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 workload and very good working relations.
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 closest 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-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)

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

One USSR 152 mm OF-540 Projectile contains 6.0 kg of pressed TNT
Total 100 gram wedge charges possible: 60 each

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

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Questions?
Thank You
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