.00	$39	$145						
				CSWE Driver/Operator	1	6.00	$24	$91						
				HP Inspector	1	2.00	$17	$64				$998	$35	$1,202
7	Waste Burial	ILW Burial Box	1:1	CSWE Driver/Operator	1	2.00	$24	$91				$181	$6	$1,209
8	Final Closure	1 ft^3 of ILW	1:1						Final Closure Costs	1	$2.00	$2	$71	$1,280

Table E-3. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Burdened ($)			
9	Final Closure	1 ft^3 of waste	1:1						Final Closure Costs	1	$1	$1	$35	$709

SITE 3

TRANSURANIC WASTE, DRUMMED, CULVERT STORED, WIPP DISPOSED

Activity 0. Generator Declares Material Waste

In CY93, approximately 15,000 ft^3 of waste managed as transuranic (TRU) was generated. Because of many uncertainties in the TRU waste program and Waste Isolation Pilot Plant (WIPP) waste acceptance criteria, the assumptions of life cycle (activity flow and tasks analyses) contain the potential for wide margins of error. The following activity descriptions define the task-level basis assumptions used in activity cost development.

Activity 1. Waste Collection

Waste is collected into plastic bags or wrapped in plastic. These waste cuts are then placed in a plastic bag lined 5-gallon pail for temporary storage before assay. The outside of the waste package is surveyed by health physics to set dose rate and contamination level, the waste is tagged, and the waste is carried to a waste accumulation area for temporary storage by an operator. It takes 0.25 hours for health physics to survey the package and 0.5 hours to seal the waste package, get the survey results, carry the box to the accumulation area, and log it in. Waste package is based on 0.7 ft^3 of waste each. Packaging material costs (plastic bags, tags, plastic wrap, etc.) are not significant. Waste pails are reused.

Activity 2. Waste Assay

It takes an operator 0.3 hours to assay a waste pail and document the results. A segmented gamma scan and neutron coincidence count is performed. The assayed waste is returned to temporary storage awaiting packaging.

Activity 3. Waste Packaging

Based on waste cut characterization, a supervisor designates how waste cuts will be grouped for packaging into a 55-gallon drum. The supervisor takes 0.75 hours per drum preparing and overseeing the waste packaging and completing waste documentation. The TRU drum, a heavy galvanized steel 55-gallon drum with a 90-mil polyethylene liner, cost $160 each. It takes two operators working together 1 hour each to get the drum ready to accept waste, waste pails to the repackaging area, an average of 10 cuts of waste placed into a drum, and the drum sealed. Waste packaging is performed in a contamination containment structure. The drums are labeled, dose rate set by health physics, and the drum is moved to a staging area until there are enough to constitute a shipment. It takes a health physics technician 1 hour to provide job coverage, survey the drum and waste pails, and complete the labeling. Activity costing is on a one drum (7 ft^3) basis.

Activity 4. Transport to Storage

Waste is loaded on a truck and transported to the storage site. An operator takes 1 hour to load the truck, a health physics technician takes 0.75 hours to complete a final survey of the load (survey required within 24 hours before shipment), and the truck driver takes 3 hours to pick up, deliver waste, unload, and return to base. A vehicle use fee of $15 per trip was assumed, based on $0.75 per mile for an average 20-mile round trip. This activity is based on a 12 drum shipment to provide an average cost.

Activity 5. Receive at Storage

This activity includes receipt inspection of shipment for container integrity, labeling, verification of shipment documentation, and a health physics check of shipment before directing the driver to the disposal trench. This activity takes an operator 0.25 hours to complete the inspection; the health physics technician

takes 0.25 hour to complete shipment radiation check; an operator/clerk 1 hour to check paperwork and to log in shipment and complete records management entry and review; and a supervisor/professional 2 hours cumulative for coordination of activities involved with a TRU waste receipt.

Activity 6. Emplace Waste

TRU waste drums containing less than 0.5 curies are stored on enclosed pads. TRU waste drums containing 0.5 curies or more are placed into a concrete culvert to provide additional protection before placement on a pad. A culvert holds 14 drums and cost $2,800 each. Waste costing will be based on culvert storage since Pu-238 waste constitutes the majority of recent waste, and it typically requires culvert storage. A crane operator, two riggers, an operator, and a health physics technician take 1.5 hours to get the waste placed in a culvert and the culvert on the pad. This includes job planning and ALARA reviews. Pad space is valued at a replacement cost of $21.62 per ft^3 of waste disposal capacity. Maintenance and surveillance of the TRU Waste Storage Facilities represent fixed costs and are not volume dependent over the expected scope of activities.

Activity 7. Prepare for Shipment

TRU waste will require recharacterization (or at least revalidation of existing characterization); possibly sorting, sampling, and repackaging; labeling, manifesting, and loading into a shipping container for transport to WIPP. This work will be done in a facility designed for this purpose, currently unfunded. Cost for this activity is estimated to be $125 per ft^3.

Activity 8. WIPP Disposal

TRU waste will be eventually disposed of in the WIPP near Carlsbad, New Mexico. WIPP costs, including shipping charges, are estimated to be $1K per ft^3 in a recently published report (report title not available).

NOTE: This seems to be an incremental (fixed + variable) cost versus a variable (avoidable) cost.

Figure E-4. Site 3: transuranic waste, drummed, culvert stored, WIPP disposed.

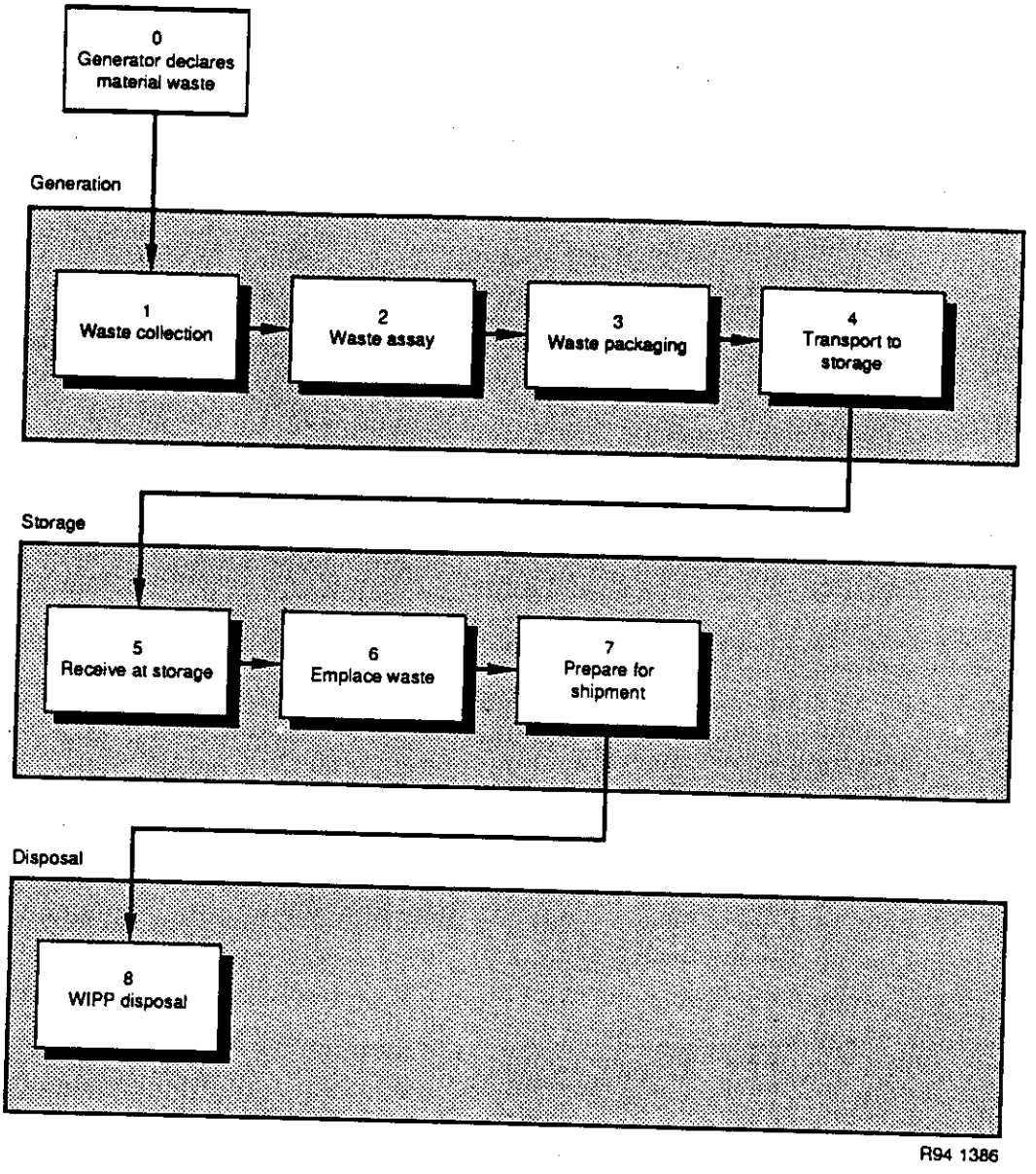


Table E-4. Site 3: transuranic waste, drummed, culvert stored, WIPP disposed.

Annual Quantity Generated: 425 m^3
Annual Quantity Disposed: 425 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Waste Collection	Waste Cut	1:1	Non-exempt, Operator/clerk	1	0.5	$24	$91						
				HP Inspector	1	0.25	$17	$64				$61	$3,099	$3,099
2	Waste Assay	Waste Cut	1:1	Non-exempt, Operator/clerk	1	0.3	$24	$91				$27	$1,372	$4,472
3	Waste Packaging	Drum	1:1	Non-exempt, Operator/clerk	1	2	$24	$91	TRU Drum	1	$160			
				Exempt, Suprv/Professional	1	0.75	$39	$145						
				HP Inspector	1	1	$17	$64				$514	$2,598	$7,069
4	Transport to Storage	12 Drums	1:1	Non-exempt, Operator/clerk	1	1	$24	$91	Vehicle Fee	1	$15			
				CSWE Driver/Operator	1	3	$17	$62						
				HP Inspector	1	0.75	$17	$64				$341	$143	$7,213
5	Receive at Storage	12 Drums	1:1	Non-exempt, Operator/clerk	1	0.25	$24	$91						
				Exempt, Suprv/Professional	1	2	$39	$145						
				HP Inspector	1	0.25	$17	$64				$329	$138	$7,351
6	Emplace Waste	12 Drums	1:1	Non-exempt, Operator/clerk	1	1.5	$24	$91	TRU Storage Culvert	1	$2,400			
				CSWE Driver/Operator	1	4.5	$17	$62						
				HP Inspector	1	1.5	$17	$64				$2,913	$1,224	$8,575
7	Prepare for Shipment	1 ft^3	1:1						Waste Preparation Costs	1	$125	$125	$4,417	$12,992
8	WIPP Disposal	1 ft^3	1:1						WIPP Costs, disposal/transport	1	$1,000	$1,000	$35,336	$48,328

SITE 3

STATE HAZARDOUS WASTE, INCINERATED, AND DISPOSED OFFSITE

Activity 0. Generator Declares Material Waste

In CY93, approximately 2,600 ft^3 of hazardous waste was generated and transported to waste management for dispositioning. An estimated 40% of this waste is transportable offsite for treatment, e.g., incineration, and disposal. The following activity descriptions define the task-level basis assumptions used in activity cost development.

Activity 1. Drum Acquisition and Set Up

Drums are purchased for $36/drum. An operator takes 1 hour per drum preparing the drum to accept waste. This includes receipt, inspection, labeling, and placing the drum in a staging or satellite waste accumulation area.

Activity 2. Waste Packaging

It is assumed that an incremental amount of hazardous waste, (1 ft^3) is generated and is classified for hazardous waste storage. An operator takes 1 hour to complete the waste determination, transport the waste from the point of generation to the storage area, and to log in the waste addition. Setup, maintenance, and surveillance of the storage area represent fixed costs and are not volume dependent.

Activity 3. Waste Characterization

Once a drum is declared full, it is characterized to validate waste classification and to determine if the waste meets waste acceptance criteria. The Sample Management Department samples and provides laboratory analysis. The

Sampling and Screening Group (S&SG) is responsible for job preplanning, procedure preparation, interface with other organizations (e.g., Health Physics and Industrial Hygiene), sampling, packaging samples for shipment, actual laboratory fees, and followup on analytical results. It is current policy that all waste shipped offsite must be screened for radioactivity. The S&SG also provides this service and uses the services of an onsite laboratory. Average costs for these services were used: $2,000 for sampling and waste characterization, toxicity characterization leveling procedure (TCLP), and $500 for radioactivity screen per waste stream. It takes a professional/supervisor and an operator a cumulative of 1 hour each to assist and interface with the S&SG. Activity costs are based on three drum composite sampling of a waste stream.

Activity 4. Waste Documentation

This activity consists of: (a) an operator/clerk taking 1 hour to complete the waste characterization form based on sample results and the waste log, and (b) a supervisor/professional taking 2 hours to assist in paperwork preparation and review, verify acceptance, prepare the work order for transport of the waste, and provide a hazardous waste transport review of documentation and waste packaging and labeling. This activity is based on a three drum waste stream to provide an average cost.

Activity 5. Transport to Storage

Waste is loaded on a truck and transported to the hazardous waste storage site. An operator takes 1 hour to load the truck and the truck driver takes 2.5 hours to pick up, deliver, unload, and return to base. A vehicle use fee of $15 per trip was assumed, based on $0.75 per mile for an average 20-mile round trip. This activity is based on a three drum waste stream to provide an average cost.

Activity 6. Receive at Storage

This activity includes review/approval of paperwork by waste management before actual shipment, receipt inspection, verification of shipment documentation, unloading the waste, logging in the waste, printing storage labels, labeling, and storing waste. A cumulative time of 2 operator/clerk hours and 2 professional/supervisor hours is charged to this activity. This activity is based on a three drum waste stream to provide an average cost. Maintenance and surveillance of the Hazardous Waste Facilities represent fixed costs and are not volume dependent.

Activity 7. Waste Shipment Offsite

It takes two operators 2 weeks to prepare for offsite waste shipment, including staging shipment (pull drums, repalletize, consolidate, and reband), labeling (removing storage labels and placing shipping labels on the drums), assisting during radiological survey and clerk paperwork. It takes 2 days of a clerk's and 2 days of a professional/supervisor's time to make preparations for shipment including paperwork preparation, interfacing with offsite waste service and transportation service, and receiving site review and approval for shipment. It takes a health physics technician 12 hours to perform a final survey of drums before release offsite. It takes 16 operator hours (two operators for 1 day) and 16 supervisor/professional hours to get the transport truck to the hazardous waste facility, then loaded, inspected, processed through purchasing, and back on the road. Transportation by a hazardous waste transport service is priced at $4,000 per shipment. An average shipment of 60 drums of waste to an offsite waste service is assumed.

Activity 8. Offsite Treatment and Disposal

Offsite vendor-supplied waste service's contract fee is assumed to be $700 per drum. This fee varies from approximately 400 to $1,200 per drum, based on waste characteristics.

Figure E-5. Site 3: State hazardous waste, incinerated and disposed offsite.

