



## CRS Report for Congress

# Improvised Explosive Devices (IEDs) in Iraq and Afghanistan: Effects and Countermeasures

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### Summary

Since October 2001, improvised explosive devices (IEDs, roadside bombs, and suicide car bombs) have been responsible for many of the more than 3,000 combat deaths in Iraq and many of the more than 240 combat deaths in Afghanistan.<sup>1</sup> Vehicle-borne IEDs and car bombs are now used to strike police stations, markets, and mosques, killing local citizens as well as U.S. troops. U.S. forces counter the devices through utilizing intelligence sources and by disrupting portions of the radio spectrum that insurgents use to trigger IEDs. However, insurgents quickly adapt to countermeasures, and new, more sophisticated IEDs are increasingly being used in both Iraq and Afghanistan. Department of Defense (DOD) officials have also charged that Iran may be supplying new IED technology to insurgents in Iraq. There is growing concern that IEDs might eventually be used by other insurgents and terrorists worldwide.<sup>2</sup> This report will be updated as events warrant.

### Background

Improvised explosive devices, also known as IEDs, roadside bombs, and suicide car bombs, have caused over 60% of all American combat casualties in Iraq and 50% of combat casualties in Afghanistan, both killed and wounded.<sup>3</sup> Some observers speculate

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<sup>1</sup> DOD Personnel and Military Casualty Statistics, Defense Manpower Data Center, *Casualty Summary by Reason, October 7, 2001 through August 18, 2007*, available at [[http://siadapp.dmdc.osd.mil/personnel/CASUALTY/gwot\\_reason.pdf](http://siadapp.dmdc.osd.mil/personnel/CASUALTY/gwot_reason.pdf)].

<sup>2</sup> The suicide attacks on American hotels in Jordan in November 2005 represent the first known case where Iraqis have conducted suicide bombings against the United States outside of Iraq. Brent Sadler, *Jordan Confirms Al Qaeda Behind Hotel Blasts*, CNN, November 12, 2005.

<sup>3</sup> DOD Personnel and Military Casualty Statistics, Defense Manpower Data Center, *Casualty* (continued...)

that much of the munitions for constructing IEDs in Iraq may have come from large Iraqi military ordnance deposits looted by insurgents, or from stockpiles scattered in secret locations throughout that country before the war.<sup>4</sup> In Afghanistan, the IED munitions supply is supported by funds from an expanding opium trade.<sup>5</sup> Afghanistan's opium crop reportedly grew 59% in 2006, yielding 6,100 tons, or 90% of the world's supply.<sup>6</sup> In 2007, the opium crop grew by another 34% and is now the source of 93% of the world's supply of heroin and morphine.<sup>7</sup>

The largest group of suicide attackers in Iraq reportedly is Sunni Iraqis, followed by foreign fighters usually from Saudi Arabia, Syria, and Kuwait.<sup>8</sup> Observers have indicated that the Taliban forces in Afghanistan appear to have learned some IED techniques from the Iraqi insurgents, and some areas of Afghanistan are now reportedly becoming too dangerous for reconstruction efforts there to continue.<sup>9</sup> DOD has found that insurgents build and deploy IEDs by using networks that, for centuries in Afghanistan and Iraq, have formed the sinews of commerce and survival for tribes and factions.<sup>10</sup>

In Iraq, small, highly skilled IED cells often hire themselves out to other insurgent groups, such as al-Qaeda in Iraq or the Sunni group Ansaar al Sunna. They advertise their skills on the Internet, and are temporarily contracted on a per-job basis but otherwise remain autonomous.<sup>11</sup> A typical IED terrorist cell consists of six to eight people, including a financier, bomb maker, emplacer, triggerman, spotter, and often a cameraman. Videos of exploding U.S. vehicles and dead Americans are distributed via the Internet to win new supporters.

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<sup>3</sup> (...continued)

*Summary by Reason, October 7, 2001 through August 18, 2007*; available at [[http://siadapp.dmdc.osd.mil/personnel/CASUALTY/gwot\\_reason.pdf](http://siadapp.dmdc.osd.mil/personnel/CASUALTY/gwot_reason.pdf)].

