

Meeting EOD's Rapidly Expanding Problem Set

The Naval Surface Warfare Center,
Indian Head Explosive Ordnance Disposal Technology Division

by Keith Plumadore

In Afghanistan—under fire and at night—an explosive ordnance disposal (EOD) Marine rendered safe booby-trapped mines. Around the world, EOD Marines neutralize increasingly varied explosive hazards. Today, they prepare for explosive chemical, biological, radiological, and/or nuclear threats. Marine Corps and EOD units across the Department of Defense (DoD) face an ever-expanding problem set—and so do others.

At the center of U.S. EOD efforts is the Naval Surface Warfare Center, Indian Head Explosive Ordnance Disposal Technology Division (NSWC IHEODTD), in Maryland. It is a “one-stop shop” for DoD EOD units, providing them information and technologies, as well as helping other U.S. agencies and partner nations. It is a fast process—and must become even faster tomorrow.

Ever-Expanding Problem Set

EOD must render safe all ordnance, but “one strange aspect of EOD is its ever-expanding scope,” wrote EOD Marine MSgt J.P. Driver in 1960.¹ He’s right. Then, only a few nations mass produced ordnance. In 2005 in Fallujah, Marine EOD found ordnance from every industrialized nation—missiles, antitank rounds, mortar rounds, and more. It’s expanding in other domains, too. For example, more than 30 countries produce sea mines and 20 export them. By one estimate, there are over 200,000 models of ordnance in the

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world today, and those uncontrolled and unexploded are immeasurable.²

“Don’t underestimate improvised devices,” wrote EOD Marine MSgt R.R. Leaz in 1962.³ They also are expanding EOD’s problem set. In Afghanistan and Iraq, proliferating improvised explosive devices (IEDs) varied in makeup, triggering, and delivery, sometimes changing in less than 2 weeks. They are spreading, too. More than 12

months before October 2013, 14,000 IED-related events occurred outside Afghanistan, causing over 32,000 casualties.⁴ And they are being seen more frequently in the United States, as well. Well known is the April 2013 Boston Marathon bombing, yet less known are 172 IEDs reported in the United States 6 months prior, including a car bomb that leveled three homes in Pennsylvania.^{5,6} “We have seen the future of warfare and it is the IED,” recently stated MGySgt Steven Williams at the Naval Explosive Ordnance Disposal School.⁷ And weapons of mass destruction are a growing concern as well, especially after chemical weapons use in Syria. Conceivably, unsecured chemical artillery shells could be detonated as IEDs.⁸



Marine Corps EOD stages unexploded ordnance in Cigini, Afghanistan. (Defense Department photo.)

The DoD's EOD mission reflects this problem set:

... to neutralize foreign and domestic, conventional, chemical, biological, radiological, nuclear, high-yield explosives (CBRNE) unexploded ordnance and improvised explosive devices.

DoD EOD units perform this mission in their Services' respective warfighting domains. (For U.S. Marine Corps EOD, see the YouTube videos "Roles in the Corps—Explosive Ordnance Disposal" and "Keeping Our Honor Clean: EOD Technicians.") They also increasingly help other organizations with the problem set. They support Federal agencies, like U.S. Secret Service, protecting the president, vice president, and foreign dignitaries.⁹ Additionally, they help local police. In September 2011, EOD Marines removed a container with explosives from a Kill Devil Hills, NC, parking lot, later detonating it.¹⁰ (Also, see the YouTube video "Marine Corps Air Station Beaufort Explosive Ordnance Disposal conducts bilateral explosive training exercise with Beaufort County Sheriff's Office.") They also help other nations' EOD, as exemplified by EOD Marines training EOD from Afghanistan, Japan, the Philippines, and others.

As EOD's problem set increases, so do the stakes and so does the need for information and technologies. And speed counts, making process as important as products.

Déjà Vu 1942

NSWC IHEODTD is the largest concentration of EOD knowledge in the world. The Division is here because its mission is to provide DoD EOD units with information and technology. Many former military EOD technicians have come here to help those on the cutting edge. Other members of the Warfare Center's EOD team are scientists, technicians, engineers, mathematicians, or business majors. But no matter the background, all are driven by the mantra, "Keep them off the wall," referring to the EOD memorial wall at Eglin Air Force Base bearing names of fallen warriors.

