ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE PACKAGING AND TRANSPORTATION ALTERNATIVES FOR LOW LEVEL AND LOW LEVEL MIXED WASTE

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ABSTRACT

In order to reduce costs and achieve schedules for closure of the Rocky Flats Environmental Technology Site (RFETS), an analysis was conducted on the use of alternative packaging and transportation methods for the disposal of RFETS low level waste (LLW).

The Site uses 55-gallon drums, plywood boxes, and metal boxes to package, ship, and dispose of LLW in accordance with Department Of Transportation (DOT) regulations for packaging radioactive waste based on activity limits. These packagings were generally sufficient to meet site needs during production. However, with the change in the Site mission from weapons production to Site closure, this is no longer the case. The Site needs to be using packagings that are more efficient where possible. Recently, the Site has begun to use cargo containers to package Decontamination & Decommissioning (D&D) waste. The primary advantage of the cargo containers is that the need to size–reduce waste items is, in many cases, eliminated. Additionally, supersacks and burrito wraps are used on Site for Environmental Restoration program soils and sludge. The primary advantage of the supersacks and burrito wraps is their relatively low cost.

Waste Guidance Inventory, and Shipping Forecasts, indicate that nearly 200,000m^3 of LLW will be shipped off site between FY2000 and FY2006. Recent efforts to replace the projected 55-gallon drums, metal crates, and plywood boxes with cargo containers have resulted in large (>$10M) savings. Further savings (> $10M) have resulted from the use of once-used cargo containers instead of new containers. This was the subject of a RFETS paper presented at WM'00.

This paper presents an analysis of further cost savings of $10 million, which could be realized by implementing a combination of the reusable (i.e., multi-trip) intermodal containers, bulk packagings, and limited rail transportation alternatives. The cost/benefit analysis includes the cost of packaging materials, transportation, and disposal. Most of the cost savings would be associated with decreased packaging costs. The Site may experience increased labor costs associated with integration of this strategy into the Site infrastructure (e.g., engineering support, building modifications, procedure preparation/revision, Integrated Work Control Procedure (IWCP) compliance, etc.) as well as additional costs associated with packaging, surveying, and inspecting the waste, and inspecting/repairing the returned packagings. The analysis includes these increased labor costs.

A transition period of considerable length is required prior to full implementation of this strategy because several key issues require resolution prior to implementation. These issues include, payload constraints associated with the weight of Industrial Package Type II (IP-2) or Type A cargo containers; the durability of soft-sided liners/inner containers, shrink wrap and fixative; the development of hazard and radiation survey methods for returned packagings; the inspection and repair of returned packagings; and the availability of storage space for the onsite staging of up to 60 multi-trip cargo containers. Additionally, each building/project would have issues requiring the customization of a packaging strategy to meet project specific needs.

INTRODUCTION

The purpose of this paper is to provide an analysis of the costs/benefits and feasibility of using alternative packaging and transportation methods at RFETS for the disposal of LLW while meeting the Site closure schedule. There are many options for alternative packaging, and each building and/or project may require different options and/or combinations of options. This paper outlines a possible strategy for resolving Site logistical issues that would prevent the use of these packagings. It will demonstrate that alternative packaging and transportation can be cost effective.

In order to reduce costs and achieve schedules for closure of RFETS, an analysis was conducted on the use of alternative packaging and transportation methods for the disposal of RFETS low level waste LLW.

It appears most sites within the Department of Energy (DOE) complex purchase new containers for packaging and shipping LLW to the Nevada Test Site (NTS) or another commercial low level waste disposal facility. Until recently, the Site adhered to this practice. However, in the Spring of 1999 when waste packaging demand was high, low production output from the vendors and quality control problems began to adversely affect performance of waste generating projects. Projects most impacted where those involving D&D, which generate large volumes of LLW from equipment stripout and demolition activities.

In order to meet the challenge of procuring sufficient waste packagings for the site, the Customer Service Organization (CSO), which is responsible for the procurement of waste commodities, investigated alternative packaging types that could be utilized at RFETS. Research on the subject indicated that Lawrence Livermore National Laboratory (LLNL) and the Mound Plant had used refurbished cargo containers to ship LLW to the NTS. Upon review of DOT regulations, it became apparent that it was unnecessary to utilize new or even refurbished cargo containers to ship most types of LLW, i.e., a used cargo container meeting the requirements of a DOT strong, tight packaging (exclusive use shipment) would be adequate.

