


IEDs are estimated to be responsible for as many as 70 percent of the Coalition deaths and casualties in Iraq and Afghanistan.
Image credit: U.S. Army/Teddy Wade



The urgent quest to detect and defeat 'insurgent' explosive devices. **Rick Adams** describes the situation and related training initiatives.

Left of Boom

They call them "improvised" explosive devices, and the impression that's left by the almost casual television reports of roadside bombs is that these deadly packages are cobbled together by amateurish average Iraqi citizens in a dark corner of their hovel, comprised of paint thinner and street litter and held together with baling wire – a sort of modern day Molotov cocktail – then hastily buried in a shallow dirt pit to await a passing convoy of coalition vehicles.

"That is not what we are dealing with," stated Lt. Gen. Russel Honoré, recently retired as commander of the US First Army. "They are more like 'precision' explosive devices. They are precisely placed, precisely timed, and precisely designed to cause casualties. The enemy may not use Space Age technology, but make no mistake, he knows what he is doing."

In the run up to Operation Iraqi Freedom, huge stockpiles of ingredients for bomb making were pilfered from Saddam Hussein's munitions caches. Artillery rounds. Land mines. Fuses. Blasting caps. Detonation cord. Some analysts estimate upwards of a million tons of explosives were looted by groups that would later supply insurgents.

Early in the conflict, the trigger of choice was a low-frequency radio signal, perhaps a cell phone or even a wireless doorbell buzzer. But the coalition forces eventually flooded the theater with jammers to defeat those signals. So

the guerrillas switched tactics. They've graduated to more sophisticated ordnance that is harder to detect and defeat and can be far more deadly.

One weapon is the explosively formed penetrator (EFP), believed to be supplied by neighboring Iran. The EFP uses a passive infrared sensor to detect radiation from a warm passing object (such as a Humvee) and fires a semi-molten disc of heavy copper that can rip through several inches of armor. Home-made? Hardly. EFPs are either milled or punched with a 20-ton hydraulic press into a concave disc up to 11 inches in diameter. The copper projectile has a velocity of 2000 meters per second. Hidden in foam blocks disguised as roadside rocks or curbstones, the only unusual visible feature is a coin-sized hole for the infrared lens (which troops have dubbed 'The Eye of Allah.')

Another pernicious tactic is the "deep buried" or underbelly bomb – as much as 100 pounds of explosives detonating beneath a vehicle, a blast not even an up-armored Humvee can withstand. The first use of this tactic took out a 26-ton armored personnel carrier and an entire squad of Marine reservists.

Insurgents have also tried pressure-plate devices, fertilizer-based bombs ala the Oklahoma City terrorist duo, chlorine gas, and of course suicide bombers, vehicles, and booby-trapped buildings.

Although many of the hole-digging "emplacers" and triggermen may be jobless young men hired as freelance

mercenaries, paid the equivalent of a few hundred dollars to perform the riskier parts of the operation, the crux of the threat is the bombmaker. These include ideologues with degrees in electrical engineering and former Republican Guard, special security, and intelligence operatives in Saddam's regime with extensive explosives knowledge.

IED specialists advertise their skills on the Internet, filming videos of their macabre conquests. Some share techniques via CD-ROM for bomb assembly, tactics like daisy-chaining charges to increase the kill zone, and intel about American and British vulnerabilities.

Plan Bee

IEDs are estimated to be responsible for as many as 70 percent of the Coalition deaths and casualties in Iraq and Afghanistan. Iraqi officials and civilians are targets as well – police stations, markets, even mosques. It's estimated that more than 12,000 non-combatants have been killed by IEDs.

The indiscriminate carnage is not limited to Iraq and Afghanistan. IEDs are a weapon of choice in places such as Somalia, the Philippines, and even Russia. Indeed, they were frequently used in the 30-year conflict in Northern Ireland. And even Lawrence of Arabia used roadside bombs to harass Turkish trains during WWI.