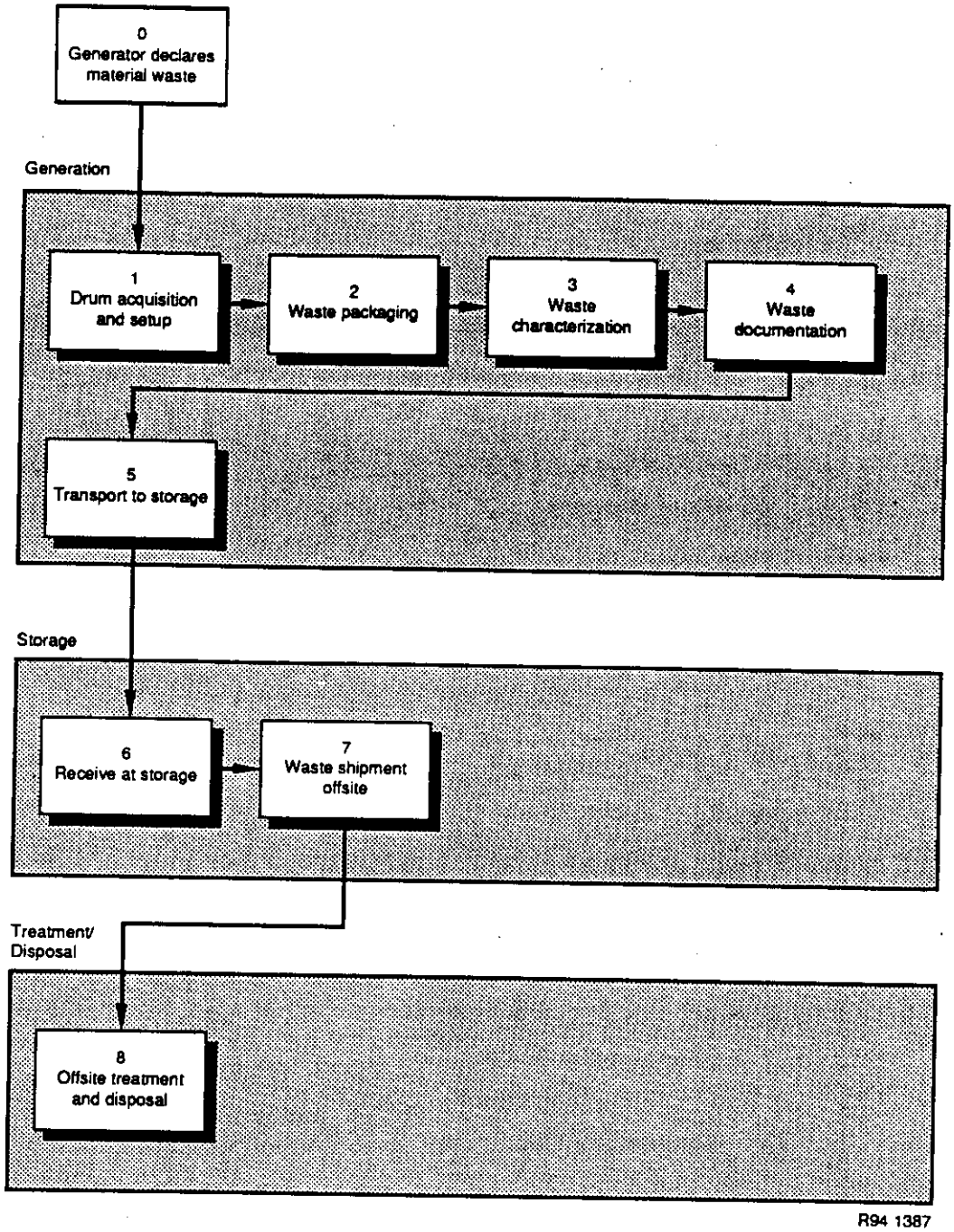


Table E-5. Site 3: State hazardous waste, incinerated and disposed offsite.

Annual Quantity Generated: 71114 kg
Annual Quantity Disposed: 71114 kg

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	Generator Declares Material Waste													$0.00
1	Drum Aquisition & Set Up	Drum	1:1	Non-exempt, operator/clerk	1	1	$24	$91	55 Gal. Drum	1	$36	$127	$0.66	$0.66
2	Waste Packaging	1 cu. ft.	1:1	Non-exempt, operator/clerk	1	1	$24	$91				$91	$3.32	$3.98
3	Waste Characterization	Stream	1:1	Non-exempt, operator/clerk	1	1	$24	$91	Analytical Costs, rad screen	1	$500			
				Exempt, Suprv/Professional	1	1	$39	$145	Analytical Costs, Charac.	1	$2,000	$2,736	$4.78	$8.76
4	Waste Documentation	Stream	1:1	Non-exempt, operator/clerk	1	1	$24	$91						
				Exempt, Suprv/Professional	1	2	$39	$145				$381	$0.67	$9.43
5	Transport to Storage	Stream	1:1	Non-exempt, operator/clerk	1	1	$24	$91	Vehicle Fee	1	$15			
				Truck Driver	1	2.5	$17	$62				$262	$0.46	$9.88
6	Receive at Storage	Stream	1:1	Non-exempt, operator/clerk	1	2	$24	$91						
				Exempt, Suprv/Professional	1	2	$39	$145				$472	$0.82	$10.71
7	Waste Shipment Off-Site	Shipment	1:1	Non-exempt, operator/clerk	1	112	$24	$91	Shipping Costs	1	$4,000			
				Exempt, Suprv/Professional	1	40	$39	$145						
				HP Inspector	1	12	$17	$64				$20,725	$36.19	$46.90
8	Off-Site Treatment and Disposal	Drum	1:1						Contract Services Costs	1	$700	$700	$1.22	$48.12

Appendix F

Site 4 WM Activity Narratives and Flow Diagrams

Appendix F:

Site 4 WM Activity Narratives and Flow Diagrams

SITE 4

LOW-LEVEL WASTE: CONTACT HANDLED: INCINERABLE

Activity 0. Generator Declares Material Waste

Generators bring waste in clear plastic bags to a central collection area where there are locked bins for incinerable, compatible, and noncompatible type low-level waste. A health physics technician visually determines which bin is appropriate for the waste and unlocks the bins. The container for incinerable waste is a 2 ft x 2 ft x 2 ft burn box.

Activity 1. Segregate

Waste is segregated to ensure that it is incinerable. The burn box is sealed.

Activity 2. Radiological Survey

A radiation control technician surveys the burn box to ensure compliance. A laborer moves the boxes if necessary.

Activity 3. Transport to Staging

A laborer transports the burn boxes from central collection area to an area where the burn box waits for shipment.

Activity 4. Prepare for Shipment

The burn boxes are loaded into a 8 ft x 8 ft x 20 ft cargo container. The cargo container is not transported until it is full (81 burn boxes). Before transport, the cargo container must have the correct shipping placards to comply with DOT regulations and the waste must meet the treatment facility's waste acceptance criteria.

Activity 5. Transport to Treatment

The cargo container is loaded onto a truck, surveyed by a radiation control technician, and shipped to the treatment facility.

Activity 6. Receive at Treatment

The cargo container is unloaded by an equipment operator.

Activity 7. Radiological Survey

A radiation control technician surveys the box to ensure compliance.

Activity 8. Store

An equipment operator moves containers into interim storage.

Activity 9. Incinerate Waste

The waste is incinerated. Approximately 4 hours is required to incinerate each container. The residue is repackaged into 55-gal drums.

Activity 10. Sample and Analyze Waste

A laborer spends 1 hour to take a sample of the incinerated waste. A laborer uses 2 hours to test the sample for toxic compound leaching procedure (TCLP). Approximately one in 20 drums fails TCLP and must be solidified. The solidification volume increase is 1:2. Twenty-seven and one-half gallons of incinerator residue is mixed with 1 bag of Petroset ($100) and mixed with water. The cost for a failed TCLP is distributed over 20 drums and added to the cost of this activity.

Activity 11. Stage for Shipping

An equipment operator spends 0.5 hours moving the drums to a staging area for shipment to the disposal facility.

Activity 12. Data Management

Information about the waste is entered into the radioactive waste management information system.

Activity 13. Transport to Disposal

A heavy equipment operator spends 2 hours loading 20 drums onto a truck. The certified shipper ensures that all DOT regulations are followed and that the appropriate information is documented. The waste is surveyed and a heavy equipment operator transports the load to the disposal facility receiving area by truck.

Activity 14. Receive at Disposal

An equipment operator unloads the truck with a forklift. A radiation control technician surveys the shipment again and the waste is unloaded at the disposal

facility receiving area. A shipper ensures that the load is properly received and documented.

Activity 15. Verify Characterization

The waste is x-rayed to ensure compliance with the disposal facility waste acceptance criteria.

Activity 16. Data Management

Information regarding the waste is entered into the official waste management database and any other tracking databases that are internal to the disposal facility.

Activity 17. Move to Burial Ground

An equipment operator loads and operates a little truck that carries the drums to where they will be placed in the burial ground.

Activity 18. Emplace Waste

An equipment operator unloads the little truck and ensures that the waste is stacked properly. This activity does not include backfilling with dirt around the drums.

Figure F-1. Site 4: low-level waste: contact handled: incinerable.

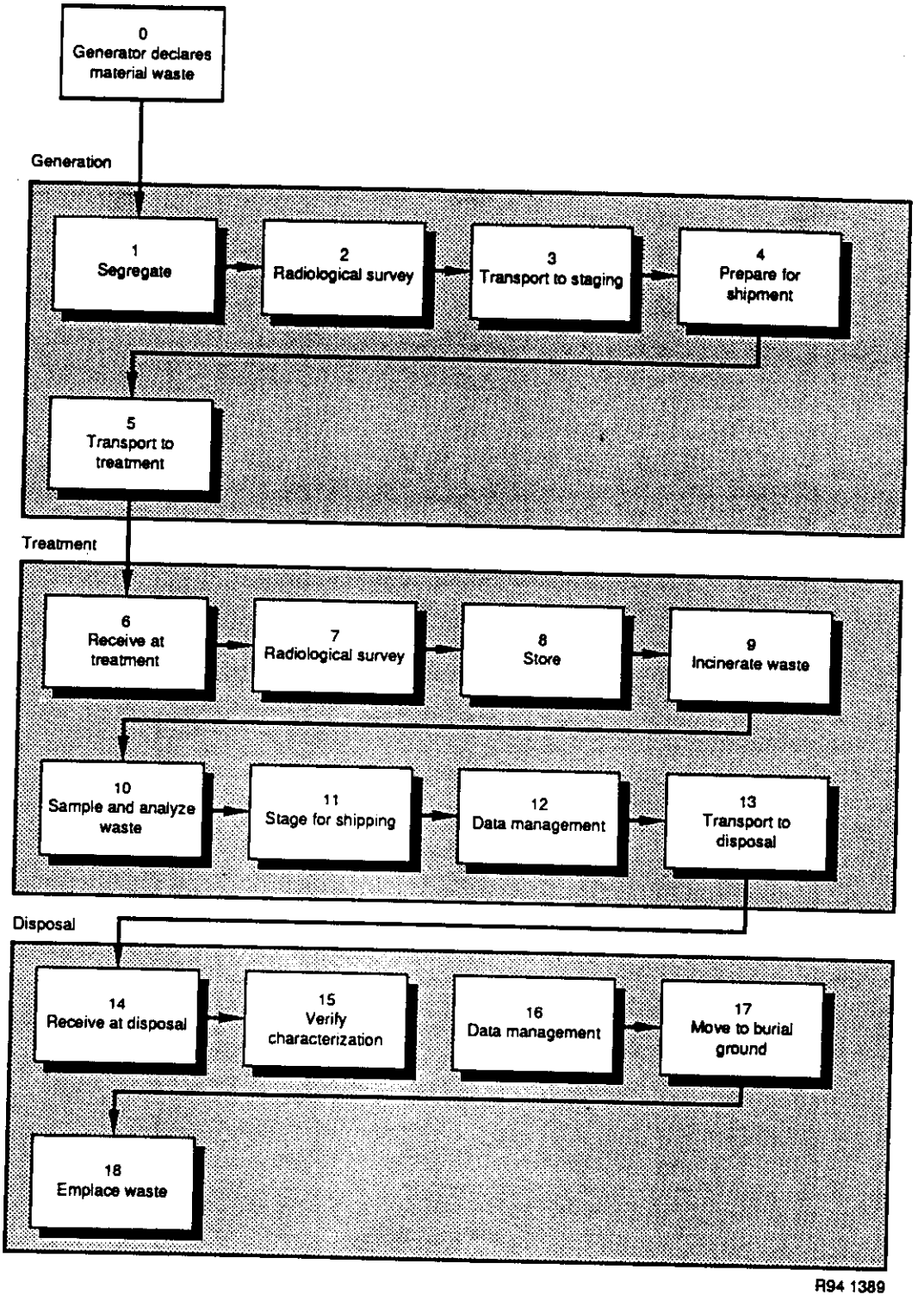


Table F-1. Site 4: low-level waste: contact handled: incinerable.

Annual Quantity Generated: 862 m³
Annual Quantity Disposed: 108 m³

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
0	Generator Declares Material Waste													
1	Segregate	2'x2'x2 burn box	1:1	Laborer	1	2	$12	$35	2'x2'x2' burn box	1	$2	$72	$316	$316
2	Radiological Survey	4 ea. 2'x2'	1:1	RCT	1	2	$14	$42						
				Laborer	1	4	$12	$35				$224	$247	$563
3	Transport to Staging	2'x2'x2'	1:1	Laborer	1	1	$12	$35				$35	$154	$718
4	Prepare for Shipment	8'x8'x20' cargo cont. contains 81 burn boxes	1:1	RCT	1	2	$14	$42						
				Laborer	1	4.5	$12	$35				$242	$13	$731
5	Transport to Treatment	cargo cont	1:1	EO	1	8	$16	$48						
				Release Agent	1	2	$17	$50						
				RCT	1	3	$14	$42						
				Traffic	1	2	$24	$70						
				Shipper (Tech)	1	2	$14	$42						
				Safety	1	2	$24	$70				$974	$53	$784
6	Receive at Treatment	cargo cont.	1:1	RCT	1	1	$14	$42						
				Receiver	1	2	$14	$42						
				EO	1	0.5	$16	$48				$150	$8	$792
7	Radiological Survey	cargo. con	1:1	RCT	1	1	$14	$42				$42	$2	$794
8	Store	cargo cont	1:1	Laborer	1	0.5	$12	$35						
				EO	1	0.5	$16	$48				$42	$2	$797
9	Incinerate Waste	58.8 ft³	8:1	Laborer	2	6	$12	$35	55 gal drum	1	$49			
				RCT	1	4	$14	$42						
				Shift Supervisor	1	4	$17	$50				$837	$503	$1,299
10	Sample/Analyze Waste	55 gal dru	1:1	Laborer	1	2	$12	$35				$70	$42	$1,341
11	Stage for shipping	20 drums	1:1	EO	1	0.5	$16	$48				$24	$2	$1,343
12	Data Management	55 gal dru	1:1	Technician	1	2	$14	$42				$84	$51	$1,394
13	Transport to Disposal	20 drums	1:1	RCT	1	0.5	$14	$42						
				Shipper (Tech)	1	2	$14	$42						
				EO	1	2	$16	$48				$201	$16	$1,410

Table F-1. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Burdened ($)			
14	Receive at Disposal	20 drums	1:1	RCT	1	1	$14	$42						
				Shipper (Tech)	1	1	$14	$42						
				EO	1	3	$16	$48						
15	Verify Characterization	55 gal	1:1	Technican	1	2	$14	$42				$228	$18	$1,428
16	Data Management	55 gal	1:1	Technician	1	0.25	$14	$42				$84	$51	$1,479
17	Move to Burial Ground	4 drums	1:1	EO	1	0.75	$16	$48				$11	$6	$1,485
18	Emplace Waste	55 gal	1:1	EO	1	0.75	$16	$48				$36	$5	$1,490
												$36	$22	$1,512

SITE 4

LOW-LEVEL WASTE: CONTACT-HANDLED: COMPACTIBLE

Activity 0. Generator Declares Material Waste

Generators bring waste in clear plastic bags to a central collection area where there are locked bins for incinerable, compatible, and noncompatible types of low-level waste. A health physics technician visually determines which bin is appropriate for the waste and unlocks the bins. The container for compatible waste is a 4 ft x 4 ft x 5 ft bin.

Activity 1. Segregate

Waste is segregated to ensure that it is incinerable. The bin is sealed.

Activity 2. Radiological Survey

A radiation control technician surveys the bin to ensure compliance. A laborer moves the boxes if necessary.

Activity 3. Transport to Staging

The waste is moved from the central collection area to a staging area for binding before shipment to treatment.

Activity 4. Prepare for Shipping

The bins are bound together and the appropriate placards to comply with DOT regulations are pasted to the bins.

Activity 5. Transport to Treatment

Traffic is notified when there are enough bins for shipment to the treatment facility. Eight bins are loaded onto a truck for shipment. The bins are surveyed. A certified shipper ensures that DOT regulations are followed.

Activity 6. Receive at Treatment

The truck is unloaded and the waste is placed in a staging area before treatment.

Activity 7. Radiological Survey

The bin is surveyed after it is unloaded from the truck.

Activity 8. Transport to Compactor

A laborer transports the waste to the compactor.

Activity 9. Compact Waste

Bags are removed from the bin and placed into a compactor box. The average volume reduction ration is 5:1.

Activity 10. Data Management

Information about the waste is entered into the official waste management database.

Activity 11. Transport to Disposal

The compactor boxes are shipped to the disposal facility. A heavy equipment operator loads the trucks with the compactor bins using a forklift. The waste is

surveyed and a certified shipper ensures that all DOT regulations are followed. The shipper also ensures that the information is entered into the appropriate database. A heavy equipment operator transports the load to the disposal facility receiving area by truck.

Activity 12. Receive at Disposal

An equipment operator unloads the truck with a forklift and a radiation control technician surveys the shipment again and the waste is unloaded at the disposal facility. A shipper ensures that the load is properly received and documented.

