CBRNe WORLD

Winter 2006

Braced for Impact
US, UK European procurement

Quick reactions
Improving response time

Clean sweep
Advances in decontamination

Leader

IT IS with great pride that I welcome you to the first edition of *CBRNe World*. This magazine is a manifestation of the many changes occurring in the field of defence against the non-conventional threat – primary among which is a need for in-depth information.

There is a great deal of excitement about the threat, whether it be chemical, biological, radiological, nuclear or explosive, that has created a market for, at best, peripheral products and, at worst, charlatans. *CBRNe World* is arguably the only magazine written *by* experts *for* experts, allowing you to ensure that certain filters are put in place to ensure accurate and useful information is delivered. *CBRNe World* represents, collectively, ten year's knowledge of the CBRN sector and more than 35 years in magazine production, ensuring that the information within is relevant and educated.

There is no doubt that the threat and response are both maturing. It has been suggested that the evolution of technology in Iraq and the Middle East is happening at an exponential rate. What took conventional terrorist groups, such as the IRA, more than 30 years to learn and perfect has happened there in three. Equally Iraq, Iran and Syria are all areas of acknowledged, or suspected, expertise in offensive chemical, biological, radiological and nuclear weapons. If South East Asia represented the "Tiger Economy", then the Middle East presents the Jackal Terrorist Economy. Across-the-board advances are being made that require a coherent and professional counter-measure. Tactics, procedures and doctrine are being perfected daily on the streets of Baghdad and Basra, which in turn feed the terrorist procurement and technical workshops, and the propaganda machine feeds these "triumphs" out to the world, encouraging more young men and women to engage in what can only be a downward spiral. Unfortunately there can be no silver bullet to stop this – whether technical or political. If American and allied troops were pulled out of Iraq, and Russian troops were pulled out of Chechenya, it would not make Washington or Moscow any safer; too many lives have been lost and too many have learned the art of the IED for there to be any solution. There must inevitably be a process of endurance while the shattered economies in countries such as Afghanistan rebuild and something approaching normality resumes. Before the projected 20 years (and if the Balkans are any example it might well be longer than that) are up, there will be a string of terrorist offensives against "unprotected" civilian targets; some will be stopped by the intelligence services, others will fail due to technical problems or interdiction by security forces. Others will succeed.

It is our intention that the pages of *CBRNe World* will be able to comment on all of those scenarios, from discussions on counter-terrorism all the way through to remediation and restoration of services after a CBRNE attack.

There is no doubt forces are maturing to face this threat. The evolution of the phrase CBRNE is not only one of rhetoric; countries such as the United States and Singapore are already linking their CBRN forces with their EOD units, and there is a strong likelihood that Nato will also start to develop their CBRNE capability, bringing the two schools closer together. It is our intention to develop a modern, insightful magazine that will be able to both comment on and provoke debate, we welcome any submissions or comments and ask that they be sent to me at gwynwinfield@btconnect.com'

'The editor would like to publicly thank, and apologise to, both designer and sub-editor for the many late nights and fraught words that were involved in the production of this issue.

One day waving, the next day shooting. Terrorism is home grown and not solely the province of desperate men. © DOD

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David and Gwyn would like to thank Sue and Jane without whom this project would not have been possible.

CBRNews

PRODUCT WATCH

AND they're off!

Despite only having been going six weeks, at time of writing, David Levitt and Gwyn Winfield have had an exceptionally busy time. October saw them at the Decontamination Conference at Munster, the Impact Symposium in Brussels and the Smiths Business Forum in London. Disaster was narrowly averted when Gwyn realised that while Münster and Munster looked alike, they were not geographically linked and is indebted to the sense of humour of the good people of Air Berlin, who merely laughed at him instead of taking his money. November saw the pair at the annual Shrivenham event, dealing with road works and many, many questions.

Smiths enter stand-off market

SMITHS Detection and Telops Inc announced their decision to start a teaming agreement to market Telops Fourier Transform Infrared technology into the chemical market. Europe's stand-off market had been dominated by Bruker Daltonics, with whom Smith's had had a strategic partnership for their Rapid FTIR product, and, in much the same way the Smiths 24/7 has been challenged by Brukers AFM, it looks like Bruker will have to deal with a new kid on the block. Telops is a Canadian company that has been involved in aerospace and defence, but is new to CBRN. It will be interesting to see whether this a one-off decision, or an increase in competition in arguably the leading European chemical detection companies.

Brand Recognition

REMPLOY Frontline recently announced that they had won Bronze for their latest advertising campaign in the Business to Business awards at the Fresh Awards NE, putting them through to the national final. This is the first time, in the Editors knowledge, that any CBRN advert has been awarded a prize and hopefully will start a trend ending in scenarios where leading editors can rub shoulders with film stars. Remploy put some of their success down to their ability to build brand awareness on the internet and their PR efforts. CBRNe World wishes them well in the final!

THREAT WATCH

Reaching the Apex

17,000 civilians were told to flee their homes in the North Carolina town of Apex after the chemical plant exploded. Initial air quality tests found nothing alarming, but a large chemical cloud was seen leaving the plant – a testimonial to the fact that the size of the explosion determines the fall of the plume. Half of the population was released out of fear that the chlorine in the plant would billow out into the town. Despite the danger of the incident the Mayor was concerned that those that had been evacuated would be back to gawk and sightsee the damage – which goes to show how important psychology is in any crowd models

A message to you, Tony

A 72 year old woman sent hoax chemical messages to the British Prime Minister Tony Blair in an effort to frighten him and his family. She sent sugar and weedkiller through the post, which were intercepted at the mailing centre. Shirley Freed was described by her own solicitor as "rather dotty" (*BBC*) and justified her actions as a protest over the UK's role in Iraq. Freed was tracked through DNA to her home and asked for 22 further offences to be taken into consideration. In a victory for odd figures, she was sentenced to a 51 week prison sentence (was 52 weeks, a year, too long?).

Non-story…

Dr Wouter Basson, the South African apartheid-era biological weapons chief, made news in September by not resigning! Dr Basson, known to the press as the unbiased 'Dr Death,' who was acquitted of all charges in 2002 has been receiving his salary from SANDF without doing any work. This has left the Military Health Service without their chief cardiologist. Clearly still well connected in the Military, CBRNe World looks forward with interest to his autobiography…

Reality check

Those that have doubted the ability, desire and creativity of the terrorist groups that the World finds itself up against had to have their views challenged by the testimony of Dhiren Barot in his conspiracy to murder trial in the UK. Barot had planned to buy large quantities of smoke detectors to create an americium 241 RDD and had also been planning a propane fuel air explosive. A creative individual, Barot had clear plans for making himself a major martyr with plans to attack major targets with cyanide or ricin devices. Barot pleaded guilty and was sentenced to life imprisonment and is a landmark case of detective work in the fight against terrorism. The next challenge will be to ensure that he doesn't become an icon for other disaffected Muslims…

More Porton BW tests revealed

Recent documents released to the National Archives at Kew showed how trials were done in the cities of Swindon and Southampton, in the south of the UK, to evaluate the possibilities of e.coli as a BWA. 'Full' records of the tests can be found through Kew, http://www.nationalarchives.gov.uk, but the trials tested such things as the effect of pollution on e.coli and wind dispersal modelling. Trials like this are rare today and while many things have changed results like these have more than just academic interest.

Photo © WIS

Bruno David of NBC Sys is surprised and grateful to find some morsels have been left by a grazing Gwyn Winfield.

Letters to the editor

SIR,

I scan every issue of NBC Defence journals on protective clothing; the ads especially provide a wealth of information on the way of thinking of the producers. "Nothing comes close; Maximum Comfort, Protection, Weartime and Shelf life; The best for the best; Improved Bio Protection". Looking at the producers in some Nato countries: Belgium 1, Denmark 1, France 1, Germany 4, Italy 2, Norway 1,Spain 2, UK 2, US 3, working independently or in combinations, there must be many more claims expressed in ads.

These claims are remarkable because all the companies are supposed to produce clothing meeting the same Nato standard.

In my view there are three different classes of skin protection:

- The air-permeable form – a textile layer to stop liquid drops and an active carbon loaded on a carrier material to stop vapour. Note that B/C aerosol protection is not mentioned. The primary reason is that the amount deposited onto the skin is insignificant in comparison with the respiratory hazard. There is a six orders of magnitude difference.

- The air-impermeable form; in the most simple version the air that might ingress is not cleaned. Rubbers, films, foils and membrane systems are used to stop liquid drops and splashes and are supposed to prevent penetration and ingress of vapour and aerosol.

- The air-impermeable form is sometimes combined with a technology to keep the inside air clean using active carbon to absorb vapours or provide overpressure with clean air.

In one of the recent issues there were 24 pictures with air-permeable suits and 23 pictures containing air-impermeable suits from which at least five had a mechanism working to clean the inside air.

There are two routes for agent to reach the skin: one is by penetration through the fabric and the other by ingress through seals and closures. The first one plays a part in air-permeable clothing; the second one holds mainly for the air-impermeable types. The bellows or pumping effect of impermeable types causes a one-to-two orders of magnitude larger ingress of agent in comparison with the permeable types. This is the reason for improving the closures and seals by using large amounts of tapes.

Over the years, models have been developed which predict the performance of the clothing and many laboratory tests have been performed to characterise the quality of the materials, and more recently also the whole system, by exposing volunteers in climate chambers to agent simulant or even in field tests. The general outcome of these studies is that air-permeable fabrics provide sufficient protection against today's military challenge of chemical and biological agents in whatever form. Some types just meet the required protection factor for C-agent vapour and some even provide more than the four-times higher desired protection factor.

In contrast, the protection provided by air-impermeable systems in the simple form must be qualified as poor. There is a significant ingress of agent, also aerosol that has nowhere else to go than into the skin. Protection factors for untaped systems are often below five, and for carefully taped systems they still are mostly below ten. This conclusion also holds for agents in particulate form.

The protection provided by impermeable systems with an active cleaning technology is not questioned, but the ingress of agent into air-impermeable systems with an added active carbon layer remains significant. Knowing that the rate of absorption onto active carbon is only three times the rate of absorption by the skin, still appreciable quantities of vapour might be taken up by the skin. Aerosols are not stopped by active carbon and the protection against aerosols remains poor.

The conclusion is that the air-impermeable systems in the simple form provide a low degree of protection. The military with the air-permeable systems are far better protected. So, if I were a first responder, I would rely on the military skin protection.

Not convinced? Do your own whole-system test with human volunteers.

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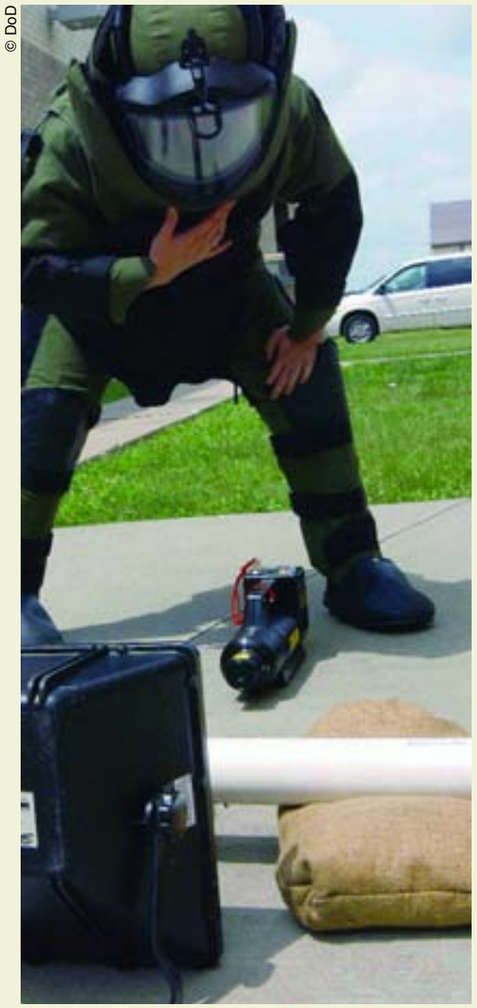
A failure to... COMMUNICATE

As civil and military CBRNE capabilities converge, William Finegan, a CBRN consultant, calls for a standardisation of language and thinking about the threat



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DURING a recent US Department of Homeland Security (DHS) CBRNE field training exercise, I witnessed a breakdown in command. The confusion was founded in a failure of language which didn't permit the incident commander to define, let alone communicate, his strategic intent. In spite of adherence to NIMS standards and years of experience the absence of standardised terminology, combined with traditionally stovepiped legacy systems, led to what I perceived as indecision and operational paralysis.

Imagine for a moment that you also witnessed this response to "a terrorism CBRNE incident with unknown casualties". All hands arrive, perform a scene size-up, don appropriate PPE and get ready to go to work. The incident commander, a fire chief, orders his hazmat techs to "classify, identify and verify" the agent involved. The quick-thinking tactical leader of the hazmat teams requests that Explosive Ordnance Disposal (EOD) checks for the presence of an IED or secondary device. The EOD boss then requests a SWAT team clear the building of possible shooters before his team lumbers down range. The SWAT sergeant has his "six man stack" geared up, but waits on giving the order to make dynamic entry until he has an all-clear from the hazmat guys. Meanwhile, EMS is clamouring to enter the structure to perform triage. This is an example of a perfectly executed Operation Catch-22. Without adequate language to characterise the threat, they were unable to define the mission, create a strategy and execute it tactically. They did everything to the best of their ability. CBRNE terrorism isn't a typical 911 response.

Terrorism is a form of Maoist insurgency; it is post-modern warfare. A leading military theorist, Col TX Hammes, USMC, defines its uniqueness with his term "Forth Generation Warfare" (4GW). In his analysis, the 4GW threat is as real for first responders as it is for any soldier or marine. The fact that many first responders may not recognise, or like, the fact that we (they) are at war cannot change the objective reality that war has been declared on us. During CBRNE terrorist events our first responders are called to become a new generation of sophisticated, highly technical and adaptive warriors with missions that differ significantly from old school warriors.

This is just one example of the globalisation of warfare, and the corresponding paradigm shift isn't limited to first responders. Our deployed military is learning the basics of emergency management and law enforcement patrol. To effectively control an insurgency, the unrestricted use of force has to be balanced with law enforcement's "force continuum" doctrine. Imagine trying to win "the hearts and minds" without having access to the term "force continuum." Without appropriate language and the

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understanding that comes with it, warriors would apply old paradigms and risk overpowering the local civilian populations. The resulting collateral damage would radicalise those populations, which in turn would support the insurgents' strategy. General Krulak, USMC found a balance with his "three block war" doctrine. The first block sees active combat. In the middle you engage in peacekeeping, and in the third you do national building. In order for first responders to create a parallel doctrine and resolve the dilemma of the domestic CBRNE incident, they need adequate language to guide them through the changing terrain.

