Golden West Humanitarian Foundation

Information Briefing

Explosive Harvesting System (EHS)

2007 Global Demilitarization Symposium

May 2007

Explosive Harvesting

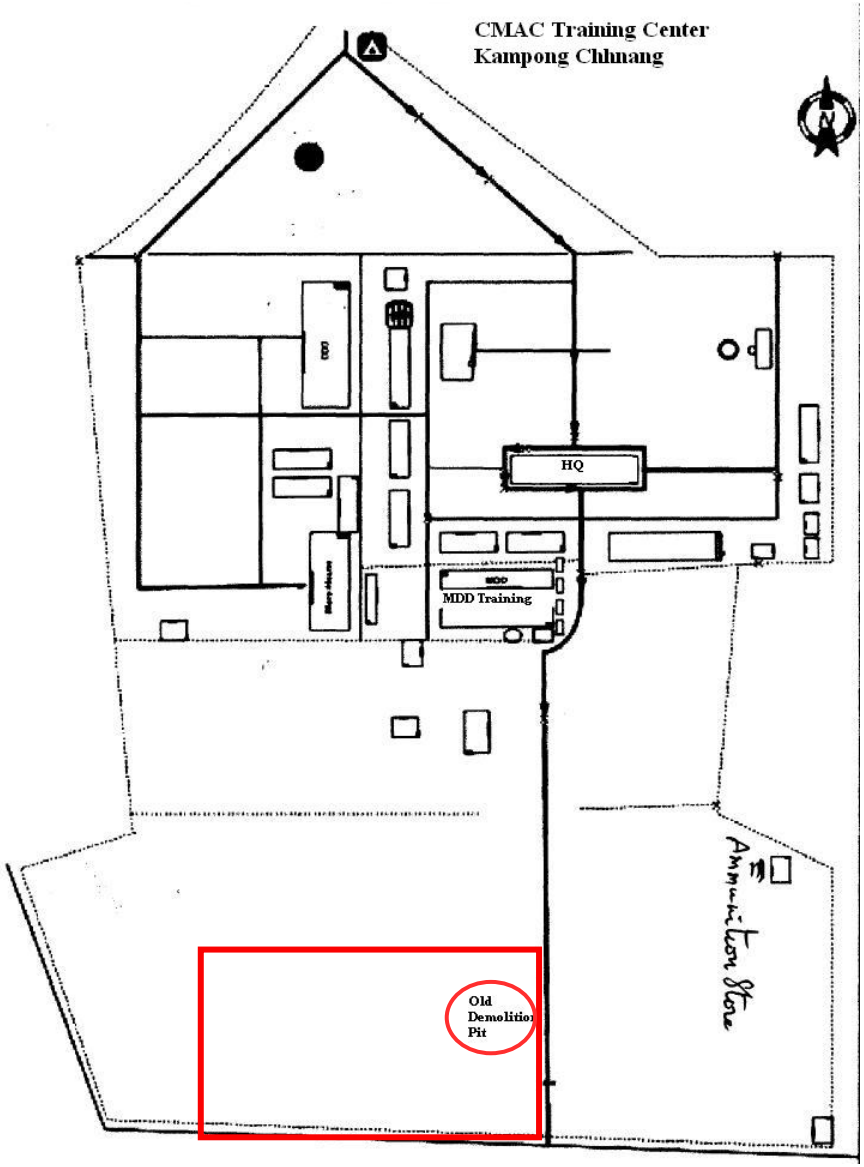
The Explosive Harvesting System (EHS) is a R&D program initially funded by the US DoD Humanitarian Demining R&D Program.

- *The goals were to establish a deployable system which can:*
  - *Safely remove the explosives from bombs, anti-tank mines, large caliber artillery projectiles, and other ordnance.*
  - *Efficiently convert the recovered explosives into disposal charges for use by the demining and EOD teams.*
- *The program was mobilized in **March 2005***