Activity 13. Verify Characterization

The waste is x-rayed to ensure compliance with the disposal site waste acceptance criteria.

Activity 14. Data Management

Information regarding the waste is entered into the official waste management database and any other tracking databases that are internal to the disposal facility.

Activity 15. Move to Burial Ground

An equipment operator loads and operates a little truck that carries the waste to where it will be placed in the burial ground.

Activity 16. Emplace Waste

An equipment operator unloads the little truck and ensures that the waste is stacked properly. This activity does not include backfilling with dirt around the waste.

Figure F-2. Site 4: low-level waste: contact-handled: compactible.

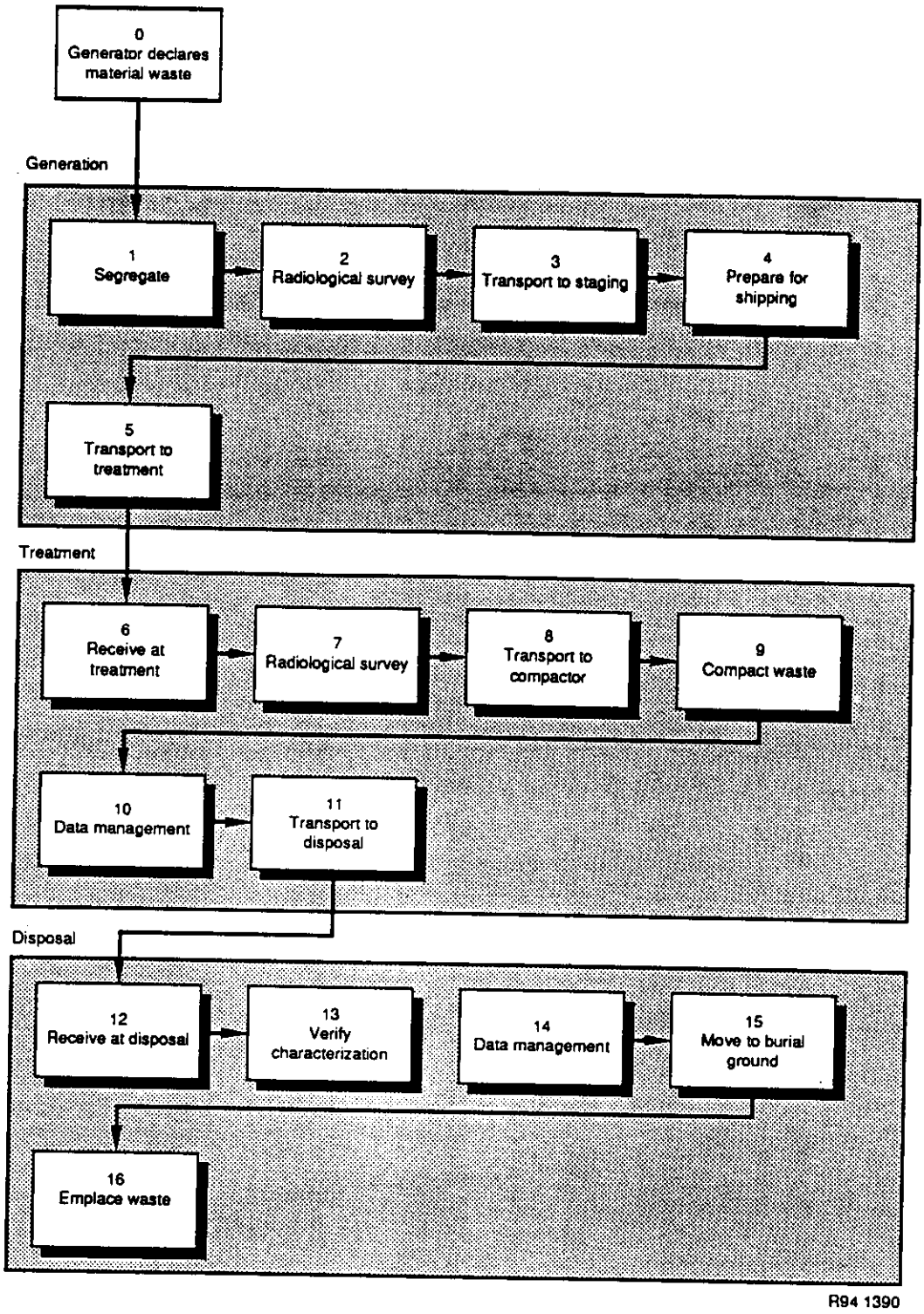


Table F-2. Site 4: low-level waste: contact-handled: compactible.

Annual Quantity Generated: 108 m^3
Annual Quantity Disposed: 36 m^3

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste		1:1											$0
1	Segregate	B-25 bin 4'x4'x5'	1:1	Laborer	1	2	$12	$35	B-25 bin (4'x4'x5')	1	$1,097	$1,167	$515	$515
2	Radiological Survey	B-25	1:1	RCT	1	2	$14	$42						
				Laborer	1	4	$12	$35				$224	$99	$614
3	Transport to Staging	B-25	1:1	Laborer	1	1	$12	$35				$35	$15	$629
4	Package for Shipping	B-25	1:1	RCT	1	2	$14	$42						
				Laborer	1	4.5	$12	$35				$242	$107	$736
5	Transport to Treatment	8 - B-25's	1:1	EO	1	8	$16	$48						
				Release agent	1	2	$17	$50						
				RCT	1	3	$14	$42						
				Traffic	1	2	$24	$70						
				Shipper (Tech)	1	2	$14	$42						
				Safety	1	2	$24	$70				$974	$54	$790
6	Receive at Treatment	8 - B-25's	1:1	RCT	1	1	$14	$42						
				Receiver	1	2	$14	$42						
				EO	1	0.5	$16	$48				$150	$8	$798
7	Radiological Survey	B-25	1:1	RCT	1	1	$14	$42				$42	$19	$817
8	Transport to Compactor	B-25	1:1	laborer	1	0.5	$12	$35				$18	$8	$824
9	Compact Waste	Compactor Box 640 ft3	5:1	laborer	2	6	$12	$35						
				RCT	1	4	$14	$42						
				Shift Supervisor	1	4	$17	$50				$788	$43	$868
10	Data Management	C. Box	1:1	Technician	1	2	$14	$42				$84	$5	$872
11	Transport to Disposal	3 - C. box	1:1	RCT	1	0.5	$14	$42						
				Shipper (Tech)	1	2	$14	$42						
				EO	1	2	$16	$48				$201	$4	$876
12	Receive at Disposal	3 - C. box	1:1	RCT	1	1	$14	$42						
				Shipper (Tech)	1	1	$14	$42						
				EO	1	3	$16	$48				$228	$4	$880
13	Verify Characterization	C. box	1:1	Technician	1	2	$14	$42				$84	$5	$885
14	Data Management	C. box	1:1	Technician	1	0.25	$14	$42				$11	$1	$885
15	Move to Burial Ground	1 - C. box	1:1	EO	1	0.75	$16	$48				$36	$2	$887
16	Emplace Waste	1 - C. box	1:1	EO	1	0.75	$16	$48				$36	$2	$889

SITE 4

LOW-LEVEL WASTE: CONTACT HANDLED: UNTREATED

Activity 0. Generator Declares Material Waste

Generators bring waste in clear plastic bags to a central collection area where there are locked bins for incinerable, compatible, and noncompatible type low-level waste. A health physics technician visually determines which bin is appropriate for the waste and unlocks the bins. The container for noncompatible untreated waste is a 4 ft x 4 ft x 8 ft plywood box.

Activity 1. Segregate

A laborer pours an average of 2 bags of "kitty litter" into each box to serve as packing material. This acts as an absorbent if there accidentally are liquids in the box. The plywood box is sealed.

Activity 2. Radiological Survey

A radiation control technician surveys the box to ensure compliance. A laborer moves the boxes if necessary.

Activity 3. Transport to Staging

An equipment operator transports the boxes from the central collection area to a staging area for shipment to the disposal facility.

Activity 4. Prepare for Shipment

A laborer paints the plywood boxes with flame retardant paint, seals and binds the and attaches placards to comply with DOT shipping regulations. One shipment equals eight boxes. A radiation control technician surveys the boxes.

Activity 5. Transport to Disposal

An equipment operator loads the truck with the boxes using a forklift. The waste is surveyed and a certified shipper ensures that all DOT regulations are followed. The shipper also ensures that the information is entered into the appropriate database. A heavy equipment operator transports the load to the disposal facility receiving area by truck.

Activity 6. Receive at Disposal

An equipment operator unloads the truck with a forklift and a radiation control technician surveys the shipment again and the waste is unloaded at the disposal facility. A shipper ensures that the load is properly received and documented.

Activity 7. Verify Characterization

The waste is X-rayed to ensure compliance with the disposal facility waste acceptance criteria.

Activity 8. Data Management

Information regarding the waste is entered into the official waste management database and any other tracking databases that are internal to the disposal facility.

Activity 9. Move to Burial Ground

An equipment operator loads and operates a little truck that carries the waste to where it will be placed in the burial ground.

Activity 10. Emplace Waste

An equipment operator unloads the little truck and ensures that the waste is stacked properly. This activity does not include backfilling with dirt around the waste.

Figure F-3. Site 4: low-level waste: contact handled: untreated.

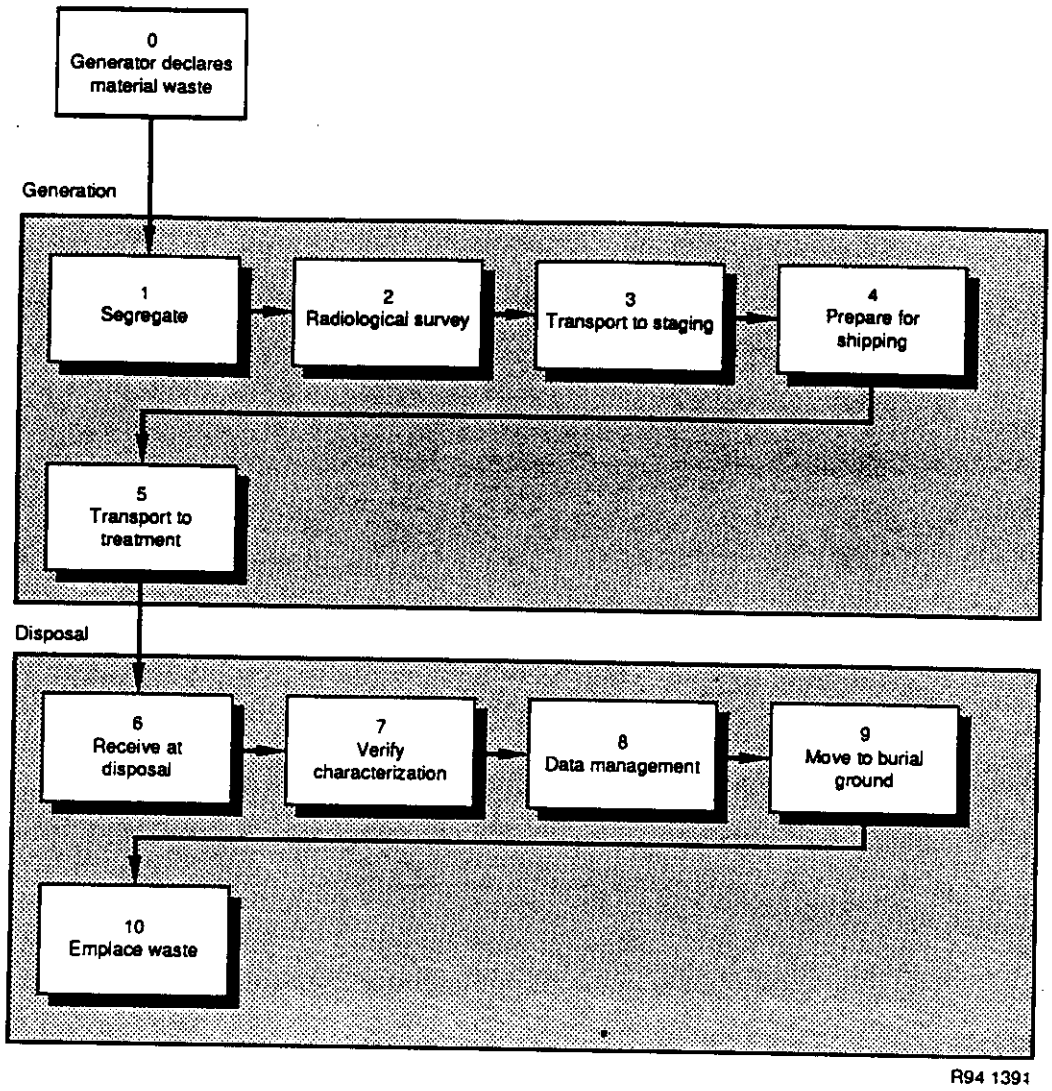


Table F-3. Site 4: low-level waste: contact handled: untreated.

Annual Quantity Generated: 108 m³
Annual Quantity Disposed: 108 m³

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
0	Generator Declares Material Waste													$0
1	Segregate	4'x4'x8' ply-wood box	1:1	Laborer	1	2	$12	$35	4'x4'x8' box	1	$700			
									kitty litter (2 ea.)	2	$4	$778	$215	$215
2	Radiological Survey	4'x4'x8'	1:1	RCT	1	2	$12	$35						
				Laborer	1	4	$14	$42						
3	Transport to Staging	4'x4'x8'	1:1	EO	1	1	$16	$48				$238	$66	$280
4	Prepare for Shipping	4'x4'x8' 8 boxes	1:1	Laborer	1	4.5	$12	$35	Paint	1	$35	$48	$13	$294
				RCT	1	2	$14	$42						
5	Transport to Disposal	8 boxes	1:1	RCT	1	0.5	$14	$42				$277	$10	$303
				Shipper	1	2	$17	$50						
				HEO	1	2	$18	$53						
6	Receive at Disposal	8 boxes	1:1	RCT	1	1	$14	$42				$227	$8	$311
				Shipper	1	1	$17	$50						
				EO	1	3	$16	$48						
7	Verify Characterization	4'x4'x8'	1:1	Technician	1	2	$14	$42				$236	$8	$319
8	Data Management	4'x4'x8'	1:1	Technician	1	0.25	$14	$42				$84	$23	$342
9	Move to Burial Ground	4 boxes	1:1	EO	1	0.75	$16	$48				$11	$3	$345
10	Emplace Waste	4'x4'x8'	1:1	EO	1	0.75	$16	$48				$36	$2	$348
												$36	$10	$357

Appendix G

Site 5 WM Activity Narratives and Flow Diagrams

Appendix G:

Site 5 WM Activity Narratives and Flow Diagrams

SITE 5

LOW-LEVEL WASTE: CONTACT-HANDLED: UNTREATED

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator, assumed average packaging is a 55-gal drum, lid, and vermiculite.

Activity 2. Waste Profile Processing

Cost of completing and data entry for a typical waste profile form.

Activity 3. Radiological Survey

Health physics technician inspection of the waste package as required for completion of the radioactive waste manifest.

Activity 4. Waste Sampling/Analysis

This is the average cost of sampling and analysis performed by Environmental Chemistry Group. $330 average charge per sample includes their labor and materials.

Activity 5. Radioactive Waste Manifest Processing

Costs of generator completing, reviewing, and forwarding radioactive waste manifest to Waste Management for review, approval, and data entry.

Activity 6. Radioactive Material Transport Documentation

Costs of the generator completing, Waste Management reviewing, and Materials Management approving the radioactive material transport documentation.

Activity 7. Arrange Transportation

Coordination performed by a waste management technician to obtain truck, driver, and clearance to move the waste.

Activity 8. Radiological Survey

Costs of health physics technician monitoring/inspecting waste, truck, reviewing and approving paperwork, and escorting load enroute.

Activity 9. Transport to Disposal

Costs of a teamster and truck to move waste to disposal site.

Activity 10. Receive at Disposal

Cost of waste management technicians that inspect load on arrival and confirm information on paperwork.

Activity 11. Emplace Waste

Costs associated with moving waste to land disposal location, placement of waste, determining exact geographic location by survey, and completing radioactive waste disposal records.

Activity 12. Waste Burial

Costs of covering wastes placed in landfill, including compacting in place, covering, and confirming location via survey.

Activity 13. Data Management

Cost of final location data entry, data verification, operational reporting, and system maintenance.

Figure G-1. Site 5: low-level waste: contact-handled: untreated.