<sup>4</sup> James Glanz and Jim Dwyer, "Looting Spree Gutted Ammo Dump," *San Francisco Chronicle*, October 28, 2004. Byron York, *Remember Al Qaeda?*, National Review Online, February 28, 2005 [<http://www.nationalreview.com/york/york200502280821.asp>].

<sup>5</sup> Peter Bergen, "The Taliban, Regrouped and Rearmed," *The Washington Post*, September 10, 2006, B1. Helen Cooper, "NATO Chief Says More Troops Are Needed in Afghanistan," *The New York Times*, September 22, 2006, p.10.

<sup>6</sup> Jason Straziuso, *Taliban netting millions from poppies*, Associated Press, Apr 10, 2007.

<sup>7</sup> Colum Lynch and Griff Witte, *Afghan Opium Trade Hits New Peak*, *The Washington Post*, August 28, 2007, A.3.

<sup>8</sup> Lionel Beehner, *Iraq: suicide Attacks*, the Council on Foreign Relations, August 1, 2005. Michael O'Hanlon and Jason Campbell, *The Iraq Index*, the Brookings Institution, July 31, 2006.

<sup>9</sup> Peter Bergen, "The Taliban, Regrouped and Rearmed," *The Washington Post*, September 10, 2006, B4.

<sup>10</sup> Gen. Montgomery Meigs, *On the Offensive: The Battle Against IEDs*, Marine Times, April 16, 2007, at [<http://www.harmonieweb.org:40793/news/Pages/OnTheOffensive.aspx>].

<sup>11</sup> Times Wire Service, "Italian Troops End Iraq Mission," *The Los Angeles Times*, September 22, 2006.

DOD officials reportedly captured four Iranian terrorists in July 2007 who are accused of smuggling explosives and personnel from Iran into Iraq.<sup>12</sup> Iran is suspected of supplying Iraq insurgents with IEDs, training, and new designs and technology for explosive devices, such as “passive infrared” electronic sensors that are used for triggering roadside bombs. The new sensors are more resistant to electromagnetic countermeasures now employed by U.S. forces. DOD officials also suspect that Iran is supplying Iraq insurgents with a more lethal IED bomb design called an explosively formed projectile (EFP). An EFP is made from a pipe filled with explosives and capped by a specially shaped metal disk. When the explosives detonate, they transform the disk into a jet of molten metal capable of penetrating armor. EFPs reportedly strike with enough power to cause pieces of a targeted vehicle’s heavy armor to turn into shrapnel, making them much more deadly than traditional IED weapons. DOD officials report there were 69 attacks utilizing EFPs in April 2007.<sup>13</sup>

U.S. military officials suspect that EFPs and other weapons were smuggled into Iraq by members of the Quds Force, which is part of the Iranian Revolutionary Guard. The same type of EFP device has been used by Shiite organizations in Lebanon, where Hezbollah receives military support from Iran. However, Iranian government officials deny involvement with any transfer of these weapons to Iraq.<sup>14</sup> In addition, U.S. intelligence officials have reportedly said that most IED attacks against U.S. forces in Iraq come from Sunni insurgents rather than from the Shia elements most directly backed by Iran.<sup>15</sup> Over time, the insurgents in Iraq have adapted to many U.S. countermeasures, and several DOD officials have stated that protective equipment sometimes seems to be less effective after being deployed for only a few months.<sup>16</sup>

## Countermeasures

DOD has established the Joint IED Defeat Organization (JIEDDO) to investigate countermeasures along with various national laboratories, the Department of Energy, contractors, and academia. The Marine Counter Improvised Explosive Device Technology Directorate and the Army Electronic Warfare Division also work with the JIEDDO to

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<sup>12</sup> Sara Carter, *Iran-Arms Importers Captured in Iraq*, Washington Times, Jul 28, 2007, p.1.

<sup>13</sup> Tom Brook, *Military tests new armored vehicle*, USA Today, Jun 11, 2007, p.1A.

