INNOVATIVE TECHNOLOGY

Summary Report

DOE/EM-0599

Blade Plunging Cutter

Deactivation and Decommissioning Focus Area

Prepared for

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INNOVATIVE TECHNOLOGY
Summary Report

Blade Plunging Cutter

OST/TMS ID 2953

Deactivation and Decommissioning Focus Area

Demonstrated at
Florida International University
Hemispheric Center for Environmental Technology
Technology Assessment Center/High Bay
Miami, Florida

INNOVATIVE TECHNOLOGY
Summary Report

Purpose of this document

Innovative Technology Summary Reports are designed to provide potential users with the information they need to quickly determine whether a technology would apply to a particular environmental management problem. They are also designed for readers who may recommend that a technology be considered by prospective users.

Each report describes a technology, system, or process that has been developed and tested with funding from DOE's Office of Science and Technology (OST). A report presents the full range of problems that a technology, system, or process will address and its advantages to the DOE cleanup in terms of system performance, cost, and cleanup effectiveness. Most reports include comparisons to baseline technologies as well as other competing technologies. Information about commercial availability and technology readiness for implementation is also included. Innovative Technology Summary Reports are intended to provide summary information. References for more detailed information are provided in an appendix.

Efforts have been made to provide key data describing the performance, cost, and regulatory acceptance of the technology. If this information was not available at the time of publication, the omission is noted.

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SECTION 1
SUMMARY

The Los Alamos Integrating Contractor Team demonstrated a Blade Plunging Cutter as an innovative metal cutting technology under the Large-Scale Demonstration and Deployment Project (LSDDP). The particular model tested was the BPC-4, developed by the Mega-Tech Services, Inc. The demonstration showed that the BPC-4 effectively removes legs and appurtenances from large metal objects, such as gloveboxes, at a higher productivity and equivalent cost than the baseline technology, a variable speed reciprocating saw. The BPC-4 is a viable option to the reciprocating saw for the dismantling or size reduction of contaminated metal components as part of the deactivation and decommissioning (D&D) of both U.S. Department of Energy (DOE) and commercial nuclear facilities. These technologies were demonstrated at Florida International University's Hemispheric Center for Environmental Technologies (FIU-HCET) technology assessment facility as part of the Los Alamos National Laboratory Large-Scale Demonstration and Deployment Project (LSDDP). The BPC-4 successfully sheared mockup glovebox legs with an average cutting rate of 18-sec/glovebox leg for Unistrut and 70 sec/glovebox leg for 3-inch pipe.

Technology Summary

Innovative Technology

The Mega-Tech[a] Blade Plunging Cutter, BPC-4, developed by Mega-Tech Services, Inc., is a fully mature and commercially available metal-cutting technology. Mega-Tech Inc. has developed and patented innovative redesigns of the technology that incorporate several proprietary features that make it safer, more reliable, and minimize worker hazards.

The Mega-Tech Blade Plunging Cutter, BPC-4, is specifically designed for cutting a range of sizes, materials, and contours used extensively in the industrial sector. The tool can be attached to a weight-nulling device, which supports, balances, and holds the BPC-4 unit while the technicians guide the tool toward the work piece to perform the cutting operation without having to carry the weight of the tool.

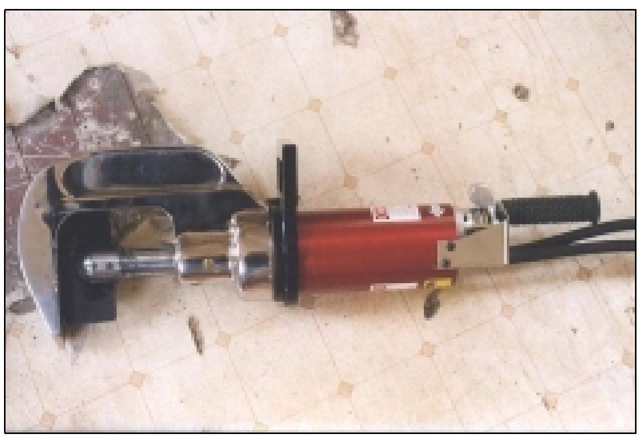

Figure 1. Mega-Tech Blade Plunging Cutter (BPC-4).

Problem Addressed

Nuclear waste volume reduction, decontamination, sorting, and segregation is a challenge affecting many DOE sites. In particular, volume reduction of contaminated metallic large metal objects, such as waste in storage awaiting disposal, is a major issue. Los Alamos National Laboratory (LANL) is currently retrieving crated oversized metal objects for processing and repackaging to meet the requirements for disposal at the LANL Solid Waste Disposal Area or for shipment to the DOE's Waste Isolation Pilot Plant for disposal as transuranic waste. Crates contain items such as gloveboxes, filters, and equipment, which were packed in fiberglass-reinforced plywood crates in the early and mid 1970s. To facilitate decontamination and size reduction of these large metal objects, appurtenances such as glovebox legs, electrical conduit, and other

[a] Mega-Tech is a registered trademark of Mega-Tech Services, Inc.

metal connections must be removed. Concurrently, the Rocky Flats Environmental Technology Site (RFETS) closure project is removing 8000 m^3 (280,000 ft^3) of gloveboxes from their facilities.

Cutting by a variable speed reciprocating saw is the baseline approach used by LANL for the dismantlement and size reduction of large metal components. Although this technology has performed satisfactorily, improvements are sought in the areas of productivity, airborne contamination, safety, and cost.

LANL, in cooperation with DOE/EM/OST (EM-50) and the DOE-Albuquerque Field Office, has assembled a team to resolve the DOE complex-wide problem of oversized metallic TRU (transuranic) waste disposal. Their mission is to provide advanced proven technology in pursuit of OST and the Accelerated Site Technology Deployment (ASTD) goals. The team will deploy, under the auspices of the Deactivation and Decommissioning Focus Area, a fully integrated Decontamination and Volume Reduction System (DVRS) initially at Los Alamos National Laboratory (LANL) and ultimately at other DOE sites. The Los Alamos DVRS industrial partners will provide the capability to process and dispose of approximately 2400 m^3 (85,000 ft^3) of oversized metallic TRU waste currently in storage at TA-54 at Los Alamos within a substantially reduced operating period. The Los Alamos LSDDP is chartered to identify and demonstrate technologies capable of improving the cost and risk effectiveness of the DVRS process.

This demonstration investigated the feasibility of using a Mega-Tech Blade Plunging Cutter, BPC-4, as an alternative to the baseline variable speed reciprocating saw for cutting glovebox leg components and appurtenances from large metal objects. The particular reciprocating saw chosen for this demonstration was the Porter Cable variable speed Tiger Saw.