The Site uses 55-gallon drums, plywood boxes, and metal boxes to package, ship, and dispose of LLW in accordance with DOT regulations for packaging radioactive waste based on activity limits. These packagings were generally sufficient to meet site needs during production. However, with the change in the Site mission from weapons production to Site closure, this is no longer the case. The Site needs to be using packagings that are more efficient where possible. Recently, the Site has begun to use cargo containers to package D&D waste. The primary advantage of the cargo containers is that the need to size-reduce waste items is, in many cases, eliminated. Additionally, supersacks and burrito wraps are used on Site for Environmental Restoration program soils and sludge. The primary advantage of the supersacks and burrito wraps is their relatively low cost.

Waste Guidance Inventory, and Shipping Forecasts, indicate that nearly 200,000m^3 of LLW will be shipped off site between FY2000 and FY2006. Recent efforts to replace the projected 55-gallon drums, metal crates, and plywood boxes with cargo containers have resulted in large (>$10M) savings. Further savings (> $10M) have resulted from the use of once-used cargo containers instead of new containers. This was the subject of a RFETS paper presented at WM'00.

OVERVIEW

The CSO of RFETS, amongst other responsibilities, controls the forecasting, specification development, and quality assurance functions for procurement of waste commodities at RFETS. In 1999, the CSO conceived of the concept of reusing cargo containers to ship RFETS LLW to NTS, and considering its procurement responsibilities, the CSO was a logical choice to administer the program. Currently, the CSO is responsible for identifying used cargo containers that are considered excess, arranging for inspection, and then overseeing the process of conducting repairs (if necessary), soliciting a quality assurance review, and final acceptance. The repair of cracked welds, tears, fractures, and holes is limited to $2,000 of labor and material costs; otherwise, it is not cost effective to reuse the container.

To date, 80 used cargo containers have been utilized to ship Service Contaminated Object (SCO)-I waste to NTS. The cost savings to the government exceeds $500,000. The anticipated cost savings to the government through site closure is estimated at $13,000,000.

This paper presents an analysis of further cost savings of $10 million, which could be realized by implementing a combination of the reusable (i.e., multi-trip) intermodal containers, bulk packagings, and limited rail transportation alternatives. The cost/benefit analysis includes the cost of packaging materials, transportation, and disposal. Most of the cost savings would be associated with decreased packaging costs. The analysis includes increased labor costs. The Site may experience increased labor costs associated with integration of this strategy into the Site infrastructure (e.g., engineering support, building modifications, procedure preparation/revision, IWCP compliance, etc.) as well as additional costs associated with packaging, surveying, and inspecting the waste, and inspecting/repairing the returned packagings.

The reusable container consists of an 8'X8.5'X20' end loading cargo container with a smooth steel roof/floor and side walls. The cargo containers that the Site currently uses do not have smooth inside walls (i.e., the structural members on the inside). However, it is anticipated that the reusable cargo container will have to be designed so that the structural members are on the outside of the cargo container with flat, unobstructed inner walls. This will allow for easy emptying of the cargo container at the disposal facility. A picture of a typical cargo container is shown in Figure 1.