First responders have effectively dealt with the addition of missions in the past. Part of their solution to those challenges included creating new language that provided standardised assumptions and a common operational perspective. For example, when they began systematically dealing with industrial chemical releases in the early 1970s, they called them hazardous materials, and from this came Hazardous Materials Technicians. At the same time, they began systematically dealing with medical emergencies which lead to the creation of Emergency Medical Technicians. The acronyms CBRNE and IED are examples of standardised language that defines part of the 4GW threat. The terms are common to the military and first responders because both recognize them as threats.

The term IED has become standardised and was readily accepted by both military and law enforcement Explosive Ordnance Disposal (EOD) Technicians because it communicated the strategic intent and tactical execution of terrorist. This "best practice" communicates standardised assumptions and gives all responders a common operational perspective. Similar standardised language would resolve the misunderstandings between hazmat techs and the military NBC communities.

The simple fact which seems to escape both communities is that the chemistry of toxic industrial chemicals (TICs) and chemical warfare agents (CWA) is identical, as is their effect on human physiology. The laws of chemistry and physics don't care if your uniform is blue, green or desert tan. The weapons that terrorist will use are *both* toxic industrial chemicals *and* chemical warfare agents. They should be considered *toxic industrial chemical warfare agents* (TICWAs). When TICWAs have been weaponised by terrorists, they become improvised chemical devices (ICDs). Like CBRNE and IED, the acronym ICD and the assumptions that drive it have strategic and tactical implications for both the military and first responders.

This is a departure from the approach taken by organisations like the National Fire Protection Administration (NFPA). In an attempt to define terms, the NFPA Committee tasked with CBRNE personal protective equipment standards created and defined chemical terrorism agents (CTA), chemical warfare agents (CWA) and dual-use industrial chemicals (DUIC). The NFPA definitions are self-referential and confusing. For example, they define CTAs as CWAs and/or DUIC that are used by terrorists. DUICs are defined as highly toxic mass-casualty threats *and* they can be used by terrorists, while CWAs are defines as chemicals used on a battlefield to kill or incapacitate an enemy. The source of the NFPA's confusion lies in the failure to recognise that terrorism is 4GW. Since civilians are the targeted enemies of terrorists, and the battlefield is the home-front, then any chemical used by a terrorist would be, according to the NFPA definitions a CWA, a DUIC, and a CTA.

There is an example of the knowledge deficit regarding the similarities and differences of toxic industrial chemicals and chemical warfare agents. The NFPA 1994 committee has created personal protective equipment (PPE) testing standards against TICs and CWAs, (but not for CTAs or DUICs). To represent CWAs, they selected VX, L, HD and GB. They chose acrolein, acronitrile and chlorine to characterise TICs. Ironically, the first CWA successfully used on the battlefields of the First World War was chlorine, and acrolein was introduced in January 1916 by the French who called it Papite. In fact, all three of their TICs were actually CWAs from the First World War.

In September 1941, the Nazi's used Zylon B, a form of hydrocyanic acid, to kill Soviet prisoners of war in Auschwitz Birkenau. This was the first use of CWAs in the Holocaust. In addition to the Nazi's other techniques, an estimated 1.5 million people were murdered in the Auschwitz Birkenau and Majdanek camps using high concentrations of Zylon B. It is still manufactured and sold in Eastern Europe for use as a pesticide.

In 1938, four German chemists created another pesticide, isopropyl methylphosphonofluoridate (CAS 107-44-8). When it was found to be too toxic for commercial use, it was further purified and modified to increase its toxicity well beyond levels that would be tolerable in industry. This TIC became a CWA and was named Sarin after its creators, Schrader, Ambos, Rudriger, and von der Linde. It was subsequently classified as the chemical warfare agent GB.

Knowledge of the use of chemical weapons spread to the Middle East before the Second World War. They were first used by Britain in Palestine during the second Battle of Gaza in the First World War. The British used them again in Iraq (mustard) in the 1920s. The Spanish used them in Morocco against the Rif rebels in 1925. Mussolini authorised the Italian Army to use CWAs in Libya (mustard) in the 1930, and Italy used mustard again in Ethiopia in the 1936.

After the Second World War, Arab Muslims began using CWAs against each other. The Egyptian military used phosgene in the 1963-67 North Yemeni Civil War. Iraq used mustard extensively against Iran in the1980-88 Iran-Iraq War. It is reported that Libya used Iranian supplied CWAs against Chadian troops in 1987-88.

Five decades after the Nazis had invented it, on March 20, 1995 the apocalyptic cult Aum Shinrikyo deployed Sarin in the Tokyo subway, killing 12 people and sending thousands to hospital. This is the only example of a terrorist organisation successfully weaponising and deploying any chemical as a weapon of mass destruction. Terrorists must improvise their weapons by using locally available materiel because they lack logistical support. With this in mind, The Dictionary of Military and Associated Terms (JCS Pub 1-02) "improvised" two definitions: improvised explosive devices (IED), and improvised nuclear device (IND).

◆ **Improvised explosive device (IED)** A device placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass, or distract. It may incorporate military stores, but is normally devised from non-military components.

◆ **Improvised nuclear device (IND)** A device incorporating radioactive materials designed to result in the dispersal of radioactive material or in the formation of nuclear-yield reaction. Such devices may be fabricated in a completely improvised manner or may be an improvised modification to a US or foreign nuclear weapon.

These definitions address the Nuclear and Explosive in CBRNE. That leaves chemical, biological and radiological undefined. Building on the structure of the JCS definition, I would propose we add the following four definitions:

◆ **Improvised chemical device (ICD)** A device incorporating the toxic attributes of chemical materials designed to result in the dispersal of these toxic chemical materials for the purpose of creating a primary patho-physiological toxic effect (morbidity and mortality), or secondary psychological effect (causing fear and behaviour modification) on a larger population. Such devices may be fabricated in a completely improvised manner or may be an improvised modification to a US or foreign weapon.

◆ **Improvised biological device (IBD)** A device incorporating biological materials designed to result in the dispersal of vector-borne biological material for the purpose of creating a primary patho-physiological toxic effect (morbidity and mortality), or secondary psychological effect (causing fear and behaviour modification) on a larger population. Such devices are fabricated in a completely improvised manner.

◆ **Improvised radioactive device (IRD or "dirty bomb") A** device incorporating radioactive materials designed to result in the dispersal of radioactive material for the purpose of area denial and economic damage, and/or for the purpose of creating a primary patho-physiological toxic effect

"Now what have we here? New devices, new threats, new language?" © DoD

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(morbidity and mortality), or secondary psychological effect (causing fear and behaviour modification) on a larger population. Such devices may be fabricated in a completely improvised manner or may be an improvised modification to a US or foreign nuclear weapon.

Finally, recognising the widespread use of arson in the Parisian intifada, and its appearance in movies, it would be prudent to consider the use of fire as a weapon and include a modern definition of the Molotov cocktail.

◆ **Improvised incendiary device (IID, arson or Molotov Cocktail)** A device leveraging exothermic chemical reactions designed to result in the rapid spread of fire for the purpose of creating a primary patho-physiological effect (morbidity and mortality), or secondary psychological effect (causing fear and behaviour modification) on a larger population. May also be used with the intent of gaining a tactical advantage. Such devices may be fabricated in a completely improvised manner or may be an improvised modification to a US or foreign weapon.

In November 2004, Iraqi and coalition forces raided an insurgent lab and recovered IED ingredients including sodium, potassium and ammonium nitrate, nitric and sulphuric acid, and black powder. They also recovered CWA ingredients including potassium cyanide and hydrochloric acid, magnesium and acetone. Documents were also found in Afghanistan with directions for the production of mustard, Sarin and VX. While we found the precursors for CWAs, we need to remember that terrorists cannot deploy them by using old-school Soviet massed artillery barrages. They weren't going to make traditional military chemical weapons.

Did we find our grandfathers' CWAs, hazmat TICs or something altogether new-ICDs? The terms ICD, IBD, IRD and IID are designed to help coalition military forces and first responder communicate the reality of CBRNE events. In the final analysis it doesn't matter if you are responsible for protecting Main Street USA, Piccadilly Circus, a checkpoint on Route Irish, or on a winding road in Afghanistan; we should all have the ability to communicate using a standardised terminology based on well founded assumptions.

A standardised language will better improve cooperation and our understanding of the threat © DoD.

BRACED FOR IMPACT

Gwyn Winfield investigates the work going on behind the scenes in the European Commission's Impact programme

TOO MANY in Europe, the work of the European Commission is neither known, nor cared about. There is too much going on in their own national spheres to wonder what the Commission is doing, especially as their work rarely has any impact on their lives. It would be an exaggeration to say that the work being done in the Innovative Measures for Protection Against CBRN Terrorism (IMPACT) will change this paradigm, yet the chances are that the programme will have a lasting effect.

There is always a great deal of scepticism about politicians, whether national or international, getting involved in the work of regional, or even national, agencies – such as police, ambulance or fire forces. This scepticism usually revolves around the belief that nothing will come of it; it will be a lot of talk and pontification, but at the end of the day it won't make a deal of difference to those on the front line. That is certainly not the intention of the forces behind Impact; in fact, it is very much the opposite. Embedded in the programme's genesis is the need for something real to emerge at the end.

Pieter de Smet, a Director General at the European Commission, strenuously denied the suggestion that Impact will result in a bundle of files no-one will read: "In the framework programme the rule is that we fund up to maximum prototype, as the way of funding only allows us to do that kind of research," he said. "But the end result has to be used in some way; there is an obligation on the consortium to either take a patent or publish it, so the taxpayers' money has a purpose."

This idea can be taken to the extreme where it actually benefits non-European industry. Once the research is published it is open source and "free" to all. Mr de Smet agreed that a scenario whereby no European company either wants, or is able, to produce a profitable model, but a US or Canadian company can, would mean that the European investment would be diminished. While the likelihood of this is slim, a solution devised in Europe but lacking the requisite national flag printed on the side – and therefore inimical to national interests – is far more likely. This may mean the solution would only find a few buyers, resulting in a high unit cost and few export sales. Mr de Smet explained further, "There are two aspects to this. We don't fund research at an EU level to find EU solutions. We fund research in support

Impact delivered a training exercise designed to study the protection requirements. All photos © TNO.

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Impact is a smorgasboard of projects; at one end there is the pure research, at the other physical prototypes that may make it into the hands of the civil first responder.

of the competitiveness of EU companies, universities and research institutions. Secondly, if that innovation is turned into a product and delivered to the market, it is down to the final users – whether private or public – to choose the products they want. They choose these products, at either a national or European Parliament level; these are "added value" at the European level.

"Then there is the issue of taking up the results for research – specifically in the security research. The end user is often a public entity, and the question is value. We want the products to make it to the market and be used even more – because Impact is about security. The last thing we want is to develop the product and have it rust away somewhere. How do we solve this? We do this during the call for proposals by bringing the end users on board or using them as a steering board to follow the product. This helps product development and allows a direction for it to be delivered to market."

Impact is a smorgasboard of projects; at one end there is the pure research, at the other physical prototypes that may make it into the hands of the civil first responder. The latter is an important distinction – the original idea was to have the programme linked into some similar work that the European Defence Agency were doing, in order to allow economies of scale and avoid duplication. While there were a number of advantages and support for this approach at the tactical level, the "Grand Strategic" political players decided they wanted this to be strictly civil – meaning that there is a high degree of visibility and transparency between the military and civil work groups. It does, however, raise the spectre of duplication and working in silos.

Impact is part of the European Security and Research Advisory Board's (ESRAB) work on counter-terrorism. This is a generic, non-CBRN specific body of research that covers four mission areas: protection against terrorism and organised crime, border security, critical infrastructure protection and restoring security in a crisis. The astute among you will have realised that, while CBRN is not a topic per se, it does in fact occur in all four mission areas. These mission areas are then assigned various work streams – in all there will be five demonstration programmes, 20 integrated projects (being mission specific) and 120 capability projects (being technology development and multi-mission and mission specific); in other words, the more specific the result, the fewer the work streams.

At the very top level there are five demonstration programmes, and one of these is CBRNE – the others being European-wide integrated border control systems, aftermath crisis management systems, logistics and supply chain security and security of mass transportation (and yes, it seemed to me that they all should have CBRNE in them too…). What perhaps makes this relevant to a whole host of people is the budget: Impact is not small beer. The Security Research part of FP7 (Financial Plan 7) comes in at €1,400m over a period of five years! €80m is likely to be spent in 2007 alone, which turns into a hell of a lot of research and hopefully an awful lot of output. Exactly where this money is going to be spent can be found in bewildering detail at http://ec.europa.eu/enterprise/security, and is likely to involve a deal of head-scratching and spreadsheets.

The last thing we want is to develop the product and have it rust away somewhere. How do we solve this? We do this during the call for proposals by bringing the end users on board or using them as a steering board to follow the product.

To pare it down to "So what does it mean to CBRN?" is a lot easier. Impact has resulted in eight work packages (WPs): WP 100 – building scenarios and preliminary risk assessment; WP 200 – mission and operational concepts; WP250 – immediate response team capability; WP 300 – CBRN weapon early warning detection systems; WP 400 – biological weapon detector technologies; WP 500 – protection of the rescue team or people involved; WP 600 – decontamination; WP800 – sampling and analysis of suspect materials. These work streams are being investigated by a series of different institutions, from CBRN-specific organisations such as France's CEB, to broad research establishments like TNO, through to CBRN industry members such as Thales, Environics, etc.

◆ WP 100 is a process of identifying CBRN scenarios to be used as planning tools and also to develop threat assessment tools. While WP100 is probably the purest research – it's scenarios are generic, meaning that they are both useful and useless to specific forces in equal measure (as no force is likely to have the exact scenario sketched out) – they are key to informing all the other WPs so they all have an idea of what "threat" they are responding to. An example might be terrorists crashing a lorry full of sulphur dioxide into a sports stadium where the release valve is stuck open and the TIC leaks out. These have proved useful to the

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stakeholders and more are planned. They have 90 agents in their database, (nine bio, 15 rad and 71 chem); this is not meant as an exhaustive list, nor as indicative of what forces will face, but it is a start and will be continually updated.

◆ WP 200, the scenario analysis, interrogates scenarios from WP 100 to establish some common themes. These have found, for example, that, out of 20 scenarios, EMS is the only first responder needed in five of them; that 14 required fire and 13 police. These are subject to national procedures, but this is eased by the fact that, for many European countries, the first responder of choice for a CBRN incident is the Hazmat team which resides universally with the fire departments. This analysis then feeds back into WP100 by identifying scenario gaps, but also results in a risk assessment model and a computer "game" of the scenarios. The team studied six European countries (Austria, the Czech Republic, France, Germany, The Netherlands and Sweden) and tried to design an operational concept, and from that requirements, for first responders.