That EOD knowledge is also here because it was hard earned at Indian Head. Established by the Navy in 1942,



GySgt Justin R. Jones, NSWC IHEODTD, participated in an explosive detection equipment user evaluation in May. (Photo from seapowermagazine.com.)

the Explosive Investigation Laboratory had the hazardous mission of disassembling enemy ordnance and determining ways to render it safe. It was manned by courageous personnel who investigated thousands of enemy munitions—torpedoes, antitank mines, and notably Germany's V1 buzz bomb and propel-

... speed counts, making process as important as products.

lant from Japan's Baka kamikaze rocket. And the lab was fast, often requested to aid others' research and development (R&D).¹¹

The lab became the Explosive Ordnance Disposal Technical Center, expert in investigating and rendering safe sea, land, and air munitions. In addition to the lab, the center also operated the Navy's Explosive Ordnance Disposal School until it moved to Eglin, FL, in 1999, training thousands of EOD technicians.¹² Since the 1950s, EOD Marines serving at Indian Head aided developments.

Since Indian Head has provided DoD's EOD units with information

and technology, this is in keeping with the Navy being assigned Joint Service EOD responsibilities for R&D and basic training in 1951, and designated as DoD's single manager in 1971. In doing this, NSWC IHEODTD focuses on speed. Here are all personnel for EOD's information management: requirements refinement, technology development, acquisition, and lifecycle support. They meet face-to-face, assess, decide, implement, and adjust. The integrated process enables a "one-stop shop," a model for other acquisition programs—a necessity for EOD.

Informing EOD

In September 2010, an EOD Marine investigated an IED never before seen in Afghanistan, having an antidisturbance switch and 35-pound directional fragmentation charge.¹³ NSWC IHEODTD collects such information, having almost 200,000 significant activity reports. It uses this and other information to develop render-safe procedures for ordnance, disseminated to DoD EOD units via an automated system on a secure portal operated by NSWC IHEODTD. To date, there are almost 10,000 EOD publications covering over 50,000 various types of ordnance. Such information, in varying forms, is shared with local, state, and federal law en-



New York Police Department investigates a car bomb in Times Square using an EOD robot. Many police EOD robots, like this one, can be traced to development at NSWC IHEODTD. (Photo by Christopher Sadowski.)

forcement agencies, U.S. intelligence agencies, and partner nations.

An expanding problem set requires multiple information sources. Disposal procedures for domestic ordnance come from weapons programs, as mandated by DoD. The challenge is getting information on foreign ordnance. Thus, NSWC IHEODTD acquires information from the following:

Finding and disassembling foreign ordnance—foreign material acquisition exploitation program. This program garnered almost 20,000 assets from Iraq and 12,000 from Afghanistan. It involves deploying “essential emergency” civilian employees into theaters to set up “foreign ordnance exploitation cells.” They acquire foreign ordnance needing coverage, working with intelligence agencies, special operators, and others. Cells scrutinize the ordnance, determine it safe, and specially ship it to IHEODTD. Here, in the disassembly

complex, EOD experts examine and radiograph ordnance, sometimes reverse engineer it. Ordnance is then armed to test render-safe procedures. EOD units expect that. Ninety-nine percent of the time they operate on armed ordnance.

Exploiting EOD finds in theater. This is done by a 70-personnel Technical Support Detachment, led by a lieutenant commander. Theater EOD units often recover explosives’ remnants, such as fragments, wires, circuit boards, and tape, which are analyzed by teams deployed from this detachment to identify technologies and biologics that trace devices to networks. Teams inform combatant commanders and NSWC IHEODTD’s initiatives. The Technical Support Detachment operates globally, with particular emphasis on U.S. Central, Southern, and Pacific commands.

