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Special Issue:

Protecting People at Risk:

How DOD Research Reduces the Impact of Terrorism

AMPTIAC is a DOD Information Analysis Center Administered by the Defense Information Systems Agency, Defense Technical Information Center and Operated by Alion Science and Technology

Issue focus:
How DOD Research Protects People and Buildings

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CLARIFICATION: The cover story for our last issue described the Army's exciting Mobile Parts Hospital project. Within that article, a technology called Laser Engineered Net Shaping™ was presented which can fabricate replacement parts using a combination of computational design templates, a computer-controlled laser, and powder metallurgy. Laser Engineering Net Shaping™ and the LENS® acronym are registered trademarks and service marks of Sandia National Laboratories and Sandia Corporation.

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US Government Initiatives Reduce Terrorist Threat to Personnel and Structures

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INTRODUCTION

One important consideration when enhancing the capabilities of the US and its allies in the War on Terrorism is the ability to rapidly develop and apply technology to meet the challenges posed by terrorists. The Technical Support Working Group (TSWG) is the US Government's focused response to this problem, and acts to coordinate the efforts of multiple departments and agencies to maximize our investment in combating terrorism. *(Please see the TSWG sidebar on page 8 for more details.)* Within the Department of Defense (DOD), the Defense Threat Reduction Agency (DTRA) takes the lead in reducing the threat of weapons of mass destruction; both in preventing their spread and use, as well as reducing the impact of their effects if they are used.

DTRA also provides operational and analytical support for nuclear stockpile stewardship duties and technical support for nuclear weapons in Defense Department custody. In addition it focuses DOD efforts to prepare for, and respond to chemical or biological attacks on US or friendly forces, including overseeing the development and implementation of special weapons technologies. These technologies provide US military commanders options for effective targeting against underground or hardened structures and enhanced capabilities to assess battle damage. The agency also implements on-site arms control inspection, escort and monitoring activities, and develops treaty verification monitoring technologies.

The main DOD thrust to develop protective technologies which protect people in buildings from terrorist bomb attacks is sponsored by the TSWG and managed DTRA. The program seeks to develop blast mitigation techniques for both retrofitting existing buildings and designing new ones. Many of these techniques are covered elsewhere in this Special Issue. While these methods and solutions have direct application to our military forces, they can also be applied to federal and commercial buildings, both domestic and abroad.

The various Government-sponsored blast mitigation projects have many goals, one of which is developing a much better understanding of vulnerability and survivability of buildings and their occupants. This involves a multi-pronged approach of characterizing blast effects, quantifying structural response, and classifying human injuries due to those factors. These are accomplished through various means, including evaluation of existing buildings, experimentation with test structures under controlled explosive events, and computational modeling. A key analytical tool to understand structural damage and injuries is to study terrorist events such as the Khobar Towers bombing in Saudi Arabia (See Figure 1) and the attack on the Murrah Federal building in Oklahoma City. Much of this work results in design guidance, which is incorporated into DOD documents for both new construction and retrofits to existing structures. Some of the most notable examples include the Pentagon in Virginia and the Ronald Reagan Building and International Trade Center in Washington, DC.

THE ORIGINS OF, AND POLICIES REGARDING, BLAST MITIGATION

The actual process of protecting people from blast effects is more a balancing act of money vs. protection, than it is of developing technology. "There are no real technology issues that can't be worked out," said Mr. Douglas Sunshine, the Program Manager at DTRA running many of the blast mitigation research efforts under DTRA and TSWG. "Most often, it's about money," he said, and balancing the need for protection with its cost, by using the various tools that structural engineers have available to them, like standoff and hardening.

In the mid-70's there was a string of Embassy bombings, encouraging Government planners to place more emphasis on structural protection. Then, the October 1983 bombing of the Marine Barracks in Beruit put a sharp point on all US efforts to protect its personnel both at home and abroad. Mr. David Coltharp, Technical Director for the Joint Antiterrorist/Force Protection Research program of the US Army Corps of Engineers' Engineer Research and Development Center (USACE/ERDC) in Vicksburg, MS said that this event truly marked the beginning of a whole new thrust within the Government to address structural protection. "The [USACE] Protective Design Center was stood-up at the Corps of Engineers' Omaha District and initial drafts of the security engineering manual were published. The State Department got involved, and stringent guidelines for new embassies were produced in the following ten years."