<sup>14</sup> Joshua Partlow, “Military Ties Iran to Arms in Iraq,” *The Washington Post*, February 12, 2007, p. A1.

<sup>15</sup> Serial numbers for infrared triggers have been traced to bulk device orders by Iran. Precision manufacturing techniques required to produce EFP bombs indicate that some may have been constructed in Iran. Michael Isikoff and Mark Hosenball, *Terror Watch: Tracking Iran’s Role in Iraq Attacks*, Newsweek, Jan 24, 2007. Tom Brook, “U.S. blames Iran for new bombs in Iraq,” *USA Today*, January 31, 2007 [[http://www.usatoday.com/news/world/iraq/2007-01-30-ied-iran\\_x.htm](http://www.usatoday.com/news/world/iraq/2007-01-30-ied-iran_x.htm)].

<sup>16</sup> The Army has reportedly suffered losses because of ambushes that follow IED attacks. Greg Grant, “Aerial IEDs Target U.S. Copters,” *Defense News*, January 16, 2006. John Anderson, Steve Fainaru, Jonathan Finer, “Bigger, Stronger Homemade Bombs Now to Blame for Half of U.S. Deaths,” *The Washington Post*, October 26, 2005, p. A1. Ann Tyson, “Thousands of Army Humvees Lack Armor Upgrade,” *The Washington Post*, February 12, 2007, p. A1.

reduce the IED threat.<sup>17</sup> DOD has also sent electronic warfare officers from the Navy and Air Force into Iraq and Afghanistan to work on counter-IED measures.<sup>18</sup> The technologies being evaluated include electronic jammers and pre-detonators, radars, X-ray equipment, robotic explosive ordnance disposal equipment, physical security equipment, and armor for vehicles and personnel.<sup>19</sup>

In the past year, JIEDDO has funded almost 14,000 jammers for Marine and Army units, including robots for explosive ordnance disposal teams, Cougar vehicles for route clearance teams, and Guardian, a man-portable jammer for dismounted operations. The JIEDDO also uses intelligence sources to assemble and distribute products to military units daily to support their efforts to destroy the networks that create IEDs.

Some counter-IED technologies include a stoichiometric diagnostic device, which can decipher chemical signatures of unknown substances through metal or other barriers. Known as the CarBomb Finder model 3C4, it sends out neutrons that cause any substance within a container or vehicle to emit back gamma rays that contain unique signatures from which the chemical formulas are derived.<sup>20</sup> Electronic jamming devices include the IED Countermeasures Equipment (ICE) and the Warlock, both of which use low-power radio frequency energy to block the signals of radio controlled explosives detonators, such as cell phones, satellite phones, and long-range cordless telephones.<sup>21</sup> Other countermeasures include the Joint IED Neutralizer (JIN) and the Neutralizing Improvised Explosive Devices with Radio Frequency (NIRF), which produce a high-frequency field to neutralize IED electronics at a distance.<sup>22</sup> A system now deployed in Iraq, code-named PING, fits inside a Humvee and sends out electromagnetic waves to penetrate the walls of buildings to detect IEDs.<sup>23</sup> Other sensors, such as the Laser-Induced Breakdown Spectroscopy system (LIBS), detect traces of explosives used for IEDs from as far away as 30 meters.<sup>24</sup>

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<sup>17</sup> Brenda Steele, "Vice Chairman Visits Troops in Afghanistan, Focuses on IED Issues," *Defense Link*, September 24, 2006 [<http://www.defenselink.mil/news/NewsArticle.aspx?ID=1156>].

<sup>18</sup> Brenda Steele, "Vice Chairman Visits Troops in Afghanistan, Focuses on IED Issues," *Defense Link*, September 24, 2006 [<http://www.defenselink.mil/news/NewsArticle.aspx?ID=1156>].

<sup>19</sup> Bruce Lieberman, "SDSU professor focuses laser research on finding killer explosives in Iraq," *SignOnSanDiego.com*, December 27, 2005; available at [<http://www.signonsandiego.com/articlelink/sdsufoundation4/sdsufoundation4.html>].

