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# FINAL DRAFT
# COST BENEFIT ANALYSIS OF WASTE COMPACTION ALTERNATIVES AT LAWRENCE LIVERMORE NATIONAL LABORATORY

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## EXECUTIVE SUMMARY

Lawrence Livermore National Laboratory (LLNL) recognizes that waste volume reduction and waste minimization are two components to a waste management program with significant environmental and economic impact. Accordingly, LLNL has performed a cost benefit analysis evaluating compaction of solid transuranic (TRU), low-level, hazardous, and mixed wastes at LLNL Hazardous Waste Management (HWM) facilities. LLNL HWM personnel, DOE contractors, compaction equipment manufacturers, and commercial and private compaction facilities were surveyed to obtain cost, operational, and technical information for the procurement and operation of additional compaction capacity at LLNL.

For hazardous waste, LLNL transportation and disposal costs are based on weight. Consequently, the benefits of hazardous waste compaction are effectively negated. Compactible mixed wastes are subject to undefined treatment standards and acceptance criteria are not yet developed, making compaction inadvisable. Thus, the scope of the analysis was limited to the evaluation of compactible low level waste (LLW) and TRU waste.

The results of the analysis indicate that compaction of TRU waste is not feasible at this time as the costs of compaction exceed the benefits. Compaction of LLW is economically viable. Tables ES-1 and ES-2 summarize the discounted present value of savings for the viable solid LLW compaction alternatives corresponding to the *current* and *potential* levels of throughput, respectively. The savings values in these tables are relative to the alternative of no compaction and correspond to an equipment economic life of 20 years.

Continuation of the present practice, compaction of LLW into bales, is warranted. Augmentation of that practice through procurement of strong tight metal containers, optimally sized to accommodate compacted bales, is indicated. This applies to the *current* throughput as well as the *potential* throughput of LLW subject to compaction. Currently, approximately half of the compactible LLW is available as throughput for the existing compactor-baler. Thus, the amount of compacted waste and corresponding benefits could conceivably double if disciplined segregation of compactible LLW from other waste streams is instituted.

Replacement of the existing compaction system, *if* the system becomes permanently disabled, is advised. At *current* throughput, as well as at the *potential* throughput, the

**Table ES-1. Current Throughput. Discounted Present Value of Savings for Solid LLW Compaction Alternatives Relative to No Compaction, 20-Year Economic Life.**

| Compaction Alternatives | Compactive Force (lbs.) | Savings ($) |
|---|---|---|
| Compactor-Baler - Installed; augmented with procurement of optimally sized containers | 100,000 | 295,000 |
| Compactor-Baler - Installed | 100,000 | 228,674 |
| Box Compactor | 100,000 | 86,330 |
| Compactor-Baler - New; combined with procurement of optimally sized containers | 100,000 | 9,477 |
| No Compaction | -- | 0 |

**Table ES-2. Potential Throughput. Discounted Present Value of Savings for Solid LLW Compaction Alternatives Relative to No Compaction, 20-Year Economic Life.**

| Compaction Alternatives | Compactive Force (lbs.) | Savings ($) |
|---|---|---|
| Compactor-Baler - Installed; augmented with procurement of optimally sized containers | 100,000 | 728,225 |
| Box Compactor | 100,000 | 710,828 |
| Box Compactor | 400,000 | 590,665 |
| Compactor-Baler - Installed | 100,000 | 572,848 |
| Compactor-Baler - New; combined with procurement of optimally sized containers | 100,000 | 442,702 |
| Drum Compactor - In storage | 85,000 | 247,259 |
| Drum Compactor - New | 85,000 | 217,259 |
| No Compaction | -- | 0 |

recommended replacement system is an enclosed system with a box compactor with a compaction force of 100,000 pounds to compact LLW into boxes. The identified box compactor, combined with a disciplined program at LLNL to segregate compactible LLW from other LLW, is the recommended method of choice.

Replacement is recommended only if the current compactor system becomes inoperable. Substitution of a new system for the currently functioning system is not recommended based on economic considerations. Finally, the employment of commercial compaction services is not recommended as a financially viable alternative.

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# 1.0 INTRODUCTION

This report presents a cost benefit analysis of the potential procurement and operation of various solid waste compactors, or, of the use of commercial compaction services, for compaction of solid transuranic (TRU), low-level radioactive, hazardous, and mixed wastes at Lawrence Livermore National Laboratory (LLNL) Hazardous Waste Management (HWM) facilities. The cost benefit analysis was conducted to determine if increased compaction capacity at HWM might afford the potential for significant waste volume reduction and annual savings in material, shipping, labor, and disposal costs.

Currently, a compactor-baler with a compaction force of 100,000 lbs. and a drum compactor with a compaction force of 85,000 lbs. are used by HWM. In addition, a second drum compactor with a compaction force of 85,000 lbs. is awaiting installation. The compactor-baler is used in the HWM 612 Complex to compact loose, low-level radioactive waste (LLW). After LLW is compacted into bales, the bales are loaded into boxes for shipment. The installed drum compactor is used for the compaction of empty drums and other containers that previously contained either hazardous waste or LLW.

In the following cost benefit analysis, capital costs and recurring costs of increased HWM compaction capabilities are considered. Recurring costs such as operating and maintenance costs are estimated based upon detailed knowledge of system parameters. When analyzing the economic benefits of enhancing compaction capabilities, continued use of the existing HWM compaction units is included for comparative purposes. In addition, the benefits of using commercial compaction services instead of procuring a new compactor system are evaluated.

## 1.1 COMMERCIALLY AVAILABLE COMPACTION UNITS

Waste minimization and volume reduction are significant environmental and economic considerations at LLNL. Commercially available waste compaction units for HWM applications may be classified into the following three types:

- Drum Compactors

- Box Compactors
- Compactor-Balers

Drum compactors compact waste in drums of various sizes, including 55-gal. drums. Box compactors compact waste in boxes, including shipping containers. Compactor-balers compact waste into bales that are contained, at a minimum, by wire and strapping. Bales can be placed into a separate container for shipping.

Industry practice is to describe compactors on the basis of compaction force rather than on pressure. Drum compactors provide compaction forces of approximately 20,000 lbs. to 90,000 lbs. depending on the model. In addition, by changing compaction heads, many drum compactors can be used to crush empty drums as well as waste within a drum. The two drum compactors at HWM are Ram Flat Model 55AR machines, made by S&G Enterprises, Milwaukee, Wisconsin.

Box compactors offer the highest compaction forces, from approximately 100,000 lbs. to several million pounds. Supercompactors, which can offer thousands of tons of compaction force, are almost always box compactors.

Compaction forces of compactor-balers range from approximately 40,000 lbs. to 100,000 lbs. Currently, the LLW compactor in use in the HWM 612 Complex is a compactor-baler with a compaction force of 100,000 lbs. It was manufactured by Consolidated Baling Machine Company, now of Jacksonville, Florida, and is approximately fifteen years old.

Compactors and supercompactors are generally distinguished by compaction force, but there is no clear demarcation between them. Machines with compaction forces in the thousands of tons are appropriately called supercompactors. However, there are units on the market, which are considered supercompactors, with compaction forces of 200 tons (400,000 lbs.).

A significant feature of supercompactors, beyond the tremendous volume reduction percentage they can provide, is the capability of compacting 55-gal. drums with previously compacted contents. This capability is available even in 200-ton compaction-force supercompactors.

## 1.2 WASTE COMPACTION SERVICES

Waste compaction service companies are available that offer disposal and compaction services for generators of LLW. Typically, when compacting waste, service companies sort compactibles from noncompactibles and hazardous wastes from radioactive wastes to enhance compaction efficiency and to segregate inadvertently combined waste streams. In effect, the sorting provides additional waste quality control. In addition, cross-contamination is avoided and traceability is maintained.

## 1.3 COMPARISON OF COMPACTORS

The technical advantages and disadvantages of various compactor types are summarized in Table 1. In addition, pertinent specification information for commercially available compactors of each classification is presented in Table 2. Specific models presented in Table 2 are not the only models available. Models with similar features and specifications may be offered by other vendors.

Drum and box compactors use container space efficiently by compacting waste directly into the containers. Compactor-balers compact wastes into bales which, when inserted into 55-gal. drums or boxes currently used by LLNL for waste containment and shipment, use the space inefficiently. In addition, drum and box compactors are capable of compacting 55-gal. drums that are filled with loose, compactible waste (drum crushing).

## 1.4 SCOPE

The following cost benefit analysis addresses compaction of the solid LLW and TRU waste streams. These waste streams largely consist of contaminated gloves, booties, clothing, and paper products.

Compaction of solid hazardous wastes was not considered. Those wastes usually are received at the HWM facility in 55-gal. drums or 5-gal. lard cans. Occasionally, strong tight metal boxes are also used. HWM personnel separate and consolidate the wastes for repackaging and shipment. A significant majority of compactible solid hazardous wastes are

## Table 1. Summary of Comparison of Compactor Types

| COMPACTOR TYPE | Springback Mitigation | Shipping Container Integrity Maintained | Compaction into Shipping Containers | Optimal Volume Reduction | Ease of Operation | Compaction of Filled Drums | Ease of Installation | Efficient Use of Building Space | Minimized Container Requirements | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| Compactor-Baler | + | + | – | – | – | – | o | o | – | Inefficient use of space in shipping containers. |
| Drum Compactor | o | + | + | o | + | o | o | + | – | Anti-springback devices for compaction into containers. |
| Box Compactor | o | + | + | o | o | + | o | o | + | (1) Can achieve high compaction with "tilted ram".<br>(2) Anti-springback devices for compaction into containers. |
| Super Compactor | o | N/A | N/A | + | o | + | – | – | + | |

**Legend**

\+ - Advantage
– - Disadvantage
o - Neutral
N/A - Not Applicable

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# Table 2. Specification Summary of L.L.W. Waste Compactors

| Mfr./ Model Number | Drum Compactors | | | | | | | | Compactor Bailers | | Box Compactors | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S&G RamFlat 55 AR | S&G RamFlat 55 AR | S&G RamFlat 55 AR | Container Products D-60 | Container Products D-40 | Cons. DOS-RAW CB1 | Cons. DOS-RAW GE1 | Cons. DOS-RAW W1 | Consolidated DHBS-2MR a | Marathon V-6030HP | Container Products B-100 | Container Products B-400 |
| Compaction Force (lb.) | 85,000 | 50,000 | 20,000 | 60,000 | 40,000 | 40,000 | 40,000 | 40,000 | 100,000 | 48,100 | 100,000 | 400,000 |
| Motor Horsepower | 10 | 10 | 7.5 | 15 | 10 | 10 | 10 | 10 | 15 | 10 | 25 | 75 |
| Compaction Chamber Height (in.) | 50.5 | 50 | 48 | 62 | 62 | b | b | 57 est | 38 | 44 | 103 est | 130 est |
| Compaction Chamber Width (in.) | 32.5 | 32.5 | 38.25 | 25.25 | 25.25 | b | b | 33 est | 54 | 60 | 84 est | 81 est |
| Machine Depth (in.) | 39 | 39 | 39 | 88 | 88 | 32 | 31.5 | 32 | 72 | 48.5 | 118 | 148.25 |
| Machine Width (in.) | 36 | 36 | 36 | 45.25 | 45.25 | 30 | 30 | 30 | 68 | 80 | 92 | 102 |
| Machine Heigh. (in.) | 103.25 | 128 | 99.75 | 118.75 | 118.75 | 107.75 | 103 | 100 | 128 | 139 | 182 | 204 |
| Approximate Weight (lb.) | 3,700 | 3,000 | 2,000 | 3,600 | 3,550 | 1,750 est | 1,750 est | 1,950 | 10,000 | 4,000 | 14,400 | 42,000 |
| System Operating Pressure (psi) | 3,000 | 2,500 | 2,000 | 2,122 | 1.415 | 2,000 | 2,000 | 2,000 | 2,000 | 1,700 | 2,100 | 1,780 |

Legend

a - Currently installed compactor in 612 Complex; still offered commercially
b - Compaction is not enclosed within a chamber in these models

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transferred to "roll-off" containers. When full, these containers are transported by a contractor to an offsite location for treatment and/or disposal. Contractors charge LLNL by weight for transportation/disposal of the hazardous waste material; therefore, the only potential benefit of compacting the material before it is shipped is a reduction in the number of trips required for its removal from LLNL. After conferring with LLNL procurement and a transport contractor, it was concluded that it is highly unlikely that LLNL would realize any significant benefits in the form of decreased transportation charges by compacting solid hazardous wastes.

Compaction of mixed wastes also has not been considered in this cost benefit analysis. The EPA claims regulatory authority over the hazardous component of mixed wastes under RCRA. Under RCRA, treatment standards are defined for individual hazardous waste streams prior to disposal. For mixed wastes, neither treatment standards nor waste acceptance criteria exist. A national capacity variance, which allows for storage while treatment/disposal methodologies are determined, is in effect. Therefore, mixed wastes being generated and stored by LLNL may be subject to future, undefined treatment. Compaction of mixed waste is inadvisable, as compaction may be detrimental to treatment.

## 2.0 BASIS FOR ANALYSIS

As a basis for performing the cost benefit analysis, compactor-balers, drum compactors, and box compactors were selected for the analysis of new compaction system procurement. Commercial compaction services were also evaluated as an alternative method.

It is understood that the drum compactor installed at HWM will be dedicated to the compaction of drums emptied of hazardous waste. Furthermore, a compaction device will be dedicated to the compaction of only one waste type, i.e., LLW or TRU waste.

### 2.1 COMPACTION SYSTEM CONFIGURATIONS

For compaction of wastes in containers, the compactor is to be part of an enclosed, ventilated system including a hopper, conveyor belt, at least two glovebox-like configurations, and an airlock or hood configuration at each end (Figure 1). From a waste accumulation container, waste is transferred by a mechanical lifting mechanism into a hopper feeding the conveyor belt. The glovebox-like configurations are available to monitor and further segregate wastes as necessary. The conveyor belt provides feed to the waste container for compaction. The ventilation system, with an airlock/hood on each end, allows for the transfer of LLW and removal of empty and loaded containers without causing contamination of personnel.

Compaction is accomplished in a stepwise manner. First, loose compactible waste is transferred into a container, occupying a fraction of its volume, and compacted. This process is repeated until the container is approximately one-third full. An anti-springback device is then permanently incorporated into the container to inhibit the waste from its tendency to return to its precompacted configuration. Each third of the container is filled in the same manner. The container lid is installed after the third anti-springback device is incorporated into the container.

This configuration was chosen after reviewing safety, operating, and regulatory considerations with LLNL personnel, and after obtaining operational experience information from compaction equipment manufacturers and personnel who operate compaction facilities at the General Electric (GE) Vallecitos Nuclear Center (Pleasanton, California), the Environmental

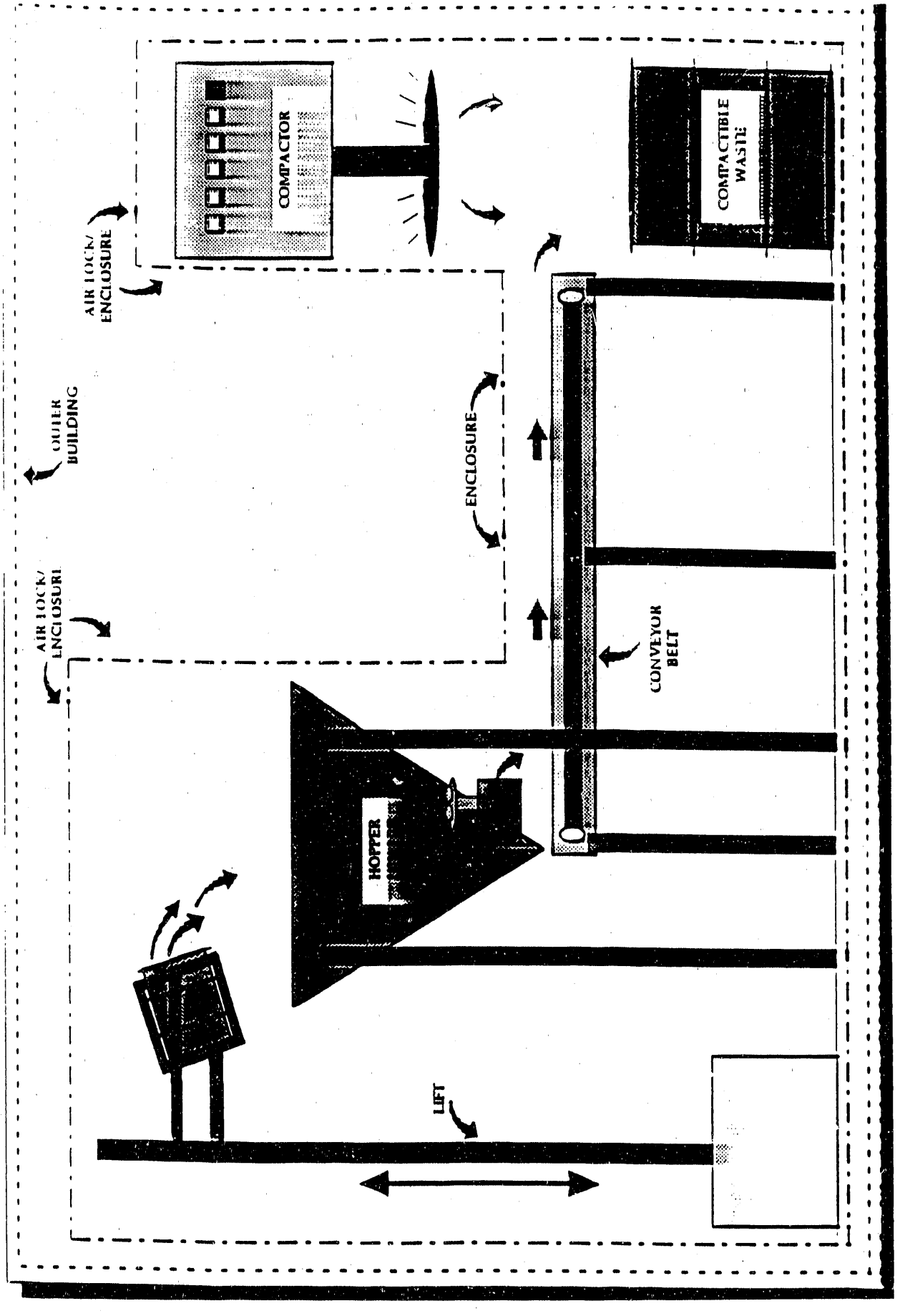


**Figure 1. Conceptual Compactor System Configuration.**

Management and Controls, Inc. (EMC) commercial compaction services facility (Turlock, California), and the Pacific Gas and Electric Company (PG&E) Diablo Canyon Nuclear Power Plant (Avila Beach, California). SAIC personnel with compaction experience were also contacted. A list of personnel interviewed and companies contacted is provided in Section 9. An enclosed ventilated system with an airlock/hood on each end was selected in response to LLNL health and safety considerations focusing on the potential for worker inhalation of airborne radioactivity.

