TECHNICAL PAPER

Standardized UXO Demonstration Sites

G-Tek Australia PTY Limited – TM-5 EMU/Sling

MOGULS SCORING RECORD NO. 579

The TM-5 EMU in the sling platform is shown being demonstrated by G-TEK Australia PTY Limited.

The TM-5 EMU in the sling platform was demonstrated by G-Tek Australia PTY Limited at the Yuma Proving Ground Standardized Demonstration Site's Moguls Area. This technical paper contains the results of that demonstration. This is a reference document only and does not serve as an endorsement of the demonstrator's product by the US Army or the Standardized UXO Technology Sites Program.

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Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (USAEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

Demonstrator's System and Data Processing Description

The man portable TM-5 electromagnetic unit (EMU) consists of a magnetometer control module produced by G-Tek, multi-period, transient electromagnetic (EM) sensors by Minelab Electronics, DGPS (digital Global Positioning System) by Ashtech, and an odometer by G-Tek.

The TM-5 EMU detector system may be configured with one or two sensors measuring the transient electromagnetic (EM) response. In the application proposed, two sensors will be mounted in an array, oriented perpendicular to the survey direction and delivering a 1.2-meter swath width. In the dual-sensor mode, the TM-5 EMU is operated by a single person.

The TM-5 EMU interfaces with both industry standard real-time kinematic (RTK) DGPS and proprietary cotton thread based odometer systems, providing versatile positioning adaptable to varied terrain and vegetation conditions. The TM-5 EMU has been successfully used for over five years. The odometer remains the positioning technology of choice in adverse terrains, while DGPS is preferred in open environments. Combined, they meet the requirements of most situations.

The TM-5 EMU user interface provides a continuous set of data quality monitors. Audio and graphic displays and alarms monitor sensor signal quality

and position data quality. A key attribute of the TM-5 EMU is its virtual immunity to hot rocks.

The TM-5 EMU detector system interfaces with both industry standard RTK DGPS and proprietary cotton thread based odometer systems, providing versatile time or position-based positioning that is adaptable to varied terrain and vegetation conditions. In both cases, where UXO detection standards of survey coverage are required, G-Tek operators use a pre-established control grid and visual sighters for straight-line navigation, and the DGPS or odometer for data positioning only.

Performance Summary

Results for the Mogul test broken out by size, depth and nonstandard ordnance are presented in table below. Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range. The results are relative to the number of ordnance items emplaced. Depth is measured from the geometric center of anomalies.

The Response Stage results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the Discrimination Stage are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and Pfp was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

Summary of Mogul Results for TM-5 EMU/Sling

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P_d	0.75	0.75	0.70	0.75	0.70	0.80	0.90	0.50	0.30
P_d Low 90% Conf	0.68	0.69	0.58	0.67	0.56	0.65	0.83	0.38	0.08
P_d Upper 90% Conf	0.79	0.83	0.78	0.82	0.78	0.93	0.94	0.62	0.60
P_{fp}	0.85	-	-	-	-	-	0.85	0.85	0.00
P_{fp} Low 90% Conf	0.81	-	-	-	-	-	0.81	0.74	0.00
P_{fp} Upper 90% Conf	0.88	-	-	-	-	-	0.89	0.91	0.68
BAR	0.10	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.55	0.50	0.55	0.65	0.45	0.35	0.65	0.35	0.15
P_d Low 90% Conf	0.46	0.44	0.43	0.54	0.32	0.20	0.57	0.23	0.01
P_d Upper 90% Conf	0.59	0.60	0.64	0.71	0.55	0.54	0.73	0.45	0.45
P_{fp}	0.55	-	-	-	-	-	0.50	0.75	0.00
P_{fp} Low 90% Conf	0.51	-	-	-	-	-	0.47	0.62	0.00
P_{fp} Upper 90% Conf	0.60	-	-	-	-	-	0.58	0.83	0.68
BAR	0.05	-	-	-	-	-	-	-	-

Response Stage Noise Level: 8.00
Recommended Discrimination Stage Threshold: 0.50

Note: *The recommended discrimination stage threshold values are provided by the demonstrator.*

To view the full Scoring Record for this demonstration and for all other demonstrations conducted at the Aberdeen and Yuma Proving Grounds in support of the Standardized UXO Technology Demonstration Sites Program please visit our Web site at: www.uxotestsites.org.