This is probably one of the most problematic of the work streams, as it will be attempting to show first responders how to deal with a CBRNE event. Chief Superintendent Andrew Sigsworth, from the UK's Police CBRN Centre, suggested this might be something the UK could learn from. "There are still areas where we can develop massively," he said. "We have good structures in place with the G8 nations, we share tactics, we have the quadrilateral group – AUSCANUKUS – and the R&T establishment is well plugged into Europe. But we have to have a structure in place at the tactical level, and I don't think we have that at the moment. The UK has had to design the command doctrine, the statements of requirement, etc, but these could have come from any country in the world. It is more difficult at the tactical level than the equipment level. You can use that same piece of equipment in many different ways – the response to any alarm could be dealt with in 30 different ways. Now, some of those may well be of interest to UK police, and others may not. We miss out on that cross fertilisation of response, but that comes down to individual capabilities."

Dr Pascal Stephan of the French DGA was of a different opinion. When asked whether this was something the French were hoping to get back from Impact there was an emphatic response: "No. For France the response is well organised, with Piratox, etc. What we would like to get from Impact is the ability to promote contractors in Europe in developing technology – not in developing concept of use. We want it to focus on technology and the involvement of companies." The need for Impact to have a wide angle on CBRNE has been dictated by the needs of the EU countries – this much is clear.

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WP 200's findings from this survey, which they want to expand, was that none of the six had an integrated team in place, that first responders are often the first trigger that something has happened (the blue canary approach) and that mass decontamination is likely to provide, due to the time it takes to set up, more of a psychological than physiological role.

◆ WP 250 – the immediate response team capability – aimed to develop three sets of requirement in CBRNE systems: training aspects, logistics and to analyse the training needs for first responders. The team has put together a requirement database, and is working towards a "system approach" and utilising the database for system and sub-system definition.

◆ WP 300 is for chemical and radiological detection, and has started with a review of current equipment and the underlying technology. WP 300 looked at four chemical detectors: Chempro 100 (Environics), Gid-3 (Smiths Detection), Raid-M (Bruker Daltonics) and AP2C (Proengin) and one radiological detector, SSM1 (Arcs). These were networked together determine whether they could provide a systems-fusion synergy. These detectors were chosen because they utilised a variety of different ways to detect (mainly) chemical agents, and were tested at CEB. The systems-fusion concept was broadly successful, but it was hampered by a number of technical problems. Since the sensors were all competing products and the sensor-fusion was also done by a competing company – Thales – there was a great deal of reticence to share information on the signal and it was agreed that there would be a modified process to guarantee commercial interests. All four chemical agents could be physically integrated and could provide both temporal and spatial data fusion, and this integration work may well be one of the major advances to reach the first responder.

◆ WP 400 is the biological part. The team came to the conclusion that, while radiological detection was mature and chemical detection was growing, biological detection was still embryonic. There was an initial technical evaluation that tested five technologies – DNA-based; analytical-chemical; affinity based and optical. These were tested for three simulants – living bacteria, spores and toxin – at three concentration levels at a total of eight laboratories. All the systems managed to detect the simulants in some form, but some lacked sensitivity, some lacked selectivity, the time of response was measured in minutes at one end of the scale and days at the other, and this response time differed from lab to lab. The team also measured the natural background of bio-aerosols and showed the sharp disparity between sampling at ten seconds and a minute – some of the spikes picked up at the ten-second sample were missed completely by the minute sampling. While the discovery that no single technology was able to do what was needed was not new, the research work that VTT did will be of inestimable value in an area that is often devoid of this sort of comparison.

◆ WP 500 – the protection of the first responder community – was focused on an evaluation of the current equipment, the task analysis of the equipment and an attempt to identify possible technological solutions. This saw the Impact team launch a full scale exercise at TNO Netherlands in September last year, to try and isolate some of the key issues. While some of these were basic, such as the need to allow drinking and to have one communication system for all units, others, such as the need to provide escape hoods for all victims and that all first responders should have PPE (even if they are safely in the Cold Zone) are more

WP 100 Building scenarios and preliminary risk assessment - FOI
This work package will aim at strengthening the understanding of the CBRN threat. An important step will be to shape a generic approach which could lead to agreed methods for analyzing the threat, tools and equipment.

WP 200 Mission and operational concepts - CEB
The objective here is to understand and establish the mission and detailed role of different first responders in participating countries. In a workshop, first responders from Europe will be gathered to share experience, problems and capabilities to be developed, ultimately leading to the design of an EU operational concept.

WP 250 Immediate response team capability - Thales
The objective is to enable quick and effective response to any CBRN event in all EU Member States employing the operational concept developed in WP 200, hereby focussing on the system itself, training aspects and logistics.

WP 300 CBRN weapon early warning detection system - TNO
The first objective is to determine which gaps exist between C and R/N detection systems available now and in the near future and the requirements for detection systems. The WP will formulate and resolve technological solutions to fill the defined gaps, build and test a network to connect different detectors.

WP 400 Biological weapon detector technologies - VTT
Recent and near-future technology developments will be reviewed, and promising technologies will be selected. The second objective is to push new developments based on the selected technologies and the defined requirements.

WP 500 Protection of the rescue team and/or people involved - ARC
The objective of this work package is to establish the required performances of protective gear used in a counter-terrorist setting. Current and state-of-the-art equipment will be evaluated.

WP 600 Decontamination - SUJCHBO
A task analysis will be performed to make an inventory of how the responders act. Furthermore, a review and evaluation of state of the art equipment and procedures will be carried out on the basis of the outcome of the first objective.

WP 800 Sampling, Transport and Analysis of suspect materials - FOI
The objectives and description of work within this work package describes the goal of having an integrated and coherent approach to sampling, transport and analysis of samples within the EU.






BRACED FOR IMPACT

interesting. The findings from 500 suggested that there was a need for more cooling systems, emergency isolation systems and monitoring systems for protection levels in PPE.

◆ WP600, the decontamination programme, aimed to define performance needs for counter-terrorist decon, define protocols for mass decontamination, field test mass decon facilities and recommend doctrinal improvements. This programme probably ran contrary to a great deal of established thinking. The team concluded that mass decontamination is not yet possible in an acceptable time, that mineral sorbents (such as Fuller's Earth) should be stockpiled, and that first responders needed to rethink disrobing at cordons because of the spread of contaminant from large piles of contaminated clothing. Two recommendations that were easier said than done were for rapid chemical decontamination of hair and legislative requirements for the management of large CBRN scenarios. The former comes up against military doctrine, which would be just shave it all off, but some countries (and many individuals) may well have ethical problems with such sudden depilatory action. As for trying to standardise any approach in legislation, as Andy Sigsworth and Pascal Stephan showed, this is not a straightforward task.

◆ WP800 – the sampling and analysis section – had main objectives of enhancing the preparedness of civil labs to handle and analyse CBRNE material. The group noted that, while there were specialised labs for CBRN, there was little experience of such and a shortage of equipment that could deal with mixed samples. There was also a worrying shortage of SOPs for toxins and TICs and that the bio experience came from the military or food and drink experience – there was little effort to focus on unknown agents and the abiding worry about the different needs of sample identification and forensic evidence. WP800 is now going to focus on developing a strategy for sampling mixes and unknown samples and to train laboratory staff under realistic conditions and scenarios (using simulants) to ensure safety and efficacy.

While some of this work is likely to end in an application, it is not the only effort going on in Europe. The European Defence Agency (EDA) and Nato are also involved in research in some of these fields, and because of the nature of the "church and state" – or civil and military – there is likely to be some form of duplication of effort. Pavel Cerny, Technology Manager of the R&T Directorate at the EDA, suggested that, while this might not be as bad as it sounds, "It would have made sense to tie the EDA and EC research even closer together, but the decision was made by the nations to keep it separate. This was not the idea of the EDA. You have to realise that 75 per cent of the EDA members are also Nato members, so there is no loss – we are not doubling up. It is down to the member states to tell us that there is some duplication."

Pieter de Smet agreed: "This is a relevant question," he said. "It is important that member states inform us where we should take care not to duplicate. EDA and the EC work closely together and we have one project in common at the moment – an example of our co-operation – the software defined radio. There is a civil application for that and a military need, and it was a project selected in the last call for preparatory action and it was also selected and recognised by the EDA, and we are pushing to get both sides together. Unfortunately there has to be a dividing line, if nothing else in the way that it is funded. We come from a community budget and they get what the member states will put in – but that is a concrete example of how we would work on future projects."

2007 will be a busy time for Impact, with a series of deadlines and contract awards. It will also see a further maturation of the various work streams. This is not a legislative process, however; the members of the EU are not forced to accept their findings, and Impact will be measured by its spread. The UK is perhaps the odd one out – as Andy Sigsworth himself noted, the UK tends to look across the Atlantic because of its multi-lateral treaties, but many of the other countries don't have this opportunity and concentrate more on the European side. As Pascal Stephan noted, France feels that its response is mature enough not to need the tactics, but other nations, particularly those new to the EU, will not be so lucky; the further down the capability scale you go, the greater the reliance on Impact's findings. It is costly and time-intensive to develop tactics and procedures, and many civilian forces that are struggling with budget deficits and a shortage of highly trained manpower will welcome Impact in a way that those more mature, and financially comfortable, countries will not. While Impact may result in a few interesting pieces of technology, its lasting legacy is probably going to be in bringing many of the CBRN undeveloped countries up to something approaching parity.

WELCOME TO THE TEAM CBRN CLUB

Gwyn Winfield gives his opinion on the work being done by UK MoD on the CBRN Defence Industrial Strategy

THE title of this article is both a challenge and a warning. The challenge is to the CBRN IPT, DEC CBRN and the industrial members of "Team CBRN". The warning is to anyone who doesn't know what Team CBRN is and still hopes to do business with the UK MoD.

The recent Defence Industrial Strategy (DIS) workshop was replete with metaphors – the exact position of the train in relation to the station being a favourite – but two things are certain: the MoD is changing and industry has to change with it. This is a loaded proposition – why should I change? – but one that needs to be addressed by current and prospective clients of the MoD. DIS is a large topic in itself (further information can be found on www.mod.uk) and is difficult to summarise, officially it is trying to level of the boom or bust, to have 'more effective delivery of military capability through partnership with industry.' What it will definitely be is the largest procurement change in the UK for ten years – since the demise of the Procurement Executive and the Quarter Master General's Office (replaced by the DPA and DLO respectively). There are two important points that need to be remembered throughout. Firstly, the Minister for Defence Procurement, Lord Drayson, has imposed change on the MoD, which is critical to remember. The changes that are occurring in the CBRN IPT and DEC CBRN are not happening because they want them to, but because they have to. Secondly, of equal importance, the previous procurement system was far from ideal – just because it is familiar doesn't mean that it was right.

It is also worth noting that this is being done in conjunction with industry. It needn't be – previous changes such as Smart Procurement, Smart Acquisition *et al*. were done with the minimum of input and the maximum of effect. While many of the problems of Team CBRN occur because of the industrial participation, it has at least "empowered" (just to start the management speak ball rolling – there may be some blue sky thinking later too, so keep up) industry to come up with a solution that they have had a hand in.

Perhaps the most important change within the IPT is the death of the future programme schedule. This was the seen as 'The Gospel According to IPT' by industry and it told them that in 2011, for example, there would be an Initial Gate decision for Biological Detection Tier 3, with a Main Gate in 2013. These would be looked upon with anticipation by industry keen to fit it in with their own technology readiness and see it as a hook to hang their research on. Often, however, these names and concepts would be dreamed up years in advance, and could achieve a mass and momentum of their own without changes in technology and threat assessment being given full consideration.

To try and free up the CBRN schedule from this there has been a move towards capability or, to be accurate, "through life capability management" (TLCM – which, by a quirk of fate, is also Torpedo Launched Cruise Missile!). This was to free the system from the sort of debacle which followed the UK Apache programme – whereby the platform was bought, but not defence lines of development: the training and simulation that would be needed to operate it. Now the system is to be governed by the trinity of water, slush and ice, with water being a pure capability – chemical surveillance on the battlefield, for example – slush having more detail – point chemical detection – and ice being the requirement – a point chemical detector than can recognise specific agents at specific amounts. – though it has to be noted that this could well be a capability too, with industry free to follow whatever path they see fit.

It will come as no surprise to those that work with the military that these are not the only new jargon and acronyms. The Director Equipment Capability (DEC) is now the sponsor organisation, and also the single point of accountability, who works with the Capability Management Group (CMG), while the Integrated Project Team (IPT) remains unchanged they will now belong to Defence Equipment and Support (DE&S) (rather than DPA or DLO) and they will be joined by a new role – the Key Strategic Partner, of which more later. Lost within the deluge of the DIS changes is one of the most fundamental – the scrapping of the previous Defence Procurement Agency and Defence Logistics Agency and the creation of a single team which was enshrined within the Enabling Acquisition Change (EAC) Report. In terms of brass tacks for UK CBRN procurement, this will see the merging of one DPA IPT and five DLO IPTs, meaning that Phil Strudley's (the IPT Leader) team may soar to about 50 people. Equally, however, it may well be that if the MoD goes down the Key Strategic Partner (KSP) route, then the IPT will shrink to about 20 MoD individuals. This is in line with DIS thinking that would like to see smaller IPTs. These 20 will, supplemented by the Key Strategic Partner (KSP), will be able to bring a greater degree of commercial understanding into the IPT.

Team CBRN is the organisation of the IPT, KSP and supplier base; this much is known, but after that it becomes a bit of

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work in progress. Exactly who, how many and exactly what the KSP does is currently under debate among the 20 members of Team CBRN – yet the current members of Team CBRN may change and multiply – or diminish – as circumstances develop. There will, eventually, be a downselect to somewhere between two and four KSPs (but again this might change over time to adapt to circumstances) from a field of, the MoD estimates, eight. "There has already been some discussion with the eight companies that could do it," said Phil Strudley. "How will we choose? We will have a competition to bring it down to two-to-four."