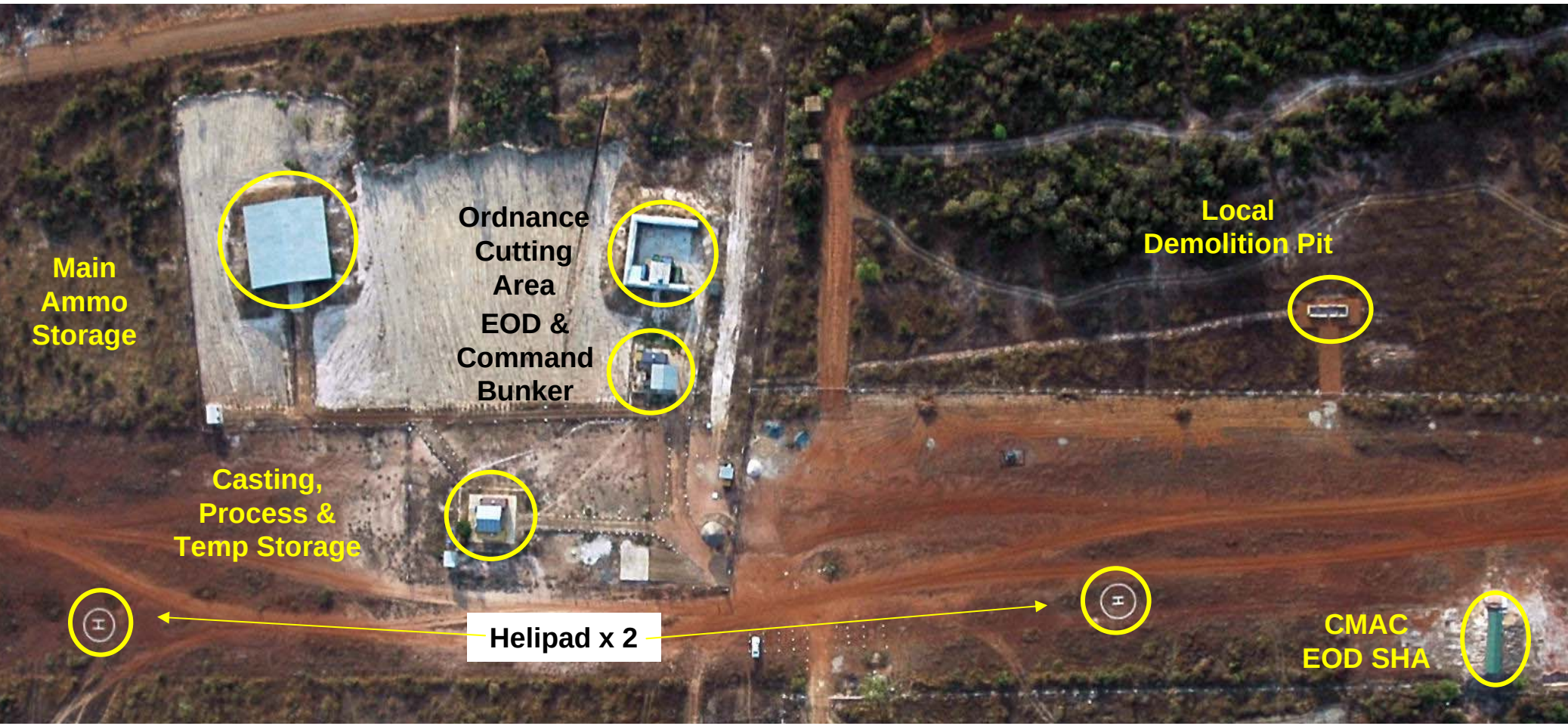
Prime Location

- Cambodia was selected as an excellent location to conduct R&D
  - CMAC is our working & implementation partner
  - Kampong Chhnang CMAC Training Center was made available to support the projects
  - Largest amount of MAA in SE Asia with a heavy work load and very good working relations.

EHS Site @ 1 March 2005

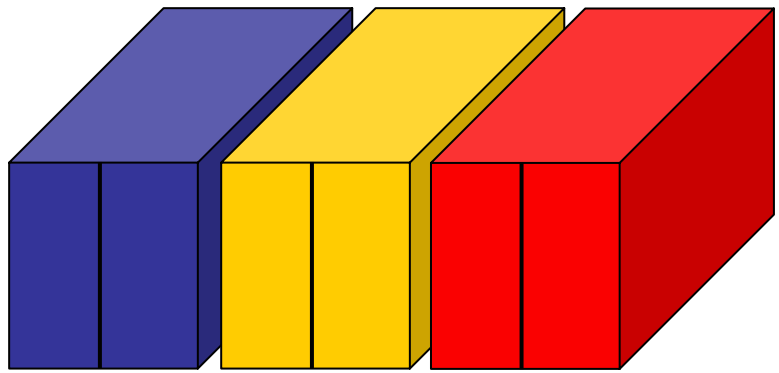


EHS Today


Main Ammo Storage
Ordnance Cutting Area
EOD & Command Bunker
Local Demolition Pit
Casting, Process & Temp Storage
Helipad x 2
CMAC EOD SHA