But protection of DOD facilities from terrorists was still not

Figure 1. Terrorists Killed 19 US Servicemen in the Khobar Towers Bombing.

a pressing issue, until the Khobar Towers bombing in June of 1996. In this instance, 19 US servicemen were killed when terrorists detonated a tanker truck containing an estimated 15,000 pounds of plastic explosive at a US military complex in Saudi Arabia. (See Figures 1 & 2) The event highlighted the vulnerability of military targets to the terrorist threat. Dr. Robert Hall, Chief of the Geosciences and Structures Division of the Geotechnical and Structures Laboratory at ERDC said, "This was where the lack of antiterrorism standards (for military installations) was made clear." Prior to the Khobar Towers incident, military installations were thought to be fairly safe from terrorist actions, due to security perimeters, vehicle and personnel entry screening, and any number of other measures employed at specific locations. Coltharp explained that the responsibility of protecting troops was contained in the established chain of command for a particular location. "Commander[s] would protect [their] troops, along with [their] other tasks and responsibilities."

In the mid-nineties, guidelines and standards for DOD installations were established to counter the terrorist threat. Hall said the key at any site is to "balance security and strengthening." Providing stand-off from a potential threat is much less expensive and intrusive than thick concrete walls and bullet proof glass. But where stand-off is not available, the structure must be hardened to the assumed threat, he said. Coltharp added, "The antiterrorist construction standards address balancing these factors. Where stand-off is available, it is used. Where urban settings limit stand-off, hardening is employed. Base commanders now have other tools available to them, as well as guidance from the chain of command." The Joint Antiterrorism/Force Protection (JAT/FP) program Hall said, "provides a web-based site to train a commander on protection techniques. This gives commanders better tools, so that they can make the best decisions," he added.

There is, however, a strong need to balance available funding with eventual safety. Since the late 80's, antiterrorism has been identified in budgeting, and is a critical feature of new construction projects. Existing buildings are being prioritized for blast mitigation retrofits, or retrofits are being incorporated into major renovations. Sometimes the retrofits are as simple as choosing a blast resistant window during a scheduled window replacement in a building, but often these decisions are much more complex. Coltharp points out that for new construction, the added cost of most structural protection measures will often be less than 5% of the total cost, and the cost of protection can be much lower if careful site planning is employed. Additionally, Sunshine said that beyond meeting the safety criteria, engineers also have to balance hardening measures, cost, and in particular, aesthetics. "It turns out that [protection solutions] have to look good also," he said.

THE ROLE OF DTRA AND THE TSWG CONNECTION

DTRA places most of its emphasis on DOD issues like weapons of mass destruction, dismantling nuclear arsenals in the former Soviet States, and force protection. Within the area of force protection, DTRA sponsors work in all three services including ERDC, the Protective Design Center, the Naval Facilities Engineering Service Center at Port Hueneme, CA, and the Air Force Research Lab/Materials and Manufacturing Directorate at Tyndall AFB, FL. Many of these projects are featured elsewhere in this Special Issue of the *AMPTIAC Quarterly*. The two key areas that Sunshine directs research in are the methodologies to do structural assessments, and the eventual solutions to protect the structures. The results of these research efforts are then transitioned to Government agencies and industry. Often this work is conducted very closely with industry, as in the case of window systems.

Sunshine is also DTRA's representative to the TSWG, which

Figure 2. The Khobar Towers Truck Bomb Left a Crater More Than 15 Feet Deep.

has a mandate as a requirements-driven, multi-agency working group, and relies on experts in particular fields. This assures that in addition to the more fundamental research projects that it directs, there are plenty of avenues to solve members' problems. Sunshine says that often agencies come to him with specific questions about structural/force protection. In one case, a specific type of building common on many foreign US Government installations was under scrutiny for what type of hardening measures it would require. About $500,000 was spent looking at the issue and recommendations were made. The agency later said that the research investment resulted in a cost savings of $10-15 Million. "Results from the research program not only increase the protection of people in buildings, but save significant amounts of money," said Sunshine.

FUTURE DIRECTIONS FOR BLAST MITIGATION RESEARCH

So, what does the future hold? Hall and Coltharp agree that there are a number of critical issues facing the Government. First is placing facilities in campus-like settings, instead of downtown locations. Next is dealing with leased buildings that the government utilizes, and how that impacts local businesses, landlords, and other tenants who currently share space in a building with the government. These local impacts are often very difficult to fully characterize. In some cases it is simply a matter of commercial entities who share building space with the Government, and are therefore put at risk. In other cases, the effect is economic. For instance, leased floor space vacated by the Government can dramatically hurt landlords, as well as support businesses like restaurants, services and local vendors in the area.

Sunshine pointed out that the vast majority of blast mitigation research has been conducted on reinforced concrete and masonry buildings. There are many existing and planned buildings which utilize steel, therefore a lot of attention will be paid to steel frame structures in the near future, he said.