How It Works

The BPC-4 is a portable hydraulic power-cutting tool. It has a 4-inch blade and is a piston-forced plunging cutter that operates through a recess in the anvil, severing the metal in a guillotine fashion during the 8-second stroke. The cutter weighs approximately 28 pounds and is 28 inches in length. It has a "dead man" switch for safe operations. It can be supported with a tension device when working from scaffolding, a lift, or a ladder. The associated HPU-12 Hydraulic Power Unit is mounted on a cart, which powers the tool with an operating pressure between 5,000 and 6,000 PSIG. The HPU-12 requires 3-phase 440VAC/ 20 amps, and it weighs 360 pounds and can be located remotely from the cutter in a non-contaminated area.

Potential Markets

Mega-Tech Blade Plunging Cutter, BPC-4, is well suited for dismantling and volume reduction of metallic waste. Thus Los Alamos LSDDP selected the BPC-4 as the Blade Cutting Plunger model most appropriate for glovebox and large metal object applications. Typical applications of metallic waste volume reduction include cutting glovebox legs, pipe, conduit, and other metallic geometries.

Advantages over the Baseline

The baseline technology for the LANL LSDDP is the Porter Cable variable speed Tiger saw, as representative of reciprocating saws. This is a handheld system that uses a reciprocating blade to cut various metallic components. The BPC-4 has a higher production rate, is safer, less noisy, and reduces the quantity of secondary waste generated when compared with the baseline technology.

Demonstration Summary

This report covers the period of September 13 to September 15, 1999, when the Mega-Tech BPC-4 hydraulic cutting tool system was demonstrated as part of the Los Alamos Large-Scale Demonstration and Deployment Project (LSDDP). The demonstration was conducted at Florida International University's Hemispheric Center for Environmental Technologies (FIU-HCET).

The purpose of this demonstration was to provide a comparison of the technologies available to the DVRS at LANL for cutting of legs and appurtenances from oversized metallic waste currently in storage at the LANL storage and disposal area (TA-54). This demonstration evaluated the effectiveness, efficiency, and health factors associated with the Mega-Tech Blade Plunging Cutter, BPC-4, for cutting glovebox legs made of Unistrut and schedule 40 stainless steel pipe. The demonstration supports potential use at LANL, elsewhere within the DOE complex, or at commercial nuclear facilities.

LANL solid waste operations provided technicians and supervisor support for operation of the cutting tools. The vendor, Mega-Tech Services, Inc., provided the Mega-Tech Blade Plunging Cutter, BPC-4, and operational direction. The IT Corporation represented the Los Alamos ICT and provided overall test direction. The International Union of Operating Engineers (IUOE) performed a health and safety analysis. FIU-HCET D&D Technology group in collaboration with the IT personnel designed and developed the test plan, prepared the demonstration site, and provided personnel for data collection and analysis.

Demonstration Site Description

The demonstration was conducted in an air-conditioned environment at the FIU-HCET assessment site in Miami, Florida. FIU-HCET has a Technology Assessment Program (TAP) and test site for evaluating the performance, cost, effectiveness, and health and safety aspects of environmental technologies used in D&D. The demonstration used non-radioactive mockups of standard gloveboxes. The demonstration consisted of a glovebox bottom (lying on its end) fabricated with carbon steel. Two representative glovebox leg types were used as legs (3-inch pipe and standard Unistrut). The mockup was so designed that either pipe (nominal, schedule 40, 3 in diameter, 30 in long) or Unistrut (12 gauge, 30" L x1 5/8" H x 1 5/8" W) could be mounted as legs. The intent was to allow realistic and rapid removal of mockup legs so that numerous glovebox de-legging operations could be performed in a short time.

The demonstration of the Mega-Tech Blade Plunging Cutter, BPC-4, was performed at two locations within FIU-HCET facilities:

- D&D test area shed – approximately 16 ft L x 10 ft W x 8 ft H in dimension, with provision for air-conditioning.
- Permacon™ unit - A modular building with dual-hinged panel doors for access and two standard doors. Containment dimensions are 20 ft L x 16 ft W x 12 ft H. A portable AC unit provided ventilation during demonstration. The containment is located inside the high bay area at the FIU-HCET facility.

The mockup for the demonstration was positioned at each of these assessment sites. The mockup was positioned “on end” to simulate a glovebox that had been turned on the side leaving two legs near the floor, pointing horizontally, and two legs at approximately 2 m (6 ft) from the floor. The Unistrut and the pipe legs were replaced as per the requirements of the demonstration.

Key Results

The Mega-Tech Blade Plunging Cutter, BPC-4, was successfully demonstrated according to a pre-approved Test Plan (Lagos, 1999). The following were the key results:

- The Mega-Tech Blade Plunging Cutter, BPC-4, successfully cut all the glovebox legs (pipe and Unistrut) with an average cutting rate of 70 seconds for pipe legs and 18 seconds for Unistrut. The Tiger Saw required 29 seconds to cut the Unistrut and 117 seconds for the pipe legs.

- Minimal airborne contamination was noted during the BPC-4 demonstration, but there was airborne emission from the reciprocating saw near the end of blade life.

- The BPC-4 was judged to reduce health and safety hazards to the technicians performing the cutting. IUOE health and safety personnel indicated a slight advantage to the ergonomic factors for BPC-4 (See appendix C).
- A cost estimate was developed for comparison of the BPC-4 and the baseline assuming full year operation in the LANL DVRS process at a two gloveboxes per week production rate. The Mega-Tech, BPC-4, provides a slight overall cost advantage with compared to the baseline technology on an annual basis using the DVRS production rate as shown below.

Task	BPC-4	Baseline
Assembly and Setup	$9,183	$8,881
Planning Sessions	$22,481	$22,481
Leg and Appurtenance Removal	$6,122	$8,881

Disassembly of Equipment	$502	$301
Demobilization of Personnel	$5,620	$5,620
Total	$43,908	$46,165

Regulatory Considerations

There are no regulatory permits required to use the BPC-4. Normal worker safety practices should be applied when using this tool in accordance with applicable regulations, particularly chapter 10, *Code of Federal Regulation* (CFR), Parts 20,835, and proposed part 834, for protection of workers and the environment from radiological contaminants; and 29 CFR Occupational Safety and Health Administration (OSHA) Worker requirements.

Commercial Availability

The BPC-4 is fully developed and commercially available from Mega-Tech Services, Inc.

Future Plans

The BPC-4 is being considered for use on future D&D projects at LANL as a dismantlement technology.

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Licensing

No licensing or permitting activities were required to support this demonstration.

Other

All published Innovative Technology Summary Reports are available on the OST Web site at www.em.doe.gov/ost under “Publications.” The Technology Management System, also available through the OST Web site, provides information about OST programs, technologies, and problems. The OST reference number for Mega-Tech Blade Plunging Cutter, BPC-4, is 2953.

SECTION 2
TECHNOLOGY DESCRIPTION

Overall Process Definition

The Mega-Tech Blade Plunging Cutter, BPC-4, is a high-pressure, hydraulically operated cutting system with spreaders and cutters that allow personnel to rapidly crimp, cut, and shear steel pipes and other structural shapes while minimizing the spread of radiological contaminants. The basic unit that supports the tools is a portable castor-wheeled HP-12 hydraulic power cart, which can be moved with a crane or forklift and from which all the hydraulic units are operated and stored. The cart is a heavy-duty customized unit built specifically for the application. The hydraulic power supply unit consists of a seven-gallon hydraulic oil reservoir, two immersed positive displacement gear pumps, and a 10 HP 3450 RPM motor that operates on either 440 or 220 V three-phase power and requires a 20-amp capacity power supply.