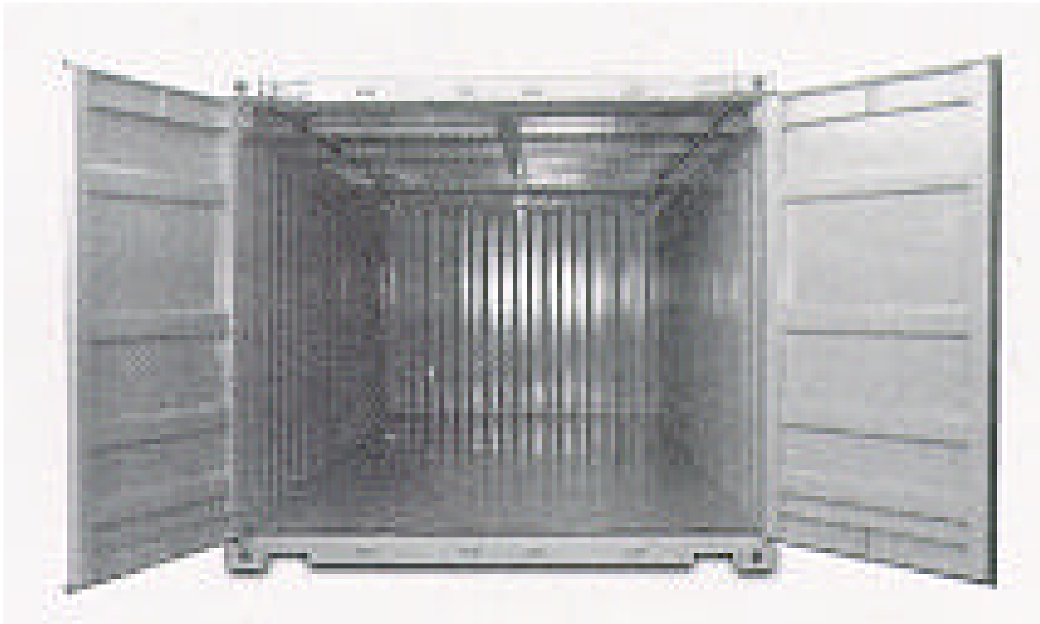

Fig. 1. Typical Cargo Container

Contamination will be controlled during loading and unloading by using an inner container to package waste. The inner container can take the place of the current method of contamination control used when loading waste into cargo containers (wrapping waste items in plastic). The inner container will not be reusable.

Three options are available for the inner container: (1) polypropylene supersacks, (2) nonflammable supersacks, and (3) metal containers.

Polypropylene Supersacks

The polypropylene supersacks can be used in areas where fire loading is not an issue. In areas where fire loading is an issue, waste generators can use the polypropylene supersack if they are temporarily stored within the building in a reusable metal container to reduce the fire burden. Once placed into the cargo container, the supersack is removed from the metal box. The supersacks will be available in three sizes: 35"X35"X35", 35"X35"X46", and 35"X35"X58". The supersacks will have a 5 mil. polyethylene liner, a duffel-type top, and a closed bottom. The supersacks will have a load limit of 3,500 lbs. Full supersacks can be moved on a pallet or they can be lifted by fork truck using four lifting loops located at the corners of the bag.

Nonflammable Supersacks

The nonflammable supersacks can be used in areas in which fire loading is an issue. The supersack will be made of a textile fire barrier consisting of silicon dioxide (sand) blended with other inorganic material. This fabric will not melt, drip, or burn at temperatures up to 1,600° F. This supersack will also be available in the sizes indicated for the polypropylene supersacks, and will have a polyethylene liner, duffel-type top, and closed bottom. This supersack will have a load limit of 2,000 lbs, and would be moved as described for the polypropylene supersack .

Metal/Wood containers

The metal inner containers will not be reusable. Two types and sizes of metal container will be available. The first type is a 4'X4'X7' and 2'X4'X7' strong tight metal box made of 12 gage carbon steel. The lid is closed using angle clips and can be lifted using lifting handles. The second option is bulk bins with lids. The bins will be available in two sizes: (1) 36"X36"X36" and (2) 44"X44"X50". They are made of 3/16" thick carbon steel and have fork lift pockets.

Plywood boxes are currently used by the Site to contain LLW and may also be used as the inner container for the reusable cargos in buildings where the authorization basis allows for it. Plywood boxes are available in 4'X4'X7' and 2'X4'X7' sizes.

Disposal Facility Logistics

NTS currently has two fundamental methods of waste disposal: (1) the stacking of non-reusable standardized waste containers in burial trenches and (2) the dumping of irregularly packaged waste into a test crater from reusable bulk containers. Reusable containers are primarily the end dump roll-off type, which contain "burrito wrapped" waste. These containers are mounted on a tilt bed truck allowing the contents to slide into the pit from the end. Pantex and Rocketdyne have both disposed of waste utilizing this method of disposal.

NTS performs a routine radiological survey on each of the containers after disposing of the waste. In the event a container found has minor surface contamination, they will decontaminate it at no additional cost. If they are unable to decontaminate it, or it requires a more extensive decontamination, they will negotiate resolution (additional decontamination or return as Radiologically Empty container) with the generating facility on a case-by-case basis.