Operators of facilities compacting well-characterized waste streams do not take such extensive precautions. Their systems are not enclosed, and workers seldom require respiratory protection. However, process ventilation is provided. These practices were permitted only after developing confidence, through experience, that the waste streams were well characterized. On the other hand, EMC operates an enclosed system and accepts an assortment of LLW from several generators. Although an enclosed system was an imposed licensing requirement, EMC did not choose to assume that generators are well disciplined when characterizing their wastes and supported the requirement. EMC's operational experience has demonstrated that their conservative approach was justified.

For drum crushing, a similar, simpler, enclosed ventilated system with an airlock configuration, using a box or drum compactor is envisioned. This system would not require a lifting mechanism, hopper, or conveyor belt, and would not provide the ability to monitor and further segregate wastes. It would then be incumbent upon the individual LLNL waste generators to monitor and segregate all LLW and TRU waste before removal to HWM facilities. Compaction is accomplished by simply placing a waste filled drum into position under the compaction head. With the airlock closed, the drum is crushed. The airlock is then opened and the crushed drum removed.

Note that the configurations selected do not include a shredder. Shredding is acknowledged as a method of changing the shape of wastes such as a wooden pallet, to reduce the space occupied by the wastes; of changing the flow characteristics of wastes to enhance compaction; and of controlling springback. To provide a perspective on shredding, the shredding of cardboard, prior to compaction, provides for an additional 10% volume reduction upon compaction.

At HWM, compaction would not be sufficiently enhanced to justify a shredder. The solid compactible TRU and LLW streams entering HWM largely consist of gloves, booties, clothing, and paper products. The shape and flow characteristics of these streams are more amenable to compaction than is unshredded cardboard. In addition, the compaction process identified for LLNL includes the use of mechanical anti-springback devices inserted into the container for springback control.

## 2.2 COMMERCIAL COMPACTION

As an alternative to procurement of a compaction system, the cost benefit analysis includes evaluation of commercial compaction services offered by EMC. The EMC facility is located in Turlock, California on a direct route to the Nevada Test Site (NTS). This location offers the potential for minimizing the time of transport and thereby reducing LLNL risk associated with transportation. For LLNL's dry, solid compactible LLW, LLNL was quoted a price of $17.35 per cubic foot. The price includes waste pick-up and transportation to EMC for compaction and transportation back to LLNL for certification. By license restrictions, EMC is not allowed to compact wastes containing alpha emitters other than source material. At this time, LLNL is not aware of a compaction facility that is permitted to compact waste contaminated with other kinds of alpha emitters. However, Scientific Ecology Group, Inc. (SEG) of Oak Ridge, Tennessee, expects to have that capability in the future. The use of a commercial facility for compaction of TRU waste can be evaluated at that time.

At EMC's facilities, waste is transferred to a box in an enclosed system by a conveyor belt. Through glovebox-like configurations, waste is inspected and segregated at several inspection stations to assure that inappropriate wastes are not compacted together. In addition, wastes are compacted during "campaigns" to assure that commingling does not occur. A "campaign" is a batch compaction of wastes, usually from a single generator.

# 3.0 IDENTIFICATION OF POTENTIAL COSTS OF COMPACTION SYSTEM PROCUREMENT

Costs of procuring and operating a new compaction system are subdivided into Capital Costs and Recurring Costs. This section presents the factors that compose these two cost categories.

These costs do not include decommissioning and decontamination (D&D) of the compaction facility. The costs of D&D are unavoidable as the compactor-baler compaction system is already established. In addition, D&D costs may easily be comparable for all alternatives, including that of no compaction. Accordingly, the relative merit of alternatives would be unaffected. This assumes that compactor-baler replacement alternatives do not necessitate the D&D of an additional building.

## 3.1 CAPITAL COSTS

Capital costs are those costs associated with procurement, installation, and preparation for operation of a compaction unit. Included costs are the following:

- Procurement and installation costs
  - Facility construction/modification
  - Compaction unit and unit installation
  - Regulatory activities

- Preparation for operation costs
  - Procedure writing/revision
  - Operator training

### 3.1.1 Costs for Procurement and Installation

**3.1.1.1 Facility Construction/Modification.** A new enclosed compaction system will require a building that meets DOE Order 6430.1A, General Design Criteria (DOE, 1990), with a ventilation system incorporating a high-efficiency particulate air (HEPA) filter. A new building meeting these requirements is expected to cost \$225 per $ft^2$. An existing

building, modified to house a compaction system, could be used also. Depending on the construction features of the existing building and its size, upgrade of the building to the requirements conceivably could exceed $225 per $ft^2$. A responsible estimate of the cost cannot be made without specifically identifying the building and analyzing its construction features. For the purposes of this analysis, $225 per $ft^2$ is used.

The compaction system, including lift mechanism, hopper, conveyor belt, and glovebox-like configurations, is assumed to require 600 $ft^2$ of building space; therefore, facility construction/modification costs for that system are assigned a value of $135,000.

A simpler drum crushing system is assumed to occupy 300 $ft^2$ of space. Accordingly, facility construction and modification costs for that system are assigned a value of $67,500.

**3.1.1.2 Compaction Unit and Unit Installation.** As previously stated, the compaction system is to be enclosed and ventilated. The systems selected for the analysis include compactor-baler, drum, compactor, and box compactors configurations. For the drum compactor, LLNL selected an 85,000 lb. compaction force model. Two box compactors were selected with one characterized by 100,000 lbs. of compaction force and the other by 400,000 lbs. The latter is considered to be a supercompactor. The compactor-baler selected is a 100,000 lb. compaction force model identical to the existing HWM compactor. Tables 3 and 4 illustrate the estimated costs of these compactors and corresponding compaction system costs when installed.

**3.1.1.3 Regulatory Activities.** There are two regulatory concerns. The first is disclosure under the National Environmental Policy Act (NEPA) which requires either a Categorical Exclusion or an Environmental Assessment. The cost to LLNL for the generation of a Categorical Exclusion is estimated to be $1,000; that for an Environmental Assessment is estimated to be $8,000.

The second regulatory concern is the potential point source radionuclide release to the air under the National Emission Standards for Hazardous Air Pollutants (NESHAP). As part of the annual site-wide dose calculation for radionuclide air releases required by NESHAP, ventilation of the compaction system exhaust air must be identified and accounted

for. Airborne radioactivity in the exhaust is expected to be minimal. In addition, HEPA filters limit the radionuclide release to an insignificant amount. No significant cost impact is foreseen at this time.

### 3.1.2 Costs of Preparation for Operation

**3.1.2.1 Procedure Writing/Revision.** Several procedures must be written before a compaction facility can be operated. They include Operational Safety Procedures, inspection and audit procedures, equipment maintenance safety procedures, and formal work controls. In addition, an HWM Facility Safety Procedure will require revision. It is estimated that $14,000 will be required for these procedural efforts.

**3.1.2.2 Operator Training.** It is estimated that course preparation and the training of six operators will require $3,000.

Tables 3 and 4 summarize all capital costs corresponding to the procurement of compaction system alternatives. Total capital costs are the initial costs for year zero, when performing the cost benefit analysis.

## 3.2 RECURRING COSTS

The compaction systems studied include four compactor types. They are a 55-gal. drum compactor with a compaction force of 85,000 lbs., a 90 $ft^3$ box compactor with a compaction force of 100,000 lbs., a 90 $ft^3$ box supercompactor with a compaction force of 400,000 lbs., and a compactor-baler with a compaction force of 100,000 lbs.

On a recurring basis, the following categories contribute to the disposal cost of dry, solid LLW:

- Disposal volume charges
- Transportation costs
- Container costs

Table 3. Capital Costs of Compactor Alternatives, Full System.

| Compactor Type | Drum | Drum | Box | Box | Compactor-Baler |
|---|---|---|---|---|---|
| Compaction Force (lbf) | 85,000 | 85,000 | 100,000 | 400,000 | 100,000 |
| Compactor Price ($) | 30,000 | 0 (in storage) | 179,000 | 342,000 | 80,000 |
| Auxiliary System Cost ($) | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| Building Modification Cost ($) | 135,000 | 135,000 | 135,000 | 135,000 | 135,000 |
| Procedures, Training, and Regulatory Costs ($) | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| **Total Capital Cost ($)** | **240,000** | **210,000** | **389,000** | **552,000** | **290,000** |

Table 4. Capital Costs of Compactor Alternatives, Simplified System for Compaction of LLW-Filled Drums.

| Compactor Type | Drum | Drum | Box | Box |
|---|---|---|---|---|
| Compaction Force (lbf) | 85,000 | 85,000 | 100,000 | 400,000 |
| Compactor Price ($) | 30,000[a] | 0 (in storage) | 179,000 | 342,000 |
| Auxiliary System Cost ($) | 5,000 | 5,000 | 5,000 | 5,000 |
| Building Modification Cost ($) | 67,500 | 67,500 | 67,500 | 67,500 |
| Procedures, Training, and Regulatory Costs ($) | 25,000 | 25,000 | 25,000 | 25,000 |
| **Total Capital Cost ($)** | **127,500** | **97,500** | **276,500** | **439,500** |

[a] LLNL already owns an extra compaction head ($1235 cost) for compaction of drums.

- Labor charges
- Man-rem costs
- On-the-job training costs
- Maintenance and repair costs

A summary of these costs, for each compaction alternative evaluated, is in the appendices.

### 3.2.1 Disposal Charges

In this analysis, disposal costs were calculated based on volume after compaction of the typical LLNL annual compactible waste stream amount. For each option, this volume was determined by applying industry average net waste densities as a function of the compressive force ratings of the compactors. These densities are based upon a standard LLW stream composition consisting mostly of gloves, booties, clothing, and paper products. This composition is comparable to typical compactible LLW and TRU waste experienced at LLNL.

**3.2.1.1 Low-Level Waste.** All LLW generated by LLNL is categorized as defense-related waste, and all defense-related LLW is required to be disposed at NTS. NTS charges LLW generators at the rate of $10 per cubic foot for waste which does not require greater confinement disposal.

**3.2.1.2 TRU Waste.** LLNL currently transfers TRU waste to NTS for temporary storage. NTS will continue to receive the waste until its final disposal destination, the Waste Isolation Pilot Project (WIPP) facility, Carlsbad, New Mexico, is ready for waste acceptance.

LLNL was informed by WIPP personnel that there will be no disposal charge *per se* to LLNL for disposal of the waste. The only LLNL cost associated with TRU waste disposal after waste leaves the LLNL site will be that of transportation.

### 3.2.2 Transportation Costs

Transportation costs for LLW and TRU wastes are considered separately.

**3.2.2.1 Low-Level Waste.** Charges presented are the costs for truck transportation of new empty waste containers, drums and metal boxes to LLNL, and for offsite disposal hauling of those containers filled with waste. Local San Francisco Bay Area suppliers of new drums and strong tight metal boxes generally use their own trucks. Therefore, there is no separate transportation charge for these deliveries to LLNL. Another supplier of 90 $ft^3$ metal boxes, located in Ogden, Utah, charges a transportation fee of $700 per truckload and typically ships 28 empty boxes per load.

Generally, for filled metal boxes, the truck payload weight limit determines the number of boxes in each shipment. For full drums, the standard shipment consists of 80 drums.

As calculated from actual shipping invoices, outgoing exclusive-use truck transportation from LLNL to NTS (a 1200-mi. roundtrip) is charged at approximately $2500 per trip.

**3.2.2.2 TRU Waste** According to WIPP personnel, each generator is to be charged $1.71 per mile per shipment, to dispose of DOE TRU waste, each way. For TRU waste contained in 55-gal. drums, each shipment is to consist of three TRU package transporters (TRU PACTS) containing fourteen 55-gal. drums each. Provisions for partial shipments are being considered. LLNL's compactible TRU waste stream is packaged in such drums. The distance from LLNL to the WIPP site is estimated to be 1320 miles; therefore, LLNL will be charged approximately $4500 per shipment.

### 3.2.3 Container Costs

The number of containers required annually is determined from the average annual compactible waste-stream throughput, the industry average net waste density for each compactor, and the volumes of the waste containers used for final disposal. The cost of each

also includes the cost of anti-springback devices to mitigate the tendency of compacted waste to return to its previous configuration.

The various types of containers utilized in the compaction processes include the following: 55-gal. drums, B-25 containers (90 $ft^3$, used by the box compactors), and strong tight metal boxes (96 $ft^3$, approximately 4' x 4' x 7'). The B-25 boxes are of varying structural reinforcements, as the strength requirements vary according to the maximum compression force of each box compactor.

The container costs that were used in the analyses are listed in Appendices A and B, in the "Inputs" sections.

### 3.2.4 Labor Charges

Labor charges reflect technicians' time to perform the various tasks required in the preparation of a ready-to-ship container of compacted waste. This involves the actions of sorting, compacting, closing, weighing, health physics surveying, logging, labeling, quality control, loading, paperwork, and shipping for each box or drum. For the box compactors, these tasks can be handled by two technicians working together. For the drum compaction process, these tasks are assumed to be handled by one, two, or three technicians, depending on the task.

This study is based on $17.70 per hour as a representative wage for a Level 8 Technician working in HWM. The LLNL payroll burden rate of 42.8% and overhead rate of 75.5% are applied to obtain an average burdened technician wage of $44.36 per hour.

### 3.2.5 Man-rem Costs

The cost associated with personnel radiation exposure is calculated assuming an average waste radiation level of 2 millirem/hour. The commonly used figure of $1000 per man-rem is the quantity specified for economic studies by the Nuclear Regulatory Commission (NRC).

### 3.2.6 Training Costs

The recurring cost of on-the-job training (OJT) is included. It is assumed that six technicians will each receive 8 hours of OJT (4 hours for a drum compactor) each year. Instruction and material costs of $1000 per year are also included.

### 3.2.7 Maintenance and Repair Costs

Preventive and standard maintenance costs are assumed to be incurred at a constant rate of 4 man-hours per month for a drum compactor system and 8 man-hours per month for box compactor and baler systems.

The magnitude of total repair costs over the 20-year economic life of the compactor, in present dollars, is assumed to be 20% of the initial cost of the compactor. In this analysis, the distribution of these repair costs over 10 years resembles the classic "bathtub" reliability curve. Hence, repair costs are not distributed equally over time; rather, they are higher at the beginning and end of a machine's life.

# 4.0 METHODOLOGY AND APPROACH

The Discounted Present Value (DPV) Method was used in performing the cost benefit analysis. DPV was selected because its application incorporates the discounting of all monies back to their worth at the present time. Other methods were rejected because they were directly applicable to the return of money on invested capital or assumed that the procurement of a compaction system was a "given." Clearly, those assumptions are not applicable.

## 4.1 DISCOUNTED PRESENT VALUE METHOD

The DPV Method is a cash flow analysis that discounts all monies back to their worth at the present time. If $R_j$ is the operational cash flow resulting from a compaction process in year j, and $C_j$ is the cash flow for costs incurred that year, then the DPV is given by the expression

$$DPV = \sum_{j=0}^{n} (R_j - C_j)\, V_i^j \qquad (1)$$

where,

$$V_i^j = \frac{1}{(1 + i)^j} \qquad (2)$$

and $i$ = annual interest rate
$n$ = economic life in years

The annual interest rate, i, is an assumed acceptable rate of return (usually, the cost of capital) and explains the use of the term "discounted" in the formal name of the method.

In the analysis presented herein, $R_j$ is always zero, as compaction does not generate a cash flow. Calculations are made for the DPV of costs for no compaction and several

compaction alternatives, including a compaction service. The annual interest rate is assumed to be the 30-year U.S. Treasury Bond rate; i.e., the federal government (hence, LLNL) "cost of capital." When evaluating the feasibility of various compaction alternatives, the decision rule employed is

> The economic alternative with the lesser discounted present value of costs is the preferred alternative.

When applying this method, costs in future years are discounted to present day values, i.e., all dollar amounts are expressed in terms of current dollars. Therefore, corrections for the rate of inflation are not necessary.

## 4.2 ANNUAL WASTE THROUGHPUT

An important variable in the evaluation of waste compactor economics is the annual waste throughput. At LLNL, compactible waste is received in HWM in a variety of containers (metal boxes, 55-gal. drums, lard cans, paint cans, and cardboard boxes). Metal boxes and drums are filled with the most significant components of that throughput. The throughput of LLW and TRU for calendar year 1989 was chosen for use in the analysis, as that data is the most recent data available for a complete year.

### 4.2.1 Low Level Waste

A compactor-baler is currently used to compact loose LLW contained in 55-gal. drums entering the HWM 612 Complex. Also, approximately one-third of the LLW arriving in metal boxes is compactible. However, opening all metal boxes and sorting the contents is not practicable and is not done. If the compactible waste received in metal boxes were to arrive in drums, a much larger compactor throughput could be achieved. Therefore, this analysis considers the following two cases:

- Case A: *Current* throughput subject to compaction
- Case B: *Potential* throughput subject to compaction.

A review of HWM radioactive container log-in sheets for 1989 showed that 920 drums of LLW and mixed waste were received. Interview of compactor-baler operators revealed that one-third of drums received are not candidates for compaction because they contain mixed waste or Dorr-Oliver sludges. Of the remaining two-thirds, practically all drums contain compactible waste. Therefore, for Case A, the annual compactible waste stream is considered to be two-thirds of 920 drums, or 613 drums (about 4500 $ft^3$). Uncompacted waste is assumed to have an average density of 15 $lb/ft^3$, so the mass of this waste stream is 67,583 lbs/year.

Likewise the 1989 radioactive box log-in sheets show 153 metal boxes of LLW waste received in HWM. An inspection of a sample of these boxes in storage revealed that approximately one-third of them contained compactible, non-mixed waste in quantities significant enough to produce possible favorable compaction results. Therefore, for Case B, the annual compactible waste stream is considered to be the equivalent of 51 metal boxes, in addition to the amount in Case A. This amount is 9400 $ft^3$ of compactible waste, which yields an annual mass of 141,000 lbs.