Original EHS Concept

- The system would be built into three color coded 20ft ISO shipping containers.
  - Blue: EOD & Cutting Tools
  - Yellow: Temporary Storage
  - Red: Explosive Casting
- The system would be self contained, requiring only fuel, water and a suitable location to set up.
- The system would be modular and adjusted up or down, depending on the customers needs.



EOD & Ordnance Cutting Container

- The Blue ISO container is dedicated for the ordnance cutting and EOD equipment.
- A 1,000 liter container supplies water and a 125kW generator set provides power to the site.
- A reinforced bunker was built to operate the controls of the cutting system from 35 meters away.

Cutting & Testing Area

- A specific area was built for the cutting of ordnance and pre-testing of explosives
- Walls are 1.4 meters thick and filled with sand with an additional three meters of sand buttressing the exterior.
- Cutting zone is additionally hardened by one-meter thick sand filled barriers & a vented 40 cm thick steel reinforced concrete roof.

Recasting Container

- The Red ISO container is outfitted with steam lines, gauges, and the required equipment to safely conduct explosive melting.
- The process is based on procedures used by the South African Counsel of Scientific and Industrial Research (CSIR), one of Golden West's partners.
- Recasting can be conducted either inside the container, or outside under the shelter when conditions allow.

Temporary Storage Container

- The Yellow ISO container is outfitted with Formica shelving suspended by stainless steel rods from the roof.
- Freshly processed charges are stored for curing/drying in a secure, controlled environment.
- The shelves are disassembled for transport when the container is used for shipping bulky items.

Main ASP Storage

- The ammo storage facility at KCTC was not suitable for the EHS needs and the distance to the local population is much **less than** preferred
- A new storage area was built and measures were taken to ensure it is as safe as possible.
- Construction:
  - The walls are 1.4 meters thick and filled with sand.
  - The outside is buttressed with over three meters of sand

Interior Barrier Walls

- Sand-filled concrete pipes separate the interior into 24 individual cells.
- This simple design prevents the propagation of a blast to the adjoining cells.
- It has been practically tested on the demolition range and proven very effective.

MCE Test

- To verify the barriers would work; a Maximum Credible Event (MCE) test was conducted.
- Live ordnance was placed in cells identical to those in the bunker.
- A cell containing 30.1 kg of explosives was then detonated.

MCE Test Result

- The barriers were destroyed, however no other ordnance was damaged or thrown beyond the immediate area.
- The ordnance color coded white was the <u>closest</u> to the blast (circled in red).
- This verified the bunker could safely store 720 kg of explosives (24 cells @ 30 kg each) *without risk to the general public.*

Freedom of Movement

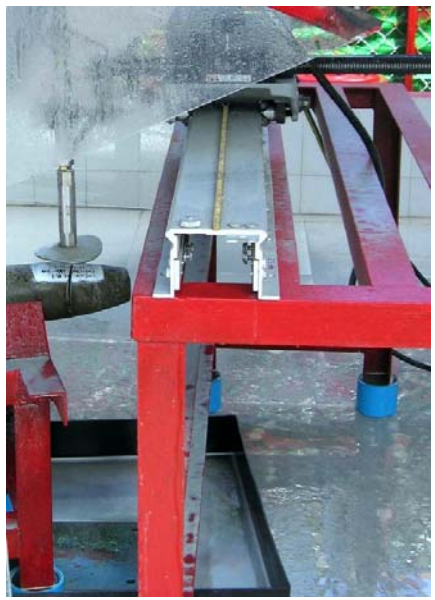
- Through the support of the US DoD-HD R&D program; the EHS was able to proceed at a pace that is rarely seen in R&D:
  - A site was quickly established to safely attempt new approaches for converting ordnance into disposal charges
  - The challenges presented by building the system in Cambodia helped tailor it for other developing countries.
  - Team members were encouraged to become creative: *we would never know unless we tried*
  - Potential damage to equipment and protective structures were permissible; as long as no one was injured in the process
- Through this methodology; some “Norms” were broken, myths dispelled, and information not previously known was discovered.