Waste Management Process

Cargo containers will be staged at a secured, centralized location outside the Protected Area (PA) until they are shipped to a waste generation location and loaded with radioactive waste. Returned containers will be surveyed, decontaminated (if required), inspected, and repaired (if required). Approved cargos will be transferred to the waste generator, loaded, shipped to NTS, unloaded, surveyed, and shipped back to RFETS, where the process occurs again.

IMPLEMENTATION STRATEGY

An Implementation Plan was prepared in order to describe what is required to implement the reusable cargo container program. As described herein, initial implementation will consist of using unlined end loading cargo containers, and packing the waste in inner containers for contamination control. Based on the schedule prepared in support of this implementation plan, multi-trip cargo container use will begin in mid-2001. Other options, such as using top loading cargo containers, equipping cargo containers with inner liners, and shipment by rail, will be considered upon successful implementation of multi-trip end loading cargo containers.

There will be some wastes that may not be suitable for packaging in reusable cargo containers, such as waste that is too large to fit into the inner containers or that contains high levels of radioactivity. Such wastes will continue to be packaged in "disposable" containers.

Determine Waste Disposal Logistics

The first task of implementation consists of researching waste disposal resources available at the NTS for unloading the reusable cargo containers. These resources include both equipment and labor.

Establish Staging Area/Decon Pad

A staging area will be required for receipt of the cargo containers upon their return from NTS. At the staging area, the cargo containers will be surveyed and inspected. Cargo containers that meet the requirements for reuse will be staged in this area until needed at the buildings for waste packing. Cargo containers deficient with respect to the reuse requirements will be decontaminated and/or repaired at another location(s). Upon decontamination or repair, they will be returned to the staging area for subsequent reuse.

Before the site can be used as a staging area, it will be necessary to prepare an operations procedure and to train operating personnel to the procedure. The operations procedure would describe the operating personnel and their responsibilities, the logistics of cargo container receipt and transfer, surveying, inspection, security, and surveillance. Training requirements for operating personnel would also be identified

Revise Cargo Container Reuse Procedure

Inspection and Acceptance of Used Cargo Containers as DOT Strong Tight Packagings, PRO-483-IAUCC, is the current Site procedure for evaluating used cargo containers to determine if they meet DOT Strong Tight Packaging requirements. The procedure was prepared to allow reuse of cargo containers currently utilized on Site for storage of supplies or waste, as DOT packagings for shipping waste to the Nevada Test Site. As such, the procedure does not address many of the features of the reusable cargo container program, and will require modification to accommodate the new program.

Although PRO-483-IAUCC is not currently suitable for the reusable cargo container program, it is sufficiently appropriate that the procedure be modified in order to accommodate the new program, rather than prepare a new procedure for inspection, repair, and acceptance of reusable cargo containers. Accordingly, PRO-483-IAUCC will be modified as follows:

- Change the scope of the procedure to include reusable cargo containers.
- Develop a process for chemical and radiological contamination evaluations consistent with Site procedures, and include it as an appendix to the procedure. Define acceptable chemical

and radiological contamination levels for a) off site repairs, and b) on site reuse as a waste packaging.
- Define the organizations that will conduct the contamination evaluations and who will decontaminate the units, if required. Define where the contamination evaluations and decontamination will be conducted.
- Indicate that reusable cargo containers will be repaired offsite if contamination is acceptable.
- Modify the instruction for marking cargo containers to accommodate reusable units.
- Modify the tracking system in the Waste and Environmental Management System (WEMS) to accommodate reusable units.

Develop and Implement Cargo Repair Operation

Cargo containers will be surveyed and inspected at the staging area for reuse suitability in accordance with the revised procedure: Inspection and Acceptance of Used Cargo Containers as DOT Strong Tight Packagings, PRO-483-IAUCC. The surveying will be done first in order to assess the need for personal protective equipment during inspection, or decontamination prior to inspection. The inspection will focus on the following attributes that were assigned to a DOT strong, tight packaging, i.e., those features that ensure that the packaging does not leak its contents under conditions normal to transportation:

- Absence of cracked welds or missing rivets.
- Absence of fractures, tears, or holes in frames, rails, corner posts, undercarriage steel members, side walls, roof, floor, undercarriage, or roof bows.
- Closure mechanisms, (including hinges, door-locking bars, and hasps) present and operable.
- Door seals present and not torn or excessively abraded.
- Absence of rust that penetrates deeper than the surface.