### 4.2.2 Compactible TRU Waste

The compactible TRU waste stream is glovebox trash accumulated in 55-gal. drums. On average, 64 to 66 drums of this type of waste are generated at LLNL annually. It is recognized that there may be some hazardous and non-compactible components contained in the drums. However, for the purpose of this analysis, the entire waste stream is considered to be compactible. Assuming 15 lbs. per cubic foot and 65 drums, the expected annual compactible TRU waste stream is approximately 480 $ft^3$, or 7200 lbs.

## 4.4 ASSUMPTIONS

The following assumptions are made for this analysis:

- The various compactor options each have an economic life of 20 years.

- When the compactor-baler is used, metal boxes (96 $ft^3$) are prepared for shipment by putting four bales into a box and then filling in the remaining space with other compactible materials from the 55-gal. drums. This reflects actual HWM practice.
- The average waste radiation level is 2 millirem/hour.
- One man-rem of exposure costs $1000. This figure is specified for economic studies by the NRC.
- Uncompacted LLW, consisting mainly of paper and plastics, has an average density of 15 $lbs/ft^3$. This is the actual experience of a commercial compaction service.
- When a metal box (96 $ft^3$) is filled without compacting, the labor required to fill, close, weigh, log, survey, label, and move it, along with paperwork, is 2 man-hours/box.
- The labor required to prepare a 96 $ft^3$ metal box using the existing compactor baler is 12.8 man-hours/box. This is based on the current baling rate, using a two-person crew, of five bales per 8-hour shift, with 4 bales per metal box.
- The overpack container for crushed LLW filled drums is a 7' x 4' x 4½' metal strong tight container and holds 12 drums crushed by a drum compactor or 18 drums crushed by a 100,000 lb. compactive force box compactor.
- The average compacted waste density for the 100,000 lb-force baler is 41 $lbs/ft^3$. This is based on an average bale weight of 550 lbs. This density is consistent with the average waste densities achieved by 100,000 lb.-force box compactors.
- Annual on-the-job training will be conducted for HWM technicians. The time allotted for this training is 4 hours per person per year if a drum compactor is procured; 8 hours per person per year if another compactor type is procured. Six technicians will receive training each year.
- The present value of total repair costs over the economic life of the compactor is assumed to be 20%of the initial cost of the compactor.
- The time allotted for routine and preventive maintenance is 4 hours per month for a drum compactor and 8 hours per month for other compactors.
- The composition of the LLNL compactible LLW stream is similar to a standard LLW stream consisting of 70% paper, plastics, and cloth; 15% composite and other material; and 15% small pieces and metal shavings.
- The cost of capital for LLNL is equivalent to the interest rate for 30-year U.S. Treasury Bonds, recently 8.7%.

Detailed tables of inputs and results for Cases A and B appear in Appendices A and B, respectively.

# 5.0 RESULTS

## 5.1 COMPACTION OF LOW-LEVEL WASTE

### 5.1.1 Results for Case A - Current Throughput

Table 5 summarizes the results of the DPV of cost calculations for each compaction alternative over a 10-year period at the rate of LLW throughput *currently* subjected to compaction.

As indicated in Table 5, the least costly alternatives, based on the discounted present values of costs, are (1) continued use of the installed compactor-baler and (2) installation of a 100,000 lb. compactive force box compactor for compaction of LLW into boxes. These are the only alternatives preferable to no compaction; of these, continued use of the existing compactor-baler is the preferred alternative.

This conclusion is reinforced if strong tight containers, optimally sized to accommodate compacted bales, are used. Calculations were made to verify this point.

### 5.1.2 Results for Case B - Potential Throughput

Table 6 summarizes the results of DPV of cost calculations for each compaction option at the *potential* compactible waste throughput. In terms of present value, the least costly alternative is the continued use of the existing compactor-baler augmented with procurement of optimally-sized containers. However, as the *potential* throughput is more than double the *current* throughput, there are several additional compaction alternatives that are preferred to no compaction. In descending order of preference, they are the following:

1. Procurement and installation of a 100,000 lb compactive force box compactor for compaction into boxes
2. Procurement and installation of a 400,000 lb. compactive force box compactor for compaction into boxes
3. Continued use of the installed compactor-baler

**Table 5. Results of Discounted Present Value of Cost Calculations for LLNL Solid LLW Compaction Alternatives - Current Throughput (20-year economic life).**

| Compaction Alternatives | Compaction Force (lb) | DPV of Capital and Recurring Costs ($) |
|---|---|---|
| Compactor-Baler - Installed | 100,000 | 683,010[a] |
| Compactor-Baler - Installed (with optimized containers) | 100,000 | 616,684[a] |
| Compactor-Baler - new (with optimized containers) | 100,000 | 902,207 |
| Drum Compactor | 85,000 | 957,243 |
| Drum Compactor - In storage | 85,000 | 927,243 |
| Box Compactor | 100,000 | 825,354 |
| Box Compactor | 400,000 | 1,001,320 |
| No Compaction | ----- | 911,684[a] |
| Compactor Service | ----- | 1,241,725[a] |
| Drum Compactor (to crush full drums) | 85,000 | 1,801,346 |
| Drum Compactor - In storage (to crush full drums) | 85,000 | 1,771,346 |
| Box Compactor (to crush full drums) | 100,000 | 1,614,087 |
| Box Compactor (to crush full drums) | 400,000 | 1,828,297 |

[a] No initial capital cost for this option. Therefore, DPV is for recurring costs only.

**Table 6. Results of Discounted Present Value of Cost Calculations for LLNL Solid LLW Compaction Alternatives - Potential Throughput (20-year economic life).**

| Compaction Alternatives | Compaction Force (lb) | DPV of Capital and Recurring Costs ($) |
|---|---|---|
| Compactor-Baler - Installed | 100,000 | 1,323,149[a] |
| Compactor-Baler - Installed (with optimized containers) | 100,000 | 1,167,772[a] |
| Compactor-Baler, new (with optimized containers) | 100,000 | 1,453,295 |
| Drum Compactor | 85,000 | 1,678,738 |
| Drum Compactor - In storage | 85,000 | 1,648,738 |
| Box Compactor | 100,000 | 1,185,169 |
| Box Compactor | 400,000 | 1,305,332 |
| No Compaction | ----- | 1,895,997[a] |
| Compactor Service | ----- | 2,590,810[a] |
| Drum Compactor (to crush full drums) | 85,000 | 3,577,774 |
| Drum Compactor - In storage (to crush full drums) | 85,000 | 3,547,774 |
| Box Compactor (to crush full drums) | 100,000 | 2,961,768 |
| Box Compactor (to crush full drums) | 400,000 | 3,198,089 |

[a] No initial capital cost for this option. Therefore, DPV is for recurring costs only.

4. Procurement and installation of a compactor-baler augmented with procurement of optimally-sized containers
5. Installation of the drum compactor in storage for compaction into drums
6. Procurement and installation of a new drum compactor for compaction into drums.

The results of the DPV calculations are a strong function of the magnitude of compactible waste throughput. Greater magnitudes yield more favorable results. In addition, the throughputs examined here are relatively low compared to the maximum capacities of the compactors. Therefore, the case of combined operation of two or more compactors has not been analyzed. This case would only make sense if the annual throughput exceeded the capacity of one of the compactors.

## 5.2 COMPACTION OF TRU WASTE

Compaction of TRU waste would require a compaction device separate from that used for compaction of LLW. This constraint is necessary to prevent the needless mixing of wastes that could conceivably result in the generation of additional TRU waste. The transportation charge on a unit volume of TRU waste is more costly than the transportation and disposal charge on a unit volume of LLW.

A crude cost benefit analysis revealed that, over a 20 year period, the costs exceeded the benefits of procurement of a compactor system exclusively used for compacting TRU waste into containers. That is, assuming a compaction ratio of 3:1 and an expected annual throughput of compactible TRU waste of sixty-five 55-gal. drums, the maximum annual benefit to LLNL is estimated to be approximately $4700. The actual benefit would be considerably less, as operating and maintenance costs have been ignored. Clearly, over a 20 year period, the cost of procuring a compaction system to compact TRU waste ($97,500 minimum) exceeds the benefits. Accordingly, no effort was made to calculate the DPV for this activity.

# 6.0 CONCLUSIONS

The cost benefit analysis results demonstrate that it is economically feasible to compact compactible LLW at the *current* throughput subject to compaction, approximately 67,600 lbs./yr. Furthermore, replacement of the existing compactor-baler system, *if* that system becomes permanently disabled, is advised. These conclusions are based on the lower DPV of costs, with respect to that of no compaction, of the existing compactor-baler and of an enhanced system using a 100,000 lb. compactive force box compactor for compacting LLW into boxes.

At the *potential* level of throughput, approximately 141,000 lb./yr., several alternatives are viable. The most feasible alternative is to use the installed compactor-baler augmented by procurement of strong tight containers that enhance efficient use of container space with bales. The next most feasible alternative is to install a box compactor with a compaction force of 100,000 lbs. for compacting LLW into boxes. These conclusions are based on the lower DPV of costs for those alternatives with respect to that of no compaction.

Replacement is recommended only if the current compactor system breaks. Substitution of a new system for the currently functional system is not recommended based on this cost benefit analysis.

Currently, approximately half of the compactible LLW is available as throughput for the existing compaction process. Therefore, the amount of compaction could conceivably double if disciplined segregation of compactible LLW from other waste streams is instituted.

Finally, regarding the compaction of TRU waste, that activity cannot be supported by the results from this cost benefit analysis.

## 7.0 RECOMMENDATIONS

This cost benefit analysis was performed because increased compaction capacity at HWM potentially offers significant waste volume reduction that could result in annual savings in material, shipping, labor, and disposal costs to LLNL. The results demonstrate that, at LLNL, compaction of LLW is cost effective. Continuation of that practice using the existing compactor-baler is recommended. Furthermore, it is recommended that containers optimally sized to accommodate compacted bales be procured. In addition, it is clear that increased throughput will enhance the benefits of compaction. Accordingly, it is recommended that LLNL seek opportunities to segregate compactible LLW from other waste to maximize throughput available for compaction.

Should the existing compactor-baler become permanently disabled, its replacement with a box compactor with a compaction force of 100,000 lbs, for compacting LLW into boxes, is recommended. However, neither shutdown of the current system nor augmentation of that system with another is indicated. The magnitude of the compactible LLW stream at this time does not justify either action. Justification for procurement of a compaction system to augment or replace the existing, functioning system would have to be based on considerations outside the scope of this analysis. For instance, worker activities required to operate a new system would not be as physically demanding as those required to operate the existing compactor-baler. The benefit of reduced risk to LLNL and its employees from industrial injury is not considered here. A safety analysis would be required to assess this benefit.

In addition, during the planning phases of the Decontamination and Waste Treatment Facility, consideration of potential installation of a compaction system is recommended. Future changes in WIPP or NTS charges and/or LLNL's compactible waste stream throughput may lead to conclusions that mignt justify an alternative system at this facility.

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# 9.0 INTERVIEWED PERSONNEL AND INDUSTRIAL CONTACTS

## Lawrence Livermore National Laboratory and Lawrence Livermore National Laboratory Contract Personnel Interviewed

Gloria Anderson
Pat Barry
Chris Carlson
Leroy Cordova
Jan Dickie
Wes Estill
Peggy Hallisey
Mike Hayes
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Dan Hoyt
Lyle Kerns
Scott Kidd
Carol Kielusiak
Fred McMurphy
Jay Morris
Maria Nelson
Robyn Peterson
Neil Riley
Bob Salazar
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Charlotte vanWarmerdam
Jim Winstanley

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General Electric Company Vallecitos Nuclear Center, Pleasanton, CA
Nevada Test Site, Mercury, NV
Northern California Compactors, Pleasanton, CA
Orwak USA, Bloomington, MN
Pacific Gas and Electric, Diablo Canyon Site, Avila Beach, CA
Perin Co., Inc., Hayward, CA
Refined Motion, Santa Clara, CA
US Pollution Control, Inc., Union City, CA
Waste Isolation Pilot Plant, Carlsbad, NM
Environmental Management and Controls, Inc., Turlock, CA
Scientific Ecology Group, Inc., Oak Ridge, TN

# APPENDIX A
# LOW LEVEL WASTE COMPACTOR COST-BENEFIT ANALYSIS
# (*Current* LLW THROUGHPUT)

TABLE A-1

I N P U T S  F O R

LLNL WASTE COMPACTOR COST-BENEFIT ANALYSIS

(current throughput)

| | | | | | |
|---|---|---|---|---|---|
| NTS Disposal Charge | 10 | $/ft^3 | | | |
| Transportation, exclusive use | 2500 | $/load | | | |
| Average compactible waste mass | 67583 | lb/yr | | | |
| Average waste radiation level | 2 | millirem/hr | | | |
| Value, 1 Man-rem of exposure | 1000 | $/Man-rem | | | |
| Industry avg net waste density | 30 | lb/ft^3, 85,000 lbf machine | | | |
| Industry avg net waste density | 40 | lb/ft^3, 100,000 lbf machine | | | |
| Industry avg net waste density | 63 | lb/ft^3, 400,000 lbf machine | | | |
| Baler avg. waste density | 41 | lb/ft^3 | | | |
| Uncompacted avg. waste density | 15 | lb/ft^3 | | | |
| Internal volume, 55 gal drum | 7.35 | ft^3 | | | |
| Burial volume, 55 gal drum | 8 | ft^3 | | | |
| Internal volume, 100K box | 90 | ft^3 | | | |
| Burial volume, 100K box | 92 | ft^3 | | | |
| Internal volume, 400K box | 89 | ft^3 | | | |
| Burial volume, 400K box | 92 | ft^3 | | | |
| Internal volume, CWC-96 box | 96 | ft^3 | | | |
| Burial volume, CWC-96 box | 103 | ft^3 | | | |
| Internal volume, CWC-118 box | 118 | ft^3 | | | |
| Burial volume, CWC-118 box | 126 | ft^3 | | | |
| Volume, paper box for baler | 13.38 | ft^3 | | | |
| Cost per load empty B-25 boxes | 700 | $ | Other: | 0 | $/load(CWC box, drums) |
| Load weight limit | 45000 | lb | | | |
| No. of empty drums per load | 160 | | | | |
| No. of full drums per load | 80 | | | | |
| No. of empty 100K boxes/load | 28 | | | | |
| No. of empty 400K boxes/load | 28 | | | | |
| No. empty CWC-96 boxes/load | 24 | | | | |
| No. of crushed drums/CWC-118 | 18 | for box compactor cases | | | |
| No. of crushed drums/CWC-118 | 12 | for drum compactor cases | | | |
| Gross weight, full 100K box | 4245 | lb | Empty: | 645 | lb |
| Gross weight, full 400K box | 6707 | lb | Empty: | 1100 | lb |
| Gross wt., full CWC-96 box | 3465 | lb | | | |
| Weight, empty CWC-96 box | 633 | lb | | | |
| Weight, empty 55 gal drum | 50 | lb | | | |
| Cost/17C or 17H drum | 32 | $/drum | | | |
| Cost of anti-springbacks/drum | 30 | $/drum | | | |
| Cost/100K box&anti-springbacks | 500 | $/box | | | |
| Cost/400K box&anti-springbacks | 975 | $/box | | | |
| Cost/CWC boxes & sec clips | 824 | $/box | | | |
| Cost of vermiculite filler | 3.25 | $/ft^3 | | | |
| Density of vermiculite filler | 2.5 | lb/ft^3 | | | |
| Sort,compact,log,survey,ship.. | 1.3 | Mhr/drum | | | |
| Sort,compact,log,survey,ship.. | 3.5 | Mhr/100K box | | | |
| Sort,compact,log,survey,ship.. | 4.33 | Mhr/400K box | | | |
| Sort,compact,log,survey,ship.. | 12.8 | Mhr/CWC metal box | | | |
| Load,log,survey...(no compact) | 2.0 | Mhr/CWC metal box | | | |
| Labor, crushing full drums | 1.0 | Mhr/drum | | | |
| Labor, prep for off-site srvc. | 0.5 | Mhr/drum | | | |
| Labor, ship precompacted boxes | 0.75 | Mhr/box | | | |
| Avg. technician wage (level 8) | 17.70 | $/hr | | | |
| Payroll burden rate | 42.8% | | | | |
| General overhead | 75.5% | | | | |
| Avg. burdened technician wage | 44.36 | $/hr | | | |

TABLE A-1: I N P U T S - current throughput
(continued)

| | | |
|---|---|---|
| OJT instruction costs | 500 | $/yr |
| OJT graphics, materials | 500 | $/yr |
| Time for OJT (drum compactor) | 4 | hrs/person/yr |
| Time for OJT (other compactor) | 8 | hrs/person/yr |
| No. of technicians attending | 6 | |
| Maintenance time(drum compact) | 4 | hrs/month |
| Maintenance time(other compact | 8 | hrs/month |
| LLNL Cost of Capital | 8.70% | assume 30-yr T-Bond rate |

| | | |
|---|---|---|
| Price of 85K drum compactor | $30,000 | |
| Extra 85k drum crushing head | $1,235 | LLNL already owns |
| Price of 100K box compactor | $179,000 | |
| Price of 400K box compactor | $342,000 | |
| Price of 100K baler compactor | $80,000 | |

| | | |
|---|---|---|
| Other Up-Front Costs: | | |
| Regulatory activities | $8,000 | |
| Training | $3,000 | |
| Procedures/revisions | $14,000 | |
| Building modifications | $135,000 | ($67500 for simplified system) |
| System equipment - | | |
| airlocks/hoods(2) | $10,000 | ($5000 for simplified system) |
| container handling device | $18,000 | (not used for simplified system) |
| gloveboxes(2) | $12,000 | (not used for simplified system) |
| 15 ft. conveyor(enclosed) | $8,000 | (not used for simplified system) |
| hopper | $2,000 | (not used for simplified system) |
| Total of Other Up-Front Costs: | $210,000 | |

| | | |
|---|---|---|
| Price for dry, solid LSA waste (Off-site compactor service) | 17.35 | $/ft^3 |