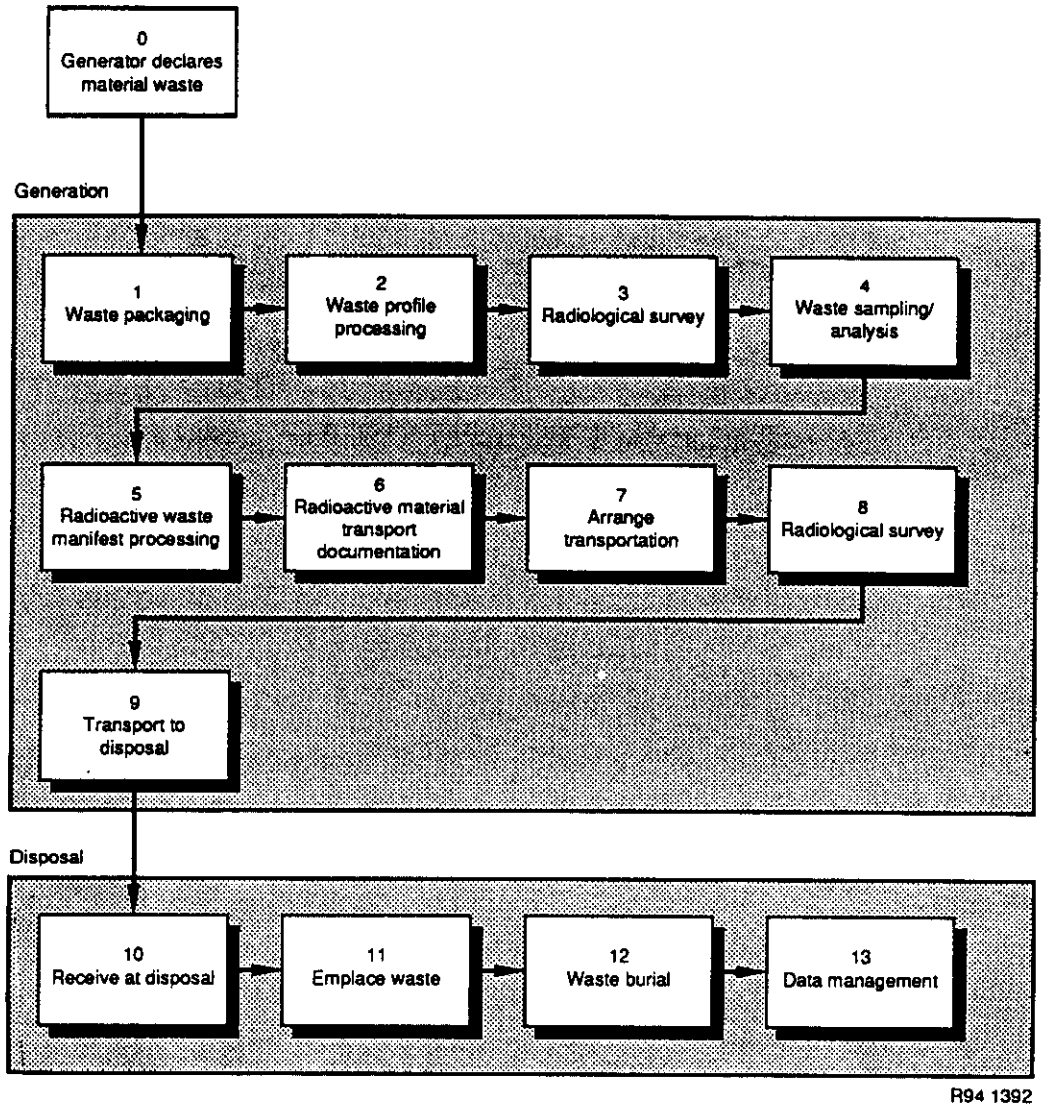


Table G-1. Site 5: low-level waste: contact-handled: untreated.

Annual Quantity Generated: 2644 m^3
Annual Quantity Disposed: 2644 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Waste Packaging	55 gal Drum	1:1	Site Avg. Employee	1	0.5	$24	$73	55 gal Drum	1	$30			
									Lid	1	$7			
									Vermiculite	1	$3	$76	$363	$363
2	Waste Profile Processing	3718 m^3	1:1	Contractor FTE	0.5	1728	$8	$24	Computer Equip. & Maint. & office Supplies	1	$27			
		4.5 m^3		Site Avg. Employee	1	0.25	$24	$73				$20,937	$10	$373
3	Radiological Survey	55 gal Drum	1:1	HP Tech.	1	0.25	$15	$46				$11	$54	$427
4	Waste Sampling/Analysis	55 gal Drum	1:1	Env. Chem Group								$0	$1,571	$1,998
5	Radioactive Waste Manifest Processing	4.5 m^3/form	1:1	Site Avg. Employee	1	0.75	$24	$73	Computer Equip. & Maint. & office Supplies	1	$27			
				WM Avg. Employee	1	1.5	$23	$69				$186	$41	$2,040
6	Radioactive Material Transport Documentation	4.5 m^3/form	1:1	Site Avg. Employee	1	1.5	$24	$73						
				WM Avg. Employee	1	1	$23	$69	Computer Equip. & Maint. & office Supplies	1	$27			
				Proc-Spec	1	1	$16	$48				$254	$56	$2,096
7	Arrange Transportation	3.5 m^3	1:1	WM Tech.	1	2	$16	$48				$95	$27	$2,123
8	Radiological Survey	3.5 m^3	1:1	HP Tech.	2	2	$15	$46				$182	$52	$2,175
9	Transport to Disposal	3.5 m^3	1:1	Contractor Teamster	1	2	$17	$50				$101	$29	$2,204

Table G-1. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor Items	Qty.	Burdened ($)			
10	Receive at Disposal	3.5 m³	1:1	WM Tech.	2	0.5	$16	$48	Gloves & Scale Maint., etc.	1	$35	$83	$24	$2,228
11	Emplace Waste	55 gal Drum	1:1	Contractor Operator	1	0.5	$24	$72						
				WM Tech	3	0.5	$16	$48				$107	$512	$2,739
12	Waste Burial	55 gal Drum	1:1	Contractor Operator	1	0.5	$24	$72						
				WM Tech	2	0.5	$16	$48				$84	$398	$3,138
13	Data Management	3718 m³	1:1	Contractor Data Clerk	2.5	1728	$8	$24	Computer Equip. & Maint. & office Supplies	1	$27	$104,487	$28	$3,166

SITE 5

LOW-LEVEL SOLID WASTE: REMOTE-HANDLED: UNTREATED

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator, assumed average packaging is a 55-gal drum.

Activity 2. Waste Profile Processing

Costs of completing and data entry for a typical waste profile form.

Activity 3. Radiological Survey

Health physics technician inspection of the waste package as required for completion of the radioactive waste manifest.

Activity 4. Waste Sampling/Analysis

This is the average cost of sampling and analysis performed by Environmental Chemistry Group. $330 average charge per sample includes their labor and materials.

Activity 5. Radioactive Waste Manifest Processing

Costs of generator completing, reviewing, and forwarding radioactive waste manifest to Waste Management for review, approval, and data entry.

Activity 6. Radioactive Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the radioactive material transport documentation.

Activity 7. Arrange Transportation

Coordination performed by waste management technician and a field engineering technician to obtain truck, driver, and clearance to move the waste.

Activity 8. Radiological Survey

Costs of health physics technician monitoring/inspecting waste, truck, reviewing and approving paperwork, and escorting load enroute.

Activity 9. Road Closure

Coordination of closing road to all traffic, including obtaining flagmen, security, and local police.

Activity 10. Transport to Disposal

Costs of a teamster and truck to move waste to disposal site.

Activity 11. Receive at Disposal

Cost of waste management technicians that inspect load on arrival and confirm information on paperwork.

Activity 12. Emplace Waste

Costs associated with moving waste to disposal location, remote placement of waste, determining exact geographic location by survey, and completing radioactive solid waste records.

Activity 13. Waste Burial

Costs of covering wastes placed in landfill, including covering and confirming location via survey.

Activity 14. Data Management

Cost of final location data entry, data verification, operational reporting, and system maintenance.

Figure G-2. Site 5: low-level solid waste: remote-handled: untreated.

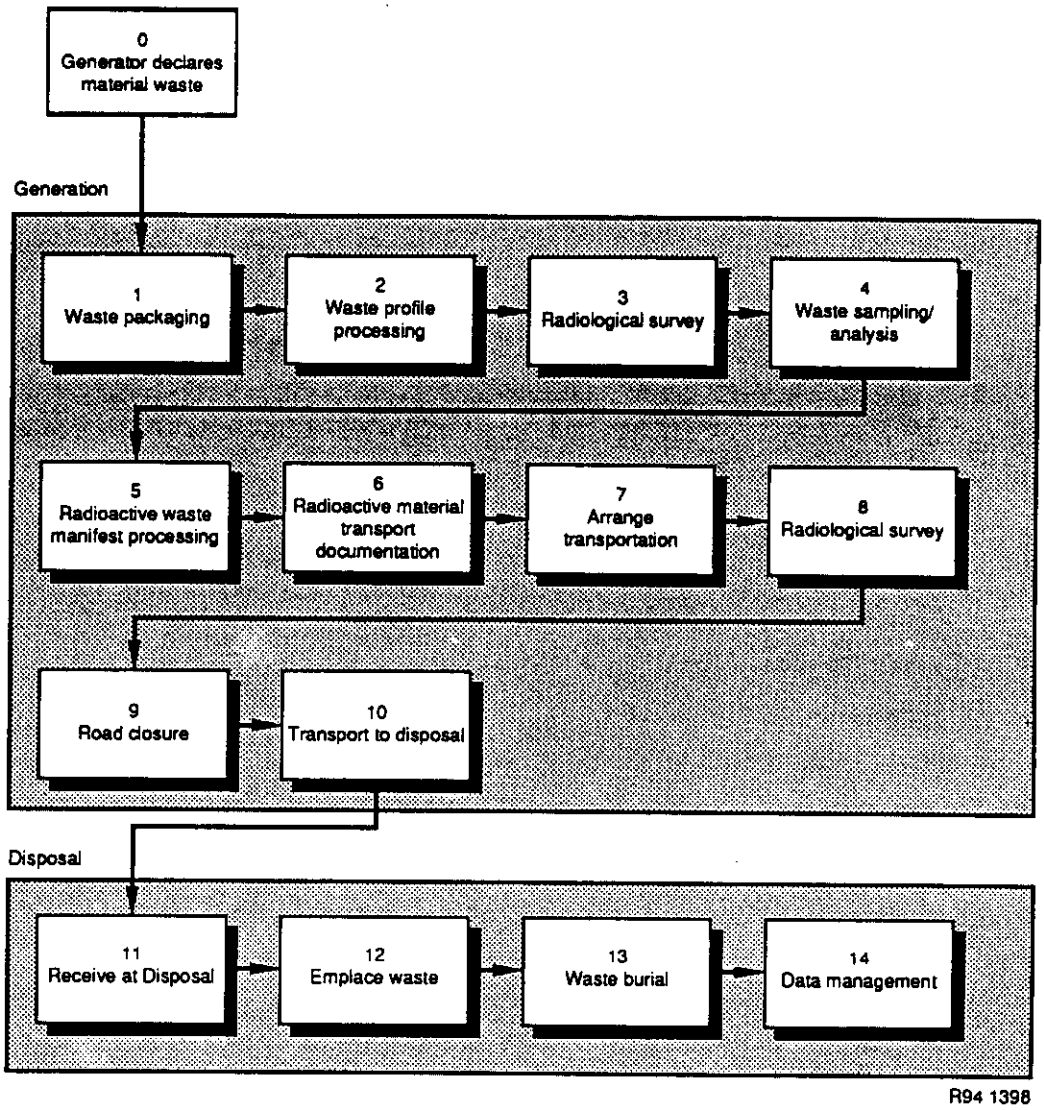


Table G-2. Site 5: low-level solid waste: remote-handled: untreated.

Annual Quantity Generated: 3 m^3
Annual Quantity Disposed: 3 m^3

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Waste Packaging	55 gal Drum	1:1	Site Avg. Employee	1	1	$24	$73	55 gal Drum	1	$30			
									Lid	1	$7			
									Vermiculite	1	$3			
									Lead	1	$46			
									Filter	1	$27	$186	$884	$884
2	Waste Profile Processing	1 m^3/form	1:1	Contractor FTE	1	0.5	$8	$24						
				Site Avg. Employee	1	0.25	$24	$73	Computer equip. & maint. & office supplies	1	$6	$36	$36	$920
3	Radiological Survey	55 gal Drum	1:1	HP Tech.	1	0.25	$15	$46				$11	$54	$975
4	Waste Sampling/Analysis	55 gal Drum	1:1									$0	$1,571	$2,546
5	Radioactive Waste Manifest Processing	1 m^3/form	1:1	Site Avg. Employee	1	0.75	$24	$73						
				WM Avg. Employee	1	1.5	$23	$69	Computer equip. & maint. & office supplies	1	$6	$165	$165	$2,710
6	Radioactive Material Transport Documentation	1 m^3/form	1:1	Site Avg. Employee	1	1.5	$24	$73						
				WM Avg. Employee	1	1	$23	$69	Computer equip. & maint. & office supplies	1	$6			
				Proc-Spec	1	1	$16	$48				$233	$233	$2,943
7	Arrange Transportation	1 m3	1:1	WM Tech.	1	2	$16	$48						
				Engr. Tech	1	0.5	$22	$65				$128	$128	$3,070
8	Radiological Survey	1 m3	1:1	HP Tech.	2	2	$15	$46				$182	$182	$3,253

Table G-2. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
9	Road Closure	1 m3	1:1	Service Charge								$0	$805	$4,058
10	Transport to Disposal	1 m3	1:1	Service Charge								$0	$445	$4,503
11	Receive at Disposal	1 m3	1:1	Contractor Operator	1	0.5	$24	$72	Gloves, Scale maint., ect.	1	$10			
				WM Tech	2	0.5	$16	$48				$94	$94	$4,596
12	Emplace Waste	1 m3	1:1	Service Charge								$0	$1,718	$6,314
13	Waste Burial	55 gal drum	1:1	Contractor Operator	1	0.667	$24	$72						
				HP Tech.	1	0.667	$15	$46						
				WM Tech	2	0.667	$16	$48				$142	$676	$6,991
14	Data Management	3718 m³	1:1	Contractor Data Clerk	2.5	1728	$8	$24	Computer equip. & maint. & office supplies	1	$6	$104,466	$28	$7,019

SITE 5

LOW-LEVEL WASTE: LIQUID WASTEWATER

NOTE: Facility maintenance and upgrade, facility inspections, employee training, audit, and administrative costs are not included in the labor and materials listed here.

Activity 0. Generator Declares Material Waste

Activity 1. Waste Profile Processing

Costs of completing, reviewing, and data entry for typical waste profile form.

Activity 2. Waste Sampling/Analysis

$330 per sample and analysis by the Environmental Chemistry group, includes both their labor and materials. Assume that 2,000 samples are performed annually.

Activity 3. Transfer to Treatment Plant

Ninety-eight percent of influent arrives via plant feed lines at no cost and 5.2% is picked up by liquid waste treatment plant technicians with tank truck and transported to plant. Costs associated with truck transport to the plant are included in Activity 4.

Activity 4. Treat Liquid Waste

Activity includes waste collection, sampling, analysis, treatment, waste packaging, documentation, characterization, transport paperwork, solid waste transport to disposal site, process wastewater release, and operations reporting.

Activity 5. Receive at Disposal

Cost of waste management technicians that inspect load on arrival and confirm information on paperwork.

Activity 6. Emplace Waste

Costs associated with moving waste to landfill location, placing of waste, determining exact location by survey, and completing radioactive waste disposal records.

Activity 7. Waste Burial

Costs of covering wastes placed in landfill, including compacting in place, covering, and confirming location via survey.

Activity 8. Data Management

Cost of final location data entry, data verification, operational reporting, and system maintenance.

Figure G-3. Site 5: low-level waste: liquid wastewater.

