



# **PINE BLUFF EXPLOSIVE DESTRUCTION SYSTEM (PBEDS)**

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## PINE BLUFF EXPLOSIVE DESTRUCTION SYSTEM

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*The Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) is responsible for the destruction of all United States non-stockpile chemical materiel, which includes recovered chemical munitions. At one time over 1,200 recovered chemical munitions were stored at Pine Bluff Arsenal (PBA), Arkansas. Since June 2006, these items have been undergoing destruction at the newly constructed Pine Bluff Explosive Destruction System (PBEDS). PBEDS employs three Explosive Destruction System (EDS) units to treat recovered chemical agent munitions at PBA. The EDS is total containment blast chamber that was first operationally deployed in 2001, that uses shaped charges to access munitions and destroy explosive components and chemical neutralization to treat the chemical fill. Prior to treatment, munitions that had been stored since the late 1980's at PBA were unpackaged, x-rayed, assessed by portable isotopic neutron spectroscopy, and repackaged, with the results reviewed by the Materiel Assessment Review Board. This assessment allowed the number of Chemical Weapons Convention declared munitions to be reduced from over 1,200 to 561.*

*The munitions to be destroyed at PBEDS range from 75mm projectiles, to 4.2-inch mortars, to German Traktor Rockets, to 100-pound aircraft bombs. Destruction operations at PBEDS are accomplished using three EDS units. Typically, two units are in operation while a third is available as a spare. One EDS operates (Day 1/Day2) Monday/Tuesday and Wednesday/Thursday while the second EDS operates Tuesday/Wednesday and Thursday/Friday. This scheme balances the level of work by avoiding concurrent Day 1 operations. Maintenance activities are performed once a week. An EDS can process up to 6 munitions at one time with 4 detonations per week (2 per EDS) in a standard 4-day processing work week. Up to 24 mustard filled or 48 phosgene or arsenical filled munitions can be destroyed in a standard 4-day processing work week. In addition, a one day process has been developed to destroy many of the undeclared items; this increases weekly system throughput to 48 munitions.*

*This paper addresses the procedures, operations, and findings of the PBEDS project and how the equipment used and information gained is applicable to destruction of recovered CWM throughout the world.*

## **Section 1**

# **Introduction**

The U.S. Army Chemical Materials Agency (CMA) has the responsibility for the destruction and disposal of Chemical Warfare Materiel (CWM). The destruction of Non-Stockpile Chemical Materiel (NSCM) is the responsibility of the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM). The PMNSCM mission responsibilities include disposal of recovered chemical warfare materiel (RCWM) such as recovered chemical munitions.

The PMNSCM has developed mobile/transportable technologies that use chemical methods to neutralize chemical warfare agents and decontaminate munition fragments. The Explosive Destruction System (EDS) has been developed to process both explosively and non-explosively configured CWM. The mission of the EDS is to safely destroy CWM and prepare the residuals for disposal. Several versions and sizes of EDSs, the EDS Phase 1 Unit 1 (P1U1) prototype, Phase 1 Units 2 and 3 (P1U2/3), and Phase 2 Units 1 and 2 (P2U1/2), have been developed to destroy RCWM. EDS operations are generally conducted by personnel from the Edgewood Chemical Biological Center (ECBC).

The Pine Bluff Arsenal (PBA) in Pine Bluff, Arkansas, had approximately 1,200 RCWM in storage. The PMNSCM has designed, constructed, tested, and is now operating the Pine Bluff Explosive Destruction System (PBEDS), a facility centering around the operation of three EDS units for the treatment of RCWM at PBA.

## **1.1 PMNSCM Mission**

The Non-Stockpile Chemical Materiel Mission is to provide centralized management and direction to the Department of Defense for disposal of NSCM in a safe, environmentally sound, and cost-effective manner while ensuring compliance with the Chemical Weapons Convention (CWC).

## **1.2 PBEDS Mission**

The PBEDS mission is to destroy the approximately 1,200 recovered chemical munitions stored at PBA in a safe, environmentally sound, cost-effective manner while ensuring compliance with the CWC.

## Section 2

# Description of PBEDS

The PBEDS facility is located on the site of the former Integrated Binary Production Facility. The site includes three environmental enclosures (EEs), each housing an EDS unit. The site contains a command post where the PBEDS operations are coordinated, a break building where the operators dress-out in appropriate gear and rest between operational steps, and a mobile chemical laboratory for analyzing liquid and vapor samples collected during operations.