TABLE A-2
85,000 LBF DRUM COMPACTOR ANNUAL COSTS
(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| A. 85,000 lbf drum compactor | | |
| Yearly compacted waste volume | 2252.8 | ft^3/yr |
| No. of drums filled/year | 307 | |
| Burial volume/year | 2456 | ft^3/yr |
| Volume * disposal charge | 24560 | $/yr |
| Disposal charge/year-85000 lbf drum compactor - Material only | $24,560 | |
| II. TRANSPORTATION CHARGES | | |
| A. 85,000 lbf drum compactor | | |
| No. drums used per year | 307 | |
| No. loads of empties/year | 2 | |
| Cost, all loads incoming | 0 | $/yr |
| No. loads of full drums/year | 4 | |
| Cost, sole-use trucks, full | 10000 | $/yr |
| Total transportation/year - 85,000 lbf drum compactor | $10,000 | |
| III. CONTAINER COSTS | | |
| A. 85,000 lbf drum compactor | | |
| Cost/year, all drums | 9824 | $/yr |
| Cost/year, anti-springbacks | 9210 | $/yr |
| Total cost of drums/year - 85,000 lbf drum compactor | $19,034 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| A. 85,000 lbf drum compactor | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 1.3 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 17704 | $/yr |
| Total labor cost/year - 85,000 lbf drum compactor | $17,704 | |
| V. MANREM COSTS | | |
| A. 85,000 lbf drum compactor | | |
| Total manhrs/year | 399.1 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.80 | Man-REM/yr |
| Man-REM cost/year | 798 | $/yr |
| Total Man-REM cost/year - 85,000 lbf drum compactor | $798 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| A. 85,000 lbf drum compactor | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE A-3
100,000 LBF BOX COMPACTOR ANNUAL COSTS
(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| B. 100,000 lbf box compactor | | |
| Yearly compacted waste volume | 1689.6 | ft^3/yr |
| No. of boxes filled/year | 19 | |
| Burial volume/year | 1748 | ft^3/yr |
| Volume * disposal charge | 17480 | $/yr |
| Disposal charge/year-100000 lb box compactor - Material only | $17,480 | |
| II. TRANSPORTATION CHARGES | | |
| B. 100,000 lbf box compactor | | |
| No. boxes used per year | 19 | |
| No. loads of empties/year | 1 | |
| Cost, all loads incoming | 700 | $/yr |
| Load limit divided by wt./box | 10 | Max. boxes/load |
| No. loads of full boxes/year | 2 | |
| Cost, sole-use trucks, full | 5000 | $/yr |
| Total transportation/year - 100,000 lbf box compactor | $5,700 | |
| III. CONTAINER COSTS | | |
| B. 100,000 lbf box compactor | | |
| Cost/year, all boxes with anti-springbacks | 9500 | $/yr |
| Total cost of boxes/year - 100,000 lbf box compactor | $9,500 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| B. 100,000 lbf box compactor | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 3.5 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 2950 | $/yr |
| Total labor cost/year - 100,000 lbf box compactor | $2,950 | |
| V. MANREM COSTS | | |
| B. 100,000 lbf box compactor | | |
| Total manhrs/year | 66.5 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.13 | Man-REM/yr |
| Man-REM cost/year | 133 | $/yr |
| Total Man-REM cost/year - 100,000 lbf box compactor | $133 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| B. 100,000 lbf box compactor | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE A-4

400,000 LBF BOX COMPACTOR ANNUAL COSTS

(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| C. 400,000 lbf box compactor | | |
| Yearly compacted waste volume | 1072.7 | ft^3/yr |
| No. of boxes filled/year | 13 | |
| Burial volume/year | 1196 | ft^3/yr |
| Volume * disposal charge | 11960 | $/yr |
| Disposal charge/year-400000 lb box compactor - Material only | $11,960 | |
| II. TRANSPORTATION CHARGES | | |
| C. 400,000 lbf box compactor | | |
| No. boxes used per year | 13 | |
| No. loads of empties/year | 0.5 | |
| Cost, all loads incoming | 350 | $/yr |
| Load limit divided by wt./box | 6 | Max. boxes/load |
| No. loads of full boxes/year | 2.5 | |
| Cost, sole-use trucks, full | 6250 | $/yr |
| Total transportation/year - 400,000 lbf box compactor | $6,600 | |
| III. CONTAINER COSTS | | |
| C. 400,000 lbf box compactor | | |
| Cost/year, all boxes with anti-springbacks | 12675 | $/yr |
| Total cost of boxes/year - 400,000 lbf box compactor | $12,675 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| C. 400,000 lbf box compactor | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 4.33 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 2497 | $/yr |
| Total labor cost/year - 400,000 lbf box compactor | $2,497 | |
| V. MANREM COSTS | | |
| C. 400,000 lbf box compactor | | |
| Total manhrs/year | 56.29 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.11 | Man-REM/yr |
| Man-REM cost/year | 113 | $/yr |
| Total Man-REM cost/year - 400,000 lbf box compactor | $113 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| C. 400,000 lbf box compactor | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE A-5a: 100,000 LBF COMPACTOR-BALER ANNUAL COSTS (current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Waste mass for compaction | 52463 | lb |
| Compacted waste volume | 1279.6 | ft^3/yr |
| No. of bales produced | 96 | |
| No. containers @4 bales ea. | 24 | |
| No. of containers(whole no) | 24 | |
| Volume for uncompacted fill | 1008 | ft^3 |
| Mass of uncompacted fill | 15120 | lb |
| Total waste mass (check) | 67583 | lb |
| Burial volume/year | 2472 | ft^3/yr |
| Volume * disposal charge | 24720 | $/yr |
| Disposal charge/year-Compactor baler - Material only | $24,720 | |
| II. TRANSPORTATION CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| No. boxes used per year | 24 | |
| No. loads of empties/year | 1 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 13 | Max. boxes/load |
| No. loads of full boxes/year | 2 | |
| Cost, sole-use trucks, full | 5000 | $/yr |
| Total transportation/year - 100,000 lbf compactor baler | $5,000 | |
| III. CONTAINER COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Cost/year, all shipping containers | 19776 | $/yr |
| Total cost of containers/year- 100,000 lbf compactor baler | $19,776 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 12.8 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 13627 | $/yr |
| Total labor cost/year - 100,000 lbf compactor baler | $13,627 | |
| V. MANREM COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Total manhrs/year | 307.2 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.61 | Man-REM/yr |
| Man-REM cost/year | 614 | $/yr |
| Total Man-REM cost/year - 100,000 lbf compactor baler | $614 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| D. 100,000 lbf compactor baler | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE A-5b : 100,000 LBF BALER W/OPTIMIZED CONTAINER ANNUAL COSTS (current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Waste mass for compaction | 67328 | lb |
| Compacted waste volume | 1642.1 | ft^3/yr |
| No. of bales produced | 123 | |
| No. containers @6 bales ea. | 20.5 | |
| No. of containers(whole no) | 21 | |
| Volume for uncompacted fill | 40.1 | ft^3 |
| Mass of uncompacted fill | 255 | lb |
| Total waste mass (check) | 67583 | lb |
| Burial volume/year | 2079 | ft^3/yr |
| Volume * disposal charge | 20790 | $/yr |
| Disposal charge/year-Compactor baler - Material only | $20,790 | |
| II. TRANSPORTATION CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| No. boxes used per year | 21 | |
| No. loads of empties/year | 1 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 12 | Max. boxes/load |
| No. loads of full boxes/year | 2 | |
| Cost, sole-use trucks, full | 5000 | $/yr |
| Total transportation/year - 100,000 lbf compactor baler | $5,000 | |
| III. CONTAINER COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Cost/year, all shipping containers | 18375 | $/yr |
| Total cost of containers/year- 100,000 lbf compactor baler | $18,375 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 12.8 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 11924 | $/yr |
| Total labor cost/year - 100,000 lbf compactor baler | $11,924 | |
| V. MANREM COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Total manhrs/year | 268.8 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.54 | Man-REM/yr |
| Man-REM cost/year | 538 | $/yr |
| Total Man-REM cost/year - 100,000 lbf compactor baler | $538 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| D. 100,000 lbf compactor baler | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE A-6
ANNUAL COSTS WITH NO COMPACTION
(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| E. No compaction | | |
| Yearly waste volume | 4505.5 | ft^3/yr |
| No. of containers filled/year | 47 | |
| Burial volume/year | 4841 | ft^3/yr |
| Volume * disposal charge | 48410 | $/yr |
| Disposal charge/year - | | |
| No Compaction - Material only | $48,410 | |
| II. TRANSPORTATION CHARGES | | |
| E. No compaction | | |
| No. boxes used per year | 47 | |
| No. loads of empties/year | 2 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 21 | Max. boxes/load |
| No. loads of full boxes/year | 2.5 | |
| Cost, sole-use trucks, full | 6250 | $/yr |
| Total transportation/year - | | |
| No compaction | $6,250 | |
| III. CONTAINER COSTS | | |
| E. No compaction | | |
| Cost/year, all shipping containers | 38728 | $/yr |
| Total cost of containers/year- | | |
| No compaction | $38,728 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| E. No compaction | | |
| Time to close, weigh, log, survey, label, QC, load, paperwork | 2 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 4170 | $/yr |
| Total labor cost/year - | | |
| No compaction | $4,170 | |
| V. MANREM COSTS | | |
| E. No compaction | | |
| Total manhrs/year | 94 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.19 | Man-REM/yr |
| Man-REM cost/year | 188 | $/yr |
| Total Man-REM cost/year - | | |
| No compaction | $188 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| E. No compaction | | |
| OJT instruction cost | 0 | $/yr |
| Labor for attendees | 0 | $/yr |
| Total OJT Cost per year | $0 | $/yr |

TABLE A-7
85,000 LBF DRUM COMPACTOR ANNUAL COSTS
FOR CRUSHING OF FULL DRUMS
(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| F. Crush full drums (85k lbf) | | |
| Yearly waste volume | 4505.5 | ft^3/yr |
| No. of drums filled/year | 613 | |
| Burial volume(boxes)/year | 6426 | ft^3/yr |
| Volume * disposal charge | 64260 | $/yr |
| Disposal charge/year-85000 lbf drum crushing - Material only | $64,260 | |
| II. TRANSPORTATION CHARGES | | |
| F. Crush full drums (85k lbf) | | |
| No. drums used per year | 613 | |
| No. loads of empties/year | 4 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 16 | Max. boxes/load |
| No. loads of full boxes/year | 3.5 | |
| Cost, sole-use trucks, full | 8750 | $/yr |
| Total transportation/year - 85,000 lbf drum crushing | $8,750 | |
| III. CONTAINER COSTS | | |
| F. Crush full drums (85k lbf) | | |
| Cost/year, all drums | 19616 | $/yr |
| Cost/year, CWC disposal boxes | 42024 | $/yr (No.=51) |
| Vermiculite filler, ft^3/year | 3566 | |
| Cost/year, vermiculite filler | 11590 | $/yr |
| Total container cost/year - | $73,230 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| F. Crush full drums (85k lbf) | | |
| Time to compact,weigh,log,survey,label, QC, load, paperwork | 1.0 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 27192 | $/yr |
| Total labor cost/year - 85,000 lbf drum crushing | $27,192 | |
| V. MANREM COSTS | | |
| F. Crush full drums (85k lbf) | | |
| Total manhrs/year | 613 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.23 | Man-REM/yr |
| Man-REM cost/year | 1226 | $/yr |
| Total Man-REM cost/year - 85,000 lbf drum crushing | $1,226 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| F. Crush full drums (85k lbf) | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE A-8
100,000 LBF BOX COMPACTOR ANNUAL COSTS
FOR CRUSHING OF FULL DRUMS
(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| G. Crush full drums (100k lbf) | | |
| Yearly waste volume | 4505.5 | ft^3/yr |
| No. of drums filled/year | 613 | |
| Burial volume(boxes)/year | 4284 | ft^3/yr |
| Volume * disposal charge | 42840 | $/yr |
| Disposal charge/year-100,000 lbf drum crushing - Material only | $42,840 | |
| II. TRANSPORTATION CHARGES | | |
| G. Crush full drums (100k lbf) | | |
| No. drums used per year | 613 | |
| No. loads of empties/year | 4 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 12 | Max. boxes/load |
| No. loads of full boxes/year | 3 | |
| Cost, sole-use trucks, full | 7500 | $/yr |
| Total transportation/year - 100,000 lbf drum crushing | $7,500 | |
| III. CONTAINER COSTS | | |
| G. Crush full drums (100k lbf) | | |
| Cost/year, all drums | 19616 | $/yr |
| Cost/year, CWC disposal boxes | 28016 | $/yr (No.=34) |
| Vermiculite filler, ft^3/year | 2173 | |
| Cost/year, vermiculite filler | 7062 | $/yr |
| Total container cost/year - | $54,694 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| F. Crush full drums (100k lbf) | | |
| Time to compact,weigh,log,survey,label, QC, load, paperwork | 1.0 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 27192 | $/yr |
| Total labor cost/year - 100,000 lbf drum crushing | $27,192 | |
| V. MANREM COSTS | | |
| G. Crush full drums (100k lbf) | | |
| Total manhrs/year | 613 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.23 | Man-REM/yr |
| Man-REM cost/year | 1226 | $/yr |
| Total Man-REM cost/year - 100,000 lbf drum crushing | $1,226 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| G. Crush full drums (100k lbf) | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE A-9

400,000 LBF BOX COMPACTOR ANNUAL COSTS

FOR CRUSHING OF FULL DRUMS

(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| H. Crush full drums (400k lbf) | | |
| Yearly waste volume | 4505.5 | ft^3/yr |
| No. of drums filled/year | 613 | |
| Burial volume(boxes)/year | 4284 | ft^3/yr |
| Volume * disposal charge | 42840 | $/yr |
| Disposal charge/year-400,000 lbf drum crushing - Material only | $42,840 | |
| II. TRANSPORTATION CHARGES | | |
| H. Crush full drums (400k lbf) | | |
| No. drums used per year | 613 | |
| No. loads of empties/year | 4 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 12 | Max. boxes/load |
| No. loads of full boxes/year | 3 | |
| Cost, sole-use trucks, full | 7500 | $/yr |
| Total transportation/year - 400,000 lbf drum crushing | $7,500 | |
| III. CONTAINER COSTS | | |
| H. Crush full drums (400k lbf) | | |
| Cost/year, all drums | 19616 | $/yr |
| Cost/year, CWC disposal boxes | 28016 | $/yr (No.=34) |
| Vermiculite filler, ft^3/year | 2844 | |
| Cost/year, vermiculite filler | 9244 | $/yr |
| Total container cost/year - | $56,876 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| F. Crush full drums (400k lbf) | | |
| Time to compact,weigh,log,survey,label, QC, load, paperwork | 1.0 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 27192 | $/yr |
| Total labor cost/year - 400,000 lbf drum crushing | $27,192 | |
| V. MANREM COSTS | | |
| H. Crush full drums (400k lbf) | | |
| Total manhrs/year | 613 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.23 | Man-REM/yr |
| Man-REM cost/year | 1226 | $/yr |
| Total Man-REM cost/year - 400,000 lbf drum crushing | $1,226 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| H. Crush full drums (400k lbf) | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE A-10

OFF-SITE COMPACTOR SERVICE ANNUAL COSTS
(current throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| J. Off-site compactor service | | |
| Yearly waste volume | 4505.5 | ft^3/yr |
| No. of drums filled/year | 613 | |
| Burial volume/year | 4904 | ft^3/yr |
| Volume * disposal charge | 85084.4 | $/yr |
| Disposal charge/year, Off-site compaction - Material only | $85,084 | |
| II. TRANSPORTATION CHARGES | | |
| J. Off-site compactor service | | |
| No. drums used per year | 613 | |
| No. loads of empties/year | 4 | |
| Cost, all loads incoming | 0 | $/yr |
| No. loads of full drums/year | 8 | |
| Cost (incl in disposal charge) | 0 | $/yr |
| Load limit/wt.of full 400K box | 6 | Max. boxes/load |
| No. loads of full boxes/year | 2.5 | (13 boxes) |
| Cost, sole-use trucks, full | 6250 | $/yr |
| Total transportation/year - Off-site compaction service | $6,250 | |
| III. CONTAINER COSTS | | |
| J. Off-site compactor service | | |
| Cost/year, all drums | 19616 | $/yr |
| Cost/year, anti-springbacks | 0 | $/yr |
| Total cost of drums/year - Off-site compaction service | $19,616 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| J. Off-site compactor service | | |
| Time to close, weigh, log,survey,label, QC, load, paperwork | 0.5 | Manhr/drum |
| Time to unload, log, survey, label, QC, load, paperwork | 0.75 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 14028 | $/yr |
| Total labor cost/year - Off-site compaction service | $14,028 | |
| V. MANREM COSTS | | |
| J. Off-site compactor service | | |
| Total manhrs/year | 306.5 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.61 | Man-REM/yr |
| Man-REM cost/year | 613 | $/yr |
| Total Man-REM cost/year - Off-site compaction service | $613 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| J. Off-site compactor service | | |
| OJT instruction cost | 0 | $/yr |
| Labor for attendees | 0 | $/yr |
| Total OJT Cost per year | $0 | $/yr |

TABLE A-11

SUMMARY OF ANNUAL COSTS FOR DISPOSAL OF COMPACTIBLE LOW LEVEL WASTE

CURRENT THROUGHPUT

(excluding maintenance and repair)

| | 85K Drum | 100K Box | 400K Box | 100K Baler | No Compact |
|---|---|---|---|---|---|
| Disposal | 24,560 | 17,480 | 11,960 | 24,720 | 48,410 |
| Transportation | 10,000 | 5,700 | 6,600 | 5,000 | 6,250 |
| Containers | 19,034 | 9,500 | 12,675 | 19,776 | 38,728 |
| Labor | 17,704 | 2,950 | 2,497 | 13,627 | 4,170 |
| Man-REM | 798 | 133 | 113 | 614 | 188 |
| Training | 2,065 | 3,129 | 3,129 | 3,129 | 0 |
| Total per year | $74,161 | $38,892 | $36,974 | $66,866 | $97,746 |

| | DRUM CRUSHING | | | 100K Baler, Compactor | |
|---|---|---|---|---|---|
| | 85K Drum | 100K Box | 400K Box | larger cont. | Service |
| Disposal | 64,260 | 42,840 | 42,840 | 20,790 | 85,084 |
| Transportation | 8,750 | 7,500 | 7,500 | 5,000 | 6,250 |
| Containers | 3,230 | 54,694 | 56,876 | 18,375 | 19,616 |
| Labor | 27,192 | 27,192 | 27,192 | 11,924 | 14,028 |
| Man-REM | 1,226 | 1,226 | 1,226 | 538 | 613 |
| Training | 2,065 | 2,065 | 2,065 | 3,129 | 0 |
| Total per year | $176,722 | $135,517 | $137,699 | $59,756 | $125,591 |