The US Department of Defense has tried nearly everything it can think of to detect and defeat this pernicious threat.

Electronic jammers and pre-detonators. Radars, x-ray equipment, and robotics. Armor for Humvees and body armor for dismounted infantry. Wallet cards with tips on how to spot and handle different devices. Secure websites with the latest IED twists. A "stoichiometric" diagnostic device for deciphering chemical signatures through metal (known as CarBomb Finder Model 3C4). Electromagnetic waves. Laser spectroscopy for detecting traces of explosives. Photo analysis. Ground-penetrating radar. Unmanned aerial vehicles. U2 spy planes. Aerostat tethered blimps. Blast-proof 'Buffalo' Mine Resistant Ambush Protected (MRAP) vehicles.

Some soldiers have used leaf blowers on truck bumpers to clear the roadside debris hiding places. Others dangled a hot toaster from a long pole to fool the heat-sensing EFPs, but insurgents adjusted by aiming the projectiles at an angle.

One scheme even tried to use C4-detecting honeybees (but the weight of their 'harness' wore the little suckers out too quickly). Another considered using Israeli-trained dogs (but most understood only Hebrew commands).

At one point, more than 130 government agencies were involved in IED issues, according to Joint Forces Command.

The good news is that deaths from IEDs have dramatically dropped, especially since the troop surge a year ago. In December there were only 8 US service deaths attributed to IEDs, 11 in January, compared with past peak months of nearly 100. US troops detect about half of all IEDs "left of boom" – that is, before they explode.

The bad news is that attempted attacks are still alarmingly high, 1000 or more a month, and the British military estimates "there are enough stocks of illegal explosives to continue the same level of attack for years without resupply."

Sight and Sound

With the rush to find solutions to solve the IED dilemma, much of the new equipment was either prototype or very low quantity production, so there was rarely any gear to spare for training. One example: for a time at the National Training Center at Fort Irwin, California, the radio-disrupting electronics were represented in Humvees by a cigar box with the word "Jammer" written in marker. Gen. James Mattis, Commander, US Joint Forces Command, told the US Congress, "Many



A screen-shot from the Deployable Virtual Training Environment (DVTE).

Image credit: Alion Science & Technology

don't get to practice with the equipment they'll use in combat because there's only enough to supply troops already in theater."

But it ultimately became evident that the best way to overcome the insurgents' ever-changing explosives schemes is through training. First, understanding the enemy. Finding the cells and particularly the bomb technicians and their supplies. Ambushing emplacements at likely target areas. And, recognizing that some IEDs will continue to get through any vigilance, teaching troops how to spot the smallest signs of danger: the dimple in the dirt, the thin wire exposed by blowing dust, even the out of place animal carcass that could conceal enough explosives to topple an APC.

Studies have shown the best bomb-spotters are those who have hunted or fished, soldiers who have experience analyzing the environment. The US Navy has a solicitation under bid for "perceptual skills screening" for the Marines, SEALs, allies, and coalition forces. They're interested in simulation and visualization approaches that can train "better anomaly detection, including changes in weather and ambient light intensity." The small business research project states, "Warfighter capacity to recognize relevant and potentially dangerous physical and local demographic changes in patrol areas requires keen vigilance and change detection skills."

One predominant counter-IED training technique has been live exercise "theater immersion" at places such as Fort Irwin; Camp Shelby in Mississippi; Fort Bliss, Texas; and even MCAS Iwakuni, Japan. Mock forward operating bases are integrated with Iraqi-style villages, complete with role-playing civil authorities and villagers and replicating the low-hanging wires and debris-littered landscape which soldiers can expect to encounter within a few weeks.

To make the preparation as realistic as possible, mock IEDs are hidden everywhere, and if undetected they go off with a disarming bang and a large cloud of non-pyrotechnic smoke. (For years, militaries used small C4 plastic explosives in training exercises – dangerous to be sure, but hardly sufficient to demonstrate the large explosions in Iraq.) At Fort Irwin, a brigade combat team will experience 80-90 IED and 40 'vehicle-borne' IED events across a two-week span in 'The Box.'