The KSPs may well be system manufacturers, or capability providers/system integrators – the official description would be intelligent systems integrators with key domain knowledge - and are likely to involve at least a few unusual suspects (Selex for example). Currently the joint MoD industry team is unsure whether to have one KSP, which many members regard as unlikely (but evidently not those members who feel they could fill those big shoes), or a range of KSPs which would then fit into categories. Exactly what those categories are is also being debated; should they be working at the sector level (Protect or Timely Warning, for example), the capability level (detection and decontamination) or the product (respirators)? Again the team is happy to admit that these will change as circumstances do – there is little point in having a Colpro KSP if the next contract is nine years away – but that those KSPs will be on a long term contract – perhaps as long as ten years. Tim Otter, Chairman of NBC UK, admitted as much: "The whole thing is a work in progress; the composition of Team CBRN will change to deal with problems that occur," he said. KSPs are not lead systems integrators (LSI) though, such as Boeing/SAIC are on the US' Future Combatant System, which could stop them bidding for contracts. The KSP can, if he felt his products were suitable, bid for the contract he was looking to fill (though, it has to be stressed, the KSP does not make the decision – that is still the role of the IPT), and could propose them as the best solution for the contract.

Now this is when the cynics among you are probably pressing the big red button – "How am I expected to win when my major competitor is a KSP?" If that is the case then I recommend you back to the first paragraph of the article – if you are not trying to engage with Team CBRN then you are not likely to do very well. It may be an unpleasant fact, but it remains a fact. The IPT leader does not need to choose the recommendation by Team CBRN, but if you have not been recommended, and passed over for some reason, or have elected not to engage with them, then you better have a bloody good story.

If any KSP abuses his power, or is felt to by other members of Team CBRN, it may well be that he is stripped of his rank (and, one would have thought, be unlikely to attain such lofty heights again).

The major theme of any discussion about Team CBRN is the need for change; change has been enforced, and it is better to embrace it than have it imposed. "New thinking is required in the MoD and new thinking is required in industry, we have to work together," said Scott Health and Safety's Nigel Holmes. There is also the need for "openness and transparency", and this is what the idealists would suggest will make the difference. If any KSP abuses his power, or is felt to by other members of Team CBRN, it may well be that he is stripped of his rank (and, one would have thought, be unlikely to attain such lofty heights again). This might be slight consolation to those companies whose business plan revolved around them winning the contract, but *c'est la guerre*. The KSPs role has yet to be finalised, but the team have put forward some suggestions – managing the strategic partnership contracts, delivering systems that meet the contracted terms of TLCM, providing advice to the IPT, selecting preferred suppliers, placing sub-contracts, demonstrating value for money or agreeing joint partnering arrangements.

Being a KSP is not open to everyone – there have been some suggested criteria such as being capable of prime contracting, domain knowledge, systems integration capability, experienced supply chain management, sympathetic to supply base, and long-term interests. It is the latter – long-term interests – which is perhaps the most important, as it refers again to the need for fair play. This is where it becomes difficult, as fair play means different things to different commercial interests. Phil Strudley suggested that there were frameworks from other projects that could help: "Processes like PPP have key performance indicators and other devices that can be measured to make sure that they are doing what they should. If not there would be a framework to stop it."

Most of the concerns about KSPs don't come from the larger companies – that will happen during the competition – but from the small-to-medium enterprises (SMEs), or "subject matter experts" (to quote Siemen's Richard le Fleming). These are the ones who are worried about the repercussions – potentially being cut out from the supplier base at one end and being squeezed by the KSPs at the other. In many respects these various companies are the losers from the current change. They will inevitably lose the ability to punch above their weight, will find themselves losing a single point of contact and having to promote their technology to both KSPs and IPT. Some of them may already also have enabling contracts which might need to be "looked at" and there is the major fear that their IPR may well be snaffled by the KSPs – all in MoD's best interests of course. Currently Team CBRN has a non-official SME champion (NBC UK) to try and promote their interests and concerns – which are many and varied – to the non-SMEs who make up the rest of Team CBRN.

In another change there is also a desire to get industry involved in S&T projects earlier. This has been described as trying to level out the "valley of death" – the graph that shows the development of technology as it is handed over from science to industry. This will see a joint development working towards a final requirement. This means that the work that DSTL does will find an application rather than needing to be modified past recognition or becoming an interesting

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How will existing contracts be affected by DIS? ©CBRNe World

aside. While there is an attraction to this there has to be the concern over competition. Just because it was invented here does not mean that it is the best – which is not in anyway a condemnation of DSTL. Innovation moves in strange ways, its wonders to perform, and there would have to be firm handling of the procurement process to make sure that the UK gets the best solution. This might mean more projects never reach the level of maturity that they currently do – industry will not continue to fund projects that will not find a commercial market, and without industry cash, and IPR, it may be that DSTL cannot do it on their own (leaving them with a legacy of half completed, but potentially valuable, products).

There is an idealism about Team CBRN that suggests that openness and transparency might work. But the team has been put together, by admission, by personality and capability, rather than company or stature. Quite whether this openness and fair play will last beyond "contact" or when individuals step down will be another thing – yet Team CBRN is all about challenges. The IPT will have to rely on industry to fulfil some of the roles, but what impact will this have on the budget and on fair competition? The KSPs will be awarded contracts for their time, but requirements and budgets change all the time in the MoD so when this inevitably happens what does it mean for the rest of the programme? Presumably, either industry then turns in a limited performance to the IPT, cutting the hours to match the budget, or extra funds have to be found for the KSP that can only come out of the procurement budget – neither of these are attractive solutions for the warfighter.

Arguably, most of the focus from the sub contractors (some of which will consider themselves snubbed prime contractors) comes over the idea of fair competition; will the KSP – who won't be a subject matter expert – understand my product? In the old system there were a number of ways into the procurement process – some through the science community who could fully appreciate what the technology could do. That has been streamlined now and access to DSTL and the IPT will be lessened. Equally, there are always personality clashes between companies; that might see valuable technology decide that it is not worth the bother and cost of competing because they "know" they will lose.

Openness needs to be embedded at the very start and Team CBRN will have to work hard to ensure people's objections are listened to; otherwise it will become the Team CBRN Club alluded to as the title of this article. Equally, however, the Team is going to have to be prepared to say no, to ensure that the process doesn't suffer the death of a thousand committees. This is perhaps best summed up by Phil Strudley's non-rhetorical question of "Do we all have the appetite for change?" Some will not, and Team CBRN will be judged on how it deals with those dissenters.

To be fair, the work that both Phil Strudley and Colonel Harris are doing personally, seeing those companies who entered into Frazer Nash's survey, has been commendable for trying to keep the wider community involved. At the same time a rigorous schedule has been imposed, and this is further reinforced by the fact that Team CBRN might become a pilot programme for the DPA's (or whatever it is called this week) approach to other business areas, so there has to be measurable progress. That progress will also be assessed by the user, and it will be interesting to see how well projects such as Light Role Team and Maritime Biological Detection System maintain their momentum during this period of change.

"Moving forward, together" is the strapline, and challenge, of Team CBRN. There has to be movement at both poles, however; the Team needs to ensure that it remains fair and open and industry has to get involved rather than sit on the sidelines and gripe. There is a lot of griping too; many of these are real fears, but are not chaperoned by action – a number of companies seem to dismiss Team CBRN as unworkable and stick their

heads in the sand. Team CBRN will happen – too much has already occurred to stop it – but, most importantly, change means there can be no maintenance of the status quo.

The IWW organiser Joe Hill's last words, "Don't mourn, organise," would seem to be apt; the old system has gone and there can be no better reaction to this than to try and prepare for the oncoming change. Will the new system be perfect? No, but you have a far better chance of making it amenable to your company/organisation if you are in the middle trying to guide it.

Those who want to know more can contact Doug MacMillan on d.macmillan@fnc.co.uk or +44 (0)117 9226242

Family planning

Doug Bryce, Deputy Joint Program Executive Officer, JPEO CBD, spoke to Gwyn Winfield about bringing up the next generation

High Score! What role for CBRNE in the NEC? © DoD

GW: Operations in Iraq and Afghanistan have put both a financial and operational squeeze on the US procurement system. This has been seen in the JPEO CBD, an example being the affect that the up-armouring of Humvees had on Stan Enatsky's Colpro program. What has been the balance on this? Have operations acted as a spur for innovation, as they were in the Copro case, or a cause for delay?

DB: Our task can be broken down to the way we see our mission and operate. We take products, we field them, then we look at improving them, and then we look at the next generation of them. We have a plan that says we field, improve and then replace with the next technology; the up-armouring was the same thing. It came at that time because the war forced us to do it then, but it didn't put any hurt on us, apart from financially – making sure that we had the money to make those changes. Sometimes that can force you into another year, but it is not as if anything has changed to make it hard or difficult for us. What it has made us do is concentrate on what we can do to that piece when it is fielded to make it better and plan for the next generation.

GW: The Transformational Countermeasures Technology Initiative (TCTI) within DTRA is about making things more innovative and less iterative. Is this going to be the part of the programme that is affected by operations? That innovation requires large amounts of work when procedures, tactics and doctrine have to be developed. Could this be the part of the programme that suffers?

DB: No. The Defence Acquisition process calls move technology in evolutionary spurts so you can get product fielded quickly to the warfighter so they can increase their capability. Then, as time goes on, you take the next iterative technology and you put it into that product and make that better and give them that increase. You keep doing that until you have revolutionised technology. So it is an evolutionary process that gets you to a revolutionary solution. That's the way the defence acquisition process works; it tells you to do those things

GW: Have we seen a change in the threat assessment for things like reconnaissance vehicles? Projects like the LOE Humvee would need to be up-armoured – shrinking the space inside and also its capability. Other examples like the Israeli – Lebanon conflict have seen a move back towards rolled steel and against FCS. Is it too soon to say that the threat assessment has changed and how does this impact on recce and monitoring vehicles?

DB: There is still a mission for recce vehicles. What we are trying to do is give a commander situational awareness in a much faster environment, giving him a net-centric view of everything – CBRN being one of those capabilities. From that he can make his decision on how he wants to make his operation move, but part of that process is saying "If I see something, I want my reconnaissance vehicle out looking around for other things that might be in the area". There are missions that say I need a recce vehicle and there are missions that say I need to know real time situational awareness. We see a mission for both.

When you talk about Humvees, we may move to a different platform – Stryker or something more up armoured and LAV for the Marines. Those systems will be more proliferated than a Humvee. The Humvee is still there; for example, you could use it in a rear area if you needed to recce on a friendly air base.

GW: Even the LAV is relatively thin-skinned. For recce and monitoring, where it takes time in a potentially hostile environment, do we want to put lives at risk? Shouldn't we devolve it to CUGR and then have a host of other vehicles such as LAV that fulfil the monitoring role as part of the battlegroup? Can we give some of the recce and monitoring to UGV/UAVs and other roles to utility platforms – bring in the holster concept, for example.

DB: Absolutely – that's the part that we are working on. We see this as a family of

Family planning

systems. You start out with an unmanned ground vehicle going up to a breach and making sure the ground you are going to go across does not have any contamination on it – that might be the start. Then your systems with the holster concept inside each of the vehicles are a way of getting situational awareness on any part of the battlefield that you move across. You would still have the specialist vehicles that would do the identification and gathering samples, etc. We are looking at a family of vehicles; something gets put out there, then something more as the situation develops, you have your battlegroup and your specialised vehicle. It is a "family of systems" approach.

GW: Another idea that has been mentioned was gun or rocket-launched unattended sensors. Have there been any tests in terms of the effect of G and roll on scientific equipment? Presumably the shock would induce false alarms?

DB: That has been one of the problems with an unattended sensor being rocket or shot out. We are looking at them, but they are in the Science and Technology bit of DTRA more than they are with us. We are interested in them as they are another way of getting a sensor out in front, or out in a different area where you don't have to put soldiers, sailors and airmen. We are looking at it, but it won't come right away. There are some programmes in DTRA that have this unattended sensor approach that we will look at and see where we can fit them into our "family of systems" approach.

GW: 2006 saw you do 11 upgrades and 15 on-going fieldings, with eight new fieldings planned. Is this too much for a small JPEO? We are no longer in the urgent operational requirement (UOR) situation that we were at the start of Operation Iraqi Freedom (OIF). How long can you continue to get so much from a small team?

DB: The team has been put together to accomplish the mission as assigned. These are not projects or upgrades that you wouldn't expect to find – what we do for a living is try to get the capability as fast as we can to our forces. In doing that, if some of them come earlier because they can, then we do that; if we can accelerate a programme we will, get it fielded and then use incremental acquisition to enhance it along the way. This is not unusual. We have been planning for this bow wave of things to come along and now what you are seeing is these things coming out the door and going out the other side. Yes, we have fielded some capability that was for the OIF initiative but they were things that we were looking at and would have eventually got to, so it does not hurt us – we are capable.

GW: How long does this bow wave last? As projects mature do you stand down some of the team and it become incrementally less? Or is there still enough stuff going on that the crest has yet to be found?

DB: I think that the crest is there. In 2006 we had eight new capabilities, and in 2007 we have seven, so it is down a little. All of these programmes have been talked about for a long time, and the JPEO and all its members are starting to get the capability out. What you might be referring to is a few items that went into OIF that are specialised. So when you wanted decontamination we didn't have the time to get all the things lined up for a decon set that we could field to everyone. We put a specialised decon solution set out there; we had a commercial solution, we even had a commercial truck with the Falcon system. We have put those capabilities in as an interim approach for OIF, but that bow wave decon programme was coming up and a solution will replace that truck-based capability.

GW: Are we too involved in preparing the warfighter for today's conflict rather than future ones? Iraq, for example, has severe environmental conditions and we might be goldplating the solutions when we compare them to other theatres – the new conditions may be different. How do you ensure that the technology is able to work with future conflicts and a different set of parameters?

UGVs have a wide range of duties in the modern battlefield. © DoD

Family planning

JB: It is a fair question and it does seem like we focus on Iraq, but when you see our requirements capability document it will explain in great detail that these must operate in the coldest and hottest of temperatures, humidity, etc. It gives all the ranges of the world and we design in these attributes as we design the equipment. It is not something that we focus on – whether it will operate in Iraq; it is whether it will operate in Iraq, in Korea or any other temperature. The same product should be able to do both.

GW: Are we repeating the mistakes of ten years ago when we found ourselves preparing for the Cold War? Even then we had a range of environmental conditions, but the Army was equipped to fight the Cold War not modern conflicts. It seems we might, post-Iraq, be equipping our armed forces to fight Iraq-type conflicts and not the all-in warfighting and other scenarios. How do you remain future proofed on the likely threat assessment?

DB: What we put in the field for our warfighter has been designed to go across all of the environmental ranges. It is not that uncommon for this type of equipment; you don't have to have a range of different equipment for different environments, and we are putting in a "family of systems" approach that can go anywhere in the world. For us this doesn't create this Cold War syndrome; we're not building aircraft and trucks, we're building the NBC defence capability. We are designing it to go into any environment, so you don't end up with a different capability for Iraq, a different one for Korea. We have one system for all of those environments.