## 2.1 Inventory

The RCWM are stored at PBA in the Bond Road Exclusion Area of the Pine Bluff Chemical Activity. The following types of munitions will be processed at PBEDS:

- German Traktor Rocket (GTR) warheads
- 4.2-inch mortars
- 75mm projectiles
- Livens projectiles
- M70A1 gas bombs

These munitions may be empty or may contain the following classes of chemical materials:

- Blister agents (mustard [H, HD] or nitrogen mustard [HN3])
- Choking agent (phosgene [CG])
- Irritants (DA/PD/TA or DA)

Prior to treatment, the munitions were unpacked, x-rayed, assessed by portable Isotopic Neutron Spectroscopy (PINS) and repackaged, with the results reviewed by the Materiel Assessment Review Board (MARB). This assessment resulted in many of the items being undeclared due their non chemical agent fill. This process reduced the number of CWC-declared items from over 1,200 to 560. Table 2-1 lists the quantity per type of munition and number that are treaty declared.

Table 2-1. PBEDS Inventory

Type	Total Inventory	Treaty-Declared Inventory
4.2-inch Mortars	703	69
German Traktor Rockets	472	457
75mm Projectiles	19	13
Livens Projectiles	16	13
M70A1 Bombs	9	8
<b>TOTALS</b>	<b>1220</b>	<b>560</b>

## 2.2 Explosive Destruction System

The PBEDS employs three EDS units to treat RCWM. The EDS is total containment blast chamber that was first operationally deployed in 2001, uses shaped charges to access the munitions and destroy explosive components, and then uses chemical neutralization to treat the chemical fill. The three EDS units at PBEDS are one Phase 1 (P1U2) and two Phase 2 units. The EDS Phase 1 and Phase 2 units are comprised of the following subsystems:

- Trailer Subsystem
- Containment Vessel Subsystem
- Clamp Hangar Subsystem (P2 units only)
- Helium Supply and Leak Detection Subsystem
- Rotary Agitation Subsystem
- Reagent Supply Subsystem
- Waste Handling Subsystem
- Electrical Subsystem
- Explosive Opening Subsystem.

The EDS P1U2 can process up to three munitions (4.2-inch mortars or 75mm projectiles) at one time, and the EDS P2 units can process up to six munitions (4.2-inch

mortars, 75mm Projectiles, or German Traktor Rockets warheads at one time. Other types of munitions are processed singularly.

## **2.3 PBEDS Site**

The PBEDS is located on the site of the former Integrated Binary Production Facility. The binary fill area equipment and buildings were previously destroyed under the provisions of the CWC. The PBEDS site was cleared and leveled prior to site construction. Concrete pads were poured to support each EDS and its ancillary equipment. Two earth-filled (sand), steel bin-type barricades (ARMCO Revetments or equivalent) were erected between the EEs. Crushed stone was placed in areas where appropriate around the modular facilities and the pad sites.

A horseshoe shape road was constructed through the site, starting at the personnel entry point and continuing to the front of the EDS units. A service road allows service vehicles access to PBEDS support equipment. Two aboveground prefabricated service magazines and a munition storage unit are located at the site. A command post (modular facility), mobile chemical laboratory, medical support station, and a break trailer/change house (modular facility) are also located on-site. To support PBEDS operations, a parking lot, guard house, and warehouse are nearby.

The site is equipped with water, power, and fiber optic lines. In addition to internet capability, fiber optic lines are used for the transfer of real-time video from PBEDS closed circuit television to treaty inspectors located off-site at PBA.

Each EDS is located in an EE that has a carbon filtered exhaust system that maintains a negative pressure within the enclosure. The EE provides environmental control of the workspace.

Major support equipment includes:

- Generator
- Air Monitoring Shelter
- Mobile Chemical Laboratory
- Command Post
- Break Trailer/Change House
- Explosive Storage Magazine
- Warehouse
- Munition Storage Units (MSUs)

The interior of an EE is depicted in Figure 2-1. Each EE contains an EDS and the following support equipment: Air Compressor, Generator, HVAC unit, Monitoring equipment and module, personnel decontamination station, and Carbon filter unit.