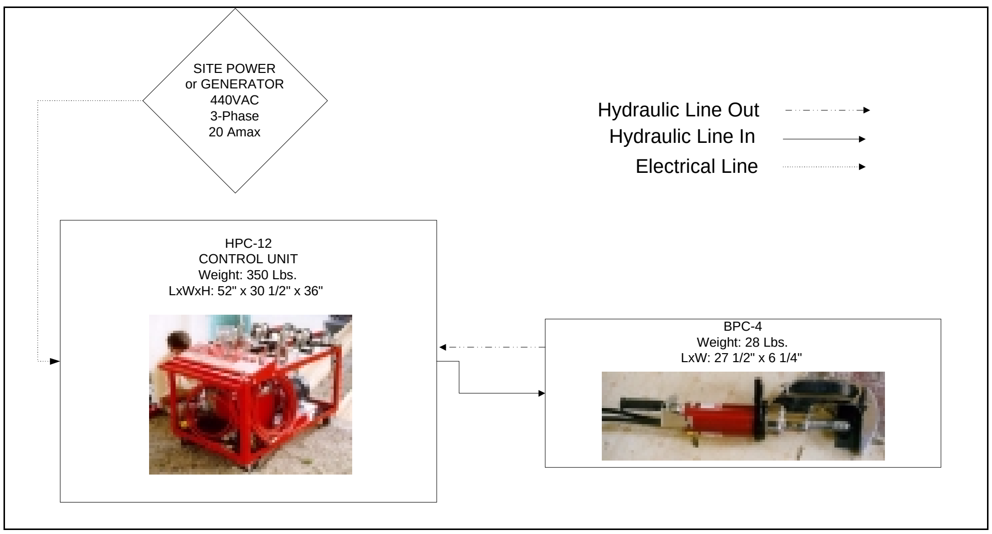

Figure 2. Process diagram of Mega-Tech Blade Plunging Cutter, BPC-4, operation.

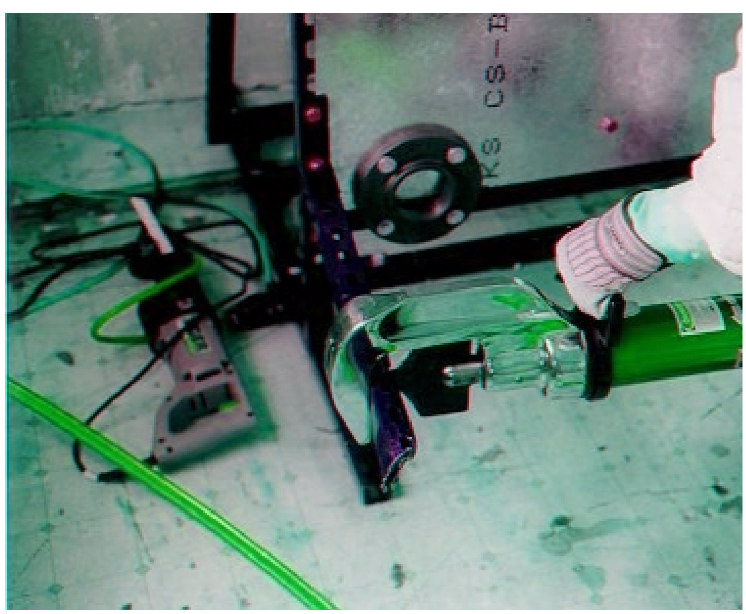

Figure 3. Mega-Tech Blade Plunging Cutter, BPC-4, in operation.

The baseline approach to remove legs and appurtenances from large metal objects in the DVRS Project at LANL is a variable speed reciprocating saw (Figure 4). This technology is a handheld portable saw and uses a reciprocating blade to perform the cutting. The selected Tiger Saw model has a unique blade clamp, which facilitates a quick and keyless blade change. It requires a 120 V, 15 amps, single-phase power supply. The Tiger saw has a variable speed feature, ranging from 0-2600 strokes per minute (SPM).

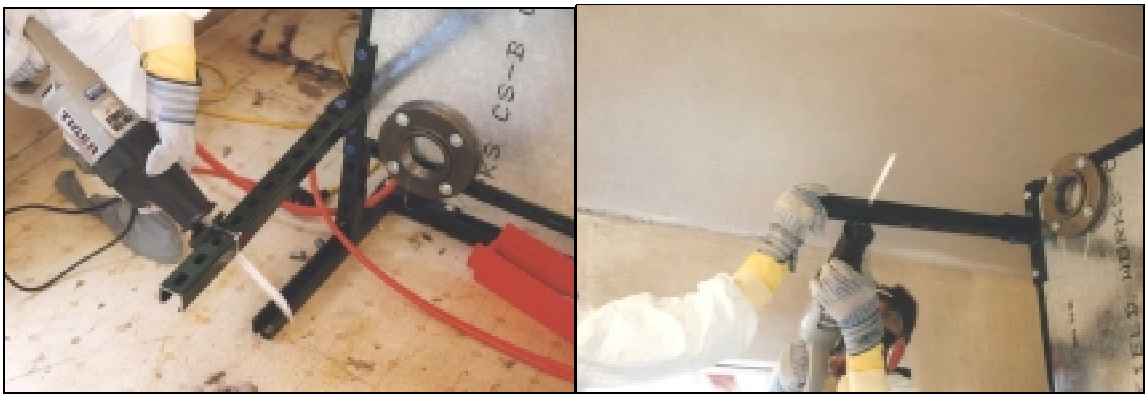

Figure 4. Variable speed Tiger saw.

System Operation

Table 1 summarizes the operational parameters and conditions of the Mega-Tech Blade Plunging Cutter, BPC-4, during the FIU-HCET demonstration.