GW: One of the trends in Iraq has been Special Forces (SF), both expansion in numbers and qualified units such as CBIRF. How does this filter into items like JSGPM, which was supposed to be for certain units and then you find that they have now migrated and will have M53 SF masks instead. How do you prepare for SF requirements and plan it into the programme?

DB: Another fair question. I can honestly tell you that the M53 was in development at the same time as JSGPM – it was not done after OIF or during; it was planned all along. The way it works is that the services figure out where their specialised units are and when we have a general purpose mask, such as JSGPM, that goes across most of the forces. Then you have the specialities – SOCOM – or some of the other special ops folk where they might have a special mission. In this case they did, and they put their requirement in.

GW: There is an impact, however, such as increased specifications cost. The M50 [JSGPM] might be $10, while M53 might be $17 – it is a higher spec mask. So that puts budgeting out as units get rebadged…
DB: That can be a problem. In our case the SOCOM guys had identified the requirement ahead of time, so we didn't see the big onslaught of "Here is the $17 mask vs the $10 mask". We had the programme for the M53 and it was planned for.

GW: Guardian has been one of those projects hit by operational spend and has suffered budget cuts. How has this affected the project? Since you started roll out to the military bases has this created a "have" and "have not" culture?
DB: We don't see it as the "haves" and "have-nots". We are putting in a baseline capability with the funding that was given to us to operate with. We will have 36 bases done by the end of December, another 36 by the end of March and by the end of 2007 we will have 129 installations going with a baseline capability. With the funding reductions we found that not all of the bases could have everything, so we had to go back to the baseline capability. Now we have a priority list of bases and will go back into those bases and increase their capability. Everyone gets a baseline capability and then those priority bases will get a bit more capability and then we will wait for the rest of the money to give everyone the same. It also included CONUS and OCONUS bases – so that drove up the costs a little bit too. The funding was enough to get that baseline capability and get priority bases done.

This wrecked Predator might be symptomatic of what'll happen to CBRN UAVs if their CONOPs are not perfected at the start. © DoD

GW: What was the definition for the OCONUS bases? These can range from very big to very small. How did you do the cut – was it based on manpower?

DB: It was not based on people – although that can be one of the drivers – but what the base does and the criticality of that base. The determination of whether it is Tier One or Tier Two is not done by the JPEO; that is done by people like the Joint Staffs who come up with their priority bases and their mission criticalities. They give us a list and we go execute.

GW: In terms of baselining, what about those bases that had been done? Was it then a case of robbing Peter to pay Paul? What about the time and money they had spent on training teams which were then not needed?

DB: That could have been a scenario but it was not one that we ran into. If you look at the bases that were completed under the original IPP programme there was only one base: Andrews AFB. So we didn't have lots of people sitting round trained and waiting for their capability – we did it as the bases occurred. So what you are seeing is everyone getting their baseline capability; they will then be trained for that baseline and marry up with that equipment when it gets there.

GW: When you look at future soldier systems the one thing that is immediately apparent is that they need lots of batteries to fuel the systems. Batteries, however, give off heat, which adds to physiological burden. This would then seem to be an insurmountable

DTRA and ECBC are currently working on an iRobot in CUGR, but what extra capability could larger UAVs offer? © DoD

challenge – fitting IPE with a low physiological load into future soldier system…

DB: What we are looking for is the technology to take care of that. If you looked at what we had today and tried to incorporate it into that scenario then I believe you would run into all those problems. If we allow technology to get us to the next level of where we should be, then our goal is to design it into the uniform of the soldier, sailors, airmen and marines, so when they put on their uniform it already has it in, it does not increase the physiological loading, it may neutralise the agent as it hits them, it will protect them, and they should not be aware they are wearing it. Technology needs to solve this, and that's why we say we will start the programme in about FY09 – FY10, and in about FY13 we think we'll have something that will do that.

GW: While the idea of the 'one suit' is laudable there would seem to be cost implications in terms of regular wear and tear and laundering. The financial aspect of building CB protection into average garments, when it increases cost for low probability, would not be well received. Isn't it better to have modularity, so when the threat is not there you are not ruining an expensive garment?

DB: That is exactly the intent of what we would do. They would wear it every day – so it is important for the warfighter to know that it imposes no more burden than what they would wear every day – but what we would envision is that you wouldn't wear it *every* day. You could wear the cheaper version and when the threat came around then you would want to give them a new set which might be more expensive. It would be given to them, and when they did the things they needed to do they would feel little or no difference.

GW: It is a hobby horse of mine that agent mitigation seems to be ignored; that there is little being done. Surely in the battlefield environment it wouldn't be too difficult to do a counter barrage of decon shells, when an attack comes in, that deals with the agent at source, stops the spread and alleviates the need for IPE?

DB: There is something like that happening. We work with a lot of agencies such as DHS, DARPA, JSTPO, Army/Navy Research Lab. They all work to provide the next generation of products. DARPA is currently working on a system that will track a missile or weapon coming in that might have CWA in it, and the intent is to track it and shoot it down before it gets into harms way. We also have a couple of decon products that have been looked at for nano-technology, where we see it could be a way of using something like the Navy chaff system to deliver it to the same target area where the shell would land do a lot of the decon before much got away from it or the cloud started forming. It is a way off, but we are looking at it; an active defence is important.

GW: This would seem to be an area where we have done a lot of offensive work that could be adapted. The US spent millions in designing binary VX shell tech, and the fundamentals would seem to be analogous to decon – achieving the right mix, splash templates, etc. It needn't be difficult or costly, but seems to be the last thing thought about…

DB: We do think about it, but I think it is a tough area to crack. There are many people working on it and we will see something in the future – we are working with DARPA on a MOA right now for a product that will do something.

GW: PCR was always seen as the way ahead for biological detection; has anything happened to change this? How are you transitioning some of the new technology from DARPA, or HSARPA, into the warfighter faster? Is it safe, or wise, to try and speed up the maturity of CBD systems in the same way that other parts of a warfighters ensemble can be?

DB: That question needs to be addressed in three parts. Firstly, PCR is definitely a good technology but we don't believe it's going to be our final solution. There's potential for the future for biological identification lying in a light-based system rather than a wet chemistry based system. Light-based systems may be able to identify in real time or near-real time, with little-to-no consumables and a much lower life-cycle cost. But, as you know, we use PCR in our current JBAIDS system and it is doing an outstanding job. In addition, our counterparts at DHS use PCR for their operations. That said, PCR is not useful in all applications of biological identification. We think there is a good possibility that some technology might replace PCR in the future. Today, there are a number of technologies that are much faster than PCR, and we are using them in our JBPDS, JPS, etc. These technologies have lower life-cycle costs than PCR or any other wet chemistry based identifiers.

Secondly, DARPA and HSARPA are making great strides in developing new technology for bio-detection. The new near-term technologies for bio-detection, however, are merely evolutionary changes to PCR's basic molecular technique of enzymatically replicating DNA without using a living organism.

Finally, we will never speed up the maturity of a system beyond its capacity to be safe, effective and suitable in operational use. That said, as a routine practice we do look to accelerate the enhancement of existing capabilities when that acceleration poses a reasonable and accexptable risk.

GW: At the last "Worldwide Chemical" at Fort Leonard Wood you could see lots of different types of UGV, but there was a lack of UAVs. They seem to be out of favour, without the same attraction – which I see as bizarre when you consider the advantages stand-off detection give you.

DB: That's more a case where we haven't figured out how we would deploy a UAV in the same way that we have for a UGV. A UGV has some ways where you could employ it and it would work. A UAV sounds simple; it will just fly around until it find a cloud. It is not that simple, however; you have a detector that is looking out and down – it is not looking ahead – so you are constantly zig-zagging and if you find the cloud and you run into it then you've contaminated the UAV, the sensor and the other packages that might be in that UAV. We've not worked out the CONOP for the UAV – it is not that we don't want to; it is about figuring our how we would employ it once we got it into the air. How do you avoid running it into the cloud?

Even though the Army was one of the initial leaders in UAVs, they've understandably focused more of their current efforts on UGVs and the ground mission. These Army UGVs are actively being developed to replace soldiers in ground missions with lethal chemical, biological, radiological, nuclear or explosive threats. These UGVs have been described as the ideal "point man" since they can search dangerous and/or inaccessible areas. They can keep soldiers out of harm's way and do all the dull, dirty and dangerous jobs that no soldier, sailor, airman or Marine needs to be doing. Remember, they can do all of this while providing the commander with actionable information and a safe first-look capability. In addition, with the new emphasis on jointness, interoperability and network centricity, the Joint Force Commander can easily task another unit – like the Air Force who have traditionally been focused on the air mission – to support the ground commander with the capability to gather near real-time data on opposing force position, composition, and state of readiness.

GW: In that case how much can we hand off to unmanned systems?

DB: We believe that will be determined by a number of technical factors like technology capability, cost, supportability, maintainability, etc. We do think that unmanned systems will have a significant future role. The National Defense Authorization Act of 2001 set a goal of making one-third of the operational ground combat vehicles "unmanned by 2015."

You'll find that the troops in Iraq and Afghanistan have grown fond of their UGVs for severe environments. Many of them have lobbied for more combat-capable UGVs as soon as possible. A big advantage of UGVs is the amount and variety of weapons and/or sensors that can be carried since they are digital platforms. As a result, the Army is currently discussing the potential of adding .50-caliber machine guns and grenade launchers to new UGVs scheduled to roll out soon. There's even been talk about developing bigger UGVs that can form a supply route. Like we said before, we believe unmanned systems will play a significant future role in combat operations. We'll use them to either augment or replace human intervention in the performance of those dirty, dull and dangerous missions that are currently putting our warfighters in harm's way.

GW: To return to UAVs, it would seem as if sensitive decon is the answer. We are confident enough to think about decontaminating night vision and radios, so something like a UAV should be able to be deconned too. Wouldn't this unlock the CONOPs?

DB: It's possible, but we don't do the CONOPs. When FLW or the Joint Combat Developers have figured out the CONOPS and how they might like to employ it then you might see a move towards UAV. In the meantime we are working on standoff in chem and bio. We also have point sensors; we'll have the UGV hopefully and the unattended sensors as well. We'll be putting a broad front out to the warfighter and the UAV might be the icing on the cake.

The up-armouring of the Humvees posed a procurement challenge for some areas in the JPEO. © DoD

Going fourth

Gwyn Winfield evaluates the 4th International Symposium on NBC Decontamination in Munster, Germany

THE Wehrwissenschaftliches Institut fur Schutztechnologien – or WIS to you and me – has quietly been running its Decon conference for eight years. Very much the European partner to the US Decon conference, this is an event aimed at decontamination professionals.

Set at the Panzer School in Munster – the one just north of Hanover rather than Münster – it is *the* thing to do in Munster in October. This is no exaggeration; Munster is a garrison town and as such it is not replete with the attractions of either Hamburg or Hannover, so delegates are not distracted from an early night – and when the bus picks up at 07.00 this is no bad thing either!

The WIS had put together a programme of more than 30 presentations from a variety of countries – mainly Germany, Italy and the US. In addition to this there were poster sessions and a demonstration of some of the German army's latest decon equipment. The papers were a mix of the strategic, from people such as DTRA's John Weimaster, to the tactical – Genencor's Chris Barnett, with his collection of chemical equations on enzymatic decontamination, springs to mind.

You're booked! Detector paper still has a role to play in training and operations. © CBRNe World.

Work in progress

Enzymatic decontamination was one of the major recurrent themes of the conference. The ability to have stable, non-toxic decontaminants has been an attractive proposition for years, and there have been a variety of organisations extolling enzymes' virtues – Genecor, Proteus, WIS, etc. Enzymatic decon would seem to hold a great deal of attraction, mainly for logistics and environmental concerns. In layman's terms, it consists of naturally occurring enzymes, which are stable and harmless, which are then mixed with water (and/or another liquid) which starts a chemical process resulting in a third substance which can be used for decontamination purposes – the most common of which appears to be peracetic acid.

As you might expect from a scientific establishment, these presentations were high on detail and, usually, low on hype. Two factors which played against them, however, were the time frame and the lack of third party testing. WIS had set a particularly punishing time scale of 15 minutes plus five minutes for questions per presentation. This gave presenters the choice of either doing the strategic bit and leaving no time for detail, or detail with no strategy – very much a case of feast or famine. The lack of third party testing was evident in all the enzymatic presentations; either the enzyme was "too new" and had only been tested in the lab – the results of which were always impressive – or had been tested and the results were classified. While I fully appreciate that not all testers want the details of their test advertised, this was down to a shortage of independent testing, through organisations like TNO, that the companies had undertaken themselves. To be fair, enzymatic decon is still new and this is part of the desire for accurate testing – to be able to benchmark it against conventional methods to see how it measures. But these tests are in the companies' interests, as those that get their results out first (assuming they are worth publishing) will steal a march on their competitors – who seem to be multiplying every month.

As well as enzymatic decon there were also other novel suggestions being offered. Two of these were silver ion decontamination and laser vaporisation decon. The former was presented by Bio Gate and offered a thin coating of either micro or nano-silver. Silver's property as a "pure" metal has long been known about, but there have been suggested side effects of silver ions (the active decon element) of causing a human brain defect, much like Alzheimers. Dr Steinrucke, from Bio Gate, admitted that this was a problem, but suggested that the size of the particles involved, and more importantly the polymer coating that they were contained within, militated against this problem. For the military that are used to the phrase "gold-plating" within their procurement, the side of silver coating cannot be much consolation, but the actual amount of silver needed in the coating to achieve a significant decontamination capability is very small – about one per cent (hopefully small enough to deter squaddies peeling it off and trying to smelt it down).

Up in smoke

Edwin Buchter, from Clean Laser, offered an extremely novel way of decontamination – the vaporisation of the upper layer. Clean Laser have a family of laser systems that have been used extensively by companies as diverse as Audi and Airbus to achieve ultra-clean surfaces (for welding purposes, for example) and are looking to diversify their activities into the CBRN arena. The handheld laser works by vaporising, rather than burning, the top few microns off the surface of the vehicle/area; the agent in that layer is completely destroyed in an instant – along with the paintwork. Clean Laser's contention is that it is a completely safe way of decontaminating platforms and is relatively quick – you don't need to wait for the decon solution to work, as it happens at the speed of light. It is, however, manpower intensive and depends on small areas of contamination; gross contamination would require far more work and time to deal with, and would also require all sensitive equipment to be removed. While it is not perhaps an ideal solution – a delegate suggested to me that he could achieve the same result with a barrel of DS2 in a fraction of the time – it is the sort of novel approach that gets people thinking that would not be available in a generic conference.