<sup>20</sup> Steve Grossman, *Car Bomb Detector Employs a Revolutionary New Approach*, *RFDesign*, November 9, 2005 [[http://rfdesign.com/military\\_defense\\_electronics/news/car\\_bomb\\_detector/](http://rfdesign.com/military_defense_electronics/news/car_bomb_detector/)].

<sup>21</sup> Sgt. Stephen D' Alessio, 2<sup>nd</sup> Marine Division, *Marines schooled in new bomb protection*, July 7, 2005, available at [<http://www.marines.mil/marinelink/mcn2000.nsf/0/b89628064c45144e85257056003871f1?OpenDocument>].

<sup>22</sup> Brendan Rivers, *U.S. to Use Directed Energy on IEDs in Iraq*, eDefenseOnline, June 7, 2005. Christopher Castelli, "General: Ability to Prematurely Detonate Enemy Bombs Badly Needed," *Inside the Navy*, August 22, 2005, at [<http://www.insidedefense.com/>].

<sup>23</sup> Loren B. Thompson, *Iraq: Stop the Bombers, Win the War*, June 10, 2005, Lexington Institute, [<http://www.lexingtoninstitute.org/defense.asp?aid=616>].

<sup>24</sup> Sebastian Sprenger, "U.S., NATO Research Could Help Troops Detect IED Threats from (continued...)

However, the Radio Frequency (RF) spectrum in the Iraq combat theater is largely not managed, and counter-IED radio jammers can sometimes lock onto other U.S. electronic combat systems because of a lack of coordination of spectrum usage. Also, Unmanned Aerial Vehicles (UAVs) can sometimes lose their radio control links due to ground-based radio interference caused by counter-IED jammers once they are far away from their control base. Therefore, DOD is now developing an “Electronic Warfare Coordination Cell” to help sort out problems that can impede friendly operations, or endanger Explosive Ordnance Teams as they disable IEDs on the ground.<sup>25</sup>

Other counter-IED research involves fusing large amounts of intelligence and surveillance data to monitor when and where bombs are planted. Using such data gathered by Unmanned Aerial Vehicles (UAVs), enemy bomb makers can be targeted before attacks can be launched. Sometimes the data can be played backward to see from where the bombers and vehicles came.<sup>26</sup>

Threat data about IEDs is tightly controlled by DOD to avoid giving feedback to the enemy about the effectiveness or ineffectiveness of different IED designs. Also, proprietary rights must be protected for those companies who produce IED countermeasures. However, these controls may sometimes limit access by other companies to important information about the effectiveness of anti-IED systems as they are tested or used in battle.<sup>27</sup> As a result, some industry officials say they are not getting access to all the information they need to help them create the most effective new solutions to counter IEDs, and suggest that relaxing some of the controls might lead to more solutions.<sup>28</sup> However, the JIEDDO has recognized this issue and is taking steps, including modifying content on its website, to improve access to information at the appropriate clearance levels.<sup>29</sup>

## Acquisition and Funding of Countermeasures

Some U.S. Army units in Iraq and Afghanistan reportedly lack the latest Humvee armor kits, and the new deployment of five additional Army brigades has added to that shortage.<sup>30</sup> Humvees can be up-armored through a rebuilding process that adds classified

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<sup>24</sup> (...continued)

Afar,” *Inside the Pentagon*, May 26, 2005. Noah Shachtman, “Improvised Bombs Baffle Army,” *Wired News*, January 26, 2005, [<http://www.wired.com/news/technology/0,1282,66395,00.html>].

<sup>25</sup> David Fulghum, “Jamming Jam-Up,” *Aviation Week & Space Technology*, November 7, 2005, Vol. 163, No. 18, P.32.

<sup>26</sup> David Fulghum, “Attacking Bombs,” *Aviation Week*, July 31, 2005.