Starting Point: Gaining Access

- The EHS started with tools, equipment and procedures based on recognized industry standards.
- The most expensive and complex was the Osprey water-abrasive cutting system for accessing the munitions.
- $85k for the system + specialized training and support materials are required

Hydro-Cutting Realities

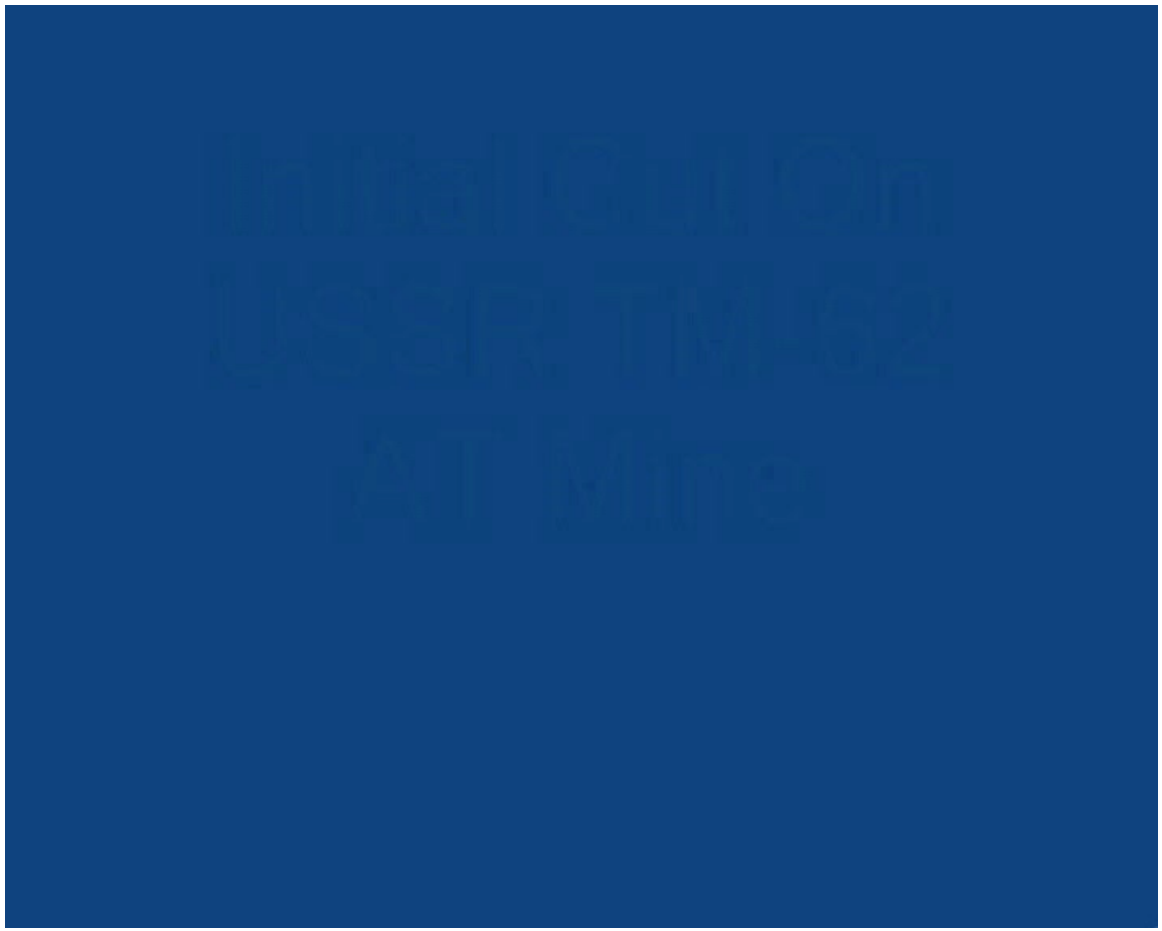
- Requires a factory trained and certified operator.
  - Failure to do so presents high risks and voids warranty.
- Relies on imported olivine sand.
  - All local options were tested and are unsuitable.
- Over-spray and water runoff must be contained, collected and processed as *explosive waste.*
  - Between 100-200 grams of HE are lost into the water during ***each cut***



Alternative process

- If the primary objective is to recover main charge explosives from *stock pile ammunition*, the following procedure is proving to be a far more *cost effective* option.