As well as novel technology, the latest equipment was being presented, if not demonstrated. Cristanini presented their DDMAS and SX34, Karcher their TEP90 and GDS 2000, and OWR their MDS and skin decontamination cream. The latter was an example of how the testing cat can be put among the competitors' pigeons. OWR's Alldecont was presented in conjunction with the German Army Surgeon's office (Zint San BW) and had been through a battery of tests that showed it's efficacy when compared to another European and a North American competitor – some representatives of which were in the audience. Skin decontamination cream is always a slightly contentious topic – not so much whether it works or not, but whether the soldier has a chance to put it on in time. With modern soldiers looking more like a Christmas tree every year they have to make judgements at what gets worn on the webbing and what goes into the Bergen/rucksack. Suffice to say of you get any G agent splashed on you the last thing you want to be doing is looking for your skin decontamination cream, but equally do you really want to wear it instead of extra ammunition, personal role radios or lightweight chemical agent detectors – all of which are likely to save your life many more times than a skin decon product. Unsurprisingly Dr Hemmer from OWR feels that it will be on every soldiers webbing, but these decisions are often made at the squad or even individual soldier level, rather than at a company or higher level, and soldiers keep to hand what they think to be useful – it is hard enough to persuade them to keep respirators close to hand.

The other contentious issue of the conference came through the live agent training debate. This was sparked by the two presentations from Dugway Proving Ground that, since Dugway doesn't offer live agent training, focused on what can be done with simulant. This provoked a storm of questions and opinions from the

Germany's purchase of Karchers TEP90 will get it a multi-role decontamination capability. © CBRNe World

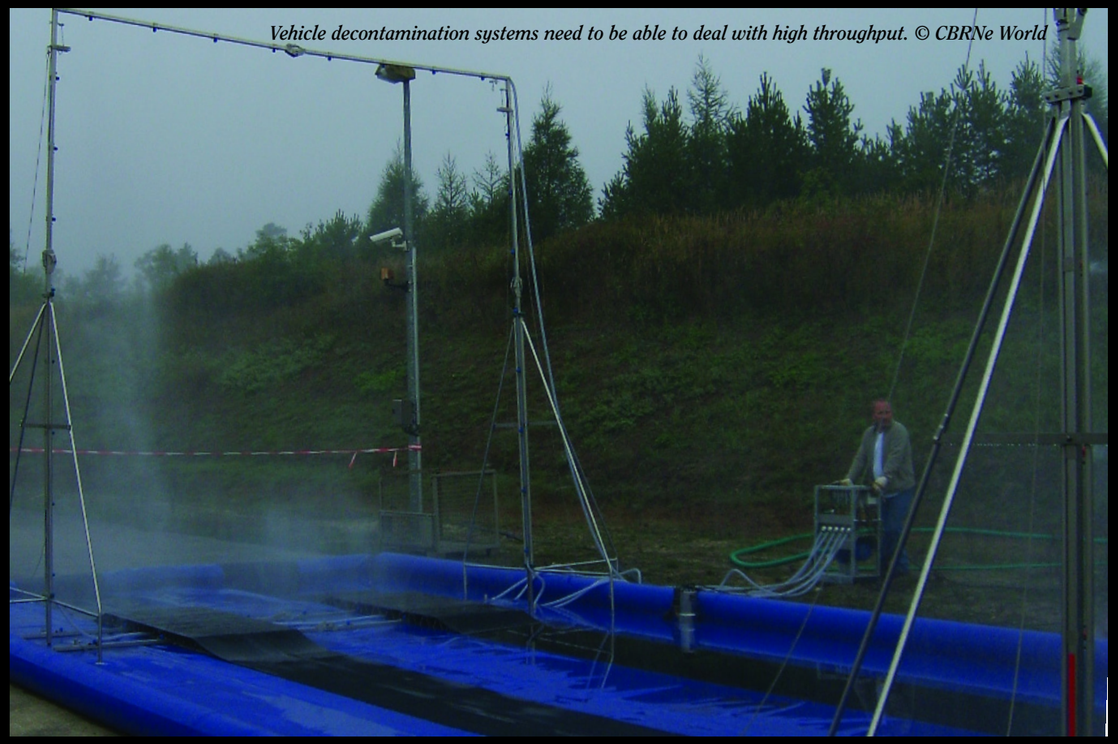
Going fourth

floor, and later in speakers' presentations, over the value of live agent training versus its cost and environmental hazard. Much of Dr Jiri Matousek's presentation flew in the face of what had been previously said and was fervently in favour of live agent work, and he was ably assisted from the floor by Dr Walter Aue who was also adamant on the need for it. This is going to be even more of an issue as the technology, such as enzymatic decontamination, develops, and the scenarios mature.

Two of the most interesting presentations came from organisations that had been doing field tests with simulants and the side effects that they had encountered. Dr Schneider from WIS gave an interesting presentation on the work that he had done with Intelagard's radiological decontamination solution and how it didn't work well on the simulant they had chosen. Dr Konstantin Volchek, from Environment Canada, also outlined some of the issues they had faced when their simulant reacted with the decontamination liquid to create a more noxious third chemical. These are all lessons which show that, while a range of simulants can be used to mimic the actions of a certain agent, they are no substitute for the real thing. That live agent testing – even for rad and bio – should be undertaken at the start of the solution's life, rather than at the end, to ascertain whether the technology works against the real thing or just against the simulant. Pragmatists would argue against this in terms of cost and whether we really want areas of the countryside, or even just sample plates, infected with cobalt 60 or anthrax. Yet cost has to be weighed up against efficacy, and for decontamination that should be an easy equation.

One element that was noticeable through its absence in the three day event was the lack of papers from the civil side. The one paper that was focused on the civil responder market didn't show up, and while there were plenty of civil responders in the audience there were none on stage. Some of the participants saw this as purely symptomatic of the lack of effort that is going into civil programmes; that they lack anything new, yet for me it was an oversight. The one skill that civil responders are developing that is far in advance of the military is the ability to do mass decontamination. The military still tend to have the cosy idea that people will make the orderly lines that they are told to, Fire and other agencies have no such idea and are developing tactics to deal with this contingency. With the World Cup having just finished there must have been some innovative ideas that could have been presented, even if the technology was fairly basic. Equally the base of countries giving papers could have been broader, with no papers from Israel, the UK and the Nordic countries – despite some innovative work being done.

These are minor niggles to an event which presented a wide range of relevant issues from soft issues like the physiological burden of decontamination in a hot environment, by CEB's Dr Warme-Janville and verifying the efficacy of decontamination in training, by the Heer's Major Kuhar, through to hard science, like improved catalytic enzymes, from WIS' Dr Richardt, and reactive nanoparticles, which IFAM's Dr Zollmer asserted would be with us in two years! The next conference is scheduled for 2008 and *CBRNE World* would recommend that rooms in the Deutches Haus hotel (with one of the two bars in Munster) are booked soon!



Vehicle decontamination systems need to be able to deal with high throughput. © CBRNe World

The sirens of titanium

Torben Seemann, Volker Zöllmer, Henning Kurz and Matthias Busse of IFAM, Judit Ménesi and Imre Dékány of the University of Szeged, Hungary, and André Richardt of the German Armed Forced Scientific Institute for Protection Technologies, explore the potential of reactive nano particles in chemical decontamination

BESIDES preventive measures, the decontamination of pollutants and warfare agents is one of the core competences of NBC defence. All substances have to be removed which makes it a challenging task.

Nano-scaled semiconductor materials such as ZnO, SnO and in particular TiO_2 are well known to show photo catalytic activity by absorbing UV-light. Electrons from the valence band are promoted to the conductive band where radicals will be produced and used to induce photochemical reactions. The aim of the current study is to investigate the potential of these reactive nano particles to degrade pollutants as well as warfare agents. In addition to the scientifically motivated questions, the aim is also to evaluate possible processing strategies to ensure a transfer from laboratory results to practical usages.

There are several challenges for using photo catalytic coatings. First of all, the rate of UV-light in sunlight is less than five per cent. Using doping materials such as Pt, Ag, or Pd, the activation energy may be lowered in order to use visible light for the activation of the photo catalyst. Secondly, the substances to be degraded have to connect on the reactive particles. So, on the one hand, the adsorption and desorption of the organic material and its degradation products must be optimised. On the other hand, the specific surface of the coating should be maximised. Nano porous coatings presented in this article provided corresponding properties. This project aims to define decontamination parameters, showing the possibility of removing warfare agents using similar but harmless substances, and to develop a concept to implement self-decontaminating coatings in technical devices.

In this understanding, a photo catalyst should have the following properties. In addition to known activities under UV-light irradiation, a useable photo catalyst for decontamination applications should also provide high photo catalytic activity at visible light irradiation, as the content of UV-light is lower than five per cent. It is evident to ensure a specific degradation of pollutants or warfare agents without decomposing the substrate surface. For this purpose, one has to ensure a very good contact of the reactive particles at the pollutants.

Will nano particles mean the sunset of normal decontamination. All pictures ©DOD

To evaluate these challenges with the current state-of-the-art technology, the degradation behaviours of the investigated different TiO_2-films are compared to that of commercial available Degussa TiO_2 P25.

The experiment

Chemical and physical approaches have been taken into account to tailor nano scaled photo catalytic materials for decontamination purposes. Nano scaled semiconductors have been produced as clay-composites, in special montmorillonite-composites, and doping of semiconducting materials has been performed to enhance the photo catalytic activity under sunlight conditions.

In a first approach, TiO_2-Ca-montmorillonite composites have been prepared by wet grinding in an agate mill. Positively charged TiO_2 nano-particles are bound to the surface of the negatively charged Montmorillonite layers via heterocoagulation. Clay minerals are used as adsorbent and support for the photo oxidation process. Aquatic solution of 0.5mM/l phenol was degraded by irradiation with UV-Vis light in suspensions of TiO_2 – clay composites.

In addition, the structural and photo catalytic properties of undoped and phosphate-doped TiO_2 have been investigated. Here, titanium isopropoxide was used as precursor of titanium dioxide. Photo catalytic properties were tested on gas-phase photo oxidation of ethanol at 25 degrees centigrade.

In addition, photo catalytic active TiO_2-layers with different structures have been prepared by physical vapour deposition methods, allowing them to tailor the structure of the photo catalytic materials on a nano-meter scale. Here, the photo catalytic active TiO_2-films have been prepared using a sputtering technology. With this technique, the morphology can be directly influenced by the sputtering pressure, time and power.

This sputter process runs in a vacuum chamber which is filled with Ar-gas. By ionisation of the Ar-gas, Ar+-ions are accelerated towards the target material (cathode), where particles and clusters are sputtered-off and collected on a substrate surface. The structure and morphology strongly depend on the sputtering power, pressure and time. The structure and morphology themselves strongly influence the photo catalytic activity of the thin film layer.

To investigate the influence of sputtering parameters on the photo catalytic activity of thin TiO_2 layers, deposition of TiO_2 has been performed by sputtering TiO_2-target materials as well as sputtering metallic titanium under the presence of oxygen.

The morphology of the produced photo catalytic layers has been investigated by scanning-electron-microscopy (SEM) – images showing the morphology of sputtered thin TiO_2-films on Si-substrates on a micrometer scale. The nano-scaled structure of TiO_2-photocatalysts could be investigated by high-resolution transmission-electron-microscopy (HRTEM). The photo catalytic activities of the prepared structures were tested in gas-phase oxidation of ethanol, phenol and also toluene at 25 degrees centigrade.

Results

Significant photo degradation on TiO_2-clay composites was observed at 40-60 per cent TiO_2/Ca-montmorillonite compositions. A synergistic effect was detected at solid/liquid interfaces for degradation of phenol and at solid/gas interfaces in the recycling flow reactors for photo oxidation of ethanol and toluene vapors.

The observed rapid oxidation of ethanol on phosphate-doped titanium dioxide was probably due to coupling between titanium dioxide and titanium phosphate, which increases the efficiency of charge separation in semiconductive nano-sclaed materials.

HR-TEM analysis of sputtered thin TiO_2

Nano-activated titanium will draw its decontamination powers from UV rays

The sirens of titanium

films (<20nm) on carbon support mostly reveals aggregated nano particles with a typical diameter of about 3-10nm. To determine the photo catalytic activity of the TiO_2-layers, a photo reactor was filled with a contaminated fluid. Samples were irradiated under UV-light (360nm) for 120 minutes. Decomposition was measured with a spectrophotometer (Ocean 2000).

Photo catalytic thin films have been prepared with different sputtering parameters. The samples produced with higher sputtering pressures show higher specific photo catalytic activities. This can be explained with a higher porosity of the thin TiO_2 films.

After defining the decontamination parameters, possible materials were chosen for the photo catalytic degradation of various pollutants. The semiconductors were doped with metals, and subsequently the effects on the degradation rate and activation with sunlight were tested. Higher degradation rates were measured with Ag, Pt and Pd doped coatings, depending on the rate of those materials.

The substrate and its influence on the photo catalytic activity were investigated as well. In particular, Montmorillonite can increase the photo catalytic activity due to improved adsorption along with its high specific surface.

The results from the lab were transferred to technical issues. The coatings were produced with reactive sputtering where titanium is sputtered at an oxygen atmosphere. During the process, Ti and O_2 react to TiO_2. This technology offers the possibility to coat surfaces with a defined, thin, and uniform layer where doping materials may be introduced flexibly. Those coatings will be tested in a special photo reactor with optional UV and visible light irradiation.

The potential of reactive nano particles for the degradation of pollutants and warfare agents could be validated. After doping the materials the degradation rate was increased and the activation with visible light indicated. Using a semiconductor-clay-composite the photo degradation will be increased significantly, which can be traced back to a synergy effect between those materials. With the sputtering technique the photo reactive materials can be applied to technical surfaces allowing a very precise definition of the coating. In the future, the technical implementation of the composites and experiments regarding the visible light activation will be the focus of this project.

Activated nano particles may well unlock the secret of sensitive decontamination

Foam on the range

Geneviève Thouin and Konstantin Volchek of the Emergencies Science and Technology Division (ESTD), Environment Canada, discuss the challenges and outcomes of their chemical decontamination trial

A LARGE-SCALE decontamination technology demonstration was recently undertaken in Western Canada. This demonstration is part of a CBRN Research and Technology Initiative of Canada project CRTI-04-0019TD. The Chemical, Biological, Radiological, and Nuclear Research and Technology Initiative of Canada is the federal science community's response to providing science solutions to CBRN terrorist threats. It has been very successful, since its inception in 2002, in funding many science and technology projects and in building linkages among non-traditional partners. These new partnerships have increased knowledge and preparedness for countering CBRN threats by working together on a common mission.

The purpose of this demonstration project was to evaluate advanced decontamination technologies of buildings and structures. To date, chemical and biological trials have been completed and a similar radiological decontamination experiment is scheduled for early 2007.