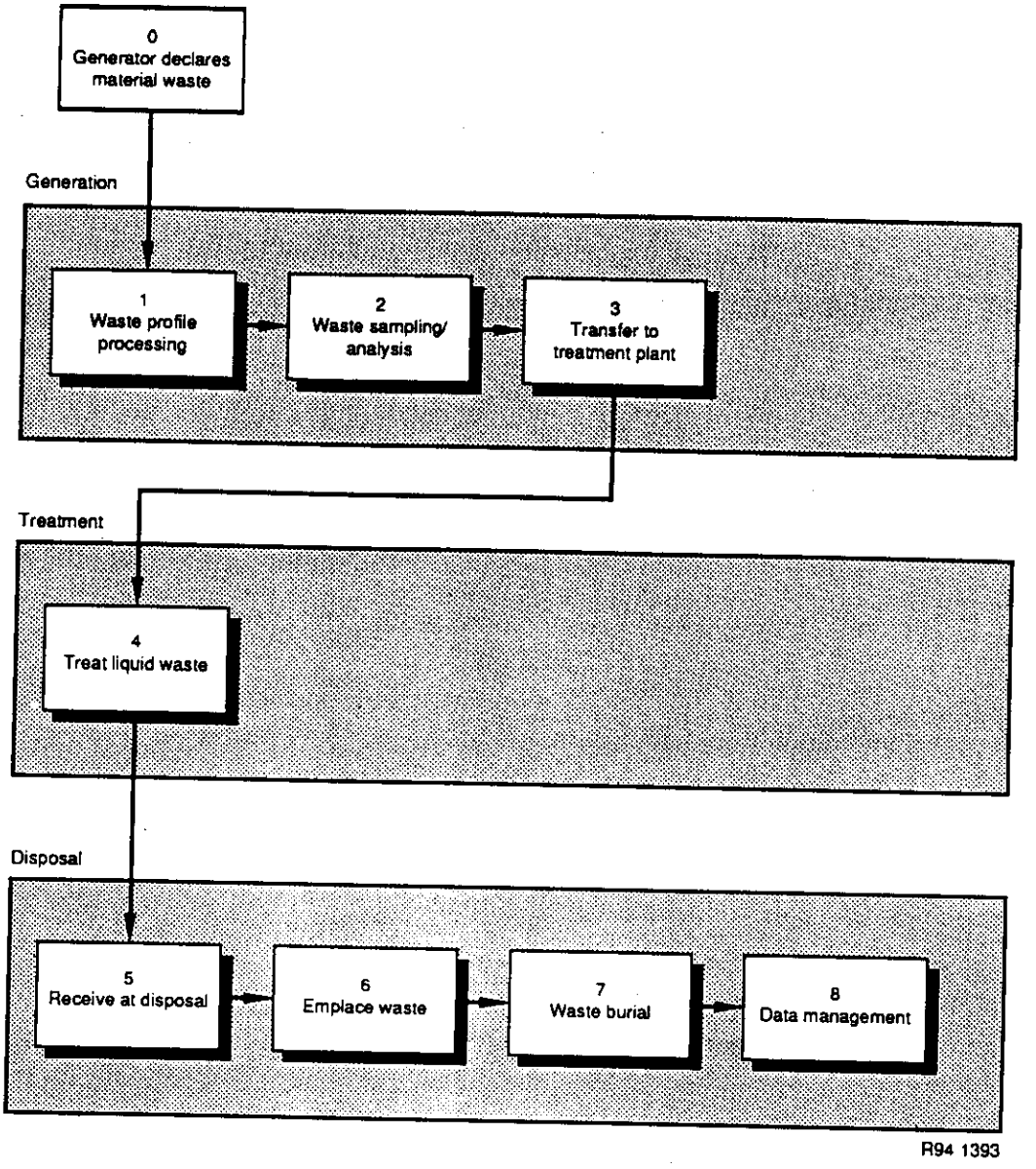


Table G-3. Site 5: low-level waste: liquid wastewater.

Annual Quantity of Liquid: 5.6 M gal
Annual Quantity of Solids: 44.7 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	LABOR: Qty.	LABOR: Time (hrs)	LABOR: Raw Rate ($/hr)	LABOR: Rate Burdened ($/hr)	NONLABOR: Nonlabor items	NONLABOR: Qty.	NONLABOR: Burdened ($)	Total by Activity ($)	Liquid Cost ($/gal)	Solid Cost ($/$m^3$)
0	Generator Delcares Material Waste													$0.00
1	Waste Profile Processing	5653 gal	1:1	RCRA Tech.	0.5	1728	$18	$55						
				Site Avg. Employee	1	0.25	$24	$73				$47,296	$0.01	$0.00
2	Waste Sampling/Analysis	5.6 M gal	1:1	Service Charge								$660,000	$0.12	$0.00
3	Transfer to Treatment Plant	44.7 m3	1:1	Costs are included in Activity 4								$0	$0.00	$0.00
4	Treat Liquid Waste	44.7 m3	1:1	WM Tech. FTE	12.3	1728	$16	$48	Chemicals	1	$100,000	$1,112,560	$0.20	$0
5	Receive at Disposal	3.5 m3	1:1	WM Tech.	2	0.5	$16	$48	Gloves, Scale Maintenance, etc.	1	$35	$83	$0.00	$23.61
6	Emplace Waste	55 gal drum	1:1	Contractor Operator	1	0.5	$24	$72						
				WM Tech.	3	0.5	$16	$48				$107	$0.00	$511.71
7	Waste Burial	55 gal drum	1:1	Contractor Operator	1	0.5	$24	$72						
				WM Tech.	2	0.5	$16	$48				$84	$0.00	$398.29
8	Data Management	3718 m3	1:1	Contractor Data Clerks	2.5	1728	$8	$24	Computer equip & maintenance & supplies, and office supplies	1	$89,232	$193,692	$0.00	$52.10
												TOTAL	$0.33	$986

SITE 5

MIXED LOW-LEVEL WASTE: STORED INDEFINITELY PENDING TREATMENT AND DISPOSAL

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator, assumed average packaging is a 55-gal drum, lid, and vermiculite.

Activity 2. Temporary Storage

Costs of setting up, documenting, and maintaining a 90-day storage area at the generator site, including Environmental Compliance group approval and inspections.

Activity 3. Waste Profile Processing

Costs of completing and data entry for a typical waste profile form.

Activity 4. Waste Sampling/Analysis

This is the average cost of sampling and analysis performed by Environmental Chemistry Group. $330 average charge per sample includes their labor and materials.

Activity 5. Radioactive and Chemical Manifest Processing

Costs of generator completing, reviewing, and forwarding the radioactive waste and chemical waste manifest forms, and Waste Management approval and data entry.

Activity 6. Waste Repackaging

Performed by Waste Management at generator storage site before waste transport whenever the waste paperwork or inspection dictates.

Activity 7. Radioactive Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the radioactive material transport documentation.

Activity 8. Arrange Transportation

Coordination performed by a waste management technician and a field engineering technician to obtain truck, driver, and clearance to move the waste.

Activity 9. Radiological Survey

Costs of health physics technician monitoring/inspecting waste and truck and reviewing and approving paperwork, and escorting load enroute.

Activity 10. Road Closure

Costs associated with coordinating road closure with flagmen, security, and local police.

Activity 11. Transport to Storage

Costs of a teamster and truck to move waste to storage site.

Activity 12. Receive at Storage

Cost of waste management technicians that inspect load on arrival and confirm information on paperwork.

Activity 13. Emplace Waste

Costs of grouping/banding drums on pallets, moving pallets to storage location, and completing waste paperwork.

Activity 14. Data Management

Cost of final location data entry, data verification, operational reporting, and system maintenance.

Figure G-4. Site 5: mixed low-level waste: stored indefinitely pending treatment and disposal.

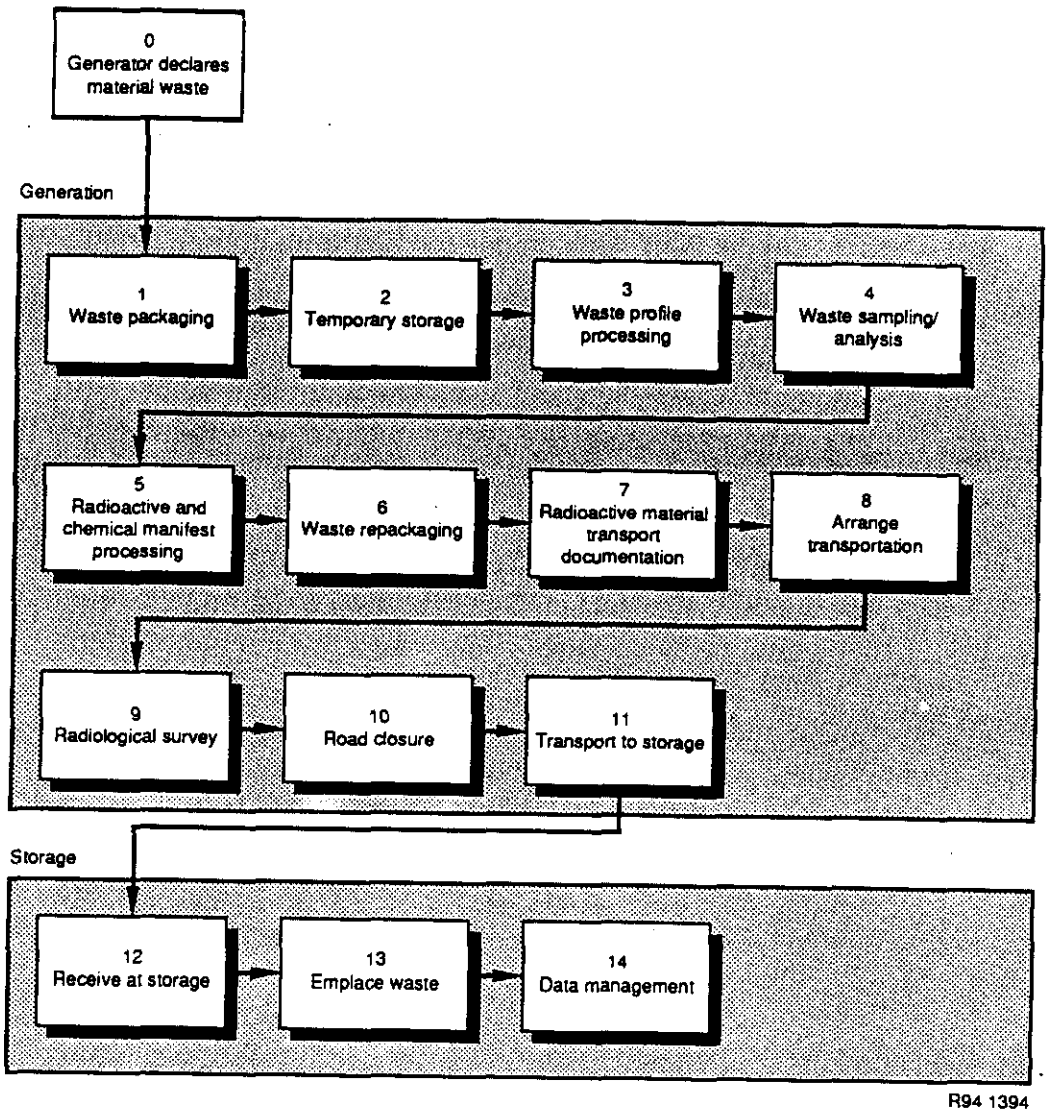


Table G-4. Site 5: mixed low-level waste: stored indefinitely pending treatment and disposal.

Annual Quantity Generated: 45.2 m^3
Annual Quantity Disposed: 45.2 m^3

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Waste Packaging	55 gal drum	1:1	Site Avg. Employee	1	1	$24	$73	Drum	1	$30			
									Lid	1	$7			
									Vermiculite	1	$3	$113	$536	$536
2	Temporary Storage	33.3 m^3	1:1	Contractor FTE	0.25	1728	$8	$24						
		55 gal drum		Site Avg. Employee	1	1.5	$24	$73				$10,555	$833	$1,369
3	Waste Profile Processing	33.3 m^3	1:1	Contractor FTE	0.25	1728	$8	$24	Computer equip. & Maint. & office supplies	1	$200			
		.21 m^3/form		Site Avg. Employee	1	0.25	$24	$73				$10,664	$406	$1,775
4	Waste Sampling/Anaylsis	55 gal drum	1:1	Env. Chem. Group									$1,571	$3,346
5	Radioactive & Chemical Manifest Processing	.21 m^3/form	1:1	Site Avg. Employee	2	0.5	$24	$73						
				WM Avg. FTE	1	1.5	$23	$69	Computer equip. & Maint. & office supplies	1	$1	$178	$847	$4,193
6	Waste Repackaging	55 gal drum	1:1	Contractor Teamster	1	0.75	$17	$50	85-gal overpack	1	$145			
				WM Staff	1	0.75	$30	$91	Lid	1	$9			
				WM Tech.	1	0.75	$16	$48	Vermiculite	1	$6	$302	$1,437	$5,630
7	Radioactive Material Transport Documentation	55 gal drum	1:1	Site Avg. Employee	1	1.5	$24	$73						
				WM Avg. FTE	1	1	$23	$69	Computer equip. & Maint. & office supplies	1	$1			
				Procurement Specialist	1	1	$16	$48				$228	$1,084	$6,715

Table G-4. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
8	Arrange Transportation	3.5 m³/load	1:1	WM Tech.	1	2	$16	$48						
				Field Engineering Tech.	1	0.5	$22	$65				$128	$37	$6,751
9	Radiological Survey	3.5 m³/load	1:1	HP Tech.	2	2	$15	$46				$182	$52	$6,803
10	Road Closure	3.5 m³/load	1:1									$0	$805	$7,608
11	Transport to Storage	3.5 m³/load	1:1	Contractor Teamster	1	2	$17	$50				$101	$29	$7,637
12	Receive at Storage	3.5 m³/load	1:1	WM Staff	1	0.5	$30	$91	Gloves, scale maintenance, etc.	1	$2			
		55 gal drum		WM Tech.	2	0.25	$16	$48				$71	$127	$7,764
13	Emplace Waste	3.5 m³/load	1:1	WM Staff	1	0.5	$30	$91						
		4-drums		Contractor Operator	1	1	$24	$72						
		4-drums		WM Tech.	2	0.5	$16	$48				$165	$155	$7,919
14	Data Management	3718 m³	1:1	Contractor Data Clerks	2.5	1728	$8	$24	Computer equip. & maint. & office supplies	1	$22,308	$126,768	$34	$7,953

SITE 5

TRU AND TRU-MIXED SOLID: CONTACT HANDLED: STORED FOR WIPP

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator; assumed average packaging is a 55-gal drum.

Activity 2. Verify Characterization

Drum X-ray, gamma assay, pan assay, and ultrasound inspection for waste acceptance certification.

Activity 3. Waste Profile Processing

Costs of generator completing and data entry for a typical waste profile form.

Activity 4. TRU Waste Manifest Processing

Costs of generator completing, reviewing, and forwarding TRU waste manifest form and Waste Management approval and data entry.

Activity 5. Radioactive Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the radioactive material transport documentation.

Activity 6. Arrange Transportation

Coordination performed by a waste management technician and field engineering technician to obtain truck, driver, and clearance to move waste.

Activity 7. Radiological Survey

Costs of health physics technician monitoring/inspecting waste and truck and reviewing and approving paperwork, and escorting load enroute.

Activity 8. Road Closure

Costs associated with coordinating road closure with flagmen, security, and local police.

Activity 9. Transport to Storage

Costs of a teamster and truck to move waste to storage site.

Activity 10. Receive at Storage

Cost of waste management personnel to inspect load on arrival and confirm information on paperwork.

Activity 11. Waste inspection

Each drum is individually inspected for package integrity, closure, filter placement, labeling, and contamination before emplacement in storage.

Activity 12. Waste Repackaging

Performed at waste management storage site whenever the waste inspection dictates, before emplacement in storage. This activity affects approximately 10% of the waste received for storage.

Activity 13. Emplace Waste

Costs of grouping/banding drums on pallets, moving pallets to storage location, performing radiation survey, and completing paperwork.

NOTE: Waste inspections in storage are not included here. However, daily drum inspections are estimated to cost $2.73 per day per drum (one waste management technician, 1 minute per drum, per day). This would total $996 per drum per year in storage, assuming inspections occurred 365 days/year.

Activity 14. Data Management

Cost of final location data entry, data verification, operational reporting, and system maintenance.

Figure G-5. Site 5: TRU and TRU-mixed solid: contact handled: stored for WIPP.