One field exercise kit, the T/IED from Unitech, typically includes a pressure-sensitive land mine simulator, a trip wire booby trap simulator, and a large IED simulator.

AAI was recently awarded a US Army contract for more than 300 IED training systems to be produced in partnership with RUAG COEL. Known as fire marker units, the devices replicate "the visual signature, sound, and trigger activation" of IEDs used against allied troops.

At Fort Bliss, the curriculum includes a "petting zoo" where servicemembers can see and feel what different IEDs look like, how they are built, and methods for concealing them.

The UK's Land Warfare Centre is using a suicide bomb vest simulator from Combat Training Solutions. Compressed air and "non-toxic, environmentally friendly" colored powder cartridges produce the "explosion," and the vests can be reused multiple times.

SGC Group offers instruction by Arie Sansolo, said to have directed bomb disposal of Israel's leading anti-terrorist unit for 15 years, and a long catalog of training aids such as a roadside EFP trainer, chemical/suitcase WMD trainers, and something ominously labeled the 'Red Scorpion.'

Virtual Worlds

The other trend in IED training is virtual. NGRAIN has worked with the Canadian forces to produce a landmine/IED database which can be ported to a ruggedized PDA device. The database includes 3D graphics on the procedures to follow in approaching and disabling an identified explosive. The company's Gabe Batstone says "with the extremely high optempo," many troops "don't have time to train on the actual equipment," and that 3D presentations over the web or via CD can reduce training time by up as much as two-thirds. Plus, instead of 10-20 percent retention from static training, interactive 3D yields 70-90 percent stickiness.

Raydon has developed the first Virtual Route Clearance Trainer (VRCT) to support the new MRAP vehicles. There are fewer than 500 Buffalo, Husky, and RG-31 MRAPs fielded to date but orders



'Vigilance' will help train military personnel to locate and identify explosive devices.

Image credit: Harrington Group, Crytek & Scaleform

for more than 10,000. Raydon turned the first VRCT around in 90 days and began training the 36th Engineer Brigade / 937 Company in December. Housed in a pair of 53-foot trainers, the VRCT offers a 360-degree spherical view of "exact virtual terrain" of Baghdad, Tikrit, Samarra, Kabul, and other battle locations.

Alion partnered with game physics specialist Ageia in developing the Deployable Virtual Training Environment (DVTE), a deployable capability for multi-echelon skill training for Marines. A DVTE suite is comprised of 33 laptops depicting real-world, real-time dynamic motion and

interaction. Among the numerous scenarios: infantry-armor integration and convoy operations in an urban environment featuring IEDs. "When users create a simulated explosion," notes Alion VP Peter Jacobs, "it causes dust and debris. When Marines use DVTE to train for convoy operations against IEDs, they will encounter an experience that mirrors the actual movement of their armored vehicle."

The Harrington Group's "Vigilance" product was selected in December as the 'People's Choice' during the Serious Games Showcase and Challenge. Vigilance was designed especially to help train military personnel to locate and identify explosive devices. "As players gain experience, they are asked to locate and identify IEDs among increasingly complex surroundings," says Harrington's James Brooks. "Once players successfully complete a training session, they can put their skills to the test. For example, the player is tasked with a route clearing exercise in which IEDs are identified and cleared from a roadway for a waiting vehicles convoy."

Forterra, a 'private virtual worlds' developer, has been asked by the Joint Advanced Distributed Learning Co-Laboratory to research methods for counter-IED training in a massively multiplayer online game (MMOG) environment. The intent is to enable groups of users who are physically distributed to collaborate for training, experimentation, or mission rehearsal. Forterra team members include Intelligent Decision Systems and Rustici Software. ms&t

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