Table 1. Operational parameters for Mega-Tech Blade Plunging Cutter, BPC-4

Working Considerations	
Work area location	HCET Technology Assessment test shed and Permacon unit
Work area access	Accessible to a forklift after segmented components are brought out of the test area.
Work area description	D&D test area shed – approximately 16 ft L x 10 ft W x 8 ft H in dimension, with provision for air-conditioning. Permacon™ unit - A modular building with dual-hinged panel doors for access and two standard doors. Containment dimensions are 20 ft L x 16 ft W x 12 ft H.
Work area hazards	Tripping hazard from hoses. Airborne contamination from metallic dust. Fire and burn hazards from electricity. Securing and transporting heavy segments of steel.
Equipment configuration	Hydraulic power unit (HPU), generator.
Work crew	Three-person work crew • Supervisor (Part time) • 2 Technicians
Additional support personnel for demonstration	• 1 data taker (FIU-HCET) • 1 health and safety personnel (IUOE) • 3 Mega-Tech advisory personnel
Specialized skills/training	LANL Technicians were trained by the Mega-Tech representative to operate the BPC-4 cutter
Waste Management	
Primary waste generated	Segmented components 8 in of pipe and 8 in of Unistrut
Secondary waste generated	Used 8 in blades from the reciprocating saw; none from the BPC-4
Waste containment and disposal	Minimal airborne particles generated; the metal scrap generated was collected in a 30 ft^3 waste container for disposal.
Equipment Specifications and Operational Parameters	
Technology design purpose	Metal cutting
Quality of cut	Jagged and sharp edges observed on pipes and Unistrut cut with both the Mega-Tech cutter and the HPU.
Dimensions	HP-12 Hydraulic Power Cart: 52 in L x 30.5 in W x 36 in H; Weight: 350 Lbs. BPC-4 Cutter: Weight 28 Lbs;Dimensions: 27.5 in L x 6.25 in W
Portability	The Mega-Tech cutter and the HPU are easily transported to the site. The HPU weighs 350 pounds and is on wheels to facilitate easy transportation.

Materials used	
Work area preparation	A portable AC unit provided ventilation during demonstration. The containment was located inside the high bay area at the FIU-HCET facility. For the D&D test area shed, a portable tent was set up to house the hydraulic power unit.
Personnel protective equipment	TYVEK anti-contamination suits, outer gloves, hood, and booties Rubber shoe covers Leather gloves Air purifying respirators
Utilities/Energy Requirements	
Fuel Electricity	Gasoline for generator 440 or 220 V 3-phase power and 20-amp capacity power supply

SECTION 3
PERFORMANCE

Demonstration Plan

Demonstration Site Description

The demonstration was conducted according to an approved test plan in an air-conditioned environment at the FIU-HCET assessment site in Miami. FIU-HCET has a Technology Assessment Program and test site for evaluating the performance, cost, effectiveness, and health and safety aspects of environmental technologies used in D&D.

The demonstration of the Mega-Tech Blade Plunging Cutter, BPC-4, was performed at two locations within the FIU-HCET facilities:

- D&D test area shed – approximately 16 ft L x 10 ft W x 8 ft H with provision for air-conditioning.
- Permacon unit - A radiation lab building with dual-hinged panels for access and two standard doors. Containment dimensions are 20 ft L x 16 ft W x 12 ft H. A portable AC unit was set on the right lateral air inlets to provide ventilation during demonstration. The containment is located in the high bay.

The glovebox mockup was positioned at each of these assessment sites, and the Unistrut and pipe legs were changed as per the requirements of the demonstration. The mockup was positioned to simulate a single station glovebox that had been tipped on its side leaving two legs near the floor and two at approximately 6 feet from the floor. This positioning was chosen to simulate a likely scenario for decommissioning operations wherein the items to be cut are in inconvenient locations and positions.

Demonstration Objectives

The principal goal of the demonstration was to establish whether the Mega-Tech Blade Plunging Cutter, BPC-4, could safely and effectively remove legs and appurtenances of different materials and sizes from a glovebox mock-up and to compare the performance and cost to the baseline technology. This determination would be based on the blade plunging cutter's ability to achieve the following objectives:

- Reduced generation of airborne secondary waste relative to the baseline technology
- Increased cutting rate relative to the baseline
- Reduced worker health risks associated with dismantlement tasks.

Demonstration System

The Mega-Tech Blade Plunging Cutter, BPC-4, was demonstrated using 1- 5/8” Unistrut legs and 3" stainless steel schedule 40 pipe. The cutter is also capable of cutting other materials and sizes; however, only the leg cutting operations were timed and evaluated. The BPC-4 can also be used as a conduit cutter because of its speed and effectiveness. These capabilities were also demonstrated during this demonstration although no data was taken. In addition, Mega-Tech personnel demonstrated a 1-½ inch Blade Cutting Plunger and a 6-inch Blade Cutting Plunger, but no data was taken. The smaller unit was able to cut the Unistrut legs very easily and the larger unit was demonstrated on a 6-inch pipe.

Results

Two LANL technicians in anti-contamination clothing performed the demonstration using both the BPC-4 and the baseline reciprocating saw. Typically one technician used the cutting tool while the other held the piece being cut off. Holding the piece was found necessary with the BPC-4 as the sheared item could eject from the location. The technicians changed their roles of cutting and holding as the legs were removed. The technicians were timed for the total of several cuts, so the time represents an average time for the multiple cuts for cutting, positioning the tool for the next cut, and removing the waste. Note that blade change in the reciprocating saw was done by ungloved personnel supporting the demonstration.

Table 2 describes the number of Unistrut and pipe legs used during the BPC-4 demonstration and their respective specifications. Note that the timing indicated in Table 3 represents an average of the time for all the cuts made.

Table 2. Total number of surrogates and specifications

Surrogate	Total number of cuts	Specifications
Unistrut	32	12 Gauge, 76 cm (30") L x4 cm (1 5/8") H x (4 cm) 1 5/8" W
3" Pipe	16	Schedule 40, Stainless Steel 7 5/8 cm (3") dia x (86 cm) 30" L

The Mega-Tech Blade Plunging Cutter, BPC-4, successfully demonstrated its ability to safely and effectively dismantle glovebox legs of Unistrut and 3-inch pipe. The technicians used a double-pointed blade for cutting the Unistrut and a single-pointed blade for the pipe. The single-pointed blade was expected to provide more penetration than the double-pointed blade.

Table 3 summarizes the results from the demonstration.

Table 3. Dismantlement summary for Mega-Tech Blade Plunging Cutter (BPC-4) ™ by material

Technologies	Mega-Tech		Tiger Saw	
Surrogates Type	Unistrut	3" Pipe	Unistrut	3" Pipe
Cutting Time (Sec)	18	70	29	117
Length of Cut [cm (in)]	12.5 (4.88)	27.9 (11.0)	12.4 (4.88)	27.9 (11.0)
Cutting Rate [cm/min (in/min)]	40.6 (16)	23.9 (9.4)	25.4 (10.0)	14.2 (5.6)
Number of Cuts per glovebox	6	4	6	4
Cutting time per glovebox (min)	1.8	4.7	2.9	7.8
Total cutting time per glovebox (min)	6.5		10.7	

The cutting rates between the two technologies favored the BPC-4 as it cut the legs in approximately 60% of the time for the reciprocating saw.

The Mega-Tech BPC-4 was more effective in cutting the Unistrut and the pipe legs. The variable speed Tiger saw required considerable saw manipulation to cut the pipe legs, while the BPC-4 unit cut through the legs in a maximum of two simple cuts.

The Mega-Tech BPC-4 was relatively noiseless (< 40dB) when compared against the baseline technology (96 to 98 dB).

The reciprocating saw required blade changes during the cutting process. Although the blade change is quick and efficient for ungloved personnel, it may be difficult for the technicians wearing double gloves. The BPC-4 unit did not require any such blade changes and could perform the entire cutting process with a single blade[b].