TABLE A-12 : 85,000 LBF DRUM COMPACTOR DPV CALCULATION (current throughput)

| | | 85K Drum Compactor Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 240,000 | 240,000 |
| 1 | 0.030 | 3,029 | 74,161 | 77,190 |
| 2 | 0.023 | 2,819 | 74,161 | 76,980 |
| 3 | 0.018 | 2,681 | 74,161 | 76,842 |
| 4 | 0.018 | 2,681 | 74,161 | 76,842 |
| 5 | 0.018 | 2,681 | 74,161 | 76,842 |
| 6 | 0.018 | 2,681 | 74,161 | 76,842 |
| 7 | 0.018 | 2,681 | 74,161 | 76,842 |
| 8 | 0.018 | 2,681 | 74,161 | 76,842 |
| 9 | 0.018 | 2,681 | 74,161 | 76,842 |
| 10 | 0.018 | 2,681 | 74,161 | 76,842 |
| 11 | 0.018 | 2,681 | 74,161 | 76,842 |
| 12 | 0.018 | 2,681 | 74,161 | 76,842 |
| 13 | 0.018 | 2,681 | 74,161 | 76,842 |
| 14 | 0.018 | 2,681 | 74,161 | 76,842 |
| 15 | 0.018 | 2,681 | 74,161 | 76,842 |
| 16 | 0.018 | 2,681 | 74,161 | 76,842 |
| 17 | 0.018 | 2,681 | 74,161 | 76,842 |
| 18 | 0.018 | 2,681 | 74,161 | 76,842 |
| 19 | 0.023 | 2,819 | 74,161 | 76,980 |
| 20 | 0.030 | 3,029 | 74,161 | 77,190 |
| | 0.400 | 54,596 | 1,723,215 | 1,777,811 |
| | | Discounted Present Value of Costs = | | 957,243 |

TABLE A-13 : 85,000 LBF DRUM COMPACTOR (IN STORAGE) DPV CALCULATION (current throughput)

| | | 85K Drum Compactor (Procured and In Storage) Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 210,000 | 210,000 |
| 1 | 0.030 | 3,029 | 74,161 | 77,190 |
| 2 | 0.023 | 2,819 | 74,161 | 76,980 |
| 3 | 0.018 | 2,681 | 74,161 | 76,842 |
| 4 | 0.018 | 2,681 | 74,161 | 76,842 |
| 5 | 0.018 | 2,681 | 74,161 | 76,842 |
| 6 | 0.018 | 2,681 | 74,161 | 76,842 |
| 7 | 0.018 | 2,681 | 74,161 | 76,842 |
| 8 | 0.018 | 2,681 | 74,161 | 76,842 |
| 9 | 0.018 | 2,681 | 74,161 | 76,842 |
| 10 | 0.018 | 2,681 | 74,161 | 76,842 |
| 11 | 0.018 | 2,681 | 74,161 | 76,842 |
| 12 | 0.018 | 2,681 | 74,161 | 76,842 |
| 13 | 0.018 | 2,681 | 74,161 | 76,842 |
| 14 | 0.018 | 2,681 | 74,161 | 76,842 |
| 15 | 0.018 | 2,681 | 74,161 | 76,842 |
| 16 | 0.018 | 2,681 | 74,161 | 76,842 |
| 17 | 0.018 | 2,681 | 74,161 | 76,842 |
| 18 | 0.018 | 2,681 | 74,161 | 76,842 |
| 19 | 0.023 | 2,819 | 74,161 | 76,980 |
| 20 | 0.030 | 3,029 | 74,161 | 77,190 |
| | 0.400 | 54,596 | 1,693,215 | 1,747,811 |
| | | Discounted Present Value of Costs = | | 927,243 |

TABLE A-14 : 100,000 LBF BOX COMPACTOR DPV CALCULATION (current throughput)

100K Box Compactor Annual Costs

| Year | Repair Frac. | Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 389,000 | 389,000 |
| 1 | 0.030 | 9,628 | 38,892 | 48,520 |
| 2 | 0.023 | 8,375 | 38,892 | 47,267 |
| 3 | 0.018 | 7,552 | 38,892 | 46,444 |
| 4 | 0.018 | 7,552 | 38,892 | 46,444 |
| 5 | 0.018 | 7,552 | 38,892 | 46,444 |
| 6 | 0.018 | 7,552 | 38,892 | 46,444 |
| 7 | 0.018 | 7,552 | 38,892 | 46,444 |
| 8 | 0.018 | 7,552 | 38,892 | 46,444 |
| 9 | 0.018 | 7,552 | 38,892 | 46,444 |
| 10 | 0.018 | 7,552 | 38,892 | 46,444 |
| 11 | 0.018 | 7,552 | 38,892 | 46,444 |
| 12 | 0.018 | 7,552 | 38,892 | 46,444 |
| 13 | 0.018 | 7,552 | 38,892 | 46,444 |
| 14 | 0.018 | 7,552 | 38,892 | 46,444 |
| 15 | 0.018 | 7,552 | 38,892 | 46,444 |
| 16 | 0.018 | 7,552 | 38,892 | 46,444 |
| 17 | 0.018 | 7,552 | 38,892 | 46,444 |
| 18 | 0.018 | 7,552 | 38,892 | 46,444 |
| 19 | 0.023 | 8,375 | 38,892 | 47,267 |
| 20 | 0.030 | 9,628 | 38,892 | 48,520 |
| | 0.400 | 156,840 | 1,166,837 | 1,323,677 |
| | | Discounted Present Value of Costs = | | 825,354 |

TABLE A-15 : 400,000 LBF COX CUMPACTOR DPV CALCULATION (current througnput)

400K Box Compactor Annual Costs

| Year | Repair Frac. | Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 552,000 | 552,000 |
| 1 | 0.030 | 14,518 | 36,974 | 51,492 |
| 2 | 0.023 | 12,124 | 36,974 | 49,098 |
| 3 | 0.018 | 10,551 | 36,974 | 47,525 |
| 4 | 0.018 | 10,551 | 36,974 | 47,525 |
| 5 | 0.018 | 10,551 | 36,974 | 47,525 |
| 6 | 0.018 | 10,551 | 36,974 | 47,525 |
| 7 | 0.018 | 10,551 | 36,974 | 47,525 |
| 8 | 0.018 | 10,551 | 36,974 | 47,525 |
| 9 | 0.018 | 10,551 | 36,974 | 47,525 |
| 10 | 0.018 | 10,551 | 36,974 | 47,525 |
| 11 | 0.018 | 10,551 | 36,974 | 47,525 |
| 12 | 0.018 | 10,551 | 36,974 | 47,525 |
| 13 | 0.018 | 10,551 | 36,974 | 47,525 |
| 14 | 0.018 | 10,551 | 36,974 | 47,525 |
| 15 | 0.018 | 10,551 | 36,974 | 47,525 |
| 16 | 0.018 | 10,551 | 36,974 | 47,525 |
| 17 | 0.018 | 10,551 | 36,974 | 47,525 |
| 18 | 0.018 | 10,551 | 36,974 | 47,525 |
| 19 | 0.023 | 12,124 | 36,974 | 49,098 |
| 20 | 0.030 | 14,518 | 36,974 | 51,492 |
| | 0.400 | 222,105 | 1,291,471 | 1,513,576 |
| | | Discounted Present Value of Costs = | | 1,001,320 |

TABLE A-16 : DPV CALCULATION FOR DISPOSAL WITH NO COMPACTION (current throughput)

| Year | Repair Frac. | Annual Costs for No Compaction: Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 0 | 0 |
| 1 | 0.030 | 0 | 97,746 | 97,746 |
| 2 | 0.023 | 0 | 97,746 | 97,746 |
| 3 | 0.018 | 0 | 97,746 | 97,746 |
| 4 | 0.018 | 0 | 97,746 | 97,746 |
| 5 | 0.018 | 0 | 97,746 | 97,746 |
| 6 | 0.018 | 0 | 97,746 | 97,746 |
| 7 | 0.018 | 0 | 97,746 | 97,746 |
| 8 | 0.018 | 0 | 97,746 | 97,746 |
| 9 | 0.018 | 0 | 97,746 | 97,746 |
| 10 | 0.018 | 0 | 97,746 | 97,746 |
| 11 | 0.018 | 0 | 97,746 | 97,746 |
| 12 | 0.018 | 0 | 97,746 | 97,746 |
| 13 | 0.018 | 0 | 97,746 | 97,746 |
| 14 | 0.018 | 0 | 97,746 | 97,746 |
| 15 | 0.018 | 0 | 97,746 | 97,746 |
| 16 | 0.018 | 0 | 97,746 | 97,746 |
| 17 | 0.018 | 0 | 97,746 | 97,746 |
| 18 | 0.018 | 0 | 97,746 | 97,746 |
| 19 | 0.023 | 0 | 97,746 | 97,746 |
| 20 | 0.030 | 0 | 97,746 | 97,746 |
| | 0.400 | 0 | 1,954,914 | 1,954,914 |
| | | Discounted Present Value of Costs = | | 911,684 |

TABLE A-17 : OFF-SITE COMPACTION SERVICE DPV CALCULATION (current throughput)

| Year | Repair Frac. | Annual Costs for Off-site Compaction Service: Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 0 | 0 |
| 1 | 0.030 | 0 | 125,591 | 125,591 |
| 2 | 0.023 | 0 | 125,591 | 125,591 |
| 3 | 0.018 | 0 | 125,591 | 125,591 |
| 4 | 0.018 | 0 | 125,591 | 125,591 |
| 5 | 0.018 | 0 | 125,591 | 125,591 |
| 6 | 0.018 | 0 | 125,591 | 125,591 |
| 7 | 0.018 | 0 | 125,591 | 125,591 |
| 8 | 0.018 | 0 | 125,591 | 125,591 |
| 9 | 0.018 | 0 | 125,591 | 125,591 |
| 10 | 0.018 | 0 | 125,591 | 125,591 |
| 11 | 0.018 | 0 | 125,591 | 125,591 |
| 12 | 0.018 | 0 | 125,591 | 125,591 |
| 13 | 0.018 | 0 | 125,591 | 125,591 |
| 14 | 0.018 | 0 | 125,591 | 125,591 |
| 15 | 0.018 | 0 | 125,591 | 125,591 |
| 16 | 0.018 | 0 | 125,591 | 125,591 |
| 17 | 0.018 | 0 | 125,591 | 125,591 |
| 18 | 0.018 | 0 | 125,591 | 125,591 |
| 19 | 0.023 | 0 | 125,591 | 125,591 |
| 20 | 0.030 | 0 | 125,591 | 125,591 |
| | 0.400 | 0 | 2,511,829 | 2,511,829 |
| | | Discounted Present Value of Costs = | | 1,171,404 |

TABLE A-18 : 85,000 LBF DRUM COMPACTOR DPV CALCULATION- CRUSHING OF FULL DRUMS (current throughput)

| Year | Repair Frac. | 85K Drum Compactor Annual Costs (Crushing of Full Drums) Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 127,500 | 127,500 |
| 1 | 0.030 | 3,029 | 176,722 | 179,752 |
| 2 | 0.023 | 2,819 | 176,722 | 179,542 |
| 3 | 0.018 | 2,681 | 176,722 | 179,404 |
| 4 | 0.018 | 2,681 | 176,722 | 179,404 |
| 5 | 0.018 | 2,681 | 176,722 | 179,404 |
| 6 | 0.018 | 2,681 | 176,722 | 179,404 |
| 7 | 0.018 | 2,681 | 176,722 | 179,404 |
| 8 | 0.018 | 2,681 | 176,722 | 179,404 |
| 9 | 0.018 | 2,681 | 176,722 | 179,404 |
| 10 | 0.018 | 2,681 | 176,722 | 179,404 |
| 11 | 0.018 | 2,681 | 176,722 | 179,404 |
| 12 | 0.018 | 2,681 | 176,722 | 179,404 |
| 13 | 0.018 | 2,681 | 176,722 | 179,404 |
| 14 | 0.018 | 2,681 | 176,722 | 179,404 |
| 15 | 0.018 | 2,681 | 176,722 | 179,404 |
| 16 | 0.018 | 2,681 | 176,722 | 179,404 |
| 17 | 0.018 | 2,681 | 176,722 | 179,404 |
| 18 | 0.018 | 2,681 | 176,722 | 179,404 |
| 19 | 0.023 | 2,819 | 176,722 | 179,542 |
| 20 | 0.030 | 3,029 | 176,722 | 179,752 |
| | 0.400 | 54,596 | 3,661,947 | 3,716,544 |
| | | Discounted Present Value of Costs = | | 1,801,346 |

TABLE A-19 : 85,000 LBF DRUM COMPACTOR (IN STORAGE) DPV CALCULATION - CRUSHING OF FULL DRUMS (current throughput)

| Year | Repair Frac. | 85K Drum Compactor (In Storage) Annual Cost (Crush Full Drums) Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 97,500 | 97,500 |
| 1 | 0.030 | 3,029 | 176,722 | 179,752 |
| 2 | 0.023 | 2,819 | 176,722 | 179,542 |
| 3 | 0.018 | 2,681 | 176,722 | 179,404 |
| 4 | 0.018 | 2,681 | 176,722 | 179,404 |
| 5 | 0.018 | 2,681 | 176,722 | 179,404 |
| 6 | 0.018 | 2,681 | 176,722 | 179,404 |
| 7 | 0.018 | 2,681 | 176,722 | 179,404 |
| 8 | 0.018 | 2,681 | 176,722 | 179,404 |
| 9 | 0.018 | 2,681 | 176,722 | 179,404 |
| 10 | 0.018 | 2,681 | 176,722 | 179,404 |
| 11 | 0.018 | 2,681 | 176,722 | 179,404 |
| 12 | 0.018 | 2,681 | 176,722 | 179,404 |
| 13 | 0.018 | 2,681 | 176,722 | 179,404 |
| 14 | 0.018 | 2,681 | 176,722 | 179,404 |
| 15 | 0.018 | 2,681 | 176,722 | 179,404 |
| 16 | 0.018 | 2,681 | 176,722 | 179,404 |
| 17 | 0.018 | 2,681 | 176,722 | 179,404 |
| 18 | 0.018 | 2,681 | 176,722 | 179,404 |
| 19 | 0.023 | 2,819 | 176,722 | 179,542 |
| 20 | 0.030 | 3,029 | 176,722 | 179,752 |
| | 0.400 | 54,596 | 3,631,947 | 3,686,544 |
| | | Discounted Present Value of Costs = | | 1,771,346 |

TABLE A-20 : 100,000 LBF BOX COMPACTOR DPV CALCULATION- CRUSHING OF FULL DRUMS (current throughput)

| Year | Repair Frac. | 100K Box Compactor Annual Costs (Crushing of Full Drums) Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 276,500 | 276,500 |
| 1 | 0.030 | 9,628 | 135,517 | 145,146 |
| 2 | 0.023 | 8,375 | 135,517 | 143,893 |
| 3 | 0.018 | 7,552 | 135,517 | 143,069 |
| 4 | 0.018 | 7,552 | 135,517 | 143,069 |
| 5 | 0.018 | 7,552 | 135,517 | 143,069 |
| 6 | 0.018 | 7,552 | 135,517 | 143,069 |
| 7 | 0.018 | 7,552 | 135,517 | 143,069 |
| 8 | 0.018 | 7,552 | 135,517 | 143,069 |
| 9 | 0.018 | 7,552 | 135,517 | 143,069 |
| 10 | 0.018 | 7,552 | 135,517 | 143,069 |
| 11 | 0.018 | 7,552 | 135,517 | 143,069 |
| 12 | 0.018 | 7,552 | 135,517 | 143,069 |
| 13 | 0.018 | 7,552 | 135,517 | 143,069 |
| 14 | 0.018 | 7,552 | 135,517 | 143,069 |
| 15 | 0.018 | 7,552 | 135,517 | 143,069 |
| 16 | 0.018 | 7,552 | 135,517 | 143,069 |
| 17 | 0.018 | 7,552 | 135,517 | 143,069 |
| 18 | 0.018 | 7,552 | 135,517 | 143,069 |
| 19 | 0.023 | 8,375 | 135,517 | 143,893 |
| 20 | 0.030 | 9,628 | 135,517 | 145,146 |
| | 0.400 | 156,840 | 2,986,842 | 3,143,683 |
| | | Discounted Present Value of Costs = | | 1,614,087 |

TABLE A-21 : 400,000 LBF BOX COMPACTOR DPV CALCULATION - CRUSHING OF FULL DRUMS (current througnput)

| Year | Repair Frac. | 400K Box Compactor Annual Costs (Crushing of Full Drums) Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 439,500 | 439,500 |
| 1 | 0.030 | 14,518 | 137,699 | 152,218 |
| 2 | 0.023 | 12,124 | 137,699 | 149,824 |
| 3 | 0.018 | 10,551 | 137,699 | 148,250 |
| 4 | 0.018 | 10,551 | 137,699 | 148,250 |
| 5 | 0.018 | 10,551 | 137,699 | 148,250 |
| 6 | 0.018 | 10,551 | 137,699 | 148,250 |
| 7 | 0.018 | 10,551 | 137,699 | 148,250 |
| 8 | 0.018 | 10,551 | 137,699 | 148,250 |
| 9 | 0.018 | 10,551 | 137,699 | 148,250 |
| 10 | 0.018 | 10,551 | 137,699 | 148,250 |
| 11 | 0.018 | 10,551 | 137,699 | 148,250 |
| 12 | 0.018 | 10,551 | 137,699 | 148,250 |
| 13 | 0.018 | 10,551 | 137,699 | 148,250 |
| 14 | 0.018 | 10,551 | 137,699 | 148,250 |
| 15 | 0.018 | 10,551 | 137,699 | 148,250 |
| 16 | 0.018 | 10,551 | 137,699 | 148,250 |
| 17 | 0.018 | 10,551 | 137,699 | 148,250 |
| 18 | 0.018 | 10,551 | 137,699 | 148,250 |
| 19 | 0.023 | 12,124 | 137,699 | 149,824 |
| 20 | 0.030 | 14,518 | 137,699 | 152,218 |
| | 0.400 | 222,105 | 3,193,482 | 3,415,588 |
| | | Discounted Present Value of Costs = | | 1,828,297 |