A cargo container that fails to meet any of the above criteria will be either repaired or sold offsite. The decision to repair or dispose will be a judgement call based on the cost of the required repairs relative to the estimated residual value of the cargo container, e.g., the extent to which the cargo container has already been reused. In order to send the cargo container offsite, the survey results will be used to determine the need for decontamination. If required, decontamination will be performed on site until the internal and external surfaces meet the Site free release limits.

In order to repair or dispose of cargo containers offsite, the following actions will be taken:

- Define the universe of repairs that may be required, i.e., the scope of service that the Site requires. This will include welding, patching, and replacement of broken or worn parts. It will also include disposal or sale of cargo containers deemed not repairable.
- Prepare a solicitation requesting fixed unit rates for the service items identified above.
- Identify suitable vendors and transmit the solicitation.
- Evaluate proposals.
- Award contract(s).

A detailed schedule for implementing the CSO reusable container program was developed which allows for full implementation of a cargo container reuse program by mid-2001.

A transition period of considerable length is required prior to full implementation of this strategy because several key issues require resolution prior to implementation. These issues include, payload constraints associated with the weight of IP-2 and Type A cargo containers; the durability of soft-sided liners/inner containers, shrink wrap, and fixative; the development of hazard and radiation survey methods for returned packagings; the inspection and repair of returned packagings; and the availability of storage space for the onsite staging of up to 60 multi-trip cargo containers. Additionally, each building/project would have issues requiring the customization of a packaging strategy to meet project specific needs.

COST ANALYSIS

Current costs for packaging, shipment, and disposal roll up to $68.4 million. New strategy costs for packaging, implementation, shipment, and disposal roll up to $57.8. Comparison of cost estimates show that up to $10.6 million may be saved if the Site implements multi-trip cargo containers with supersacks as inner containers.

Implementing reusable cargo containers may result in increased cost savings due to decreasing disposal costs. NTS calculates our disposal fee based on external package volume. It has been estimated that disposable cargo containers contain approximately 20% void space. It is anticipated that NTS will calculate our disposal fee based on the volume of the supersacks rather than the reusable cargo containers. It is likely that there will be less void space associated with the supersacks than with the disposed cargo containers. Assuming void space could be reduced between 10-20%, disposal costs would be reduced by the same percentage. Thus, an additional $4 million to $8 million dollar cost savings could be realized. This cost savings would be in addition to the savings reflected in Table I.

Table I. Cost Comparison of Llw Packagings

Cost Elements	IP-1 Drums* 165/Shipment 34.6m^3/Shipment 44.8K lbs/load	IP-2 Metal Box* 11/Shipment 34.9m^3/Shipment 44.6K lbs/load	IP-1 Cargo Container* 1/load 36.2m^3/load 44.7K lbs/load	Used Cargo Container* 1/load 36.2m^3/load 44.7K lbs/load	Multi-Use Cargo Container 36.2 $m^{3/}$/load 44.7 lbs/load
Packaging [1]	$5,600	$15,400	$10,000	$4,000	$200
Waste Packing Labor[2]	$16,500	$1,100	$100	$100	$100
Verification/ Certification[3]	$8,250	$550	$50	$50	$50
Assay/RTR[4]	$157,000	$10,500	$950	$950	$950
Air Lock Construction[5]	N.A.	N.A.	$700	$700	$700
Cargo Handling Equipment [6]	N.A.	N.A.	$550	$550	$550
Shipping Cost to NTS[7]	$3,400	$3,400	$3,400	$3,400	$3,400
Total Cost/ Shipment	$190,750	$30,950	$15,750	$9,750	$5,950
Total Cost/m^3 of Waste Shipped	$5,500	$890	$440	$270	$164

*Waste shipment basis - Given approximately 75% of loaded plywood boxes weigh 2,500 lbs, and conservatively assuming the other 25% weigh the RFETS limit of 5,000 lbs, the average loaded plywood box weight is 3,125 lbs. Given a capacity of 112 ft^3 per box, this equates to a density of 27.9 lbs/ft^3, which is used to determine the gross waste shipping weights for the packagings. Empty drums, metal boxes, and cargo containers weigh approximately 65 lbs., 930 lbs., and 9,000 lbs., respectively. Their capacities in ft^3 (m^3) are 7.4 (0.21), 112 (3.17), and 1,280 (36.2), respectively. The number of packagings (and the waste volume) per waste shipment is limited by the DOT weight limit for the truck (80,000 lbs gross vehicle weight; 45,000 lbs gross load).