Table 4 compares the key performance indicators of the baseline and innovative technologies that were assessed during the demonstration.

Table 4. Comparison of key performance indicators of cutting technologies

[b] Blade was changed once on the BPC-4 to a different blade type (single point) to maximize cutting speed through 3" pipes.

	Variable speed Tiger Saw (baseline)	Mega-Tech Blade Plunging Cutter, BPC-4
Total segments cut during demonstration	24	24
Surrogate type	3" pipe & Unistrut	3" pipe & Unistrut
Required personnel	Two-person crew	Two-person crew
Set-up time (man hrs)	0.117 hrs (7 min)	1.1hr
Productivity (cutting rate)	SEE Table 3	
Cutting media used during demonstration	6 carbide blades	1 double-pointed blade 1 single-point blade (not consumed in demo)
Utilities	Electrical: 120V, 2A, single-phase	Electrical: 480V, 15A, 3-phase
Primary waste generated	Segmented components	Segmented components
Airborne contamination	The Tiger saw produced noticeable amounts of airborne and residual saw chips.	None

SECTION 4
TECHNOLOGY APPLICABILITY AND ALTERNATIVES

Competing Technologies

The baseline technology that competes with the Mega-Tech Blade Plunging Cutter BPC-4 is the variable speed reciprocating saw used throughout the LANL complex to cut and size reduce metallic glovebox legs and appurtenances. Other technologies that may be used for segmenting include the following:

Plasma Arc Cutting

The plasma arc cutting technology is based on establishing a direct current (DC) arc between a tungsten electrode and the metal being cut. The arc is established in a gas that flows though a constricting orifice in the torch nozzle to the metal surface. The constricting effect of the orifice on both the gas and the arc results in very high current densities and high temperatures in the stream (17,540°F – 42,740°F). The stream, or plasma, consists of positively charged ions and free electrons. The plasma is ejected from the torch at a very high velocity and, in combination with the arc, melts the contacted metal and blows the molten metal away. A typical cut starts at the metal edge, and a through cut is made in a single pass by simply moving the torch along at a preset speed. This technology can cut though metals such as carbon steel, stainless steel, and aluminum. It is able to cut most metals up to 7 inches thick.

The plasma cutter is expensive, durable, and as rugged as other cutting technologies, such as the BPC-4. A disadvantage of this technology is the particulate airborne contamination that is generated during operation. Although the plasma cutter has a very high cutting rate, the fact that it is a thermal cutting technology may limit its applicability and acceptance in some DOE sites and some applications.

Oxy-Gasoline Torch

The oxy-gasoline torch is fueled by a mixture of gasoline and oxygen. The fuel components are delivered to the torch by hoses from portable pressurized gasoline tank and oxygen cylinder. The gasoline tank may be pressurized either by a built-in hand pump or by an external source of compressed air. The gasoline and oxygen are combined in a mixer in the head of the torch. The fuel mixture travels to the tip of the torch where it is lit. After a few seconds of preheating, the tip of the torch becomes warm enough to vaporize the gasoline in the tip. The rapid expansion results in a high velocity stream of highly combustible oxygen/gasoline vapor that fuels the cutting flame of the torch.

Although the oxy-gasoline torch has a very high cutting rate, the fact that it is a thermal cutting technology makes it undesirable in some DOE sites and some applications (D&D Focus Area, 1998). This technology also produces large amounts of "slag," or secondary waste, which is undesirable in any D&D activity.

Guillotine Saw

The Guillotine Saw is a hydraulically powered portable reciprocating saw. A chain pipe vise clamps the Guillotine Saw to the pipe. The machined cast iron "V"-saddle base assures square cuts at right angles and the saw can be mounted in any position around the pipe. It works equally well on vertical and horizontal piping. Through the use of a gear motor, the guillotine is lowered onto the cutting surface. The carbide tip cuts the pipe leaving a slightly jagged edge. The reciprocating saw action produces particles too heavy to become airborne. The Guillotine Saw is similar in process description to the baseline technology. The Guillotine Saw has a lower production and cutting rate while having a high level of secondary waste in comparison to the Mega-Tech Blade Plunging Cutter BPC-4.

Self-Contained Pipe Cutting Shear

The self-contained pipe cutting shear is a hand-held hydraulic shear that is powered by a built-in rechargeable battery or portable auxiliary rechargeable battery (D&D Focus Area, 1998). The tool is capable of cutting up to 2.5-inch diameter piping and cannot cut 3-inch pipe. The battery has approximately a one-hour charge at continuous use. The tool weighs 23 kg (50 lbs.).

Technology Applicability

The Mega-Tech Blade Plunging Cutter, BPC-4, is a fully developed and commercially available tool for cutting and segmenting steel. Its superior performance over the baseline variable speed Tiger saw, particularly in the areas of productivity, airborne contamination, and worker safety, makes it a prime candidate technology for deployment throughout the DOE complex. This technology could be integral for volume reduction in dismantling operations, particularly for glovebox legs, could increase cutting speeds, especially with Unistrut, and has the potential to accelerate dismantlement schedules and significantly reduce D&D costs. Although the BPC-4 was demonstrated only on glovebox legs, the technology can also be used for components such as pipe, conduit, beams, railings, and other similar geometries.

Patents/Commercialization/Sponsor

This demonstration involved the use of a fully developed technology, as required under the terms of the LSDDP. The Mega-Tech Blade Plunging Cutter, BPC-4, is patent pending. No permits were required to demonstrate the BPC-4 at the FIU-HCET technology assessment site.

SECTION 5
COST

Methodology

The objective of the analysis is to provide a cost estimate for implementation of the Mega-Tech BPC-4 technology on a production scale at a DOE site. The actual costs developed during the demonstration formed the basis of the cost estimate. To approach realistic implementation costs, additional assumptions were invoked regarding the greater efficiency of a production, rather than demonstration, setting.

Key assumptions for the cost estimate are listed below. Other assumptions and details on the cost analysis are presented in Appendix C.

- The various appurtenances on a glovebox would increase the use of the BPC-4 beyond 4 leg cuts per glovebox. It was assumed that 10 cuts would be made on each glovebox; 4 pipe legs and 6 other appurtenances equivalent to Unistrut.

- DVRS will process two gloveboxes per week, or that equivalent in similar equipment.

- The Tiger Saw cost is from a catalog. The Tiger Saw cost is low, and it is considered an expendable item (no repairs).

- The Mega-Tech system cost was provided by the manufacturer, along with the cost of replacement blades for use in the cost evaluation. Blade replacement for the Mega-Tech system is anticipated to be a yearly event, and takes little time. Although contamination is an issue at LANL, no decontamination time was assumed as the cutter itself will remain in the PermaCon and the hydraulic unit remains in the uncontaminated area.

- Fully burdened labor rates for LANL personnel were used in the estimate.

- The operating protocol was assumed to consist of rapid removal of the legs and appurtenances in a sequential fashion.