TABLE A-22 : 100,000 LBF COMPACTOR-BALER DPV CALCULATION - EXISTING MACHINE (current throughput)

| | | 100K Baler Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | | |
| 1 | 0.018 | 5,730 | 66,866 | 72,597 |
| 2 | 0.018 | 5,730 | 66,866 | 72,597 |
| 3 | 0.018 | 5,730 | 66,866 | 72,597 |
| 4 | 0.023 | 6,098 | 66,866 | 72,965 |
| 5 | 0.030 | 6,658 | 66,866 | 73,525 |
| 6 | 0.030 | 6,658 | 66,866 | 73,525 |
| 7 | 0.030 | 6,658 | 66,866 | 73,525 |
| 8 | 0.030 | 6,658 | 66,866 | 73,525 |
| 9 | 0.030 | 6,658 | 66,866 | 73,525 |
| 10 | 0.030 | 6,658 | 66,866 | 73,525 |
| 11 | 0.030 | 6,658 | 66,866 | 73,525 |
| 12 | 0.030 | 6,658 | 66,866 | 73,525 |
| 13 | 0.030 | 6,658 | 66,866 | 73,525 |
| 14 | 0.030 | 6,658 | 66,866 | 73,525 |
| 15 | 0.030 | 6,658 | 66,866 | 73,525 |
| 16 | 0.030 | 6,658 | 66,866 | 73,525 |
| 17 | 0.030 | 6,658 | 66,866 | 73,525 |
| 18 | 0.030 | 6,658 | 66,866 | 73,525 |
| 19 | 0.030 | 6,658 | 66,866 | 73,525 |
| 20 | 0.030 | 6,658 | 66,866 | 73,525 |
| | 0.558 | 129,825 | 1,337,328 | 1,467,152 |
| | | Discounted Present Value of Costs= | | 683,010 |

TABLE A-23 : 100,000 LBF COMPACTOR-BALER DPV CALCULATION - EXISTING MACHINE, OPTIMIZED SHIPPING CONTAINERS (current throughput)

| | | 100K Baler Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | | |
| 1 | 0.018 | 5,730 | 59,755 | 65,486 |
| 2 | 0.018 | 5,730 | 59,755 | 65,486 |
| 3 | 0.018 | 5,730 | 59,755 | 65,486 |
| 4 | 0.023 | 6,098 | 59,755 | 65,854 |
| 5 | 0.030 | 6,658 | 59,755 | 66,414 |
| 6 | 0.030 | 6,658 | 59,755 | 66,414 |
| 7 | 0.030 | 6,658 | 59,755 | 66,414 |
| 8 | 0.030 | 6,658 | 59,755 | 66,414 |
| 9 | 0.030 | 6,658 | 59,755 | 66,414 |
| 10 | 0.030 | 6,658 | 59,755 | 66,414 |
| 11 | 0.030 | 6,658 | 59,755 | 66,414 |
| 12 | 0.030 | 6,658 | 59,755 | 66,414 |
| 13 | 0.030 | 6,658 | 59,755 | 66,414 |
| 14 | 0.030 | 6,658 | 59,755 | 66,414 |
| 15 | 0.030 | 6,658 | 59,755 | 66,414 |
| 16 | 0.030 | 6,658 | 59,755 | 66,414 |
| 17 | 0.030 | 6,658 | 59,755 | 66,414 |
| 18 | 0.030 | 6,658 | 59,755 | 66,414 |
| 19 | 0.030 | 6,658 | 59,755 | 66,414 |
| 20 | 0.030 | 6,658 | 59,755 | 66,414 |
| | 0.558 | 129,825 | 1,195,104 | 1,324,929 |
| | | Discounted Present Value of Costs = | | 616,684 |

TABLE A-24 : 100,000 LBF COMPACTOR-BALER DPV CALCULATI NEW SYSTEM, OPTIMIZED SHIPPING CONTAINERS (current throughput)

| | | 100K Baler Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 290,000 | 290,000 |
| 1 | 0.030 | 6,658 | 59,755 | 66,414 |
| 2 | 0.023 | 6,098 | 59,755 | 65,854 |
| 3 | 0.018 | 5,730 | 59,755 | 65,486 |
| 4 | 0.018 | 5,730 | 59,755 | 65,486 |
| 5 | 0.018 | 5,730 | 59,755 | 65,486 |
| 6 | 0.018 | 5,730 | 59,755 | 65,486 |
| 7 | 0.018 | 5,730 | 59,755 | 65,486 |
| 8 | 0.018 | 5,730 | 59,755 | 65,486 |
| 9 | 0.018 | 5,730 | 59,755 | 65,486 |
| 10 | 0.018 | 5,730 | 59,755 | 65,486 |
| 11 | 0.018 | 5,730 | 59,755 | 65,486 |
| 12 | 0.018 | 5,730 | 59,755 | 65,486 |
| 13 | 0.018 | 5,730 | 59,755 | 65,486 |
| 14 | 0.018 | 5,730 | 59,755 | 65,486 |
| 15 | 0.018 | 5,730 | 59,755 | 65,486 |
| 16 | 0.018 | 5,730 | 59,755 | 65,486 |
| 17 | 0.018 | 5,730 | 59,755 | 65,486 |
| 18 | 0.018 | 5,730 | 59,755 | 65,486 |
| 19 | 0.023 | 6,098 | 59,755 | 65,854 |
| 20 | 0.030 | 6,658 | 59,755 | 66,414 |
| | 0.400 | 117,201 | 1,195,104 | 1,312,305 |
| | | Discounted Present Value of Costs = | | 902,207 |

# APPENDIX B
# LOW LEVEL WASTE COMPACTOR COST-BENEFIT ANALYSIS
# (*Potential* LLW THROUGHPUT)

TABLE B-1

I N P U T S  F O R

LLNL WASTE COMPACTOR COST-BENEFIT ANALYSIS

(potential throughput)

| | | | | |
|---|---|---|---|---|
| NTS Disposal Charge | 10 | $/ft^3 | | |
| Transportation, exclusive use | 2500 | $/load | | |
| Average compactible waste mass | 141000 | lb/yr | | |
| Average waste radiation level | 2 | millirem/hr | | |
| Value, 1 Man-rem of exposure | 1000 | $/Man-rem | | |
| Industry avg net waste density | 30 | lb/ft^3, 85,000 lbf machine | | |
| Industry avg net waste density | 40 | lb/ft^3, 100,000 lbf machine | | |
| Industry avg net waste density | 63 | lb/ft^3, 400,000 lbf machine | | |
| Baler avg. waste density | 41 | lb/ft^3 | | |
| Uncompacted avg. waste density | 15 | lb/ft^3 | | |
| Internal volume, 55 gal drum | 7.35 | ft^3 | | |
| Burial volume, 55 gal drum | 8 | ft^3 | | |
| Internal volume, 100K box | 90 | ft^3 | | |
| Burial volume, 100K box | 92 | ft^3 | | |
| Internal volume, 400K box | 89 | ft^3 | | |
| Burial volume, 400K box | 92 | ft^3 | | |
| Internal volume, CWC-96 box | 96 | ft^3 | | |
| Burial volume, CWC-96 box | 103 | ft^3 | | |
| Internal volume, CWC-118 box | 118 | ft^3 | | |
| Burial volume, CWC-118 box | 126 | ft^3 | | |
| Volume, paper box for baler | 13.38 | ft^3 | | |
| Cost per load empty B-25 boxes | 700 | $ | Other: | 0 $/load(CWC |
| Load weight limit | 45000 | lb | | box, drums) |
| No. of empty drums per load | 160 | | | |
| No. of full drums per load | 80 | | | |
| No. of empty 100K boxes/load | 28 | | | |
| No. of empty 400K boxes/load | 28 | | | |
| No. empty CWC-96 boxes/load | 24 | | | |
| No. of crushed drums/CWC-118 | 18 | for box compactor cases | | |
| No. of crushed drums/CWC-118 | 12 | for drum compactor cases | | |
| Gross weight, full 100K box | 4245 | lb | Empty: | 645 lb |
| Gross weight, full 400K box | 6707 | lb | Empty: | 1100 lb |
| Gross wt., full CWC-96 box | 3465 | lb | | |
| Weight, empty CWC-96 box | 633 | lb | | |
| Weight, empty 55 gal drum | 50 | lb | | |
| Cost/17C or 17H drum | 32 | $/drum | | |
| Cost of anti-springbacks/drum | 30 | $/drum | | |
| Cost/100K box&anti-springbacks | 500 | $/box | | |
| Cost/400K box&anti-springbacks | 975 | $/box | | |
| Cost/CWC boxes & sec clips | 824 | $/box | | |
| Cost of vermiculite filler | 3.25 | $/ft^3 | | |
| Density of vermiculite filler | 2.5 | lb/ft^3 | | |
| Sort,compact,log,survey,ship.. | 1.3 | Mhr/drum | | |
| Sort,compact,log,survey,ship.. | 3.5 | Mhr/100K box | | |
| Sort,compact,log,survey,ship.. | 4.33 | Mhr/400K box | | |
| Sort,compact,log,survey,ship.. | 12.8 | Mhr/CWC metal box | | |
| Load,log,survey...(no compact) | 2.0 | Mhr/CWC metal box | | |
| Labor, crushing full drums | 1.0 | Mhr/drum | | |
| Labor, prep for off-site srvc. | 0.5 | Mhr/drum | | |
| Labor, ship precompacted boxes | 0.75 | Mhr/box | | |
| Avg. technician wage (level 8) | 17.70 | $/hr | | |
| Payroll burden rate | 42.8% | | | |
| General overhead | 75.5% | | | |
| Avg. burdened technician wage | 44.36 | $/hr | | |

TABLE B-1: I N P U T S - potential throughput
(continued)

| | | |
|---|---|---|
| OJT instruction costs | 500 | $/yr |
| OJT graphics, materials | 500 | $/yr |
| Time for OJT (drum compactor) | 4 | hrs/person/yr |
| Time for OJT (other compactor) | 8 | hrs/person/yr |
| No. of technicians attending | 6 | |
| Maintenance time(drum compact) | 4 | hrs/month |
| Maintenance time(other compact | 8 | hrs/month |
| LLNL Cost of Capital | 8.70% | assume 30-yr T-Bond rate |
| Price of 85K drum compactor | $30,000 | |
| Extra 85k drum crushing head | $1,235 | LLNL already owns |
| Price of 100K box compactor | $179,000 | |
| Price of 400K box compactor | $342,000 | |
| Price of 100K baler compactor | $80,000 | |
| Other Up-Front Costs: | | |
| Regulatory activities | $8,000 | |
| Training | $3,000 | |
| Procedures/revisions | $14,000 | |
| Building modifications | $135,000 | ($67500 for simplified system) |
| System equipment - | | |
| airlocks/hoods(2) | $10,000 | ($5000 for simplified system) |
| container handling device | $18,000 | (not used for simplified system) |
| gloveboxes(2) | $12,000 | (not used for simplified system) |
| 15 ft. conveyor(enclosed) | $8,000 | (not used for simplified system) |
| hopper | $2,000 | (not used for simplified system) |
| Total of Other Up-Front Costs: | $210,000 | |
| Price for dry, solid LSA waste (Off-site compactor service) | 17.35 | $/ft^3 |

TABLE B-2
85,000 LBF DRUM COMPACTOR ANNUAL COSTS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| A. 85,000 lbf drum compactor | | |
| Yearly compacted waste volume | 4700 | ft^3/yr |
| No. of drums filled/year | 640 | |
| Burial volume/year | 5120 | ft^3/yr |
| Volume * disposal charge | 51200 | $/yr |
| Disposal charge/year-85000 lbf drum compactor - Material only | $51,200 | |
| II. TRANSPORTATION CHARGES | | |
| A. 85,000 lbf drum compactor | | |
| No. drums used per year | 640 | |
| No. loads of empties/year | 4 | |
| Cost, all loads incoming | 0 | $/yr |
| No. loads of full drums/year | 8 | |
| Cost, sole-use trucks, full | 20000 | $/yr |
| Total transportation/year - 85,000 lbf drum compactor | $20,000 | |
| III. CONTAINER COSTS | | |
| A. 85,000 lbf drum compactor | | |
| Cost/year, all drums | 20480 | $/yr |
| Cost/year, anti-springbacks | 19200 | $/yr |
| Total cost of drums/year - 85,000 lbf drum compactor | $39,680 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| A. 85,000 lbf drum compactor | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 1.3 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 36906 | $/yr |
| Total labor cost/year - 85,000 lbf drum compactor | $36,906 | |
| V. MANREM COSTS | | |
| A. 85,000 lbf drum compactor | | |
| Total manhrs/year | 832 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.66 | Man-REM/yr |
| Man-REM cost/year | 1664 | $/yr |
| Total Man-REM cost/year - 85,000 lbf drum compactor | $1,664 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| A. 85,000 lbf drum compactor | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE B-3
100,000 LBF BOX COMPACTOR ANNUAL COSTS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| B. 100,000 lbf box compactor | | |
| Yearly compacted waste volume | 3525 | ft^3/yr |
| No. of boxes filled/year | 40 | |
| Burial volume/year | 3680 | ft^3/yr |
| Volume * disposal charge | 36800 | $/yr |
| Disposal charge/year-100000 lb box compactor - Material only | $36,800 | |
| II. TRANSPORTATION CHARGES | | |
| B. 100,000 lbf box compactor | | |
| No. boxes used per year | 40 | |
| No. loads of empties/year | 1.5 | |
| Cost, all loads incoming | 1050 | $/yr |
| Load limit divided by wt./box | 10 | Max. boxes/load |
| No. loads of full boxes/year | 4 | |
| Cost, sole-use trucks, full | 10000 | $/yr |
| Total transportation/year - 100,000 lbf box compactor | $11,050 | |
| III. CONTAINER COSTS | | |
| B. 100,000 lbf box compactor | | |
| Cost/year, all boxes with anti-springbacks | 20000 | $/yr |
| Total cost of boxes/year - 100,000 lbf box compactor | $20,000 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| B. 100,000 lbf box compactor | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 3.5 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 6210 | $/yr |
| Total labor cost/year - 100,000 lbf box compactor | $6,210 | |
| V. MANREM COSTS | | |
| B. 100,000 lbf box compactor | | |
| Total manhrs/year | 140 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.28 | Man-REM/yr |
| Man-REM cost/year | 280 | $/yr |
| Total Man-REM cost/year - 100,000 lbf box compactor | $280 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| B. 100,000 lbf box compactor | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE B-4
400,000 LBF BOX COMPACTOR ANNUAL COSTS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| C. 400,000 lbf box compactor | | |
| Yearly compacted waste volume | 2238.1 | ft^3/yr |
| No. of boxes filled/year | 26 | |
| Burial volume/year | 2392 | ft^3/yr |
| Volume * disposal charge | 23920 | $/yr |
| Disposal charge/year-400000 lb box compactor - Material only | $23,920 | |
| II. TRANSPORTATION CHARGES | | |
| C. 400,000 lbf box compactor | | |
| No. boxes used per year | 26 | |
| No. loads of empties/year | 1 | |
| Cost, all loads incoming | 700 | $/yr |
| Load limit divided by wt./box | 6 | Max. boxes/load |
| No. loads of full boxes/year | 4.5 | |
| Cost, sole-use trucks, full | 11250 | $/yr |
| Total transportation/year - 400,000 lbf box compactor | $11,950 | |
| III. CONTAINER COSTS | | |
| C. 400,000 lbf box compactor | | |
| Cost/year, all boxes with anti-springbacks | 25350 | $/yr |
| Total cost of boxes/year - 400,000 lbf box compactor | $25,350 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| C. 400,000 lbf box compactor | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 4.33 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 4994 | $/yr |
| Total labor cost/year - 400,000 lbf box compactor | $4,994 | |
| V. MANREM COSTS | | |
| C. 400,000 lbf box compactor | | |
| Total manhrs/year | 112.58 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.23 | Man-REM/yr |
| Man-REM cost/year | 225 | $/yr |
| Total Man-REM cost/year - 400,000 lbf box compactor | $225 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| C. 400,000 lbf box compactor | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE B-5a: 100,000 LBF COMPACTOR-BALER ANNUAL COSTS (potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Waste mass for compaction | 109500 | lb |
| Compacted waste volume | 2670.7 | ft^3/yr |
| No. c bales produced | 200 | |
| No. containers @4 bales ea. | 50 | |
| No. of containers(whole no) | 50 | |
| Volume for uncompacted fill | 2100 | ft^3 |
| Mass of uncompacted fill | 31500 | lb |
| Total waste mass (check) | 141000 | lb |
| Burial volume/year | 5150 | ft^3/yr |
| Volume * disposal charge | 51500 | $/yr |
| Disposal charge/year-Compactor baler - Material only | $51,500 | |
| II. TRANSPORTATION CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| No. boxes used per year | 50 | |
| No. loads of empties/year | 2.5 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 13 | Max. boxes/load |
| No. loads of full boxes/year | 4 | |
| Cost, sole-use trucks, full | 10000 | $/yr |
| Total transportation/year - 100,000 lbf compactor baler | $10,000 | |
| III. CONTAINER COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Cost/year, all shipping containers | 41200 | $/yr |
| Total cost of containers/year- 100,000 lbf compactor baler | $41,200 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 12.8 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 28390 | $/yr |
| Total labor cost/year - 100,000 lbf compactor baler | $28,390 | |
| V. MANREM COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Total manhrs/year | 640 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.28 | Man-REM/yr |
| Man-REM cost/year | 1280 | $/yr |
| Total Man-REM cost/year - 100,000 lbf compactor baler | $1,280 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| D. 100,000 lbf compactor baler | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE B-5b : 100,000 LBF BALER W/OPTIMIZED CONTAINER ANNUAL COSTS (potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Waste mass for compaction | 140799 | lb |
| Compacted waste volume | 3434.1 | ft^3/yr |
| No. of bales produced | 257 | |
| No. containers @6 bales ea. | 42.8333333 | |
| No. of containers(whole no) | 43 | |
| Volume for uncompacted fill | 13.4 | ft^3 |
| Mass of uncompacted fill | 201 | lb |
| Total waste mass (check) | 141000 | lb |
| Burial volume/year | 4257 | ft^3/yr |
| Volume * disposal charge | 42570 | $/yr |
| Disposal charge/year-Compactor baler - Material only | $42,570 | |
| II. TRANSPORTATION CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| No. boxes used per year | 43 | |
| No. loads of empties/year | 2 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 12 | Max. boxes/load |
| No. loads of full boxes/year | 4 | |
| Cost, sole-use trucks, full | 10000 | $/yr |
| Total transportation/year - 100,000 lbf compactor baler | $10,000 | |
| III. CONTAINER COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Cost/year, all shipping containers | 37625 | $/yr |
| Total cost of containers/year- 100,000 lbf compactor baler | $37,625 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| D. 100,000 lbf compactor baler | | |
| Time to sort, size, compact, close, weigh, log, survey, label, QC, load, paperwork | 12.8 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 24415 | $/yr |
| Total labor cost/year - 100,000 lbf compactor baler | $24,415 | |
| V. MANREM COSTS | | |
| D. 100,000 lbf compactor baler | | |
| Total manhrs/year | 550.4 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.10 | Man-REM/yr |
| Man-REM cost/year | 1101 | $/yr |
| Total Man-REM cost/year - 100,000 lbf compactor baler | $1,101 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| D. 100,000 lbf compactor baler | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 2129 | $/yr |
| Total OJT Cost per year | $3,129 | $/yr |