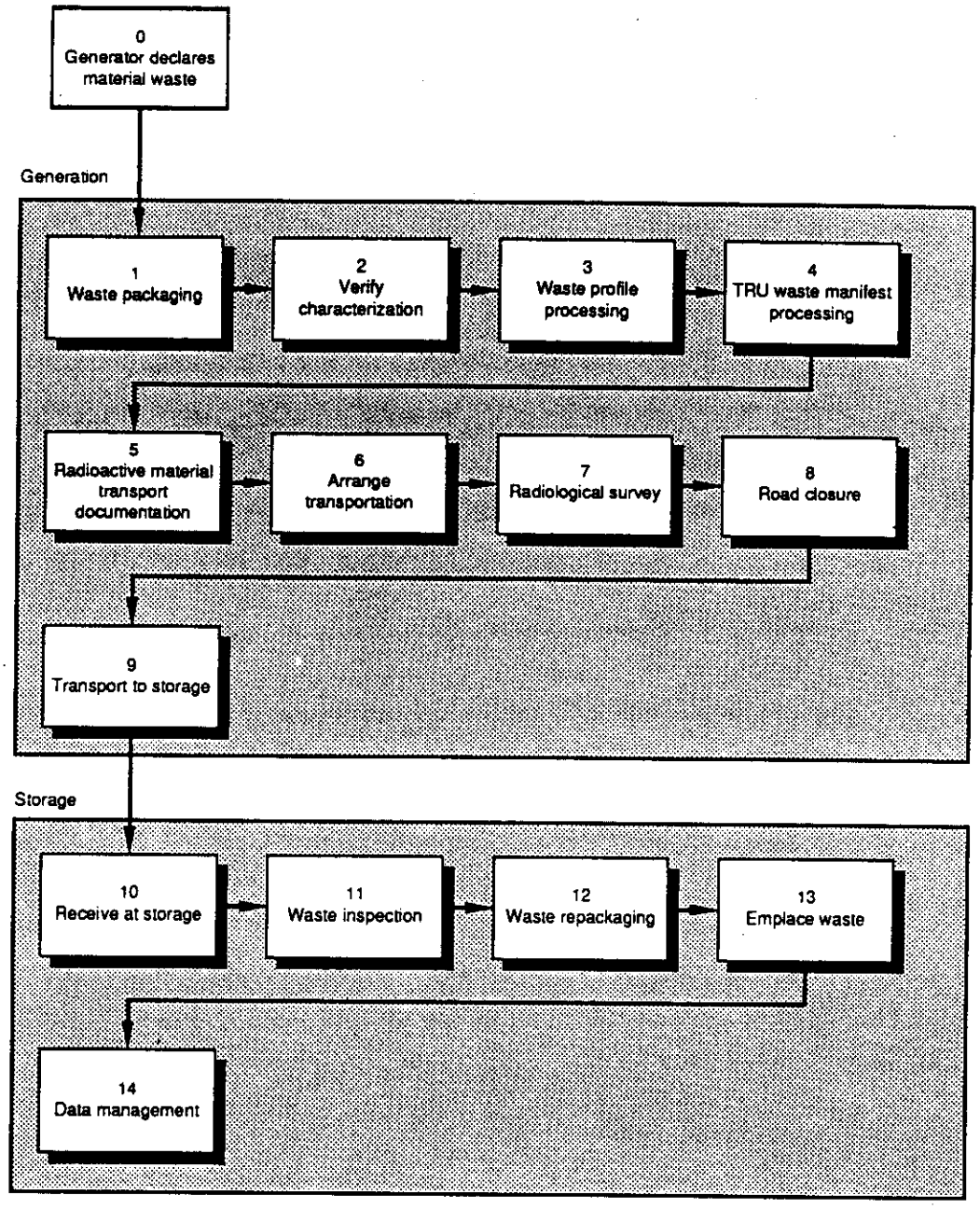


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Table G-5. Site 5: TRU and TRU-mixed solid: contact handled: stored for WIPP.

Annual Quantity Generated: 242 m^3
Annual Quantity Disposed: 242 m^3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
0	Generator Declares Material Waste													$0
1	Waste Packaging	55 gal drum	1:1	Site Avg. Employee	1	1	$24	$73	Drum	1	$250			
									Lid	1	$7			
									Bag	2	$15			
									Filter	1	$27			
									Vermiculite	1	$6	$392	$1,868	$1,868
2	Verify Characterization	55 gal drum	1:1	WM Tech.	8	1	$16	$48						
				WM Tech.	4	0.25	$16	$48						
				WM Staff	1	1	$30	$91				$520	$2,475	$4,343
3	Waste Profile Processing	.21 m^3/form	1:1	Contractor FTE	1	0.5	$8	$24	Computer Equipment, Office Supplies	1	$1			
				Site Avg. Employee	1	0.25	$24	$73				$31	$150	$4,492
4	TRU Waste Manifest Processing	.21 m^3/form	1:1	Site Avg. Employee	2	0.5	$24	$73						
				WM Avg. FTE	1	1.5	$23	$69	Computer Equipment, Office Supplies	1	$1	$178	$847	$5,339
5	Radioactive Material Transport Documentation	55 gal drum	1:1	Site Avg. Employee	1	1.5	$24	$73						
				WM Avg. FTE	1	1	$23	$69	Computer Equipment, Office Supplies	1	$1			
				Procurement Specialist	1	1	$16	$48				$228	$1,084	$6,424

Table G-5. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
6	Arrange Transportation	3.5 m3	1:1	WM Tech.	1	2	$16	$48						
				Field Engineering Tech.	1	0.5	$22	$65				$128	$37	$6,460
7	Radiological Survey	3.5 m³	1:1	HP Tech.	2	2	$15	$46				$182	$52	$6,513
8	Road Closure	3.5 m³	1:1	Service Charge									$805	$7,318
9	Transport to Storage	3.5 m³	1:1	Contractor Teamster	1	2	$17	$50				$101	$18	$7,336
10	Receive at Storage	3.5 m³	1:1	WM Staff	1	0.5	$30	$91	Gloves, Scale maintenance	1	$2			
		55 gal		WM.Tech.	2	0.25	$16	$48				$71	$116	$7,452
11	Waste Inspection	55 gal	1:1	WM Tech. FTE	1	0.5	$16	$48						
				HP Tech.	1	0.25	$15	$46				$35	$168	$7,619
12	Waste Repackaging	55 gal	1:1	Contractor Teamster	1	0.75	$17	$50	85-gal Overpack	1	$145			
				WM Staff	1	0.75	$30	$91	Lid	1	$9			
				WM Tech.	1	0.75	$16	$48	Vermiculite	1	$6			
									Filter	1	$27	$329	$1,565	$9,185
13	Emplace Waste	3.5 m³	1:1	WM Staff	1	0.5	$30	$91						
		4 drum		WM Tech.	2	0.5	$16	$48						
				Contractor Operator	1	1	$24	$72						
				HP Tech.	1	1	$15	$46				$211	$210	$9,394
14	Data Management	3718 m³	1:1	Contractor Data Clerks	2.5	1728	$8	$24	Computer equip. & maint. & office supplies	1	$22,308	$126,768	$34	$9,428

SITE 5

TRU AND TRU-MIXED SOLID: REMOTE HANDLED: STORED FOR WIPP

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator; assumed average packaging is a 55-gal drum.

Activity 2. Waste Profile Processing

Costs of completing and data entry for a typical waste profile form.

Activity 3. Radiological Survey

Cost of a health physics technician inspecting the waste package as required for completion of the radioactive waste manifest.

Activity 4. Waste Sampling/Analysis

This is the average cost of sampling and analysis performed by the Environmental Chemistry Group. $330 average charge per sample includes their labor and materials.

Activity 5. TRU Waste Manifest Processing

Costs of generator completing, reviewing and forwarding TRU waste storage manifest form to Waste Management for review, approval, and data entry.

Activity 6. Radioactive Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the Radioactive Materials Transport documentation.

Activity 7. Arrange Transportation

Coordination performed by a waste management technician and a field engineering technician to obtain truck, driver, and clearance to move the waste.

Activity 8. Radiological Survey

Costs of health physics technician monitoring/inspecting waste and truck and reviewing and approving paperwork, and escorting load enroute.

Activity 9. Road Closure

Coordination of closing road to all traffic, including obtaining flagmen, security, and local police.

Activity 10. Transport to Storage

Costs of a teamster and truck to move waste to storage site.

Activity 11. Receive at Storage

Cost of waste management technicians that inspect load on arrival and confirm information on paperwork.

Activity 12. Emplace Waste

Costs associated with moving waste to storage location, remote placement of waste, determining exact geographic location by survey, and completing radioactive waste storage records.

Activity 13. Data Management

Cost of final location data entry, data verification, operational reporting, and system maintenance.

Figure G-6. Site 5: TRU and TRU-mixed solid: remote handled: stored for WIPP.

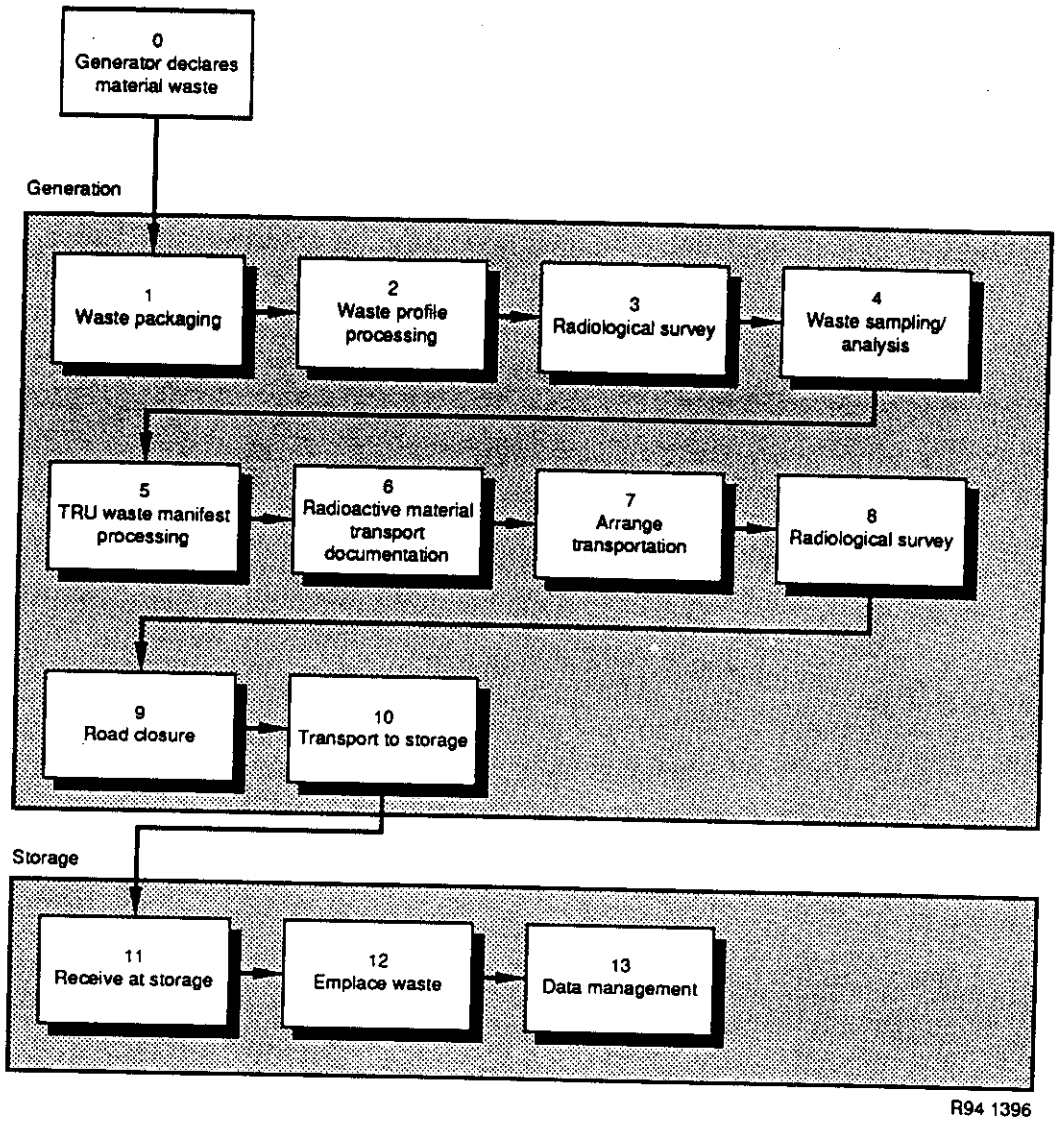


Table G-6. Site 5: TRU and TRU-mixed solid: remote handled: stored for WIPP.

Annual Quantity Generated: 12.9 m^3
Annual Quantity Disposed: 12.9 m^3

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/$m^3$)	Cumulative Total ($/$m^3$)
0	Generator Declares Material Waste													$0
1	Waste Packaging	55 gal drum	1:1	Site Avg. Employee	1	2	$24	$73	Drum	1	$250			
									Bag	2	$15			
									Lid	1	$7			
									Lead	1	$128			
									Cement	1	$12			
									Filter	1	$27			
									Vermiculite	1	$6	$605	$2,880	$2,880
2	Waste Profile Processing	55 gal drum	1:1	Contractor FTE	1	0.5	$8	$24	Computer Equipment, Office	1	$1			
				Site Avg. FTE	1	0.25	$24	$73				$33	$155	$3,036
3	Radiological Survey	55 gal drum	1:1	HP Tech.	1	0.25	$15	$46				$11	$54	$3,090
4	Waste Sampling/Anaylsis	55 gal drum	1:1	Env. Chem. Group								$0	$1,571	$4,661
5	TRU Waste Manifest Processing	55 gal drum	1:1	Site Avg. FTE	1	0.25	$24	$73						
				Site Avg. FTE	1	0.5	$24	$73	Computer equip. & Maint. & office supplies		$1			
				WM Avg. FTE	1	1.5	$23	$69				$159	$755	$5,416
6	Radioactive Material Transport Documentation	55 gal drum	1:1	Site Avg. FTE	1	1.5	$24	$73						
				WM Avg. FTE	1	1	$23	$69	Computer equip. & Maint. & office supplies		$1			
				Procurement Specialist	1	1	$16	$48				$227	$1,079	$6,495

Table G-6. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	LABOR: Qty.	LABOR: Time (hrs)	LABOR: Raw Rate ($/hr)	LABOR: Rate Burdened ($/hr)	NONLABOR: Nonlabor items	NONLABOR: Qty.	NONLABOR: Burdened ($)	Total by Activity ($)	Activity Cost ($/m³)	Cumulative Total ($/m³)
7	Arrange Transportation	1 m³	1:1	WM Tech.	1	2	$16	$48						
				Field Engineering Tech.	1	0.5	$22	$65				$128	$128	$6,623
8	Radiological Survey	1 m³	1:1	HP Tech.	2	2	$15	$46				$182	$182	$6,805
9	Road Closure	1 m³	1:1	Service Charge									$805	$7,610
10	Transport to Storage	1 m³	1:1	Service Charge									$445	$8,055
11	Receive at Storage	1 m³	1:1	WM Tech. FTE	2	0.5	$16	$48	Gloves, scale maintenance	1	$10			
				HP Tech.	1	0.5	$15	$46						
				WM Staff	1	0.25	$30	$91				$103	$103	$8,158
12	Emplace Waste	55 gal drum	1:1	HP Tech.	1	0.5	$15	$46						
				WM Tech.	2	0.5	$16	$48						
				Contractor Service Charge								$1,788	$8,516	$16,675
13	Data Management	3718 m³		Contractort Data Clerks	2.5	1728	$8	$24	Computer equip. & maint. & office supplies	1	$22,308	$126,768	$34	$16,709

SITE 5

RCRA HAZARDOUS WASTE: OFFSITE TREATMENT AND DISPOSAL

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator; assumed average packaging is a 55-gal drum, lid, and vermiculite.

Activity 2. Temporary Storage

Costs associated with waste generator establishing, inspecting, and obtaining approval for 90-day storage site, and Environmental Compliance group oversight.

Activity 3. Waste Sampling/Analysis

$330 per sample and analysis by the Environmental Chemistry group, includes both their labor and materials. Assume every drum of waste is sampled.

Activity 4. Waste Profile Processing

Includes completion and review of waste profile form and approval of the form by the Environmental Compliance group.

Activity 5. Chemical Waste Manifest Processing

The cost of filling out the chemical waste manifest form and forwarding it to Waste Management for review/approval.

Activity 6. Waste Repackaging

Costs for waste management technicians to repackage waste at generator storage site, as needed, before the waste being transported to the waste management storage site.

Activity 7. Hazardous Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the hazardous material transport documentation.

Activity 8. Transport to Storage

Waste management technicians pick up waste from generator storage area and transport it to onsite storage facility to await shipment offsite for disposal.

Activity 9. Receive at Storage

Costs of waste management technicians to inspect load of waste upon arrival at storage facility.

Activity 10. Store for Shipment

Costs associated with waste management technicians segregating newly-arrived wastes and storing them with like materials to await offsite shipment for disposal, and updating waste paperwork and database.

Activity 11. Prepare for Shipment

This cost represents the time of two waste management technicians validating labeling, paperwork, and drum contents before shipment offsite (all repackaging costs have been captured in Activity 6).

Activity 12. Offsite Shipment for Treatment/Disposal

These are the average costs per kg charged by outside contractors for accepting this type of waste for treatment/disposal by their companies. The costs include both their labor and materials for transporting the wastes offsite, treating and disposing, and returning a certificate of destruction.