<sup>27</sup> Michael Moss, “Many Missteps Tied to Delay Of Armor to Protect Soldiers,” *The New York Times*, March 7, 2005, online at [<http://www.globalsecurity.org/org/news/2005/050307-armor-missteps.htm>].

<sup>28</sup> Anne Plummer, “Deadly Threat of Explosive Devices in Iraq Prompts Secrecy Debate,” *Inside the Pentagon*, November 18, 2004, vol. 20, no. 47.

<sup>29</sup> Personal communication, JIEDDO, Aug 28, 2007

<sup>30</sup> Ann Tyson, “Thousands of Army Humvees Lack Armor Upgrade,” *The Washington Post*, (continued...)

technology called “Frag 5” or “Frag 6,” which are armor kits that are said to offer increased protection against side-penetrating EFPs.<sup>31</sup> However, the weight of extra armor may sometimes hinder the payload and performance of humvees. In October 2007, the Army expects to begin taking delivery of the first wave of blast-proof trucks, called Mine Resistant Ambush Protected (MRAP) vehicles.<sup>32</sup> All Humvees in Iraq are to be replaced by MRAPs, which are better designed to withstand traditional IEDs. However, some DOD officials have reportedly stated that the MRAP may not be able to stop EFPs unless additional armor is added, and that this known vulnerability will cause insurgents to increase their use of EFPs.<sup>33</sup> The Army and Marine Corps are also planning to gradually replace the humvee fleet with the new Joint Light Tactical Vehicle (JLTV), starting in FY2012. The FY2008 budget request includes \$82.3 million for JLTV research and development, \$4.6 million for program management, and \$77.6 million for prototype design and development.<sup>34</sup>

On August 5, 2007, the House passed H.R. 3222, the Department of Defense Appropriations Act of 2008, where \$500,000,000 was made available to the Joint IED Defeat Fund, until September 30, 2010. The Joint IED Defeat Fund allows DOD to allocate funds where needed. However, under this legislation, funds allocated for operating and administrative expenses are limited to not more than \$110,000,000, and within 60 days of enactment, the Office of the Secretary of Defense (OSD) must submit a plan to the defense committees explaining the intended management and use of the amounts provided.

For FY2006 (Title IX Bridge Fund and FY-06 Supplement), the funding enacted for the Joint IED Defeat Fund was \$3.3 billion. For FY2007 (Title IX Bridge Fund and FY2007 Supplement), the amount was \$4.3 billion. The FY2008 budget request from DOD (Baseline DOD and FY2008 Global War On Terror Budget Request) is \$4.5 billion. The FY2008 budget request includes for programs such as Attack the Network (\$926,000), Defeat the Device (\$2.7 million), and Train the Force (\$334,000).<sup>35</sup> The total funding thus far is \$7.6 billion, and including the FY2008 budget request, the total is \$12.1 billion.<sup>36</sup>

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<sup>30</sup> (...continued)

February 12, 2007, A1.

<sup>31</sup> David Crane, *New Vehicle Armor Developed to Defeat Explosively Formed Penetrators (EFPs)*, Defense Review.com, June 27, 2007.

<sup>32</sup> For more information about MRAP vehicles, see CRS Report RS22707, *Mine-Resistant, Ambush-Protected (MRAP) Vehicles: Background and Issues for Congress*, August 21, 2007, by Andrew Feickert.

<sup>33</sup> Tom Brook, *MRAPs can't stop newest weapon*, USA Today, May 31, 2007, p.1A.

<sup>34</sup> Newsstand, *MRAP Sheet*, the Insider.com, Jul 12, 2007, [<http://defense.iwpnewsstand.com/insider.asp?issue=07122007>].

<sup>35</sup> Office of the Secretary of Defense, FY 2008 Global War on Terror Request, February 2007.

<sup>36</sup> See CRS Report RL33110, *The Cost of Iraq, Afghanistan, and Other Global War on Terror Operations Since 9/11*, by Amy Belasco, and CRS Report RL33999, *Defense: FY2008 Authorization and Appropriations*, by Pat Towell, Stephen Daggett, and Amy Belasco.