Anti-Tank Mines



Recovered HE

Modified Band Saw Advantages

- All working parts and supplies are readily available.
- Minimum operator training required.
- Minimum explosive loss.
- Minimum over-spray and run-off.
- Over 60% smaller in size and weight.
- Cuts ordnance over 50% faster
- No measurable temperature increase in the case or explosive.
- Over 25 band saws can be purchased and modified for the cost of ***one*** Hydro-abrasive set
  - *Note: The Osprey was the **least** expensive of all systems surveyed*

HE Recovery from Projectiles

- The most time and cost effective way to remove the explosives from the ordnance casing was also assessed.
- A simple steaming adapter was locally fabricated that allows the explosive to drop free within 3-5 minutes

Steam Adapter

End Result

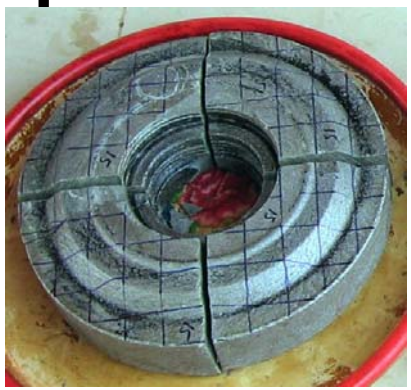
- The HE Packages are quickly removed from the casing and processed into disposal charges.
- The empty casings are thermally treated to 1,000c using locally available charcoal and turned over for recycling.

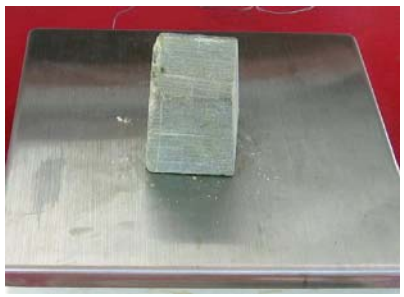
Processing Explosives

– Direct Processing (*Fastest Method*)

– Partial-Reprocessing (Medium)

– Full Reprocessing (Slowest Method)






“Desirable” Ordnance

- The ordnance found to contain “Cap Sensitive” Explosive to date are:
  - USSR TM-62M AT Mine.
  - USSR TM-57 AT Mine ***with*** “MS” filler code
  - USSR 122mm M-21F Rocket warhead
  - USSR RPG-2
  - USSR RPG-7
  - USSR 152mm OF-540
  - USSR 130mm OF-482M
  - USSR 122mm OF-462
  - USSR 122mm OF-56*
  - USSR 122mm OF-56-1*
  - USSR 100mm OF-412
  - US 105mm M-1 ***with*** Comp-B filler
  - US 81mm M-374 ***with*** Comp-B filler
  - USSR PMN-2 AP Mine

Harvest Ratios (Actual)

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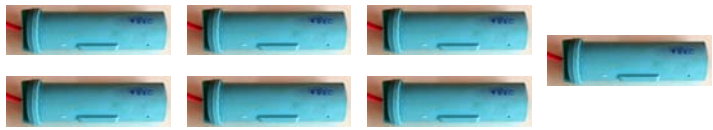

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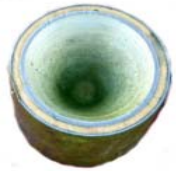

One USSR RPG-2 Anti-tank Grenade contains 535 grams of TG-50 (50% RDX)

Total 70 gram cast charges possible: 7 each or one EOD Shaped Charge

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One USSR 152 mm OF-540 Projectile contains 6.0 kg of pressed TNT

Total 100 gram wedge charges possible: 60 each

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One USSR TM-62M Antitank mine contains 7.0 kg of Cap Sensitive Explosive (TM)