One of the most critical issues facing the military in general and the Government in particular is the patience of terrorists. Coltharp says that the enemy "is devious and patient. He attacks the 'soft spot,' and he doesn't really care where that spot is. If we secure the military base, he targets the Federal building. If we harden that, then he targets the Post Office, or the school." Coltharp adds that placing the emphasis for structural protection on many more types and classes of buildings that have rarely been considered as likely targets before will be one of the most critical issues facing us in the future, and one of the most expensive. Hall points out that while ERDC and similar DOD labs have well-defined roles in military force and infrastructure protection, their role in Homeland Security is still very much in flux. "We are still figuring that out," he said.

CONCLUSION

Protecting people from the threat of terrorism is one of the most challenging problems we currently face. While our response to the threat is still taking shape, agencies and groups like DTRA and TSWG are leading the fight. The research into blast mitigation, including structural hardening, structural retrofits, and site planning, obviously has importance to DOD, but is also critical in domestic preparedness measures. Much of this technology may be transitioned directly to many types of structures in all parts of the United States and around the world.

The Army, Navy, and Air Force are actively involved in developing the tools and technologies needed to harden buildings. They maintain close coordination between research activities that are developing novel approaches to employ materials in ways never envisioned when the materials were first developed. This Special Issue highlights how newer materials, such as polymers or composites, can be used in buildings to help protect them and their inhabitants from terrorist bombings.

The TSWG – *Closeup*

This sidebar presents a brief introduction to the Technical Support Working Group, or TSWG. Many government agencies participate in it and form the core of the US's development effort for counterterrorism technologies.

THE TECHNICAL SUPPORT WORKING GROUP (TSWG)

The April 1982, National Security Decision Directive (NSDD) 30 assigned responsibility for the development of overall US policy on terrorism to the Interdepartmental Working Group on Terrorism (IG/T) chaired by the Department of State (DOS). The TSWG was an original subgroup of the IG/T, which later became the Interagency Working Group on Counterterrorism. In its February 1986 report, a cabinet level Task Force on Counterterrorism led by then Vice-President George H.W. Bush cited the TSWG as assuring "the development of appropriate counterterrorism technological efforts."

Today, TSWG still performs that counterterrorism technology development function as a stand-alone interagency working group. TSWG's mission is to conduct the national interagency research and development (R&D) program for combating terrorism requirements. It also has commenced efforts to conduct and influence longer-term R&D initiatives and, reflecting the shift to a more offensive strategy, balance its technology and capability development efforts among the four pillars of combating terrorism: intelligence support, counterterrorism, antiterrorism, and consequence management.