TABLE B-6
ANNUAL COSTS WITH NO COMPACTION
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| E. No compaction | | |
| Yearly waste volume | 9400 | ft^3/yr |
| No. of containers filled/year | 98 | |
| Burial volume/year | 10094 | ft^3/yr |
| Volume * disposal charge | 100940 | $/yr |
| Disposal charge/year - | | |
| No Compaction - Material only | $100,940 | |
| II. TRANSPORTATION CHARGES | | |
| E. No compaction | | |
| No. boxes used per year | 98 | |
| No. loads of empties/year | 4.5 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 21 | Max. boxes/load |
| No. loads of full boxes/year | 5 | |
| Cost, sole-use trucks, full | 12500 | $/yr |
| Total transportation/year - | | |
| No compaction | $12,500 | |
| III. CONTAINER COSTS | | |
| E. No compaction | | |
| Cost/year, all shipping containers | 80752 | $/yr |
| Total cost of containers/year- | | |
| No compaction | $80,752 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| E. No compaction | | |
| Time to close, weigh, log, survey, label, QC, load, paperwork | 2 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 8694 | $/yr |
| Total labor cost/year - | | |
| No compaction | $8,694 | |
| V. MANREM COSTS | | |
| E. No compaction | | |
| Total manhrs/year | 196 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 0.39 | Man-REM/yr |
| Man-REM cost/year | 392 | $/yr |
| Total Man-REM cost/year - | | |
| No compaction | $392 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| E. No compaction | | |
| OJT instruction cost | 0 | $/yr |
| Labor for attendees | 0 | $/yr |
| Total OJT Cost per year | $0 | $/yr |

TABLE B-7
85,000 LBF DRUM COMPACTOR ANNUAL COSTS
FOR CRUSHING OF FULL DRUMS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| F. Crush full drums (85k lbf) | | |
| Yearly waste volume | 9400 | ft^3/yr |
| No. of drums filled/year | 1279 | |
| Burial volume(boxes)/year | 13482 | ft^3/yr |
| Volume * disposal charge | 134820 | $/yr |
| Disposal charge/year-85000 lbf drum crushing - Material only | $134,820 | |
| II. TRANSPORTATION CHARGES | | |
| F. Crush full drums (85k lbf) | | |
| No. drums used per year | 1279 | |
| No. loads of empties/year | 8 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 16 | Max. boxes/load |
| No. loads of full boxes/year | 7 | |
| Cost, sole-use trucks, full | 17500 | $/yr |
| Total transportation/year - 85,000 lbf drum crushing | $17,500 | |
| III. CONTAINER COSTS | | |
| F. Crush full drums (85k lbf) | | |
| Cost/year, all drums | 40928 | $/yr |
| Cost/year, CWC disposal boxes | 88168 | $/yr (No.=107) |
| Vermiculite filler, ft^3/year | 7510 | |
| Cost/year, vermiculite filler | 24408 | $/yr |
| Total container cost/year - | $153,504 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| F. Crush full drums (85k lbf) | | |
| Time to compact,weigh,log,survey,label, QC, load, paperwork | 1.0 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 56735 | $/yr |
| Total labor cost/year - 85,000 lbf drum crushing | $56,735 | |
| V. MANREM COSTS | | |
| F. Crush full drums (85k lbf) | | |
| Total manhrs/year | 1279 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 2.56 | Man-REM/yr |
| Man-REM cost/year | 2558 | $/yr |
| Total Man-REM cost/year - 85,000 lbf drum crushing | $2,558 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| F. Crush full drums (85k lbf) | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE B-8
100,000 LBF BOX COMPACTOR ANNUAL COSTS
FOR CRUSHING OF FULL DRUMS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| G. Crush full drums (100k lbf) | | |
| Yearly waste volume | 9400 | ft^3/yr |
| No. of drums filled/year | 1279 | |
| Burial volume(boxes)/year | 8946 | ft^3/yr |
| Volume * disposal charge | 89460 | $/yr |
| Disposal charge/year-100,000 lbf drum crushing - Material only | $89,460 | |
| II. TRANSPORTATION CHARGES | | |
| G. Crush full drums (100k lbf) | | |
| No. drums used per year | 1279 | |
| No. loads of empties/year | 8 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 12 | Max. boxes/load |
| No. loads of full boxes/year | 6 | |
| Cost, sole-use trucks, full | 15000 | $/yr |
| Total transportation/year - 100,000 lbf drum crushing | $15,000 | |
| III. CONTAINER COSTS | | |
| G. Crush full drums (100k lbf) | | |
| Cost/year, all drums | 40928 | $/yr |
| Cost/year, LWC disposal boxes | 58504 | $/yr (No.=71) |
| Vermiculite filler, ft^3/year | 4341 | |
| Cost/year, vermiculite filler | 14758 | $/yr |
| Total container cost/year - | $114,190 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| F. Crush full drums (100k lbf) | | |
| Time to compact,weigh,log,survey,label, QC, load, paperwork | 1.0 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 56735 | $/yr |
| Total labor cost/year - 100,000 lbf drum crushing | $56,735 | |
| V. MANREM COSTS | | |
| G. Crush full drums (100k lbf) | | |
| Total manhrs/year | 1279 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 2.56 | Man-REM/yr |
| Man-REM cost/year | 2558 | $/yr |
| Total Man-REM cost/year - 100,000 lbf drum crushing | $2,558 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| G. Crush full drums (100k lbf) | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE B-9
400,000 LBF BOX COMPACTOR ANNUAL COSTS
FOR CRUSHING OF FULL DRUMS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| H. Crush full drums (400k lbf) | | |
| Yearly waste volume | 9400 | ft^3/yr |
| No. of drums filled/year | 1279 | |
| Burial volume(boxes)/year | 8946 | ft^3/yr |
| Volume * disposal charge | 89460 | $/yr |
| Disposal charge/year-400,000 lbf drum crushing - Material only | $89,460 | |
| II. TRANSPORTATION CHARGES | | |
| H. Crush full drums (400k lbf) | | |
| No. drums used per year | 1279 | |
| No. loads of empties/year | 8 | |
| Cost, all loads incoming | 0 | $/yr |
| Load limit divided by wt./box | 12 | Max. boxes/load |
| No. loads of full boxes/year | 6 | |
| Cost, sole-use trucks, full | 15000 | $/yr |
| Total transportation/year - 400,000 lbf drum crushing | $15,000 | |
| III. CONTAINER COSTS | | |
| H. Crush full drums (400k lbf) | | |
| Cost/year, all drums | 40928 | $/yr |
| Cost/year, CWC disposal boxes | 58504 | $/yr (No.=71) |
| Vermiculite filler, ft^3/year | 5942 | |
| Cost/year, vermiculite filler | 19311 | $/yr |
| Total container cost/year - | $118,743 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| F. Crush full drums (400k lbf) | | |
| Time to compact,weigh,log,survey,label, QC, load, paperwork | 1.0 | Manhr/drum |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 56735 | $/yr |
| Total labor cost/year - 400,000 lbf drum crushing | $56,735 | |
| V. MANREM COSTS | | |
| H. Crush full drums (400k lbf) | | |
| Total manhrs/year | 1279 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 2.56 | Man-REM/yr |
| Man-REM cost/year | 2558 | $/yr |
| Total Man-REM cost/year - 400,000 lbf drum crushing | $2,558 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| H. Crush full drums (400k lbf) | | |
| OJT instruction cost | 1000 | $/yr |
| Labor for attendees | 1065 | $/yr |
| Total OJT Cost per year | $2,065 | $/yr |

TABLE B-10

OFF-SITE COMPACTOR SERVICE ANNUAL COSTS
(potential throughput)

| | | |
|---|---|---|
| I. DISPOSAL VOLUME CHARGES | | |
| J. Off-site compactor service | | |
| Yearly waste volume | 9400 | ft^3/yr |
| No. of drums filled/year | 1279 | |
| Burial volume/year | 10232 | ft^3/yr |
| Volume * disposal charge | 177525.2 | $/yr |
| Disposal charge/year, Off-site compaction - Material only | $177,525 | |
| II. TRANSPORTATION CHARGES | | |
| J. Off-site compactor service | | |
| No. drums used per year | 1279 | |
| No. loads of empties/year | 8 | |
| Cost, all loads incoming | 0 | $/yr |
| No. loads of full drums/year | 16 | |
| Cost (incl in disposal charge) | 0 | $/yr |
| Load limit/wt.of full 400K box | 6 | Max. boxes/load |
| No. loads of full boxes/year | 4.5 | (26 boxes) |
| Cost, sole-use trucks, full | 11250 | $/yr |
| Total transportation/year - Off-site compaction service | $11,250 | |
| III. CONTAINER COSTS | | |
| J. Off-site compactor service | | |
| Cost/year, all drums | 40928 | $/yr |
| Cost/year, anti-springbacks | 0 | $/yr |
| Total cost of drums/year - Off-site compaction service | $40,928 | |
| IV. LABOR AND SUPPORT CHARGES | | |
| J. Off-site compactor service | | |
| Time to close, weigh, log,survey,label, QC, load, paperwork | 0.5 | Manhr/drum |
| Time to unload, log, survey, label, QC, load, paperwork | 0.75 | Manhr/box |
| Average technician wage | 44.36 | $/hr |
| Labor cost/year | 29232 | $/yr |
| Total labor cost/year - Off-site compaction service | $29,232 | |
| V. MANREM COSTS | | |
| J. Off-site compactor service | | |
| Total manhrs/year | 639.5 | Man-hrs/yr |
| Average area radiation level | 0.002 | REM/hr |
| Total exposure/year | 1.28 | Man-REM/yr |
| Man-REM cost/year | 1279 | $/yr |
| Total Man-REM cost/year - Off-site compaction service | $1,279 | |
| VI. ON-THE-JOB TRAINING COSTS | | |
| J. Off-site compactor service | | |
| OJT instruction cost | 0 | $/yr |
| Labor for attendees | 0 | $/yr |
| Total OJT Cost per year | $0 | $/yr |

TABLE B-11

SUMMARY OF ANNUAL COSTS FOR DISPOSAL OF COMPACTIBLE LOW LEVEL WASTE

POTENTIAL THROUGHPUT

(excluding maintenance and repair)

| | 85K Drum | 100K Box | 400K Box | 100K Baler | No Compact |
|---|---|---|---|---|---|
| Disposal | 51,200 | 36,800 | 23,920 | 51,500 | 100,940 |
| Transportation | 20,000 | 11,050 | 11,950 | 10,000 | 12,500 |
| Containers | 39,680 | 20,000 | 25,350 | 41,200 | 80,752 |
| Labor | 36,906 | 6,210 | 4,994 | 28,390 | 8,694 |
| Man-REM | 1,664 | 280 | 225 | 1,280 | 392 |
| Training | 2,065 | 3,129 | 3,129 | 3,129 | 0 |
| Total per year | $151,515 | $77,469 | $69,568 | $135,499 | $203,278 |

| | DRUM CRUSHING | | | 100K Baler, Compactor | |
|---|---|---|---|---|---|
| | 85K Drum | 100K Box | 400K Box | larger cont. | Service |
| Disposal | 134,820 | 89,460 | 89,460 | 42,570 | 177,525 |
| Transportation | 17,500 | 15,000 | 15,000 | 10,000 | 11,250 |
| Containers | 153,504 | 114,190 | 118,743 | 37,625 | 40,928 |
| Labor | 56,735 | 56,735 | 56,735 | 24,415 | 29,232 |
| Man-REM | 2,558 | 2,558 | 2,558 | 1,101 | 1,279 |
| Training | 2,065 | 2,065 | 2,065 | 3,129 | 0 |
| Total per year | $367,181 | $280,008 | $284,561 | $118,840 | $260,214 |

TABLE B-12 : 85,000 LBF DRUM COMPACTOR DPV CALCULATION (potential throughput)

| | | 85K Drum Compactor Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 240,000 | 240,000 |
| 1 | 0.030 | 3,029 | 151,515 | 154,545 |
| 2 | 0.023 | 2,819 | 151,515 | 154,335 |
| 3 | 0.018 | 2,681 | 151,515 | 154,197 |
| 4 | 0.018 | 2,681 | 151,515 | 154,197 |
| 5 | 0.018 | 2,681 | 151,515 | 154,197 |
| 6 | 0.018 | 2,681 | 151,515 | 154,197 |
| 7 | 0.018 | 2,681 | 151,515 | 154,197 |
| 8 | 0.018 | 2,681 | 151,515 | 154,197 |
| 9 | 0.018 | 2,681 | 151,515 | 154,197 |
| 10 | 0.018 | 2,681 | 151,515 | 154,197 |
| 11 | 0.018 | 2,681 | 151,515 | 154,197 |
| 12 | 0.018 | 2,681 | 151,515 | 154,197 |
| 13 | 0.018 | 2,681 | 151,515 | 154,197 |
| 14 | 0.018 | 2,681 | 151,515 | 154,197 |
| 15 | 0.018 | 2,681 | 151,515 | 154,197 |
| 16 | 0.018 | 2,681 | 151,515 | 154,197 |
| 17 | 0.018 | 2,681 | 151,515 | 154,197 |
| 18 | 0.018 | 2,681 | 151,515 | 154,197 |
| 19 | 0.023 | 2,819 | 151,515 | 154,335 |
| 20 | 0.030 | 3,029 | 151,515 | 154,545 |
| | 0.400 | 54,596 | 3,270,308 | 3,324,905 |
| | | Discounted Present Value of Costs = | | 1,678,738 |

TABLE B-13 : 85,000 LBF DRUM COMPACTOR (IN STORAGE) DPV CALCULATION (potential througnput)

| | | 85K Drum Compactor (Procured and In Storage) Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 210,000 | 210,000 |
| 1 | 0.030 | 3,029 | 151,515 | 154,545 |
| 2 | 0.023 | 2,819 | 151,515 | 154,335 |
| 3 | 0.018 | 2,681 | 151,515 | 154,197 |
| 4 | 0.018 | 2,681 | 151,515 | 154,197 |
| 5 | 0.018 | 2,681 | 151,515 | 154,197 |
| 6 | 0.018 | 2,681 | 151,515 | 154,197 |
| 7 | 0.018 | 2,681 | 151,515 | 154,197 |
| 8 | 0.018 | 2,681 | 151,515 | 154,197 |
| 9 | 0.018 | 2,681 | 151,515 | 154,197 |
| 10 | 0.018 | 2,681 | 151,515 | 154,197 |
| 11 | 0.018 | 2,681 | 151,515 | 154,197 |
| 12 | 0.018 | 2,681 | 151,515 | 154,197 |
| 13 | 0.018 | 2,681 | 151,515 | 154,197 |
| 14 | 0.018 | 2,681 | 151,515 | 154,197 |
| 15 | 0.018 | 2,681 | 151,515 | 154,197 |
| 16 | 0.018 | 2,681 | 151,515 | 154,197 |
| 17 | 0.018 | 2,681 | 151,515 | 154,197 |
| 18 | 0.018 | 2,681 | 151,515 | 154,197 |
| 19 | 0.023 | 2,819 | 151,515 | 154,335 |
| 20 | 0.030 | 3,029 | 151,515 | 154,545 |
| | 0.400 | 54,596 | 3,240,308 | 3,294,905 |
| | | Discounted Present Value of Costs = | | 1,648,738 |

TABLE B-14 : 100,000 LBF BOX COMPACTOR DPV CALCULATION (potential throughput)

| | | 100K Box Compactor Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 389,000 | 389,000 |
| 1 | 0.030 | 9,628 | 77,469 | 87,098 |
| 2 | 0.023 | 8,375 | 77,469 | 85,845 |
| 3 | 0.018 | 7,552 | 77,469 | 85,021 |
| 4 | 0.018 | 7,552 | 77,469 | 85,021 |
| 5 | 0.018 | 7,552 | 77,469 | 85,021 |
| 6 | 0.018 | 7,552 | 77,469 | 85,021 |
| 7 | 0.018 | 7,552 | 77,469 | 85,021 |
| 8 | 0.018 | 7,552 | 77,469 | 85,021 |
| 9 | 0.018 | 7,552 | 77,469 | 85,021 |
| 10 | 0.018 | 7,552 | 77,469 | 85,021 |
| 11 | 0.018 | 7,552 | 77,469 | 85,021 |
| 12 | 0.018 | 7,552 | 77,469 | 85,021 |
| 13 | 0.018 | 7,552 | 77,469 | 85,021 |
| 14 | 0.018 | 7,552 | 77,469 | 85,021 |
| 15 | 0.018 | 7,552 | 77,469 | 85,021 |
| 16 | 0.018 | 7,552 | 77,469 | 85,021 |
| 17 | 0.018 | 7,552 | 77,469 | 85,021 |
| 18 | 0.018 | 7,552 | 77,469 | 85,021 |
| 19 | 0.023 | 8,375 | 77,469 | 85,845 |
| 20 | 0.030 | 9,628 | 77,469 | 87,098 |
| | 0.400 | 156,840 | 1,938,384 | 2,095,225 |
| | | Discounted Present Value of Costs = | | 1,185,169 |