Cost Analysis

To develop an estimate for implementation, the anticipated DVRS operation rate was assumed, which is reflected in the key assumptions above. Activities were grouped under higher level work titles per the work breakdown structure (WBS) shown in the Hazardous, Toxic, Radioactive Waste Remedial Action Work Breakdown Structure and Data Dictionary (HTRW RA WBS) (U.S. Army Corps of Engineers, 1996).

Figure 5 provides a summary of the annual implementation costs assuming the 2 gloveboxes per week (20 cuts per week).

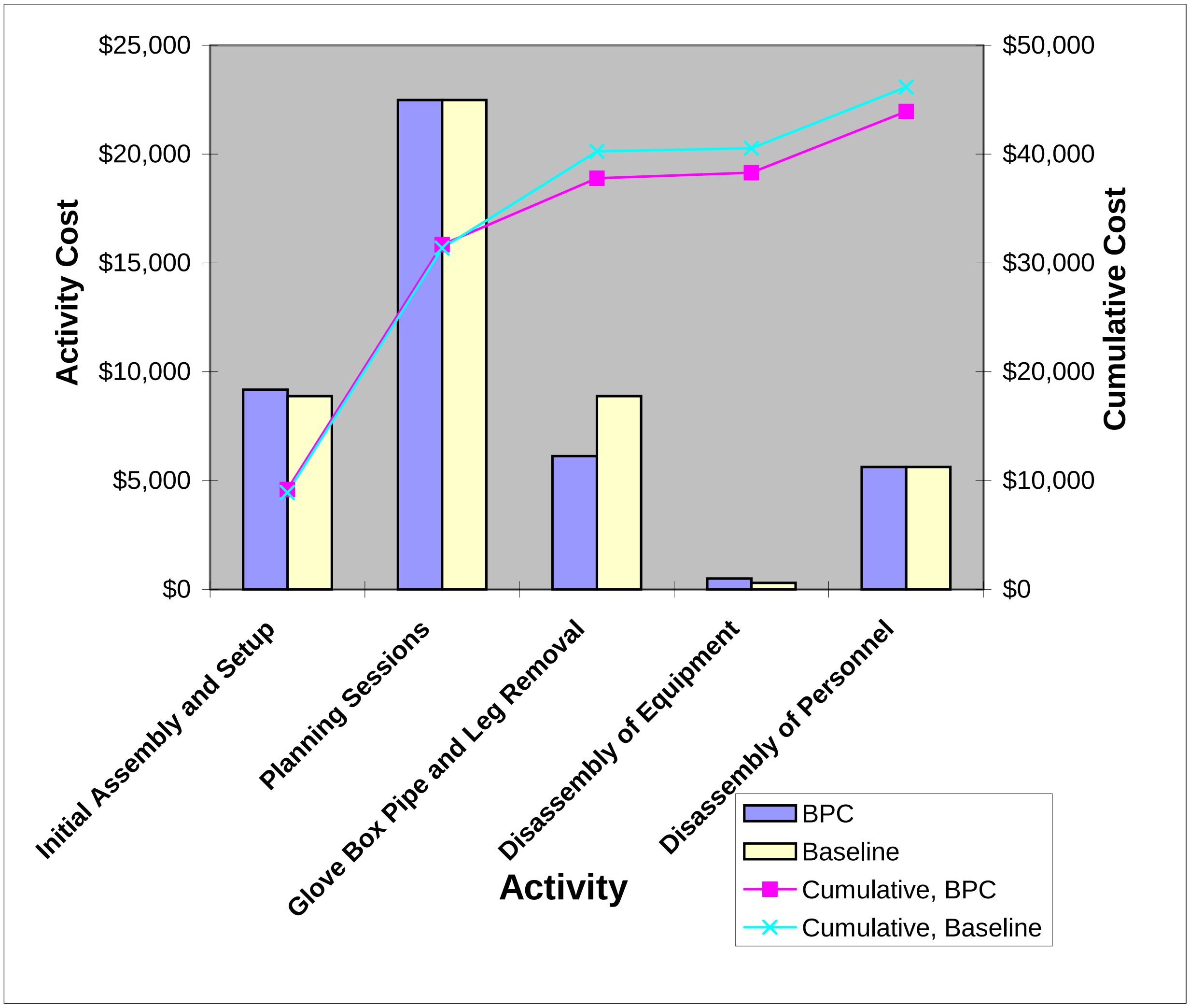

Figure 5. Annual Cost Comparison of Mega-Tech BPC-4 vs. Baseline Reciprocating Saw

Cost Conclusions

The cost estimate provides a reasonable cost comparison for implementation of the Mega-Tech BPC-4 at the DVRS processing gloveboxes or similar large metal objects. Using the demonstration costs as a basis, costs were developed for mobilization and planning, glovebox leg and appurtenance removal, and demobilization. As seen in Figure 5, the mobilization, planning and demobilization/disassembly costs for the BPC-4 and the baseline technology are essentially the same. The time advantages offered by the BPC-4 make a considerable difference in the removal steps and results in a slight overall cost savings. The annual costs for BPC-4 were estimated at $43,900, whereas the simpler baseline reciprocating saw annual costs were estimated at $46,165. It is recognized that these costs are very similar, and other factors (such as safety) may be the deciding factors for deployment decisions. Other candidate deployment sites may use this basis to scale up their anticipated costs by considering the number of gloveboxes to be disassembled and the production rate.

SECTION 6
REGULATORY AND POLICY ISSUES

Regulatory Considerations

The following safety and health regulations govern the regulatory/permitting issues related to the operation of the Mega-Tech Blade Plunging Cutter, BPC-4, at the LANL.

- Occupational Safety and Health Administration (OSHA) 29 CFR 1926

- 1926.300 to 1926.307	Tools – Hand and Power
- 1926.400 to 1926.449	Electrical – Definitions
- 1926.28	Personal Protective Equipment
- 1926.102	Eye and Face Protection
- 1926.103	Respiratory Protection

- Occupational Safety and Health Administration (OSHA) 29 CFR 1910

- 1910.211 to 1910.219	Machinery and Machine Guarding
- 1910.241 to 1910.244	Hand and Portable Powered Tools and Other Hand-Held Equipment
- 1910.301 to 1910.399	Electrical Definitions
- 1910.132	General Requirements (Personal Protective Equipment)
- 1910.133	Eye and Face Protection
- 1910.134	Respiratory Protection

Safety, Risks, Benefits, and Community Reaction

The Mega-Tech Blade Plunging Cutter, BPC-4, system is safer to use and operate than the variable speed Tiger saw blade. It generates less airborne contamination and poses less risk to workers and the environment. The manufacturer of the Mega-Tech Blade Plunging Cutter, BPC-4, incorporated extensive safety mechanisms, including a "dead man" switch, into the system to minimize risks to personnel, the work area, and the environment, thereby reducing the potential for liability. Appendix C provides a safety and health assessment provided by the International Union of Operating Engineers.