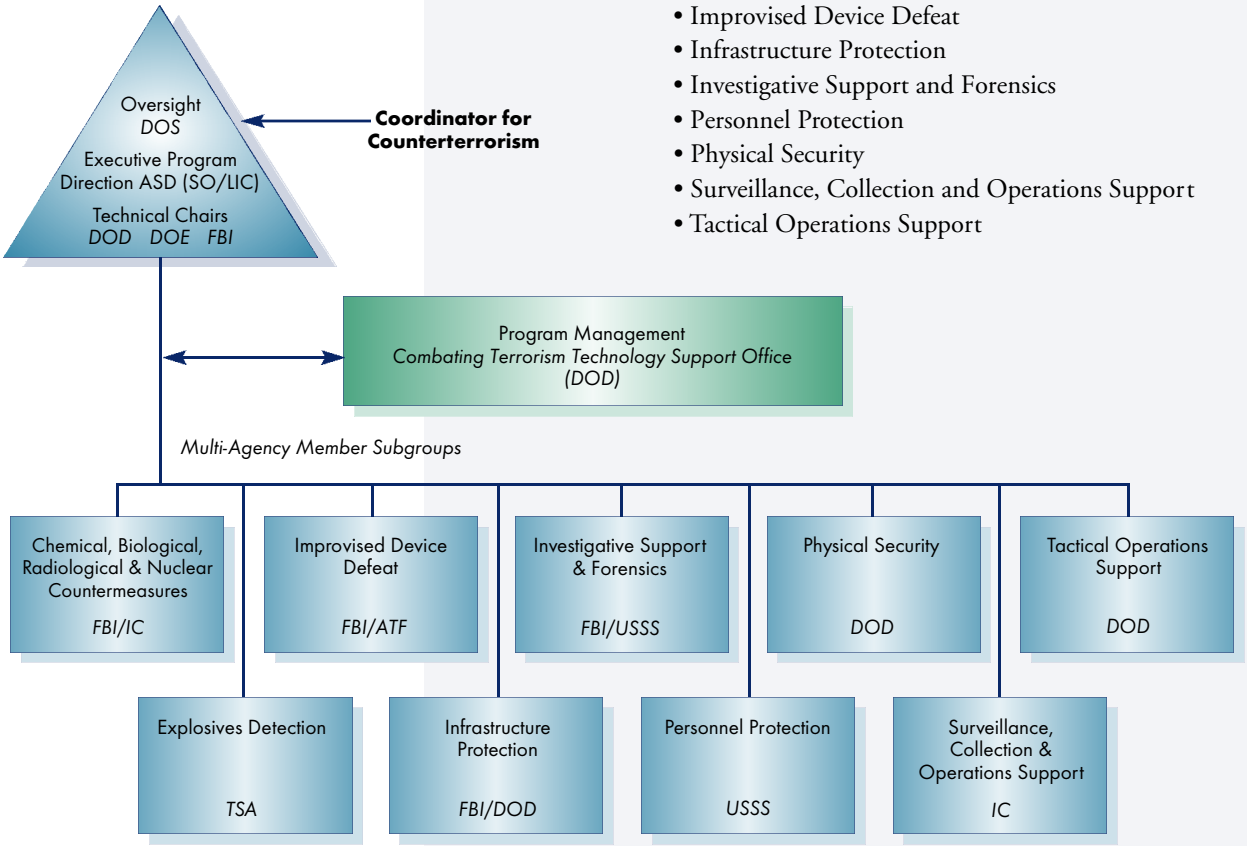
Structure

TSWG operates under the policy oversight of the Department of State's Coordinator for Counterterrorism, and the management and technical oversight of the DOD Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict (ASD (SO/LIC)). Participation is open to all federal departments and agencies, and current membership includes representatives from over eighty organizations across the Federal Government. While the TSWG's core funds are derived principally from DOD's Combating Terrorism Technology Support (CTTS) Program, and the DOS, other departments and agencies contribute additional funding. They also provide personnel to act as project managers and technical advisors. TSWG conducts cooperative R&D with the United Kingdom, Canada, and Israel through separate bilateral agreements.

Member departments and agencies work together by participating in one or more TSWG subgroups. The nine subgroups, each focusing on a specific area of technology, are as follows:

- Chemical, Biological, Radiological and Nuclear Countermeasures
- Explosives Detection
- Improvised Device Defeat
- Infrastructure Protection
- Investigative Support and Forensics
- Personnel Protection
- Physical Security
- Surveillance, Collection and Operations Support
- Tactical Operations Support

TSWG Organization



RELEVANT PROGRAM AREAS

One can see that the mission of TSWG crosses many technical areas and scientific disciplines. The areas of most relevance to the structural protection community are presented below in more detail. More information on the complete activities of TSWG may be found at www.tswg.gov.

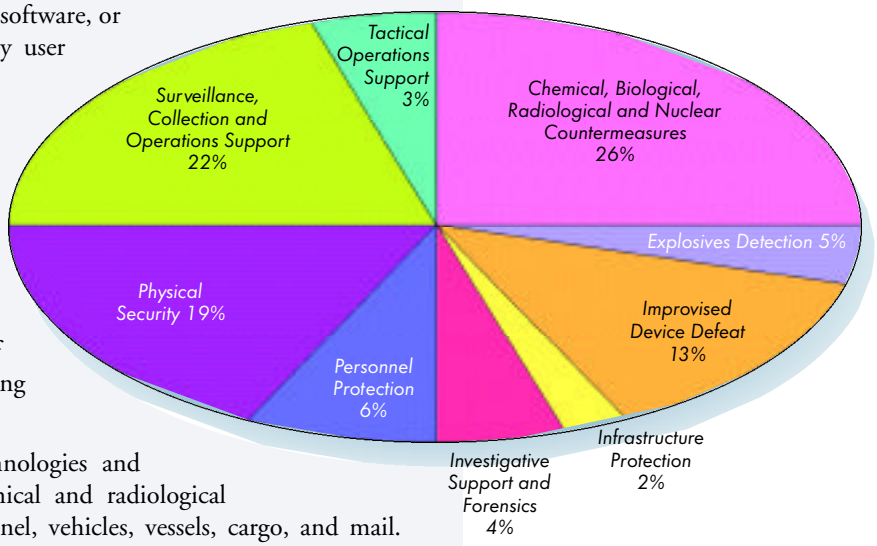
Infrastructure Protection

The Infrastructure Protection (IP) Subgroup's mission is to identify, prioritize, and execute research and development projects that satisfy interagency requirements for the protection and assurance of critical Government, public, and private infrastructure systems required to maintain the national and economic security of the United States. These critical systems include control systems for electric power, natural gas, petroleum products, and water; telephone, radio, and television communications systems; ground, rail, and air transportation facilities; and cyber communications networks.