- Recent purchase prices: IP-1 Drum - $34; IP-2 Metal Box - $1,400; IP-1 Std. Cargo Container (includes blocking and bracing system and tie down accessories) - $10,000; used Cargo Container - $4,000 (includes blocking and bracing system and tie down accessories).
- 2 man-hrs/package at $50/man-hr. Includes WEMS entry, W/R Traveler preparation, labeling the package, and closing the package. Does not include the labor for placing the waste in the containers as the unit cost for this activity is similar for each alternative. However, it is recognized that the costs of preparing waste for packing may be significantly different for the various packaging options, e.g., size reduction activity would be significantly greater to prepare waste for loading into a drum or even an IP-2 metal box relative to a cargo container.

- Verification and certification each require 0.5 man-hrs/package at $50/man-hr.
- An IP-2 metal box or IP-1 drum can be run through Nondestructive Assay (NDA) and Real-Time Radiography (RTR), whereas waste placed in a cargo container must be pre-characterized (sampling/analysis for LSA; smears and surveys for SCO) and the loading operation requires 100% inspection. Waste placed in a metal box or drum can also be pre-characterized and 100% inspected. Regardless, assume NDA and sampling/radiological analysis are similar costs, and 100% inspection and RTR are similar costs. NDA and RTR costs are as follows: NDA - $700/container, RTR - $250/container.
- If waste is not surveyed out of a Contaminated Area (CA) (surveying is labor intensive), then a soft-sided containment must be constructed to get the waste from the CA to the cargo container. Conservatively assume 100 liner feet of containment is required for a building and it would take a 6 man crew 1 week to build it (240 man-hrs). At $50/man-hr, this equates to $12,000. Adding in materials and design cost, assume a soft-sided containment will cost $20,000. If 4 different containments are required per building, the total cost per building is $80,000. The number of cargo containers projected for use in Buildings 771 and 779 is 240, or 120/building. The cost of soft-sided containment per cargo container (i.e., shipment) is 80,000/120 = $700.
- The RFETS existing 21,000 lb. fork truck has inadequate capacity to move full cargo containers. The cost of a 25 ton fork truck is approximately $200,000, which is $28,600/yr over 7 years (no interest). At 50 shipments per year, this equates to ~$550/shipment. Fork trucks with adequate capacity currently exist at NTS.
- High end of vendor quotes for shipping cost per truckload (roundtrip).

CONCLUSIONS

This Implementation Plan has been prepared in order to describe the scope of work that is required to implement the reusable cargo container program. Initial implementation of a multi-use cargo container program will consist of using unlined end loading cargo containers, and packing waste in inner containers for contamination control. Based on the schedule prepared in support of this implementation plan, multi-trip cargo container use will begin in mid-2001. Other options, such as using top loading cargo containers, equipping cargo containers with inner liners, and shipping by rail, will be considered upon successful implementation of multi-trip end loading cargo containers.

The packaging configuration will consist of inner containers inside an 8'X8.5'X20' end loading cargo container. The inner container options include a polypropylene supersack (three sizes), a nonflammable fabric supersack (three sizes), bulk steel bins (two sizes), strong tight metal boxes (two sizes), and plywood boxes (two sizes).

This analysis showed that a cost savings of $10 million could be achieved by implementing reusable (i.e., multi-trip) intermodal containers and bulk packagings.

This analysis covers 75% of the low level waste forecast by RFETS. There will be some wastes that may not be suitable for packaging in reusable cargo containers, such as waste that is too large to fit into the inner containers or that contains high levels of radioactivity. Such wastes will continue to be packaged in "disposable" containers.