SECTION 7
LESSONS LEARNED

Implementation Considerations

The Mega-Tech Blade Plunging Cutter, BPC-4, is a fully developed and commercially available technology. The product is available in several models: BPC-4, BPC-6, MS-5, and MS-10 (Mechanical Spreader).

The following items were identified by the technicians and observers during the demonstration and should be considered when selecting the BPC-4 as a cutting or dismantling technology:

- The unit is quite heavy; weighing approximately 28 lbs. Overhead cutting with this tool presents a potential safety hazard since the technicians performing the operation will not be able to see the cutting action clearly and balancing the tool becomes a problem. The technicians felt that if the BPC-4 tool was suspended using the weight-nulling device, this hazard would be reduced, since the operator could just let go of the tool or release the dead-man switch and the cutting action would stop, while the tool would remain suspended.

- The dead man switch actuation of the cutting system makes it difficult for the technicians to retain complete control the operation. During the demonstration, the technicians felt that the legs on the mockup of the glovebox were too close, this created a problem in maneuvering the tool in between the legs during the cutting operation. In comparison, the variable speed Tiger saw was lighter and easier to maneuver around the mockup. The technicians also felt that the mockup width between the glovebox legs was not as wide as typical LANL gloveboxes. This could make a difference while using the technology on site at LANL.

- The Mega-Tech cutter swings while the cutting is in operation, which may be a problem in tight spaces. However, if the operator lets the tool twist along with the metal being cut, the cutting becomes smoother and easier. Mega-Tech personnel suggested this as best practice. Also, the technicians felt that over time, the learning curve would come into effect, and they could learn to operate the tool in a much more effective manner.

- The baseline technology generates some airborne particles and filings as secondary waste. These secondary wastes might create a contamination hazard to the worker and the environment. Additional steps, such as localized source capture, may be required.

- The Mega-Tech Cutting tool cuts with a crimping action and leaves a jagged edge on the segmented metal. This potentially poses an injury hazard to the technicians at the site. Preventive steps, such as taping cut surfaces, may need to be taken to avoid potential accidents.

- While operating the Tiger Saw, it was difficult to estimate when the cut was completed, which presented the potential danger of accidental injury to the helper when the cut was completed.

- The technicians felt that the chances of the segmented component flying off from the end being cut and causing potential injury to the helper was higher with the BPC-4 system.

Technology Limitations and Needs for Future Development

The Mega-Tech Blade Plunging Cutter, BPC-4, would benefit from the following design improvements:

- An improvement over the existing dead-man switch operating system. The existing switch has to be turned to the right by the thumb. If the switch took less effort, then technicians felt that the technology would be more ergonomic.

- At approximately 28 lbs., the tool is very heavy for continued use without the weight-nulling device. Reducing the weight without losing any effectiveness would greatly increase the efficiency of the tool.

Technology Selection Considerations

The Mega-Tech Blade Plunging Cutter, BPC-4, is an effective product for cutting and dismantling of contaminated metals. The use of Mega-Tech Blade Plunging Cutter is especially applicable for facilities that have a substantial amount of material to be dismantled and size reduced.

APPENDIX A
REFERENCES

Deactivation and Decommissioning Focus Area, “Innovative Technology Summary Report; Self-Contained Pipe Cutting Shear,” February 1998.

Deactivation and Decommissioning Focus Area, “Innovative Technology Summary Report; Oxy-Gasoline Torch,” OST Reference # 1847, February 1998.

Lagos, Leonel, Chung, Man, “Test Plan for LANL Mega-Tech/Champion Hydraulic Cutting System Demonstration”, 1999.

U.S. Army Corps of Engineers, “Hazardous, Toxic, Radioactive Waste Remedial Action Work Breakdown Structure and Data Dictionary (HTRW RA WBS),” 1996

APPENDIX B
TECHNOLOGY COST COMPARISON

To be provided by the Army Corps of Engineers

Basis of Estimated Cost

The activity titles shown in this cost analysis for implementation were derived from observation of the work performed and from a reasonable estimate of the level of effort required for implementation at other DOE sites. In the estimate the activities are grouped under higher level work titles according to the work breakdown structure shown in the Hazardous, Toxic, Radioactive Waste Remedial Action Work Breakdown Structure and Data Dictionary (HTRW RA WBS) (U.S. Army Corps of Engineers, 1996). The HTRW RA WBS, developed by an interagency group, and is used in this analysis to provide consistency with the established national standards. The costs shown in this analysis are computed form observed duration and hourly rates for the crew and equipment.

Activity Descriptions

The scope of each WBS element, computation of production rates, and assumptions (if any) for each work activity are described in this section.

Mobilization and Preparatory Work (WBS 33.1.01)

Mobilization of Equipment – It was assumed that the BPC-4 was purchased and used in the DVRS process at the Los Alamos National Laboratory. It was estimated that equipment was prepared for use in 1 hour.

Submittals/Implementation Plans – Plans were assumed to be complete prior to the start of work. No permits were required. It was estimated that BPC-4 Operators required 2 hours of training and familiarization prior to operation.

Miscellaneous Demolition and Removal (WBS 33.1.10)

Glovebox Leg and Appurtenance Removal – Based on the LANL demonstration, the simple cutting steps for the BPC-4 was estimated to be 13 minutes per week and 21 minutes per week for the baseline technology. These times were rounded up to 30 minutes and 45 minutes to account for the time to retrieve the tools and position them for cutting.

The hourly rates for the BPC-4 and the baseline technology were calculated using the procedures of Circular No. A-94 of the Office of Management and Budget. The purchase price for the BPC-4 was provided by the manufacturer as $31,000, and the lifetime is expected to be 10 years. The Tiger Saw catalog price is $197 and it is expected to last approximately one year. Replacement saw blades were assumed to cost $12/ea.

Demobilization (WBS 33.1.21)

Disassembly of Equipment and Demobilization of Personnel –Based on the demonstration experience, 30 minutes was allowed for personnel to clean and re-place the equipment to the storage location.

Cost Estimate Details

The cost analysis details are summarized in Figure B-1. The table breaks out each member of the crew, each labor rate, each piece of equipment used, each equipment rate, each activity duration, and all production rates so that site-specific differences in these items can be identified and a site-specific cost estimate can be developed.