Physical Security

The Physical Security (PS) subgroup identifies the physical security requirements of federal agencies, both within the United States and abroad, and then develops the technology to protect their personnel and property from terrorist attack. The technology is developed by creating prototype hardware, software, or systems for technical and operational evaluation by user agencies.

TSWG FY 2002 Program Funding



Focus Areas The PS Subgroup focus areas reflect the prioritized requirements of the physical protection community. The following are some of the topics explored in FY 2002:

- Blast Mitigation - Develop building construction and retrofit techniques that better protect people and facilities from the two main causes of injuries resulting from terrorist bomb blasts - flying debris and structural collapse.
- Entry Point Screening - Develop multiple technologies and techniques to detect explosives, weapons, chemical and radiological material, and other contraband on or in personnel, vehicles, vessels, cargo, and mail. Solutions will increase the detection rate, throughput, and safety while reducing the number of security forces required to perform the screening process.
- Perimeter Protection - Develop advanced perimeter intrusion detection and surveillance systems that have a higher probability of detection, a lower false alarm rate, and the ability to operate continuously in demanding operational environments. These systems will provide security forces with improved early warning and response capabilities on land and at sea.

(Compiled from US Government-supplied information.)

Example TSWG Projects

COMPLETED

Structural Retrofit Methods

Retrofit design concepts and guidelines for strengthening existing reinforced concrete buildings against terrorist bomb attacks were developed. Retrofit techniques, such as spray-on polymers and composite wraps for structural columns have been evaluated and design guidance written. These techniques have been used to upgrade embassies and military facilities.

Quick Reaction Perimeter Intrusion Detection Sensor (QUPID)

QUPID is an ultra-wide impulse radar system with adjustable range gates that projects a "virtual fence" beyond the perimeter to detect intruders at distances up to 100 meters. TSWG successfully developed two prototype versions of the sensor in FY 2002: the first is compatible with the USAF Tactical Automated Security System and the second works with a commercial intrusion detection system. The Air Force transitioned QUPID into an acquisition program in July 2002 with fielding planned for FY 2003.

Military Mobile Vehicle and Cargo Inspection System (MMVACIS)

MMVACIS, a mobile gamma radiation imaging system, was developed for the inspection of vehicles and cargo. The system provides rapid deployment capability to established bases or with US expeditionary forces. It has been employed by the DOD since Fall 2001, and has been integrated into contraband interdiction and force protection operations.

ONGOING

Blast Effects Estimation Model (BEEM)

BEEM will be a single model capable of estimating the effects of blasts, fragmentation, building damage and personal injury. BEEM will incorporate the best features of two existing models, the Force Protection Tool (FPT) and the Anti-Terrorism Planner (AT-Planner) tool.

Glass Penetration Model

A human injury prediction model based on multi-hit glass penetration is being developed. The model inputs will be window characteristics, blast parameters, and the location of a person relative to the window. The model will output the severity of the injuries to that person. The final product will be a software model that will complement BEEM.

Lightweight Portable Boom and Underwater Sentry System

A lightweight boom, equipped with fiber optic and acoustic sensors to provide standoff detection of intruders for US Navy ships, is being developed. It is designed for easy deployment and redeployment by the ship's crew dockside or at anchor in transit ports. It will provide a temporary legal perimeter barrier as well as surface and subsurface intrusion detection capabilities against attacks by small boats and swimmers. The prototype system will continue developmental testing and evaluation during FY 2003, and will begin operational testing in FY 2004.

Advanced Vehicle Driver Identification System

The Advanced Vehicle Driver Identification System (AVIDS) is being developed to expedite the screening process at vehicle entry points by providing force protection personnel with near real-time access to control databases. This modular system allows users to select only those components needed at their facility. AVIDS has been installed at a DOD facility, enabling verification of the occupants of a vehicle in less than three seconds over a secure wireless LAN that covers eighteen square miles and five vehicle entry points. Weigh-in-motion, RF tags, and license plate reader modules were expected to be integrated by the end of 2002, with biometrics modules integrated in 2003.

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AMPTIAC Celebrates Its 6th Birthday
On November 1st, AMPTIAC's staff took a few minutes out of their busy day to mark the IAC's sixth birthday. The six years have flown by, but are replete with accomplishments. We are proud of our success serving the DOD materials and processes community and look forward to continued service in the future.