This paper describes the chemical trial conducted in August 2006. Personnel from the Counter Terrorism Technology Centre, Defence Research and Development Canada in Suffield (DRDC Suffield), Environment Canada, Allen Vanguard Corporation, Science Applications International Corporation (SAIC Canada), and the US Environmental Protection Agency (US EPA) were all participants in this trial. The trial was carried out at DRDC Suffield, a designated Nato test site for such exercises.

To accommodate the chemical trial, a building was erected with three rooms that contained different combinations of the surface materials. Room A contained ceiling tiles, brick walls, and ceramic floor. Room B had ceiling tiles, drywall and carpet floor. Room C had ceiling tiles, wood wall panelling, and vinyl floor. The building was first contaminated with a mixture of the selected chemicals, diethyl malonate (DEM) and malathion, using spray dissemination. DEM was used to mimic the physical and chemical properties of nerve agents, while Malathion is representative of a large category of toxic industrial chemicals. The rooms were then decontaminated using the Surface Decontaminating Foam, also known as the Universal Containment System formulation. This product was developed by researchers of DRDC Suffield and is now marketed by Allen-Vanguard. The concentration of the target simulants on test surfaces and in the air was monitored prior to, during and after decontamination. A sequence of events is presented in Table 1.

Table 1:
Sequence of chemical demonstration major events (15 August 2006)

Time	Event
9:00	Equipment set-up
10:00	Decontamination line set-up and start of demonstration
10:43	First dissemination (Room C)
10:47	Malfunction with the spraying unit Preparation of alternate spraying device
11:37	Second dissemination (Rooms B and A)
11:45	Structure door closed
12:04	Collection of pre-decontamination surface samples
12:10	Structure door opened
12:33	Structure door closed
12:38	Surface decontamination
13:08	Rinse
13:23	Defoaming
13:35	Collection of post-decontamination surface samples
13:55	Structure door opened
14:03	Personnel decontamination and end of demonstration

Results of the trials were analysed, and the effectiveness of the decontamination technology was evaluated for different construction materials. Associated material and labour consumption is being assessed.

The exercise was a collaborative effort of several Canadian and US agencies, and was led by the Emergencies Science and Technology Division (ESTD) of Environment Canada. ESTD is responsible for chemical and oil spill research, development, training, and technology transfer. Its prime function is the development of knowledge and tools for oil and chemical spill preparedness. For almost 30 years the division has had a continuing national programme of research and development on spilled hazardous materials and spill countermeasures. Results of this research are regularly applied to real spill incidents, providing assistance to spill responders and feedback to the researchers on the direction of their work.

Technology transfer is an important component of the programme, and the group is active in providing operational guides, manuals and training, as well as some aspects of contingency planning. Additionally, the Division has an operational remote-sensing capability and also can provide specialised technical advice or analysis in support of real spill events. As the lead in this project, ESTD provided scientific, technological and analytical support, dissemination equipment, field analytical equipment, laboratory facilities and equipment for the analysis of surface, water and air samples, and qualified personnel in environmental emergency response, laboratory techniques, and analytical chemistry. Prior to conducting this decontamination demonstration, ESTD carried out major research funded by the CBRN Research and Technology Initiative to develop and evaluate surface decontamination technologies on a bench scale.

DRDC Suffield is one of Canada's main defence science and technology assets. It is located in southeast Alberta near Medicine Hat on one of the largest Nato military training facilities. Established in the early months of the Second World War, DRDC Suffield has long been active in the development of effective defensive countermeasures for chemical and biological weapons. DRDC Suffield has a chemical research group that is internationally renowned for both fundamental research and technology commercialisation.

The Counter Terrorism Technology Centre is part of DRDC Suffield. This centre is a key component of Canada's ability to respond to domestic and international chemical, biological and radiological, nuclear, and explosive (CBRNE) incidents. It uses highly specialised and safely equipped facilities to

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combat specific CBRNE threats. For the chemical trial, DRDC Suffield provided trial support, military detection equipment, detector paper witness cards and experimental expertise and personnel. The Counter Terrorism Technology Centre provided premises for test facilities, built the test structure, and provided personnel for support for contamination and decontamination tasks as well as an overall organisational support.

Allen-Vanguard is the leader in developing and marketing CBRNE decontamination equipment and technologies in Canada, the United States and the United Kingdom. The firm was assigned with the responsibility of decontamination for the chemical trial. For this demonstration, Allen-Vanguard tested the new Response Trike, developed during another project of the CBRN Research and Technology Initiative. This new system, which allows mixing and spray-application of the Surface Decontamination Foam ingredients, incorporates product improvements for enhanced material compatibility and cross-applications for other decontamination or hazmat scenarios.

SAIC Canada is a diversified high-technology research and engineering company focusing primarily in the market areas of environment, energy, and health. Its Environmental Emergencies Program, located in Environment Canada's Environmental Technology Centre in Ottawa, Ontario, focuses on research, development, and evaluation work related to the environmental emergency response. SAIC Canada provided personnel for logistics, sampling, and sample analysis.

The Environmental Response Team (ERT) is recognised as a vital link in the US EPA's continuing efforts to remediate and limit environmental damage to air, land, and water, and also in the evaluation of threats to human health. Established in 1978, the Environmental Response Team is comprised of a group of EPA technical professionals who provide experienced technical and logistical assistance in responding to environmental emergencies such as oil or hazardous materials spills, and the characterisation and clean up of hazardous waste sites. The ERT provides a full range of support for remediation of terrorist attacks, hazardous substance releases, and other complex emergency incidents. In such cases, the team can bring in special equipment with technically adept responders who provide experience and advice to the on-scene co-ordinator or lead responder. For the chemical field demonstration, the US EPA provided a team of experts as well as air analytical equipment, including a Trace Atmospheric Gas Analyzer (TAGA) bus.

Table 2: Surface Contamination Levels for DEM

Material	Location	Concentration (g/m²)				Decontamination Rate (%)
		Before	St Dev	After	St Dev	
Ceiling tile	Rooms A, B, and C	3.08	3.51	0.17	4.16	94
Brick	Room A	5.00	3.55	0.00	0.00	100
Mortar	Room A	0.03	0.02	0.00	0.00	100
Ceramic tile	Room A	11.69	11.60	2.02	3.96	82
Grout	Room A	0.43	0.46	0.00	0.00	100
Drywall	Room B	6.63	3.21	0.00	0.01	100
Carpet	Room B	28.05	11.02	1.01	2.33	96
Wood panel	Room C	7.74	3.22	3.21	1.62	59
Vinyl tile	Room C	14.02	4.17	21.40	16.19	-53

Table 3: Surface Contamination Levels for malathion and malaoxon (in brackets)

Material	Location	Concentration (g/m²)				Decontamination Rate (%)
		Before	St Dev	After	St Dev	
Ceiling tile	Rooms A, B, and C	3.83 (0.00)	4.28	2.30 (1.34)	3.60	40
Brick	Room A	2.79 (0.00)	1.99	0.25 (0.15)	0.22	91
Mortar	Room A	0.16 (0.00)	0.08	0.01 (0.00)	0.02	94
Ceramic tile	Room A	6.05 (0.00)	4.12	2.62 (0.31)	4.46	57
Grout	Room A	2.42 (0.00)	1.47	0.23 (0.00)	0.22	85
Drywall	Room B	3.03 (0.00)	1.62	0.70 (0.42)	0.63	77
Carpet	Room B	10.20 (0.00)	3.32	1.55 (0.57)	1.07	85

Equipment Deployed

The demonstration was monitored by an array of sensors including about 100 sampling and monitoring instruments. These included portable Chemical Agent Monitors (CAMs), Chemical Agent Detection Systems (CADS II), AreaRAEs, TAGA, surface coupons, weather stations, etc.

Standard video and still photography were used in each room to obtain evidence of the spray pattern of the agent simulant mixture, mitigation properties of the Surface Decontamination Foam, and to provide a visual record of the trial. Witness cards comprised of three-way detector paper were used to obtain data on liquid agent droplet distribution and contamination density of the chemical simulants and their vapour presence were measured by portable Chemical Agent Monitors (CAMs), Chemical Agent Detection Systems (CADS II), and TAGA. All radio messages were recorded to provide an audio parallel to the video recordings.

The Canadian Forces use hand-held CAM sensors to detect chemical warfare agent vapour in air. This instrument is a portable ion-mobility spectrometer using a radioactive source to ionise substrates in sample air flows. It can be operated in either positive-ion mode (to detect G agents and VX) or negative mode (to sense vesicants such as mustard gas). DEM can trigger the positive detection mode. The CAMs were complemented with the CADS II, a real-time remote point source that can receive information from up to eight CAMs either by land line or by wireless radio frequency transmission, process, and record the signals.

An extensive air monitoring and sampling programme was undertaken in support of this project. Unique sampling ports were constructed and fastened to the building to permit monitoring and sampling of indoor air. In addition, several stations were positioned around the outside of the building. The data from one of those real-time air monitors is included in this report. The AreaRAE is a commercially available instrument with up to five gas detectors, including a photo-ionisation detector for parts-per-million measurement of volatile organic compounds (VOCs), a lower explosive limit (LEL), oxygen sensor as well as two electrochemical toxic sensors for measurement of specific toxic substances such as chlorine and sulphur dioxide. The field unit has an AC/DC power supply and is equipped with a wireless radio frequency modem which allows the unit to communicate and transmit readings and other information on a real-time basis with a remotely located base controller and computer.

TAGA is a triple quadrupole mass spectrometer, capable of monitoring with positive or negative ionisation using either a low pressure chemical ionisation source or an atmospheric pressure chemical ionisation source. To perform ambient air monitoring for the demonstration, the TAGA was used in positive ion mode to detect DEM.

Decontamination Results

In order to detect levels of contamination on building surfaces before and after decontamination, surface samples were extracted and analysed by GC/MS in the laboratory facilities of ESTD at the Environmental Technology Centre in Ottawa, Ontario.

In general, results for surface samples show an effective reduction in contamination levels after application of SDF. Not surprisingly, decontamination was better on non-porous surfaces than on porous surfaces, though the decontamination effectiveness on porous surfaces was higher than one would expect.

Table 2 shows concentration levels for DEM on the ceiling, walls, and the floor in each room, prior to and after decontamination. Relevant standard deviations and calculated decontamination rates are also presented. Table 3 shows similar results for malathion. It also shows, in brackets, numbers for malaoxon, a toxic degradation by-product of malathion.

A comparison of results in Tables 2 and 3 reveals a more effective destruction of DEM over malathion. This was not unexpected given the fact that DEM is relatively easily oxidised. The concentration of DEM was reduced on average by more than 90 per cent in Rooms A and B but far less in Room C. Room C was over-sprayed with a mixture of DEM and malathion as a result of a sprayer malfunctioning during the simulant dissemination phase. Much higher quantities of the simulant were released in Room C than it was called for in the test protocol. However, the amount of SDF used remained the same as was described in the protocol. Consequently, the quantity of SDF was not sufficient to react with the simulant in Room C. It was observed that the foam simply washed the simulant off the walls as opposed to reacting with it; simulant simply collected on the floor. Thus, the construction materials from the floor in Room C ended up with actual higher concentrations of simulant after decontamination. This resulted in a "negative" calculated decontamination rate. Similar trends are seen for the results for malathion in Table 3. According to Table 3, malaoxon formation was observed on some surfaces. This was likely the result of an incomplete oxidation of malathion.

In general, decontamination was quite effective considering the fact Allen-Vanguard used a highly diluted version of SDF for this trial. Doing this would allow them to gather important information on stoichiometry of a range of decontaminants for various substrates in a trial field setting. This is an important and valuable opportunity for any manufacturer.

Because of time constraints, decontamination was carried out only once, without being repeated. Prior to this field trial, a comprehensive two-year laboratory study at ESTD demonstrated that a higher strength SDF and repeated applications would result in practically 100 per cent destruction of malathion and virtually no malaoxon formed. Results of this trial suggest that a higher strength decontamination formulation and multiple applications will likely be required if the level of initial contamination is not known.

Along with surfaces samples, real-time air monitoring as well as air samples were collected throughout the trial. Responses increased during those times in which higher simulant vapour levels would be expected to be found (following application, downwind door opening, etc) and lower following decontamination. Despite the fact that CAMs are not designed to be used with DEM, the results generated by the CADS II during this demonstration have provided supporting data about the vapour levels of simulant present and the effect of applying decontaminant to the modules.

Real-time monitoring instruments were positioned outside the building. Tubing was used to connect the instruments to the sampling ports, thereby permitting air from inside the test structure to be examined. The data collected in room C – the first room that was contaminated and the last room downwind – by an instrument having a combination of combustible gas, toxic gas, and VOC sensors, From this data, additional information is collected. VOC peaks appear both with the dissemination of the simulants and the spraying of the decontamination agent, suggesting that both the agent mixture and decontamination agent contain VOCs. Chlorine peaks, however, only appear when the decontamination agent is applied, suggesting that chlorine may be evolved from the hypochlorite-based SDF. No concerns were associated with the oxygen levels, explosive vapour, or sulphur dioxide levels throughout the trial.

The TAGA was able to detect DEM levels as low as pptv in the downwind plume. As for the CAMs and AreaRAE, a good correlation between the events in the structure and the TAGA recordings was observed. Results from real-time air monitoring showed a reduction of over 90 per cent of the initial contamination levels after the decontamination formulation application. This illustrates the vapour suppression characteristic of SDF as well as its decontamination properties.

Conclusion

This exercise provided a unique opportunity to demonstrate large-scale decontamination of a building affected by chemical terrorism in a real field environment. It helped evaluate the performance of decontamination technologies by providing invaluable real-scenario information not always available in a laboratory setting. It proves that protocols and field trials are invaluable prior to finalising product development. It provided valuable scientific and technical information for future research and development as well as a more accurate estimate of resources required in terms of personnel, equipment, decontamination formulation, etc. It was also an opportunity to test and evaluate new monitoring instruments and equipment, as well as response procedures. This test will help in the development of equipment operator manuals, responder manuals, emergency procedures and guidelines.

This trial, along with the biological and radiological demonstrations, will also allow technological transfer, health and safety procedure sharing, and co-operation work between technology developers and users in the areas of emergency response and decontamination.

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Inspector John Bureaux, Officer in Charge, Explosives Disposal and Technologies Section at the Royal Canadian Mounted Police, talks to Gwyn Winfield about the CBRN work on the Northern side of the border

IT IS a simple mistake to make: if you asked any industry individual which Police Force in North America has 26,000 employees they'd probably go for one of the major US cities such as Washington DC or New York. If you then added that they have a "beat" of almost ten million square kilometres there would be a pretty blank look for a couple of minutes before the answer dawned: the Royal Canadian Mounted Police, or Mounties. There is always an exaggerated focus on the more boisterous of the North American countries, but Canada has a large piece of the CBRN pie – through organisations such as DRDC and various multilateral agreements (such as CANUKUS – Canada, UK and US) and it should come as no shock that this has filtered down to the police too.