Reachback to the Technical Support Center 24/7/365. NSWC IHEODTD’s

Technical Support Center is available to the warfighter 24 hours a day, 7 days a week, 365 days a year. In July 2013 EOD Marines in Afghanistan contacted this center requesting identification of foreign ordnance. Center personnel determined it be a 90mm antistructure munition, requiring more information, which was subsequently obtained. The same week, Holcomb, KS, police requested information on the explosive, Tannerite. The Center also received inquiries regarding the Boston Marathon bombing. This Center collects and provides information to EOD units in DoD; local, state, and Federal agencies; and foreign militaries. It averages 250 contacts a month via phone, e-mail, and even snail mail.

Intelligence agencies. At NSWC IHEODTD, intelligence analysts reach into intelligence agencies’ repositories for EOD-relevant information. Because of NSWC IHEODTD’s close proximity to intelligence agencies in the Washington, DC, area, personnel also readily meet face-to-face, exchanging information. This information is refined for EOD units in weekly intelligence reports or publications. Such EOD-related information, in controlled and varying forms, is also shared with:

- U.S. intelligence agencies.
- Department of Homeland Security.
- Bureau of Alcohol, Tobacco, Firearms, and Explosives.
- Federal Bureau of Investigation.

National laboratories. Sandia, Lawrence Livermore, and Oak Ridge provide EOD-related information on weapons of mass destruction.

Partner nations. They provide information on foreign ordnance via international agreements. NSWC IHEODTD also provides partner nations with controlled and tailored EOD-related information.

Developing Tools

For a decade, EOD Marines have used Remote Ordnance Neutralization System robots to address explosive threats at their bases; these same robots have now migrated to police bomb squads in the United States and other nations. Robots are one of many EOD

tools developed by NSWC IHEODTD using a process that emphasizes speed and stakeholder inputs.

Collected information aids EOD requirements determination and technology developments. It's analyzed along with information from U.S. Central Command's Combined Information Data Network Exchange, the Federal Bureau of Investigation's Terrorist Explosive Device Analytical Center, and other sources. The analysis determines capability gaps and trends.

Such information also aids NSWC IHEODTD's other R&D efforts. Marines carry lightweight kits, rapidly detecting homemade explosives used in Afghanistan's IEDs. EOD technologists collaborated with other NSWC IHEODTD scientists on the development of these kits. Homemade explosives information helped even more scientists address tactical vehicles' survivability.

Inputs on EOD requirements and technology developments come from several other sources, including the Services' EOD representatives, all located at NSWC IHEODTD. They help quantify gaps and ways to close them. Additionally, as members of the Military Technical Acceptance Board, they approve EOD technologies and procedures for joint Service use.

And input comes from experienced EOD technologists anticipating the future. Over 30 years ago, NSWC IHEODTD technologists designed counters to radio-controlled explosives devices. When uses increased in Afghanistan and Iraq—initiated by cell phones, two-way radios, garage door openers, and more—NSWC IHEODTD rapidly built the counters, fielded as jammers, termed “counter radio-controlled improvised explosive device electronic warfare.”

Today, EOD technologists “red team” new commercial technologies, anticipating possible applications for explosive devices. Notably, analog transmissions have initiated explosive devices. Now digital transmissions are increasingly seen as initiators, occurring in cyberspace. When threat applications seem likely, NSWC IHEODTD readies a tool for EOD.

In addition to neutralizing explosives, development addresses other EOD requirements:

EOD awareness of attacks. Enemies often observe EOD technicians rendering safe IEDs and then develop IED layouts for follow-on attacks. NSWC IHEODTD provides technologies and information to increase EOD personnel's situational awareness of such attacks.

Reducing EOD load. EOD technology has often maxed out ground vehicles, containers, and created significant loads for dismounted personnel. Development continually pursues lighter, smaller, and more multifunctional equipment, sharing existing power sources to lighten the load. Equipment must also work in varying worldwide environments.

Enabling fast upgrades. This is especially sought for robots. They need motor skills matching those of humans, better instrumentation, vision systems, and more. But upgrading robots has been problematic. A new family of robots, termed Advanced Explosive Ordnance Disposal Robotic Systems, will have greater functionality. More notably, NSWC IHEODTD engineered the open architecture, standardizing physical and electrical interfaces. Thus, robots can employ “plug-and-play” modules, enabling varying functions and fast upgrades. It is a gamechanger for robot acquisition and uses.