TABLE B-15 : 400,000 LBF BOX COMPACTOR DPV CALCULATION (potential throughput)

| | | 400K Box Compactor Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 552,000 | 552,000 |
| 1 | 0.030 | 14,518 | 69,568 | 84,086 |
| 2 | 0.023 | 12,124 | 69,568 | 81,692 |
| 3 | 0.018 | 10,551 | 69,568 | 80,119 |
| 4 | 0.018 | 10,551 | 69,568 | 80,119 |
| 5 | 0.018 | 10,551 | 69,568 | 80,119 |
| 6 | 0.018 | 10,551 | 69,568 | 80,119 |
| 7 | 0.018 | 10,551 | 69,568 | 80,119 |
| 8 | 0.018 | 10,551 | 69,568 | 80,119 |
| 9 | 0.018 | 10,551 | 69,568 | 80,119 |
| 10 | 0.018 | 10,551 | 69,568 | 80,119 |
| 11 | 0.018 | 10,551 | 69,568 | 80,119 |
| 12 | 0.018 | 10,551 | 69,568 | 80,119 |
| 13 | 0.018 | 10,551 | 69,568 | 80,119 |
| 14 | 0.018 | 10,551 | 69,568 | 80,119 |
| 15 | 0.018 | 10,551 | 69,568 | 80,119 |
| 16 | 0.018 | 10,551 | 69,568 | 80,119 |
| 17 | 0.018 | 10,551 | 69,568 | 80,119 |
| 18 | 0.018 | 10,551 | 69,568 | 80,119 |
| 19 | 0.023 | 12,124 | 69,568 | 81,692 |
| 20 | 0.030 | 14,518 | 69,568 | 84,086 |
| | 0.400 | 222,105 | 1,943,361 | 2,165,467 |
| | | Discounted Present Value of Costs = | | 1,305,332 |

TABLE B-16 : DPV CALCULATION FOR DISPOSAL WITH NO COMPACTION (potential throughput)

| Year | Repair Frac. | Annual Costs for No Compaction: Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 0 | 0 |
| 1 | 0.030 | 0 | 203,278 | 203,278 |
| 2 | 0.023 | 0 | 203,278 | 203,278 |
| 3 | 0.018 | 0 | 203,278 | 203,278 |
| 4 | 0.018 | 0 | 203,278 | 203,278 |
| 5 | 0.018 | 0 | 203,278 | 203,278 |
| 6 | 0.018 | 0 | 203,278 | 203,278 |
| 7 | 0.018 | 0 | 203,278 | 203,278 |
| 8 | 0.018 | 0 | 203,278 | 203,278 |
| 9 | 0.018 | 0 | 203,278 | 203,278 |
| 10 | 0.018 | 0 | 203,278 | 203,278 |
| 11 | 0.018 | 0 | 203,278 | 203,278 |
| 12 | 0.018 | 0 | 203,278 | 203,278 |
| 13 | 0.018 | 0 | 203,278 | 203,278 |
| 14 | 0.018 | 0 | 203,278 | 203,278 |
| 15 | 0.018 | 0 | 203,278 | 203,278 |
| 16 | 0.018 | 0 | 203,278 | 203,278 |
| 17 | 0.018 | 0 | 203,278 | 203,278 |
| 18 | 0.018 | 0 | 203,278 | 203,278 |
| 19 | 0.023 | 0 | 203,278 | 203,278 |
| 20 | 0.030 | 0 | 203,278 | 203,278 |
| | 0.400 | 0 | 4,065,566 | 4,065,566 |
| | | Discounted Present Value of Costs = | | 1,895,997 |

TABLE B-17 : OFF-SITE COMPACTION SERVICE DPV CALCULATION (potential throughput)

| Year | Repair Frac. | Annual Costs for Off-site Compaction Service: Maint. & Repair | Operations | Total |
|---|---|---|---|---|
| 0 | | | 0 | 0 |
| 1 | 0.030 | 0 | 260,214 | 260,214 |
| 2 | 0.023 | 0 | 260,214 | 260,214 |
| 3 | 0.018 | 0 | 260,214 | 260,214 |
| 4 | 0.018 | 0 | 260,214 | 260,214 |
| 5 | 0.018 | 0 | 260,214 | 260,214 |
| 6 | 0.018 | 0 | 260,214 | 260,214 |
| 7 | 0.018 | 0 | 260,214 | 260,214 |
| 8 | 0.018 | 0 | 260,214 | 260,214 |
| 9 | 0.018 | 0 | 260,214 | 260,214 |
| 10 | 0.018 | 0 | 260,214 | 260,214 |
| 11 | 0.018 | 0 | 260,214 | 260,214 |
| 12 | 0.018 | 0 | 260,214 | 260,214 |
| 13 | 0.018 | 0 | 260,214 | 260,214 |
| 14 | 0.018 | 0 | 260,214 | 260,214 |
| 15 | 0.018 | 0 | 260,214 | 260,214 |
| 16 | 0.018 | 0 | 260,214 | 260,214 |
| 17 | 0.018 | 0 | 260,214 | 260,214 |
| 18 | 0.018 | 0 | 260,214 | 260,214 |
| 19 | 0.023 | 0 | 260,214 | 260,214 |
| 20 | 0.030 | 0 | 260,214 | 260,214 |
| | 0.400 | 0 | 5,204,287 | 5,204,287 |
| | | Discounted Present Value of Costs = | | 2,427,045 |

TABLE B-18 : 85,000 LBF DRUM COMPACTOR DPV CALCULATION- CRUSHING OF FULL DRUMS (potential throughput)

| | | 85K Drum Compactor Annual Costs (Crushing of Full Drums) | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 127,500 | 127,500 |
| 1 | 0.030 | 3,029 | 367,181 | 370,210 |
| 2 | 0.023 | 2,819 | 367,181 | 370,000 |
| 3 | 0.018 | 2,681 | 367,181 | 369,862 |
| 4 | 0.018 | 2,681 | 367,181 | 369,862 |
| 5 | 0.018 | 2,681 | 367,181 | 369,862 |
| 6 | 0.018 | 2,681 | 367,181 | 369,862 |
| 7 | 0.018 | 2,681 | 367,181 | 369,862 |
| 8 | 0.018 | 2,681 | 367,181 | 369,862 |
| 9 | 0.018 | 2,681 | 367,181 | 369,862 |
| 10 | 0.018 | 2,681 | 367,181 | 369,862 |
| 11 | 0.018 | 2,681 | 367,181 | 369,862 |
| 12 | 0.018 | 2,681 | 367,181 | 369,862 |
| 13 | 0.018 | 2,681 | 367,181 | 369,862 |
| 14 | 0.018 | 2,681 | 367,181 | 369,862 |
| 15 | 0.018 | 2,681 | 367,181 | 369,862 |
| 16 | 0.018 | 2,681 | 367,181 | 369,862 |
| 17 | 0.018 | 2,681 | 367,181 | 369,862 |
| 18 | 0.018 | 2,681 | 367,181 | 369,862 |
| 19 | 0.023 | 2,819 | 367,181 | 370,000 |
| 20 | 0.030 | 3,029 | 367,181 | 370,210 |
| | 0.400 | 54,596 | 7,471,125 | 7,525,721 |
| | | Discounted Present Value of Costs = | | 3,577,774 |

TABLE B-19 : 85,000 LBF DRUM COMPACTOR (IN STORAGE) DPV CALCULATION - CRUSHING OF FULL DRUMS (potential throughput)

| | | 85K Drum Compactor (In Storage) Annual Cost (Crush Full Drums) | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 97,500 | 97,500 |
| 1 | 0.030 | 3,029 | 367,181 | 370,210 |
| 2 | 0.023 | 2,819 | 367,181 | 370,000 |
| 3 | 0.018 | 2,681 | 367,181 | 369,862 |
| 4 | 0.018 | 2,681 | 367,181 | 369,862 |
| 5 | 0.018 | 2,681 | 367,181 | 369,862 |
| 6 | 0.018 | 2,681 | 367,181 | 369,862 |
| 7 | 0.018 | 2,681 | 367,181 | 369,862 |
| 8 | 0.018 | 2,681 | 367,181 | 369,862 |
| 9 | 0.018 | 2,681 | 367,181 | 369,862 |
| 10 | 0.018 | 2,681 | 367,181 | 369,862 |
| 11 | 0.018 | 2,681 | 367,181 | 369,862 |
| 12 | 0.018 | 2,681 | 367,181 | 369,862 |
| 13 | 0.018 | 2,681 | 367,181 | 369,862 |
| 14 | 0.018 | 2,681 | 367,181 | 369,862 |
| 15 | 0.018 | 2,681 | 367,181 | 369,862 |
| 16 | 0.018 | 2,681 | 367,181 | 369,862 |
| 17 | 0.018 | 2,681 | 367,181 | 369,862 |
| 18 | 0.018 | 2,681 | 367,181 | 369,862 |
| 19 | 0.023 | 2,819 | 367,181 | 370,000 |
| 20 | 0.030 | 3,029 | 367,181 | 370,210 |
| | 0.400 | 54,596 | 7,441,125 | 7,495,721 |
| | | Discounted Present Value of Costs = | | 3,547,774 |

TABLE B-20 : 100,000 LBF BOX COMPACTOR DPV CALCULATION- CRUSHING OF FULL DRUMS (potential throughput)

| | | 100K Box Compactor Annual Costs (Crushing of Full Drums) | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 276,500 | 276,500 |
| 1 | 0.030 | 9,628 | 280,008 | 289,636 |
| 2 | 0.023 | 8,375 | 280,008 | 288,383 |
| 3 | 0.018 | 7,552 | 280,008 | 287,560 |
| 4 | 0.018 | 7,552 | 280,008 | 287,560 |
| 5 | 0.018 | 7,552 | 280,008 | 287,560 |
| 6 | 0.018 | 7,552 | 280,008 | 287,560 |
| 7 | 0.018 | 7,552 | 280,008 | 287,560 |
| 8 | 0.018 | 7,552 | 280,008 | 287,560 |
| 9 | 0.018 | 7,552 | 280,008 | 287,560 |
| 10 | 0.018 | 7,552 | 280,008 | 287,560 |
| 11 | 0.018 | 7,552 | 280,008 | 287,560 |
| 12 | 0.018 | 7,552 | 280,008 | 287,560 |
| 13 | 0.018 | 7,552 | 280,008 | 287,560 |
| 14 | 0.018 | 7,552 | 280,008 | 287,560 |
| 15 | 0.018 | 7,552 | 280,008 | 287,560 |
| 16 | 0.018 | 7,552 | 280,008 | 287,560 |
| 17 | 0.018 | 7,552 | 280,008 | 287,560 |
| 18 | 0.018 | 7,552 | 280,008 | 287,560 |
| 19 | 0.023 | 8,375 | 280,008 | 288,383 |
| 20 | 0.030 | 9,628 | 280,008 | 289,636 |
| | 0.400 | 156,840 | 5,876,660 | 6,033,500 |
| | | Discounted Present Value of Costs = | | 2,961,768 |

TABLE B-21 : 400,000 LBF BOX COMPACTOR DPV CALCULATION - CRUSHING OF FULL DRUMS (potential throughput)

| | | 400K Box Compactor Annual Costs (Crushing of Full Drums) | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 439,500 | 439,500 |
| 1 | 0.030 | 14,518 | 284,561 | 299,079 |
| 2 | 0.023 | 12,124 | 284,561 | 296,685 |
| 3 | 0.018 | 10,551 | 284,561 | 295,112 |
| 4 | 0.018 | 10,551 | 284,561 | 295,112 |
| 5 | 0.018 | 10,551 | 284,561 | 295,112 |
| 6 | 0.018 | 10,551 | 284,561 | 295,112 |
| 7 | 0.018 | 10,551 | 284,561 | 295,112 |
| 8 | 0.018 | 10,551 | 284,561 | 295,112 |
| 9 | 0.018 | 10,551 | 284,561 | 295,112 |
| 10 | 0.018 | 10,551 | 284,561 | 295,112 |
| 11 | 0.018 | 10,551 | 284,561 | 295,112 |
| 12 | 0.018 | 10,551 | 284,561 | 295,112 |
| 13 | 0.018 | 10,551 | 284,561 | 295,112 |
| 14 | 0.018 | 10,551 | 284,561 | 295,112 |
| 15 | 0.018 | 10,551 | 284,561 | 295,112 |
| 16 | 0.018 | 10,551 | 284,561 | 295,112 |
| 17 | 0.018 | 10,551 | 284,561 | 295,112 |
| 18 | 0.018 | 10,551 | 284,561 | 295,112 |
| 19 | 0.023 | 12,124 | 284,561 | 296,685 |
| 20 | 0.030 | 14,518 | 284,561 | 299,079 |
| | 0.400 | 222,105 | 6,130,713 | 6,352,818 |
| | | Discounted Present Value of Costs = | | 3,198,089 |

TABLE B-22 : 100,000 LBF COMPACTOR-BALER DPV CALCULATION - EXISTING MACHINE (potential throughput)

| | | 100K Baler Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | | |
| 1 | 0.018 | 5,730 | 135,499 | 141,229 |
| 2 | 0.018 | 5,730 | 135,499 | 141,229 |
| 3 | 0.018 | 5,730 | 135,499 | 141,229 |
| 4 | 0.023 | 6,098 | 135,499 | 141,597 |
| 5 | 0.030 | 6,658 | 135,499 | 142,157 |
| 6 | 0.030 | 6,658 | 135,499 | 142,157 |
| 7 | 0.030 | 6,658 | 135,499 | 142,157 |
| 8 | 0.030 | 6,658 | 135,499 | 142,157 |
| 9 | 0.030 | 6,658 | 135,499 | 142,157 |
| 10 | 0.030 | 6,658 | 135,499 | 142,157 |
| 11 | 0.030 | 6,658 | 135,499 | 142,157 |
| 12 | 0.030 | 6,658 | 135,499 | 142,157 |
| 13 | 0.030 | 6,658 | 135,499 | 142,157 |
| 14 | 0.030 | 6,658 | 135,499 | 142,157 |
| 15 | 0.030 | 6,658 | 135,499 | 142,157 |
| 16 | 0.030 | 6,658 | 135,499 | 142,157 |
| 17 | 0.030 | 6,658 | 135,499 | 142,157 |
| 18 | 0.030 | 6,658 | 135,499 | 142,157 |
| 19 | 0.030 | 6,658 | 135,499 | 142,157 |
| 20 | 0.030 | 6,658 | 135,499 | 142,157 |
| | 0.558 | 129,825 | 2,709,971 | 2,839,796 |
| | | Discounted Present Value of Costs= | | 1,323,149 |

TABLE B-23 : 100,000 LBF COMPACTOR-BALER DPV CALCULATION - EXISTING MACHINE, OPTIMIZED SHIPPING CONTAINERS (potential throughput)

| | | 100K Baler Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | | |
| 1 | 0.018 | 5,730 | 118,840 | 124,570 |
| 2 | 0.018 | 5,730 | 118,840 | 124,570 |
| 3 | 0.018 | 5,730 | 118,840 | 124,570 |
| 4 | 0.023 | 6,098 | 118,840 | 124,938 |
| 5 | 0.030 | 6,658 | 118,840 | 125,498 |
| 6 | 0.030 | 6,658 | 118,840 | 125,498 |
| 7 | 0.030 | 6,658 | 118,840 | 125,498 |
| 8 | 0.030 | 6,658 | 118,840 | 125,498 |
| 9 | 0.030 | 6,658 | 118,840 | 125,498 |
| 10 | 0.030 | 6,658 | 118,840 | 125,498 |
| 11 | 0.030 | 6,658 | 118,840 | 125,498 |
| 12 | 0.030 | 6,658 | 118,840 | 125,498 |
| 13 | 0.030 | 6,658 | 118,840 | 125,498 |
| 14 | 0.030 | 6,658 | 118,840 | 125,498 |
| 15 | 0.030 | 6,658 | 118,840 | 125,498 |
| 16 | 0.030 | 6,658 | 118,840 | 125,498 |
| 17 | 0.030 | 6,658 | 118,840 | 125,498 |
| 18 | 0.030 | 6,658 | 118,840 | 125,498 |
| 19 | 0.030 | 6,658 | 118,840 | 125,498 |
| 20 | 0.030 | 6,658 | 118,840 | 125,498 |
| | 0.558 | 129,825 | 2,376,796 | 2,506,621 |
| | | Discounted Present Value of Costs = | | 1,167,772 |

TABLE B-24 : 100,000 LBF COMPACTOR-BALER DPV CALCULATI NEW SYSTEM, OPTIMIZED SHIPPING CONTAINERS (potential throughput)

| | | 100K Baler Annual Costs | | |
|---|---|---|---|---|
| Year | Repair Frac. | Maint. & Repair | Operations | Total |
| 0 | | | 290,000 | 290,000 |
| 1 | 0.030 | 6,658 | 118,840 | 125,498 |
| 2 | 0.023 | 6,098 | 118,840 | 124,938 |
| 3 | 0.018 | 5,730 | 118,840 | 124,570 |
| 4 | 0.018 | 5,730 | 118,840 | 124,570 |
| 5 | 0.018 | 5,730 | 118,840 | 124,570 |
| 6 | 0.018 | 5,730 | 118,840 | 124,570 |
| 7 | 0.018 | 5,730 | 118,840 | 124,570 |
| 8 | 0.018 | 5,730 | 118,840 | 124,570 |
| 9 | 0.018 | 5,730 | 118,840 | 124,570 |
| 10 | 0.018 | 5,730 | 118,840 | 124,570 |
| 11 | 0.018 | 5,730 | 118,840 | 124,570 |
| 12 | 0.018 | 5,730 | 118,840 | 124,570 |
| 13 | 0.018 | 5,730 | 118,840 | 124,570 |
| 14 | 0.018 | 5,730 | 118,840 | 124,570 |
| 15 | 0.018 | 5,730 | 118,840 | 124,570 |
| 16 | 0.018 | 5,730 | 118,840 | 124,570 |
| 17 | 0.018 | 5,730 | 118,840 | 124,570 |
| 18 | 0.018 | 5,730 | 118,840 | 124,570 |
| 19 | 0.023 | 6,098 | 118,840 | 124,938 |
| 20 | 0.030 | 6,658 | 118,840 | 125,498 |
| | 0.400 | 117,201 | 2,376,796 | 2,493,997 |
| | | Discounted Present Value of Costs = | | 1,453,295 |

# END

# DATE FILMED

01/29/91