Activity 13. Data Management

Cost of updating and maintaining waste records in database, data verification, and systems maintenance.

Figure G-7. Site 5: RCRA hazardous waste: offsite treatment and disposal.

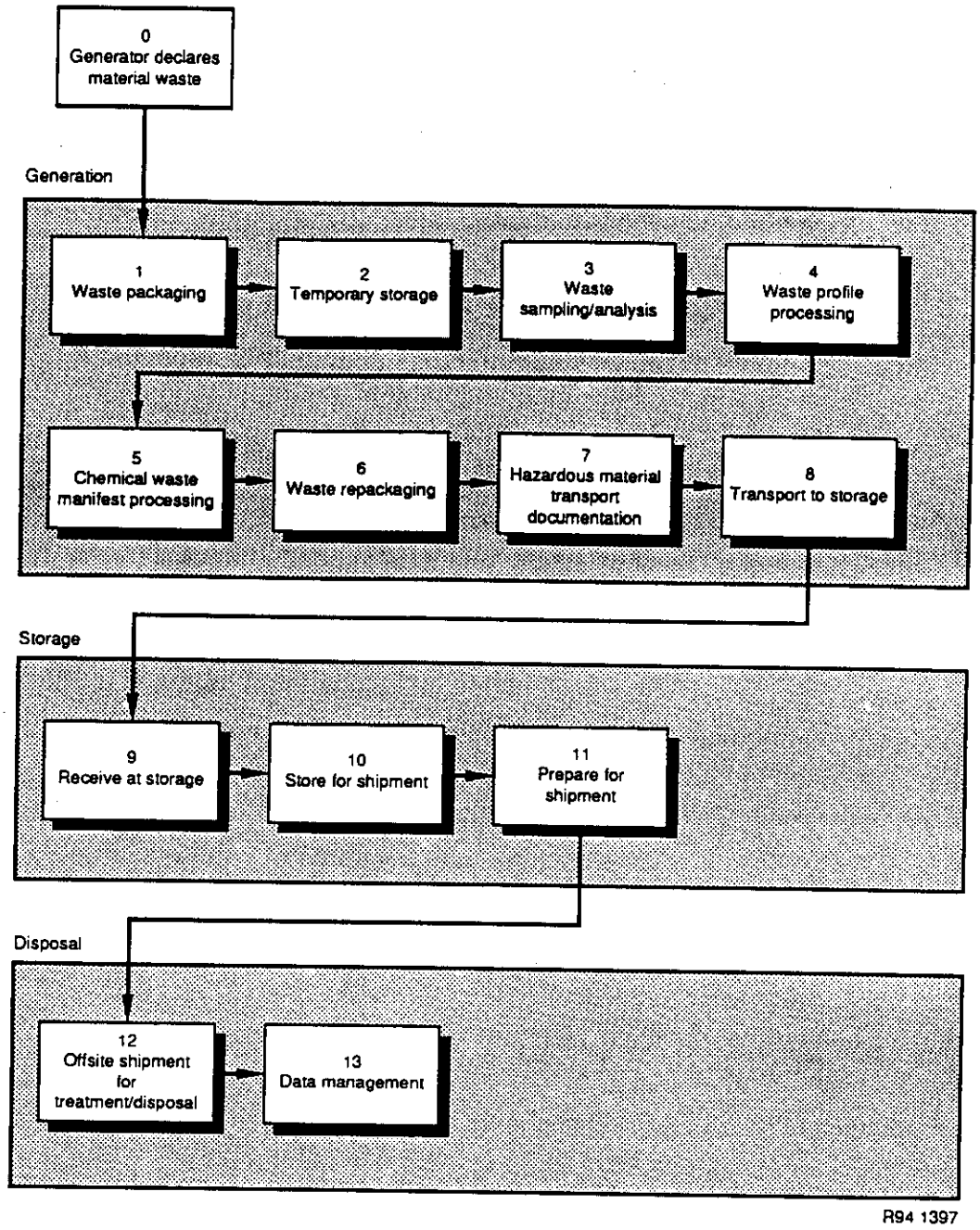


Table G-7. Site 5: RCRA hazardous waste: offsite treatment and disposal.

Annual Quantity Generated: 69679.6 kg primary waste & 13537.8 kg secondary waste
Annual Quantity Disposed: 83217.4 kg

				LABOR					NONLABOR					
ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	Generator Declares Material Waste													$0.00
1	Waste Packaging	200 kg	1:1	Site Avg. Employee	1	2	$24	$73	Drum	1	$30			
									Lid	1	$7			
									Liner	1	$39			
									Vermiculite	1	$7	$228	$1.14	$1.14
2	Temporary Storage	69680 kg	1:1	Contractor FTE	1	1728	$8	$24	Computer equip. & maint. & supplies	1	$232			
		200 kg		Site Avg. Employee	1	1.5	$24	$73				$42,125	$1.15	$2.29
3	Waste Sampling/Analysis	200 kg	1:1	Env. Chem. Group									$1.65	$3.94
4	Waste Profile Processing	69680 kg	1:1	RCRA Comp Tech.	1	1728	$18	$55	Computer equip. & Maint. & office supplies	1	$232			
		200 kg		Site Avg. Employee	1	0.25	$24	$73				$94,930	$1.45	$5.39
5	Chemical Waste Manifest Processing	69680 kg		WM Avg. FTE	0.5	1728	$23	$69	Computer equip. & Maint. & office supplies	1	$232			
		200 kg	1:1	Site Avg. Employee	1	0.25	$24	$73				$60,190	$0.95	$6.35
6	Waste Repackaging	235 kg	1:1	WM Tech.	2	0.5	$16	$48	85-gal Overpack	1	$145			
									Lid	1	$9			
									Liner	1	$29			
									Vermiculite	1	$6	$237	$1.01	$7.35
7	Hazardous Material Transport Documentation	3400 kg	1:1	Site Avg. Employee	1	0.5	$24	$73	Computer equip. & Maint. & office supplies	1	$11			
				WM Avg. FTE	1	0.25	$23	$69						
				Procurement Specialist	1	0.5	$16	$48				$89	$0.03	$7.38
8	Transport to Storage	3400 kg	1:1	WM Tech.	2	2	$16	$48				$191	$0.06	$7.44
9	Receive at Storage	3400 kg	1:1	WM Tech.	2	3	$16	$48				$286	$0.08	$7.52
10	Store for Shipment	200 kg	1:1	WM Tech.	2	0.5	$16	$48	Computer equip. & Maint. & office supplies	1	$1	$48	$0.24	$7.76
11	Prepare for Shipment	200 kg	1:1	WM Tech.	2	1	$16	$48				$95	$0.48	$8.24

Table G-7. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
12	Off-Site Shipment for Treatment/Disposal	200 kg	1:1	Service Charge									$16.00	$24.24
13	Data Management	3718000 kg	1:1	Contractor FTE	2.5	1728	$8	$24	Computer equip. & Maint. & office supplies	1	$12,392	$116,852	$0.03	$24.27

SITE 5

STATE HAZARDOUS WASTE: OFFSITE TREATMENT AND DISPOSAL

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator; assumed average packaging is a 55-gal drum, lid, and vermiculite.

Activity 2. Temporary Storage

Costs associated with waste generator establishing, inspecting, and obtaining approval for 90-day storage site, and Environmental Compliance group oversight.

Activity 3. Waste Sampling/Analysis

$330 per sample and analysis by the Environmental Chemistry group, includes both their labor and materials. Assume one in five drums of waste is sampled.

Activity 4. Waste Profile Processing

Includes completion and review of waste profile form and approval of the form by the Environmental Compliance group.

Activity 5. Chemical Waste Manifest Processing

The cost of filling out the chemical waste manifest form and forwarding it to Waste Management for review/approval.

Activity 6. Waste Repackaging

Costs for waste management technicians to repackage waste at generator storage site, as needed, before the waste being transported to the storage site.

Activity 7. Hazardous Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the hazardous material transport documentation.

Activity 8. Transport to Storage

Waste management technicians pick up waste from generator storage area and transport it to onsite storage facility to await shipment offsite for disposal.

Activity 9. Receive at Storage

Costs of waste management technicians to inspect load of waste upon arrival at storage facility.

Activity 10. Store for Shipment

Costs associated with waste management technicians segregating newly-arrived wastes and storing them with like materials to await offsite shipment for disposal, and updating waste paperwork and database.

Activity 11. Prepare for Shipment

This cost represents the time of two waste management technicians validating labeling, paperwork, and drum contents before shipment offsite (all repackaging costs have been captured in Activity 6).

Activity 12. Offsite Shipment for Treatment/Disposal

These are the average costs per kg charged by outside contractors for accepting this type of waste for treatment/disposal by their companies. The costs include both their labor and materials for transporting the wastes offsite, treating and disposing, and returning a certificate of destruction.

Activity 13. Data Management

Cost of updating and maintaining waste records in database, data verification, and systems maintenance.

Figure G-8. Site 5: State Hazardous waste: offsite treatment and disposal.

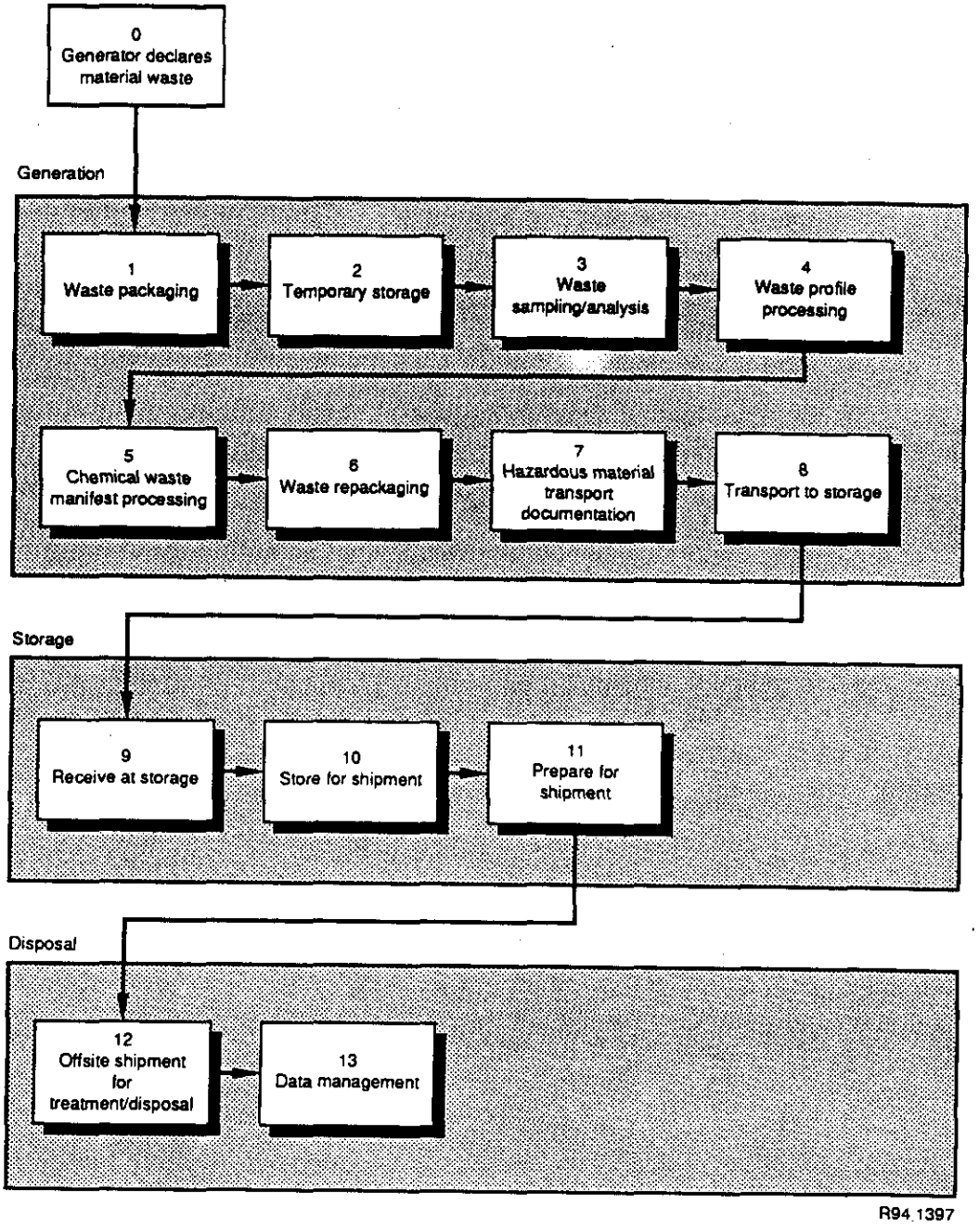


Table G-8. Site 5: State Hazardous waste: offsite treatment and disposal.

Annual Quantity Generated: 402,438.8 kg primary waste 50284.4 kg secondary waste
Annual Quantity Disposed: 452723 kg

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	Generator Declares Material Waste													$0.00
1	Waste Packaging	200 kg	1:1	Site Avg. Employee	1	2	$24	$73	Drum	1	$30			
									Lid	1	$7			
									Liner	1	$39			
									Vermiculite	1	$7	$228	$1.14	$1.14
2	Temporary Storage	402439	1:1	Contractor FTE	1	1728	$8	$24	Computer equipl & maint. & supplies	1	$1,341			
		200 kg		Site Avg. Employee	1	1.5	$24	$73				$43,234	$0.65	$1.79
3	Waste Sampling/Analysis	1000 kg	1:1	Env. Chem. Group									$0.33	$2.12
4	Waste Profile Processing	402439 kg	1:1	RCRA Tech FTE	1	1728	$18	$54	Computer equip. & Maint. & office supplies	1	$1,341			
		200 kg		Site Avg. Employee	1	0.25	$24	$73				$94,672	$0.33	$2.45
5	Chemical Waste Manifest Processing	402439	1:1	WM Avg. FTE	0.5	1728	$23	$69	Computer equip. & Maint. & office supplies	1	$1,341			
		200 kg		Site Avg. Employee	1	0.25	$24	$73				$61,300	$0.24	$2.69
6	Waste Repackaging	235 kg	1:1	WM Tech.	2	0.5	$16	$48	85-gal Overpack	1	$145			
			1:1						Lid	1	$9			
									Liner	1	$29			
									Vermiculite	1	$6	$237	$1.01	$3.70
7	Hazardous Material Transport Documentation	3400 kg	1:1	Site Avg. Employee	1	0.5	$24	$73	Computer equip. & Maint. & office supplies	1	$11			
				WM Avg. FTE	1	0.25	$23	$69						
				Procurement Specialist	1	0.5	$16	$48				$89	$0.03	$3.73
8	Transport to Storage	3400 kg	1:1	WM Tech.	2	2	$16	$48				$191	$0.06	$3.78
9	Receive at Storage	3400 kg	1:1	WM Tech.	2	3	$16	$48				$286	$0.08	$3.87
10	Store for Shipment	200 kg	1:1	WM Tech.	2	0.5	$16	$48	Computer equip. & Maint. & office supplies	1	$1	$48	$0.24	$4.11
11	Prepare for Shipment	200 kg	1:1	WM Tech.	2	1	$16	$48				$95	$0.48	$4.58

Table G-8. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
12	Off-Site Shipment for Treatment/Disposal	200 kg	1:1	Service Charge									$5.75	$10.33
13	Data Management	3718000 kg	1:1	Contractor FTE	2.5	1728	$8	$24	Computer equip. & Maint. & office supplies	1	$12,392	$116,852	$0.03	$10.37

SITE 5

TSCA WASTE: OFFSITE TREATMENT AND DISPOSAL

Activity 0. Generator Declares Material Waste

Activity 1. Waste Packaging

Performed by waste generator; assumed average packaging is a 55-gal drum, lid, and vermiculite.

Activity 2. Temporary Storage

Costs associated with waste generator establishing, inspecting, and obtaining approval for 90-day storage site, and Environmental Compliance group oversight.

Activity 3. Waste Sampling/Analysis

$330 per sample and analysis by the Environmental Chemistry group, includes both their labor and materials. Assume one in five drums of waste is sampled.

Activity 4. Waste Profile Processing

Includes completion and review of waste profile form and approval of the form by the Environmental Compliance group.

Activity 5. Chemical Waste Manifest Processing

The cost of filling out the chemical waste manifest form and forwarding it to Waste Management for review/approval.

Activity 6. Waste Repackaging

Costs for waste management technicians to repackage waste at generator storage site, as needed, before the waste being transported to the storage site.