Fast development and acquisition. Enabled by its Concept Realization Innovation and Prototyping Cell, NSWC IHEODTD rapidly takes concepts from “bar napkin to functional prototype” using advanced systems like three dimensional scanning and manufacturing, done in-house, without requiring contracts. Thus, EOD technicians may propose new tools, which a cell can make for confirmation, modification, and testing. Such prototyping informs development and acquisition upfront—a “try before buy”—rather than after they might produce technologies not meeting expectations and increasing costs and causing delays.

Fielding and Support

To speed fielding, NSWC IHEODTD personnel deploy to help introduce

new EOD tools, some deploying routinely to Afghanistan and Iraq. For example, when Marine EOD robots first hit Iraq, NSWC IHEODTD personnel set up a repair facility at Camp Taqaddum, fixing the first damaged robot in 4 hours. The challenge was greater repairs on all EOD equipment. Previous logistics systems took 6 to 9 months. When robots are unavailable, EOD technicians must put on bomb suits, go downrange, and investigate explosive hazards.

NSWC IHEODTD logisticians pioneered a worldwide logistics system, making EOD tools operationally available over 97 percent of the time in combat theaters, getting FedEx's attention, which sent representatives to learn more. The system tracks over 75,000 items, each costing \$5,000 or more and considered a major repair part. Using the system, NSWC IHEODTD moves items to users, repair facilities, and manufacturers.

For example, a Navy EOD unit had a robot's arm break. Unit personnel logged on to a website, reporting the broken arm. NSWC IHEODTD sent a replacement, pulling the broken arm back to the manufacturer, who repaired it. The improved tracking system is helping return EOD tools to use in no more than 14 to 21 days. The system essentially works as follows:

- Items are marked with machine-readable, “unique item identifiers,” like a Social Security number.
- Items' identifiers are input into a web-based system, collecting data on uses, failures, and repairs.
- Items, when shipped or warehoused, are in containers with radio frequency identification tags, pinpointing locations.

In addition to high operational availability of EOD tools, this logistics system has enabled the following efficiencies:

Reduced lifecycle costs. Previously, when a component or module failed, it was discarded and replaced with a new one—particularly expensive if it's a \$30,000 robotic arm. The current system enables items' multiple repairs, collecting data on their costs. Analysis found that repairing that arm 5 times

over 7 years cost \$27,000 with shipping, cheaper than replacing it just once with a new one.

Reduced losses. The previous logistics system had a 20 to 25 percent lost or misplaced rate. Using the current system, all items have 100 percent accountability, dramatically reducing losses to almost zero.

Reduced inventory times. Previous inventories were done quarterly, taking 1 person more than 2 months to resolve discrepancies and causing warehouse shutdowns for 4 weeks annually. Today, the current system does daily inventories, with warehouse antennas scanning items and 1 person resolving discrepancies in 30 minutes.

Efficient buying of replacement items. These are kept in NSWC IHEODTD's warehouses and pushed to EOD units when requested. The current system provides 100 percent accountability of items in EOD units, enabling NSWC IHEODTD to keep just 7 days of parts

on shelves, avoiding under and over buying from manufactures.

Logistics is also informing engineering and acquisition of future EOD systems. Analysis shows components' failure trends and differences that fixes made. NSWC IHEODTD logisticians provide these and other insights as members of integrated development teams. Additionally, the logistics system will be able to push new technologies and upgrades to EOD units.

A Matter of National Security

It is not enough to maintain this process. Consider MSgt Drivers' 1960 truism about EOD's ever-expanding scope. Now consider the National Intelligence Council's projection for 2025, which addresses portions of EOD's problem set:

The proliferation of advanced tactical weapons will increase the potential that they will be used by terrorists. Improved anti-tank guided missiles and other manportable weapon systems, thermobaric and other advanced explosives, and the spread of cheap sensors and robotics that could be used to create more capable improvised explosive devices illustrate this danger.¹⁴

EOD development is about anticipating and staying ahead of this rapidly expanding problem set. NSWC IHEODTD's process is tight and fast. Staying ahead means making it even tighter and faster. It's very much a matter of national security.

Notes

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