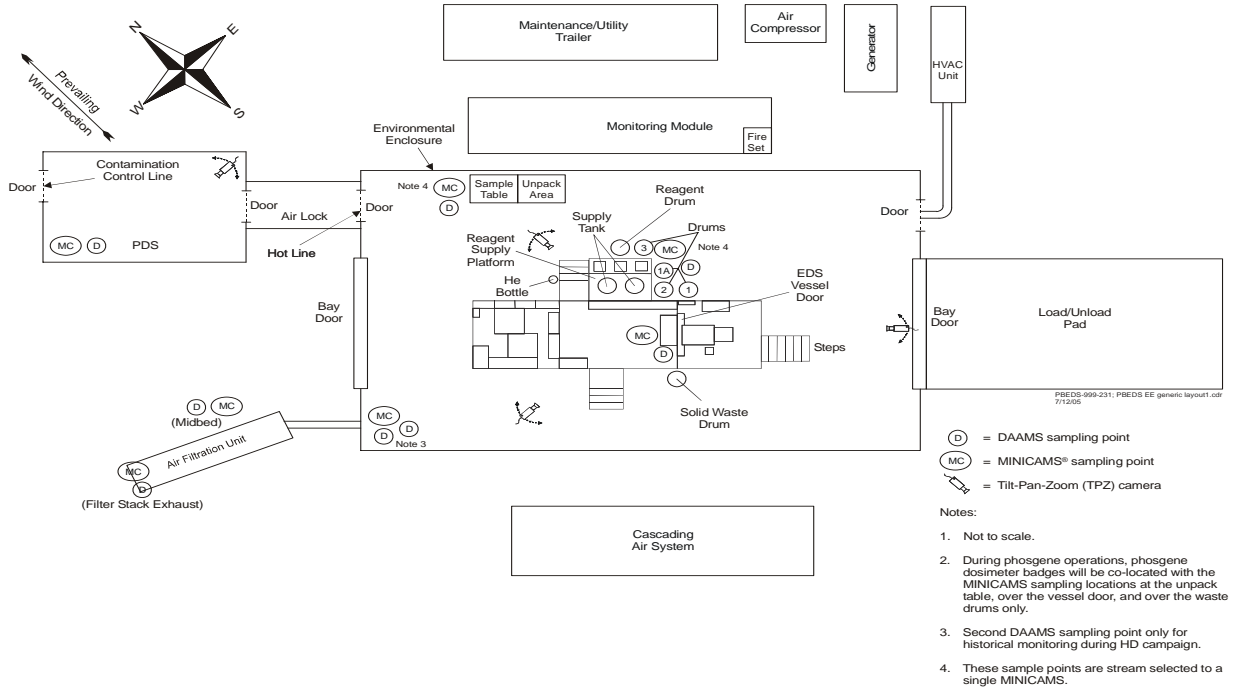


Figure 2-1. Environmental Enclosure Layout

### Section 3

## General Site Operations

The successful destruction of RCWM at PBEDS requires a coordinated effort by numerous organizations and individuals.

### 3.1 Operational Schedule

Destruction operations at PBEDS are accomplished using three EDS units; one Phase 1 and two Phase 2 Units. Typically, two units are in operation on the same day, while the third is available as a spare. The spare unit is maintained in a readiness mode such that it can be quickly brought on line in the event of a failure or issue with one of the operating units. For the standard two-day EDS operational cycle, Day 1 operations, which include the detonation of the shaped charges and the neutralization process, require a longer time onsite than Day 2 operations. The current operational plan is for one EDS to operate (Day 1/Day 2) Monday/Tuesday and Wednesday/Thursday while the second EDS operates Tuesday/Wednesday and Thursday/Friday (see Figure 3-1). This scheme balances the level of work during the week by avoiding concurrent Day 1 operations. Maintenance activities are planned to be performed once a week, every Monday by one EDS crew and every Friday by the other EDS crew.

EDS	Monday	Tuesday	Wednesday	Thursday	Friday
A	Day 1	Day 2	Day 1	Day 2	Maint
B	Maint	Day 1	Day 2	Day 1	Day 2

Figure 3-1. Planned Operational Week Cycle for Two-Day Operations

Phosgene, arsenical (DA/PD/TPA), and certain empty munitions can be processed in a single day operational cycle. Empty mortars are planned to be processed using the one-day operational cycle when final approvals are received. When this process is used, a complete cycle is planned for four days per week, with maintenance on the non-operating day (see Figure 3-2).

EDS	Monday	Tuesday	Wednesday	Thursday	Friday
A	1 Day Ops	1 Day Ops	1 Day Ops	1 Day Ops	Maint
B	Maint	1 Day Ops	1 Day Ops	1 Day Ops	1 Day Ops

Figure 3-2. Planned Operational Week Cycle for One-Day Operations

## 3.2 Operations Process

Operating an EDS at PBEDS consists of several procedures which can be broken down into three categories; setup, operations, and post-operations. These categories are described in more detail as follows:

- **Setup:** Setup of the operation includes doing pre-operational checks to ensure that all fluid levels meet requirements and equipment is online and operational, preparing explosives that will be used for the scheduled munitions, and preparing the fragment suppression system (FSS) to receive the munitions
- **Operations:** All operations are conducted using the near-real-time MINICAMS<sup>®</sup> which monitors for the chemical of concern for that operation. The operation begins with the receipt of munition(s) at the EE. Munitions may be received from the Arsenal or may be stored on-site in the MSU. The munition overpacks are moved into the EE and unpacked. Once unpacked, the munitions are moved to the loading table on the EDS trailer and placed into the bottom half of the FSS, linear (and conical, as needed) shaped charges are positioned and the top half of the FSS is put into place. The FSS is used to help protect the interior surfaces of the EDS vessel. The FSS is then pushed into the vessel and the vessel door is sealed and leak tested with helium. Operators then detonate the shaped charges, fill the vessel with appropriate reagent, heat and rotate for a specified time or until the samples collected are analyzed to meet the treatment goal. The vessel is rinsed with water and rotated for specified times and then the door is opened and the debris removed. The FSS is an expendable component and is discarded with the munition fragments.
- **Post-Operations:** Once the vessel is empty, clean up operations are initiated. The vessel interior is cleaned, door parts are removed and cleaned, all solid waste is bagged, and liquid and solid wastes are removed to the warehouse for further disposition. Post operation checks are completed. At this point, the EDS is ready for the next operation.

## 3.3 Restricted Operations

During PBEDS two-day operations, the potential exists for chemical accidents to occur. Operations are coordinated and integrated through the PBEDS Site Integration Plan to minimize the possibility of having two chemical accidents or incidents occur at the same time. Table 3-1 lists the restricted operations that are only allowed to occur at one EE at a time. Unrestricted operations at one EE may occur simultaneously with restricted operations at another EE.

Table 3-1. PBEDS Restricted Operations During Two-Day Operations

Procedure	Start*	Stop*	Time**(min)
Day 1 Operations			
Munition overpack(s) opening and monitoring (see EDS SOP Procedure 6*)	Prior to opening the overpack(s).	After an adequate seal is achieved and all valves on the containment vessel door are closed.	20
Fragment Suppression System (FSS) assembly and placement within the vessel (see EDS SOP Procedure 7*)			30
Door closure and sealing (see EDS SOP Procedure 9*)			30
Neutralent liquid sampling (see EDS SOP Procedure 13*)	Prior to clearing the liquid sample line.	After the liquid sample is packed into secondary containment, a new sample valve assembly is attached to the containment vessel door and all valves on the containment vessel door (excluding valve 23) are closed.	30
Day 2 Operations			
Helium flushing and Tedlar bag sampling (see EDS SOP Procedure 16*)	Prior to purging the containment vessel with helium	After the Tedlar bag is transferred to monitoring personnel and the supply hose is vented of Helium.	10
Opening of vessel door and monitoring (see EDS SOP Procedure 17*)	Prior to venting containment vessel.	After all solid debris is removed from the vessel.	40
Solid waste removal (see EDS SOP Procedure 18*)			15
Vessel cleaning (see EDS SOP Procedure 19*)	Prior to servicing the containment vessel and containment vessel door.	After appropriate door parts are removed from the containment vessel door and placed into secondary containment and appropriate lines are cleared.	90

\* These are approximate start and stop points for Restricted Operations. The Operations Order denotes the start and stop SOP steps for each Restricted Operation

\*\* Estimated time required to perform each procedure when processing a mustard munitions 6-pack over a 2-day time period.

### **3.4 Status of Operations**

PBEDS operations began on 13 June 2006 with the processing of three 4.2-inch mortars. Since that time a majority of the 4.2-inch mortars have been processed in a six-pack configuration. Figure 3-3 shows six 4.2-inch mortars in a six pack FSS prior to placing the top half of the FSS on and pushing the assembly in the EDS vessel. To date, over 70 six-pack 4.2-inch mortars have been processed at PBEDS in this manner. The 23 4.2-inch mortars that were assessed as "armed and fuzed" were processed in a single-munition configuration. All treaty declared 4.2-inch mortars in inventory at PBA have been destroyed.

The miscellaneous campaign began in December 2006 with the processing of three 75mm projectiles. All 19 75mm projectiles in inventory at PBA have been processed. In addition, five Livens projectiles have been processed.

The processing of German Traktor Rocket Warheads began in February 2007 and is ongoing. Figure 3-4 shows the six-pack configuration for German Traktor Rockets. The processing of the remaining Livens projectiles and the M70 bombs is expected to occur in the summer of 2007



Figure 3-3. 4.2-inch Mortars



Figure 3-4. German Traktor Rocket Warheads

## Section 4

# Conclusions

PBEDS began operations on 13 June 2006. To date, all treaty declared 4.2-inch mortars in inventory at PBA have been destroyed. All 75mm projectiles have also been destroyed. CG, HN3, and HD items have been processed at PBEDS. PBEDS has successfully demonstrated several firsts during its operations.

- 1) PBEDS is the first operation to employ multiple EDS Units
- 2) PBEDS is the first operation to operate multiple EDS Units simultaneously.
- 3) PBEDS is the first operation to operate multiple EDS Units over an extended period of time in an assembly line type processing.

PBEDS has successfully processed over 40% of the PBA RCWM inventory and is on schedule to complete the destruction of the entire inventory by end of 2007.