Activity 7. Hazardous Material Transport Documentation

Costs of generator completing, Waste Management reviewing, and Materials Management approving the hazardous material transport documentation.

Activity 8. Transport to Storage

Waste management technicians pick up waste from generator storage area and transport it to onsite storage facility to await shipment offsite for disposal.

Activity 9. Receive at Storage

Costs of waste management technicians to inspect load of waste upon arrival at storage facility.

Activity 10. Store for Shipment

Costs associated with waste management technicians segregating newly-arrived wastes and storing them with like materials to await offsite shipment for disposal, and updating waste paperwork, and database.

Activity 11. Prepare for Shipment

This cost represents the time of two waste management technicians validating labeling, paperwork, and drum contents before shipment offsite (all repackaging costs have been captured in Activity 6).

Activity 12. Off-Site Shipment for Treatment/Disposal

These are the average costs per kg charged by outside contractors for accepting this type of waste for treatment/disposal by their companies. The costs include both their labor and materials for transporting the wastes offsite, treating and disposing, and returning a certificate of destruction.

Activity 13. Data Management

Cost of updating and maintaining waste records in database, data verification, and systems maintenance.

Figure G-9. Site 5: TSCA waste: offsite treatment and disposal.

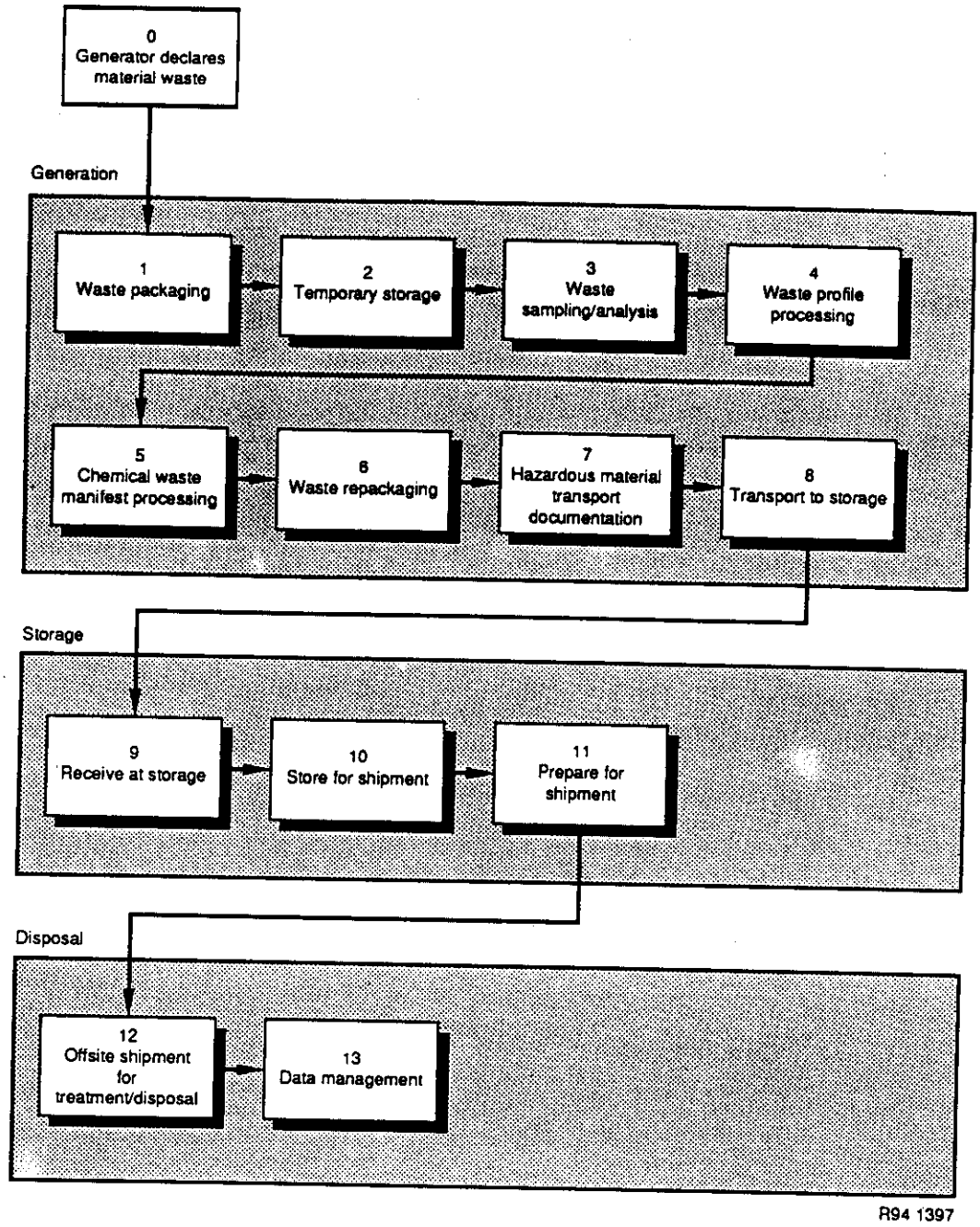


Table G-9. Site 5: TSCA waste: offsite treatment and disposal.

Annual Quantity Generated: 190096 kg
Annual Quantity Disposed: 190096 kg

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	NONLABOR: Nonlabor items	Qty.	Burdened ($)	Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
0	Generator Declares Material Waste													$0.00
1	Waste Packaging	200 kg	1:1	Site Avg. Employee	1	3	$24	$73	Drum	1	$30			
									Lid	1	$7			
									Liner	1	$39			
									Absorbant	1	$52	$346	$1.73	$1.73
2	Temporary Storage	190096 kg	1:1	Contractor FTE	1	1728	$8	$24	Computer equip.& maint. & supplies	1	$634			
		200 kg		Site Avg. Employee	1	1.5	$24	$73				$42,527	$0.77	$2.50
3	Waste Sampling/Analysis	1000 kg	1:1	Env. Chem. Group.								$330	$0.33	$2.83
4	Waste Profile Processing	190096 kg	1:1	RCRA Comp. Tech.	1	1728	$18	$55	Computer equip. & Maint. & office supplies	1	$634			
		200 kg		Site Avg. Employee	1	0.25	$24	$73				$95,332	$0.59	$3.42
5	Chemical Waste Manifest Processing	190096 kg		WM Avg. FTE	0.5	1728	$23	$69	Computer equip. & Maint. & office supplies	1	$634			
		200 kg	1:1	Site Avg. Employee	1	0.25	$24	$73				$60,592	$0.41	$3.83
6	Waste Repackaging		1:1									$0	$0.00	$3.83
7	Hazardous Material Transport Documentation	3400 kg	1:1	Site Avg. Employee	1	0.5	$24	$73	Computer equip. & Maint. & office supplies	1	$11			
				WM Avg. FTE	1	0.25	$23	$69						
				Procurement Specialist	1	0.5	$16	$48				$89	$0.03	$3.86
8	Transport to Storage	3400 kg	1:1	WM Tech.	2	2	$16	$48				$191	$0.06	$3.91
9	Receive at Storage	3400 kg	1:1	WM Tech.	2	3	$16	$48				$286	$0.08	$4.00
10	Store for Shipment	200 kg	1:1	WM Tech.	2	0.5	$16	$48	Computer equip. & Maint. & office supplies	1	$1	$48	$0.24	$4.24
11	Prepare for Shipment	200 kg	1:1	WM Tech.	2	1	$16	$48				$95	$0.48	$4.71
12	Off-Site Shipment for Treatment/Disposal		1:1	Service Charge									$7.85	$12.56

Table G-9. (continued).

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR					NONLABOR			Total by Activity ($)	Activity Cost ($/kg)	Cumulative Total ($/kg)
				Labor Type	Qty.	Time (hrs)	Raw Rate ($/hr)	Rate Burdened ($/hr)	Nonlabor items	Qty.	Burdened ($)			
13	Data Management	3718000 kg	1:1	Contractor FTE	2.5	1728	$8	$24	Computer equip. & Maint. & office supplies	1	$12,392	$116,852	$0.03	$12.59

SITE 5

SANITARY WASTE

Activity 0. Generator Declares Material Waste

Activity 1. Trash Collection

Trash is collected from laboratory facilities by custodial personnel.

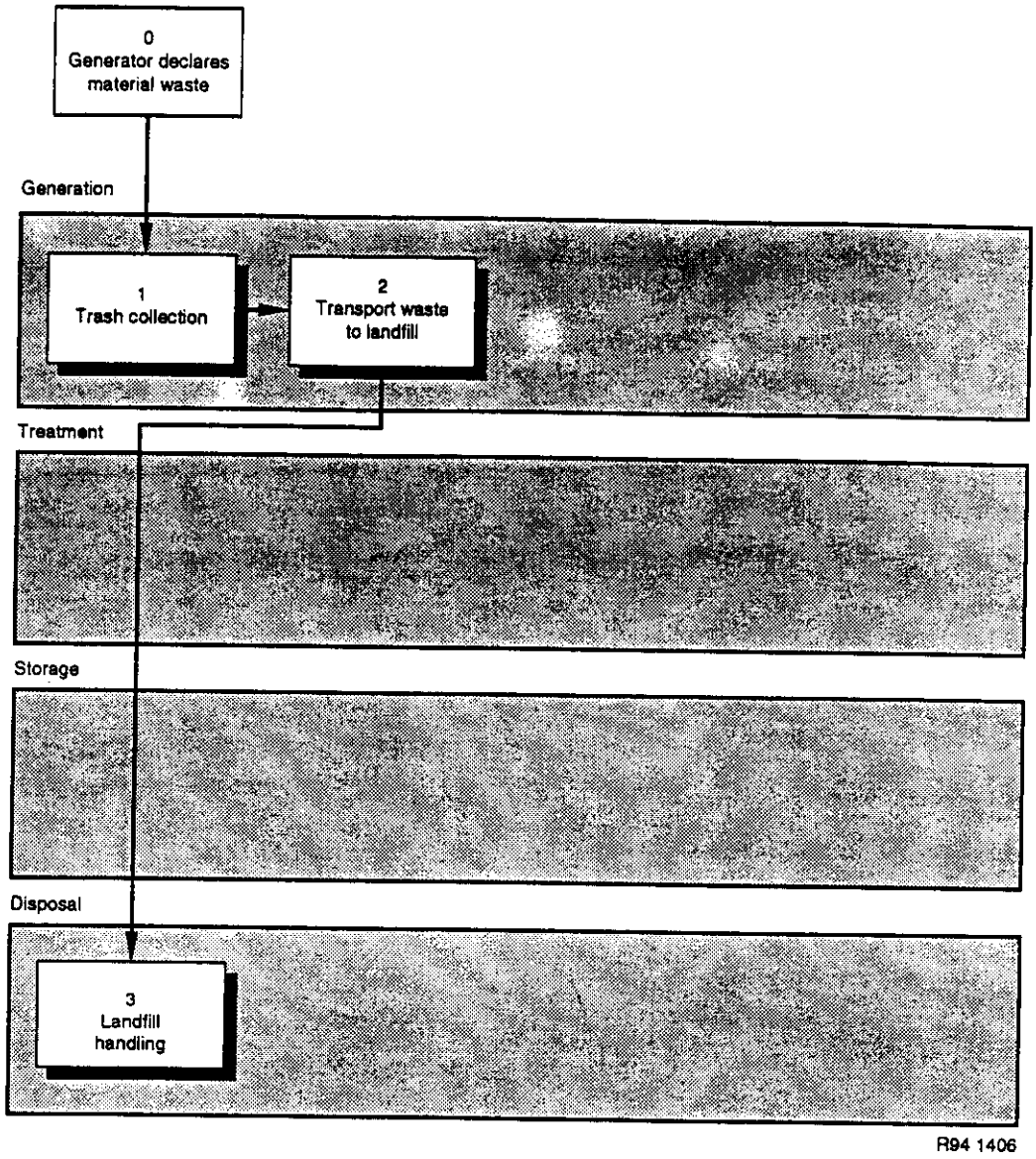
Activity 2. Transport Waste to Landfill

Waste is transported to the landfill by contractor personnel.

Activity 3. Landfill Handling

Waste is dumped at the landfill, and covered. Proper documentation is filed.

Figure G-10. Site 5 sanitary waste.



Appendix H

Site 6 WM Activity Narratives and Flow Diagrams

Appendix H:
Site 6 WM Activity Narratives and Flow Diagrams

SITE 6
TRU WASTE

Activity 0. Waste Generator, Solid Materials, End of Use, Declared a Waste

Generator at facility declares material waste.

Activity 1. Waste Containerization

Waste is placed in an appropriate container, most commonly a 55-gallon drum, by an operator. The waste is then surveyed and assayed for disposal. The drum is closed and placed in staging area.

Activity 2. Acceptance

Documentation is completed for shipment of TRU waste to on-site storage.

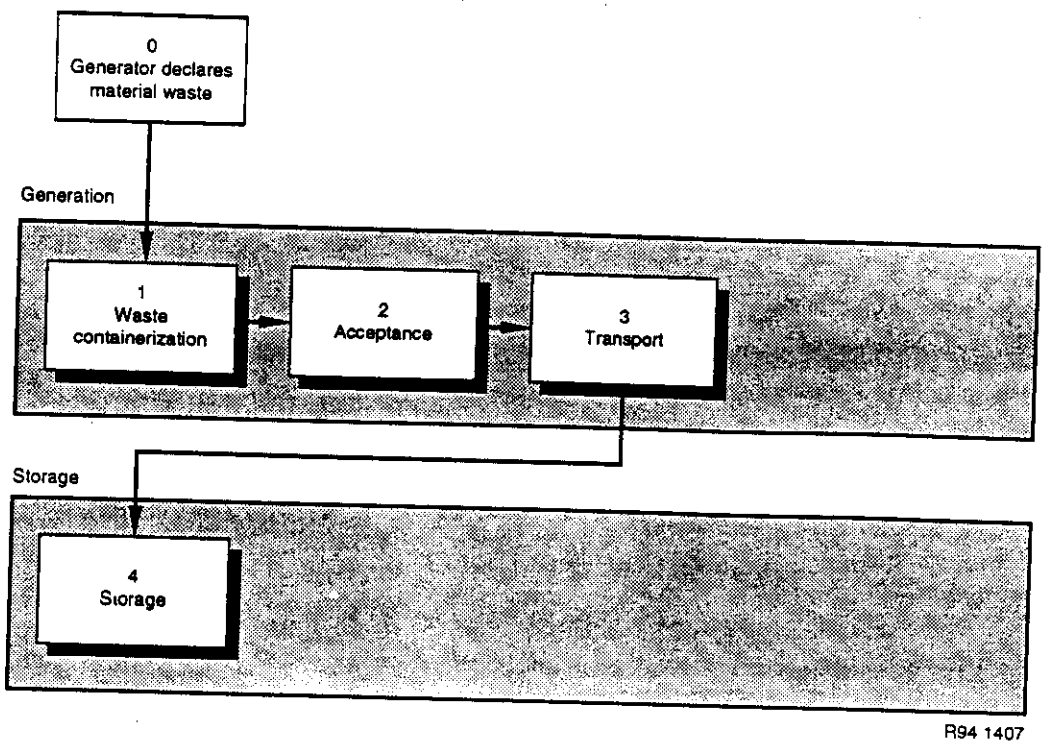
Activity 3. Transport

The waste is picked up and loaded on a truck by a rigger, and transported by truck to an on-site storage area.

Activity 4. Storage

The waste is placed in long term storage facility.

Figure H-1. Site 6 TRU waste.



Annual Quantity Generated: 140 m3
Annual Quantity Disposed: 140 m3

ID	ACTIVITY DESCRIPTION	Basis	Volume Change Ratio	LABOR: Labor Type	LABOR: Qty.	LABOR: Time (hrs)	LABOR: Raw Rate ($/hr)	LABOR: Rate Burdened ($/hr)	NONLABOR: Nonlabor Items	NONLABOR: Qty.	NONLABOR: Burdened ($)	Total by Activity ($)	Cumulative Total ($/m3)
0	Waste Generator, Solid Materials, end of use–declared a waste												
1	Waste Containerization	55 gal drum	0	Operator	1	10		$44	55 gal drum	1	$130	$570	
				Rad Tech	1	4		$46				$184	
				Engineer	1	10		$58				$580	
				Scheduler	1	2		$45				$90	
				QC Inspector	1	1		$65				$65	$7,151.78
2	Acceptance	55 gal drum	0	Engineer	1	2		$58				$116	
				Acceptance Reviewer	1	12		$54				$648	$10,821.33
3	Transport	55 gal drum	0	Truck Driver	1	8		$48				$384	$12,665.71
4	Storage												

Table H-1. Site 6 TRU waste.