WBS Activity	Labor	Equipment	Other Costs	Unit of Measure	Unit Cost	Quantity	Subtotals
Mobilization and Preparatory Work (WBS 33.1.01)							$ 608.92
Initial Assembly and Setup							*$176.60*
	Supervisor			hour	$ 61.26	0.75	$ 45.95
	Technician 1			hour	$ 48.45	0.75	$ 36.34
	Technician 2			hour	$ 48.45	0.75	$ 36.34
	Equipment Operator			hour	$ 58.00	0.75	$ 43.50
		Forklift		hour	$ 11.00	0.75	$ 8.25
		Megatech Cutter		hour	$ 8.30	0.75	$ 6.23
Planning Sessions							*$432.32*
	Supervisor			hour	$ 61.26	2	$ 122.52
	Technician 1			hour	$ 48.45	2	$ 96.90
	Technician 2			hour	$ 48.45	2	$ 96.90
	Equipment Operator			day	$ 58.00	2	$ 116.00
Miscellaneous Demolition and Removal (WBS 33.1.10)							$ 117.73
Glove Box Pipe and Leg Removal							*$117.73*
	Supervisor			hour	$ 61.26	0.5	$ 30.63
	Technician 1			hour	$ 48.45	0.5	$ 24.23
	Technician 2			hour	$ 48.45	0.5	$ 24.23
	Equipment Operator			hour	$ 58.00	0.5	$ 29.00
		Forklift		hour	$ 11.00	0.5	$ 5.50
		Megatech Cutter		hour	$ 8.30	0.5	$ 4.15
Demobilization (WBS 33.1.21)							$ 117.73
Disassembly of Equipment							*$ 9.65*
		Forklift		hour	$ 11.00	0.5	$ 5.50
		Megatech Cutter		hour	$ 8.30	0.5	$ 4.15

Disassembly of Personnel							*$108.08*
	Supervisor			hour	$ 61.26	0.5	$ 30.63
	Technician 1			hour	$ 48.45	0.5	$ 24.23
	Technician 2			hour	$ 48.45	0.5	$ 24.23
	Equipment Operator			hour	$ 58.00	0.5	$ 29.00

Figure B-1 Megatech BPC Implementation Cost Detail, Per Week of Operation

WBS Activity	Labor	Equipment	Other Costs	Unit of Measure	Unit Cost	Quantity	Subtotals
Mobilization and Preparatory Work (WBS 33.1.01)							$ 603.12
Initial Assembly and Setup							*$170.80*
	Supervisor			hour	$ 61.26	0.75	$ 45.95
	Technician 1			hour	$ 48.45	0.75	$ 36.34
	Technician 2			hour	$ 48.45	0.75	$ 36.34
	Equipment Operator			hour	$ 58.00	0.75	$ 43.50
		Forklift		hour	$ 11.11	0.75	$ 8.33
		Reciprocating Saw		hour	$ 0.46	0.75	$ 0.35
Planning Sessions							*$432.32*
	Supervisor			hour	$ 61.26	2	$ 122.52
	Technician 1			hour	$ 48.45	2	$ 96.90
	Technician 2			hour	$ 48.45	2	$ 96.90
	Equipment Operator			day	$ 58.00	2	$ 116.00
Miscellaneous Demolition and Removal (WBS 33.1.10)							$ 170.80
Glove Box Pipe and Leg Removal							*$170.80*
	Supervisor			hour	$ 61.26	0.75	$ 45.95
	Technician 1			hour	$ 48.45	0.75	$ 36.34
	Technician 2			hour	$ 48.45	0.75	$ 36.34
	Equipment Operator			hour	$ 58.00	0.75	$ 43.50
		Forklift		hour	$ 11.11	0.75	$ 8.33
		Reciprocating Saw		hour	$ 0.46	0.75	$ 0.35
Demobilization (WBS 33.1.21)							$ 113.87
Disassembly of Equipment							*$ 5.79*
		Forklift		hour	$ 11.11	0.5	$ 5.56
		Reciprocating Saw		hour	$ 0.46	0.5	$ 0.23

Disassembly of Personnel							*$108.08*
	Supervisor			hour	$ 61.26	0.5	$ 30.63
	Technician 1			hour	$ 48.45	0.5	$ 24.23
	Technician 2			hour	$ 48.45	0.5	$ 24.23
	Equipment Operator			hour	$ 58.00	0.5	$ 29.00

Figure B-2 Baseline Reciprocal Saw Implementation Cost Detail, Per Week of Operation

APPENDIX C

HEALTH AND SAFETY ASSESSMENT BY THE INTERNATIONAL UNION OF OPERATING ENGINEERS

Safety and Health Concern	Porter♦Cable Sawzall	Mega-Tech Cutter	Comments
Electrical (Lockout/Tagout)	2 (Electricity)	3 (Electricity and Hydraulic)	Lockout/Tagout of concern during maintenance
Fire and Explosion	2 (potential for sparks from cutting)	1	
Confined Space Entry			Proper precautions for both if used in a confined space
Mechanical Hazards	4	4	
Pressure Hazards	1	4 (Hydraulic lines)	
Tripping and Falling	3	3	Hoses and electrical lines
Ladders and Platforms	N/A	N/A	
Moving Vehicles	N/A	N/A	
Buried Utilities, Drums, Tanks	N/A	N/A	
Protruding Objects	N/A	N/A	
Gas Cylinders	N/A	N/A	
Trenching and Excavations	N/A	N/A	
Overhead Lifts	N/A	N/A	
Overhead Hazards	3	3	Presents some overhead hazards when cutting required saw/cutter to be held above head height to perform cutting
Inhalation Hazard	3	2	All air samples taken showed levels well below allowable limits but due to mechanism of cutting saw has more potential to create airborne contaminants
Skin Absorption	1	2 (Hydraulic fluid)	
Heat Stress	1-4	1-4	Dependent on environment where being used
Noise	4 (8-hour projected exposures of 234.29% and 304.85% dose)	1 (8-hour projected exposures of 11.46% and 11.56% dose)	Allowable 8-hour exposure level is 100% dose
Non-ionizing Radiation	N/A	N/A	
Ionizing Radiation			Not direct part of either technology but sawzall has greater potential for generation of creating airborne if cutting contaminated surface

Safety and Health Concern	Porter♦Cable Sawzall	Mega-Tech Cutter	Comments
Cold Stress	1-4	1-4	Dependent on environment where being used
Ergonomic Hazards	4	3	Both have ergonomic hazards associated with positions required for cutting and the weight of the saw/cutter but sawzall also has hand-arm vibration associated with it
Other		Would require hazcom be considered because of hydraulic fluids being used	

Key:

1. Hazard may be present but not expected over background level
2. Some level of hazard above background level known to be present
3. High hazard potential
4. Potential for imminent danger to life and health

APPENDIX D
ACRONYMS AND ABBREVIATIONS

ASTD	Accelerated Site Technology Deployment
BPC	Blade Plunging Cutter
CFR	Code of Federal Regulations
D&D	Deactivation and Decommissioning
DOE	Department of Energy
DVRS	Decontamination and Volume Reduction System
EM	Environmental Management
FIU-HCET	Florida International University's Hemispheric Center for Environmental Technology
Gal	Gallon
H	Hour
HEPA	High efficiency particulate air
HPU	Hydraulic Power Unit
in.	Inch
IUOE	International Union of Operating Engineers
LANL	Los Alamos National Laboratory
LSDDP	Large-Scale Demonstration and Deployment Project
OSHA	Occupational Safety and Health Administration
OST	Office of Science and Technology
PPE	Personal protective equipment
RFETS	Rocky Flats Environmental Technology Site
USACE	United States Army Corps of Engineers
TAP	Technology Assessment Program
TRU	Trans Uranic