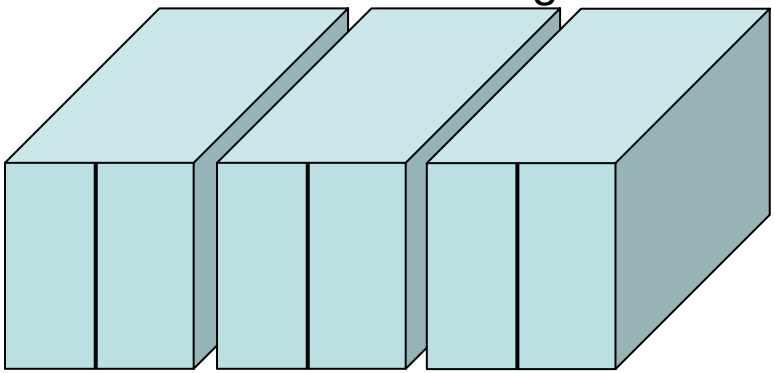
Total 100 gram block charges possible: 70 each

Charges on Demand

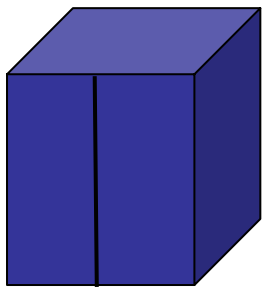
- Using the ordnance listed; the EHS has been able to
  - Converted 13,000+ kg of ordnance into more than 17,000 charges
    - 16,000 of which have been *used in clearance operations*.
  - Destroy over 700 mines and UXO items during live testing
  - Return 7,000+ kg of thermally treated FFE metal for recycling
- *Thanks to **DoD/NVESD** for the funding to make this happen and **DoS/WRA** to help sustain it for 2007*

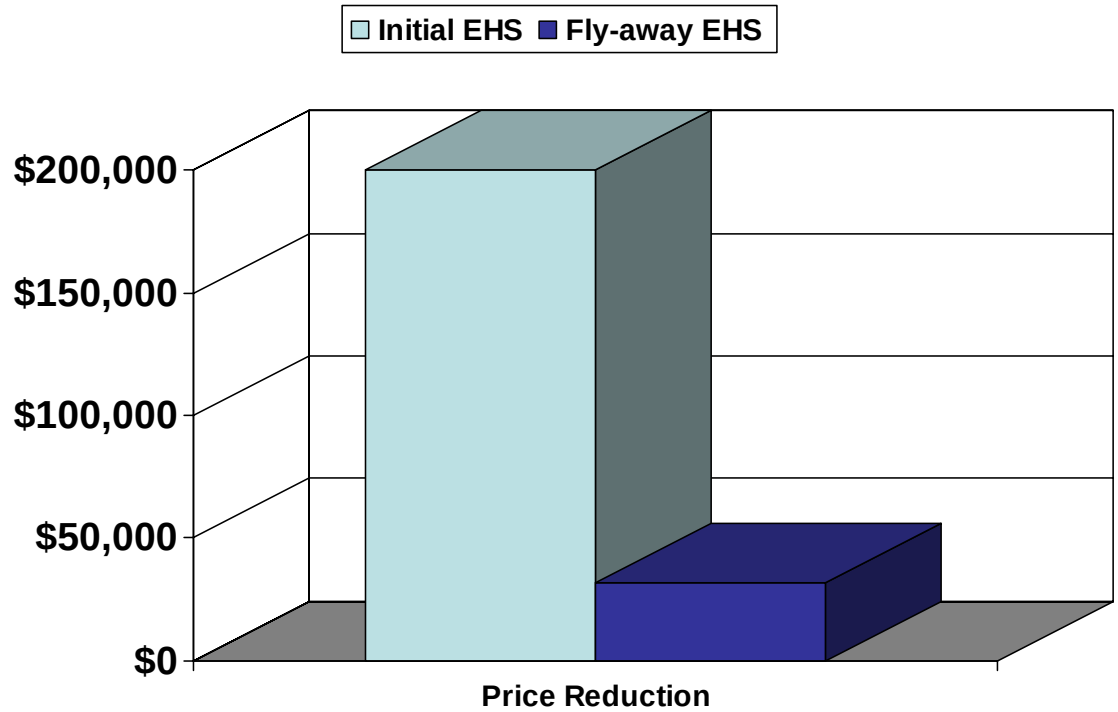
EHS Size and Cost Reductions

Initial EHS Configuration



“Fly-away” EHS Configuration





Questions?

Thank You

Golden West HUMANITARIAN FOUNDATION

Office of Weapons Removal & Abatement

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