In Canada the RCMP are the national police. Previously there might have been some truth behind the contention that more attention should be focused on the US as the chances of a terrorist attack were so much higher. This would disregard two key points, however. The first is that the deployment of Canadian forces overseas gives much the same "rationale" to Canadian would-be terrorists as it does UK or US ones; the other would be the events of 3 June 2006. This date saw RCMP officers arrest 17 individuals who had acquired three tons of ammonium nitrate, allegedly to create an explosive device that would have targeted the civil infrastructure. Much like the London attacks of 7 July 2005, these were home-grown terrorists and, if found guilty, further add to the evidence that there is a growing movement attracted to attacking the countries and cities that raised them. Inspector Bureaux felt that the alleged plot did not come as a surprise. "There were no major lessons learned," he said. "We considered it was not if, but when this sort of thing would occur."

The attempted terrorist attack is still an issue nearly six months later. Canada is lucky enough to have huge tracts of rural land – perfect for walking, picnicking or training terrorist groups. This was the case in the June incident, where the suspects had trained and perfected their plans in splendid isolation, before aiming to bring them to fruition in the city. This rural/urban divide would seem to be the perfect place for a disconnect – the junction of two forces and mindsets. With Quebec and Ontario being separate from the RCMP this would seem to engender fundamental psychological differences – these differences may well be the cracks on which the intelligence picture can stumble and perhaps allow an attack. John Bureaux disagreed: "We have an excellent working relationship," he said. "This was shown in the recent conspiracy to bomb targets in Toronto and Ottawa."

The June arrests are, perhaps, a symbol of how the large unified command can work – a seamless flow of information, as

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opposed to one with divisional breaks. Yet police forces, and other intelligence/detective-led units, are notoriously circumspect in sharing information with brother officers outside their area. This is usually prompted by the fear that the more people who know something, the likelier it is that someone will make an error that might affect undercover officers or informants. These differences often occur in the town/country divide, where forces have differing opinions of their neighbours' professional ability. "We are fortunate in Canada having very few 'agencies of jurisdiction,'" said John Bureaux. "For the most part, we have mutual understanding of respective roles between municipalities, provinces and national agencies. We at the national level know our counterparts on a first name basis; we often train and exercise together."

While exercising can bring greater understanding, familiarity can still breed contempt and lack of understanding. Often it needs a large-scale exercise, bringing together many parts of the jigsaw, to show all parties that different need not necessarily mean bad. Mr Bureaux suggested that part of the glue that kept geographically diverse units together was the subject matter. "I am not going to say issues do not exist, but they are minimised by the fact that we have the integrated intelligence teams, and that the bomb techs and crime scene specialists who form the technical response attend the basic EDU/Crime Scene Specialist through introductory to advanced CBRN response training and revalidation courses together. The classes for the technical responders have a mix of all police agencies in Canada. Each scenario is a composite of different police agencies taking turns in the lead. In addition we have joint exercises, R&D and workshops. The Canadian Bomb Data Center works hard to keep open communication between all levels of police response."

The RCMP is but one of many agencies to respond in a CBRN incident and is part of the Department of Public Safety and Emergency Preparedness Canada. The Government has outlined that: "The RCMP is responsible for conducting law enforcement operations to prevent and respond to CBRN terrorist incidents," (*The CBRN Strategy of the Government of Canada*). Inspector Bureaux went into detail: "The

Canada has a range of very capable units © RCMP

RCMP is the lead agency in Canada for response to the terrorist use of CBRN materials. We have four regional CBRN teams and a national team (National CBRN Response Team – NCBRNRT). We are composed of RCMP officers, members of the Canadian Forces and Health Canada laboratory technicians. The Ontario Provincial Police, Quebec Provincial and many cities have a CBRN response capability.

"The RCMP is the lead agency in acts of terrorism, and provides assistance to police of jurisdiction when the incident is beyond their capability."

"The RCMP is the lead agency in acts of *terrorism,* and provides assistance to police of jurisdiction when the incident is beyond their capability. The NCBRNRT does detection, cordon control, forensics and evidence gathering, and decontamination; but not remediation. Transport Canada has the responsibility to co-ordinate private contractors to carry out remediation."

As is usually the case there is a range of organisations that all seem like they should be involved: National Security Enforcement Teams, Emergency Response Teams, Integrated Border Enforcement Teams, etc. Inspector Bureaux picked through the main players. "The National Security Enforcement Teams are not involved at the CBRN crisis management scene; these are intelligence or investigative personnel only. Currently, scene security is managed by RCMP. At present all RCMP members have received CBRN incident recognition and avoidance training and have a gas mask with an upgraded filter (from just CS gas to CBRN). They will take up duties on the outer cordon of the cold zone. The ERT teams are our armed intervention teams; some have received training and equipment for tactical operations in CBRN contaminated environments."

This still leaves a distinction between the capability of the national and regional teams. Is this based on a size of incident, training or capability? "The four regional teams are fully equipped with response tools and vehicles, and consist of two full time and four-to-six part time RCMP members, supported by local EMS and fire/hazmat," explained Inspector Bureaux. "The national team is equipped to a higher level; the regional team members can be integrated as required to a total of approximately 25 RCMP, a larger number of DND and six-to-eight Health Canada staff.

"The regional CBRN response teams are police officers trained to: conduct high

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The RCMP has a fully swept up CBRNE capability. © RCMP

risks searches in clandestine labs or storage facilities of CBRN materials; render safe improvised CBRNE devices; conduct crime scene investigation including recovery, interpretation and packaging of contaminated evidence," he explained. "The Emergency Medical Service (EMS) provides the requisite emergency medical intervention for exposed police officers. The hazmat component conducts the survey and extent-of-hazard prediction, personnel and equipment decontamination and expedient area decontamination as required."

In terms of equipment, the regional and national teams are well catered for too. "The regional teams have a Hazmat ID, Cam, NAVD's, 3-way paper, etc," Bureaux explained. "Also a variety of TIC detectors, immuno-assay bio tickets, real time PCR bio identification, a variety of radiation detection for gamma, neutrons, alpha and beta, expedient decon equipment, the Universal Containment System, various PPE Level B/C, robots, remote camera systems, evidence recovery and packaging equipment, CBRN bomb suits, SCBA, weather stations, nerve and cyanide antidote kits and numerous other miscellaneous tools."

With all that, it's no wonder that the Mounties always get their man! The regional team is very much the "average" first responder, while the national team is "alpha" first responder. "The national team has a significantly enhanced response. These are additional people with higher levels of skill (PhD-level scientists in C,B and R/N), they are better equipped (HAPSITE, portable Level 4 laboratory, communications and COLPRO) and trained (live agent training, advanced dispersal device intervention).

The latter is perhaps one of the more distinctive functions of the national team, and one that is missing in many other national capabilities. John Bureaux explained further: "The advanced dispersal device intervention includes advanced procedures and equipment. Hazardous devices technicians with greater skills in device diagnostics (x-ray interpretation and device analysis based on witness or expert sightings), better skills in threat assessment and hazard prediction of a particular device design, broader selection of RSP options and enhanced ability for containment of a device or contaminated environment." As Inspector Bureaux commented previously, the regional teams utilise Allen Vanguard's Universal Containment Device. This (like other commercially available devices such as Nabco's Radiation Shield) allows them to detonate a CBRN IED with a relative amount of safety and impunity.

The Canadian approach, much like the US, will trigger the RCMP approach if it is deemed to be a terrorist attack – otherwise another agency would take the lead. Yet unless there is an explosively disseminated device co-ordinated with a handy suicide video mailed to the authorities, it is unlikely to immediately be evident that it is a terrorist, rather than criminal or environmental event. John Bureaux suggested that the key to this was in the Canadian Government's Strategy paper. "If it is criminal, the police are involved; we become the lead agency when it becomes a terrorist incident," he said. "Hazmat and Environment Canada handle accidental releases. Our response depends on the type and magnitude of the incident, not the origin; the strategy document is very informative on this." That said, however, the strategy paper is not prescient and while the role of the government bodies are outlined it is difficult in the 'Golden Hour' to pin down exactly what the incident is.

One thing Canada is highly enviable about is the Suffield training facility. Along with BRNO in the Czech Republic this is one of the few open air, large-scale live agent testing facilities. While the UK is reticent about admitting the role of live agent training in it's CBRN responders, Suffield is part of BATUS (British Army Training Unit Suffield), which the RCMP is not – and benefits greatly from it. "The RCMP engages in four levels of training for response to incidents involving the criminal or terrorist use of CBRN materials," said Bureaux. "The first level is general awareness and is taken by all members of the RCMP while the second, third and fourth levels of training are given to police explosives technicians and forensic identification members. Levels two-to-four

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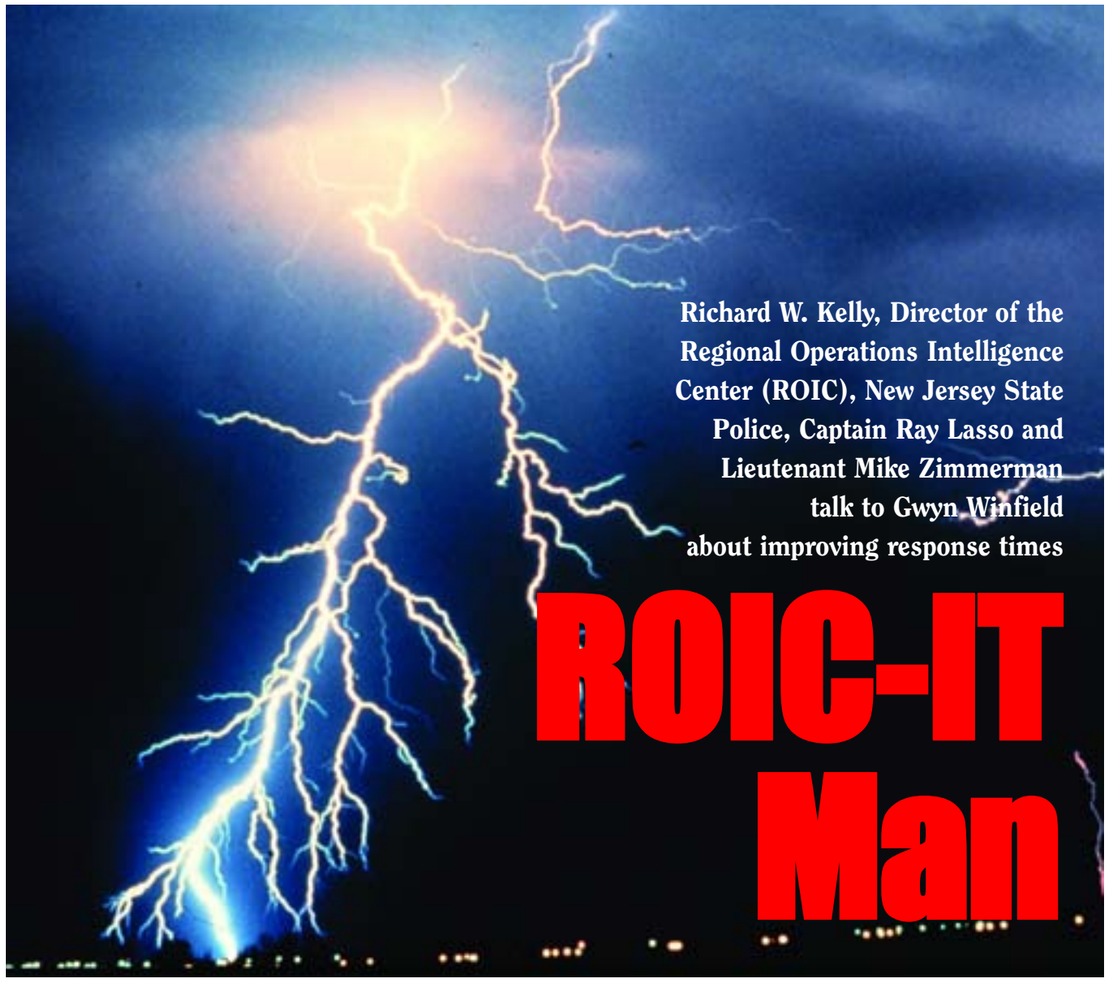
involve a progress-training programme to enable police officers to work within a CBRN contaminated crime scene. The curriculum teaches properties and effects of the agents, methods of defeating improvised dispersal devices, evidence recovery and packaging and agent identification. The fourth level involves live-agent training that includes handling and identification of a wide variety of agents."

As has been previously noted, the RCMP are very well equipped and, while Inspector Bureaux didn't want to go into too much detail on what future requirements might be, he pointed to the close and beneficial relationship they have with the CRTI (CBRN Research and Technology Initiative). "There have been a large number of tools and techniques that have been developed and/or provided within this initiative which are in use by some aspect of CBRNE first response in Canada," he said. "Of note are the CBRN bomb helmet, portable Level Four isolator, neutron bubble detectors, standards work on PPE, and Real Time PCR units."

While it is not sensational, the work that is being done on the standards will probably prove the greatest use and spark the widest debate. Standards in CBRN have previously rotated around the work that NIOSH have done; law enforcement agencies in the US, for example, have begun to challenge this and the work that the CRTI is doing will hopefully see which NIOSH regulations can be embraced, which can be modified and which need to be rejected. Any comprehensive piece of work that can do this will be of value to responders worldwide.

If one facet had to be chosen that makes the RCMP one of the leading proponents of CBRN in the world it wouldn't be the technology. There are many forces out there with analogous equipment, and some with even more; what sets them apart is the level of training. As Andy Sigsworth commented elsewhere in this issue, it is not so much the technology that is important but the ways in which it can be used – and these can best be discovered in the live agent environment. Detectors are often excellent at detecting simulants, but there is a universal shortage of live agent testing. To understand the quirks of the technology it is better to appreciate them in a "real" environment. Equally, confidence in the PPE and tactics is improved when the user has been in a potentially dangerous environment and performed his duty with nothing more arduous than the usual physiological burdens. Live agent testing produces robust and confident officers, and it is the RCMPs efforts in putting officers through their Level Four testing that will bring them dividends should the intelligence picture break down and the attack happen.

RCMP work closely with the other Canadian police forces. © RCMP



Richard W. Kelly, Director of the Regional Operations Intelligence Center (ROIC), New Jersey State Police, Captain Ray Lasso and Lieutenant Mike Zimmerman talk to Gwyn Winfield about improving response times

ROIC-IT Man

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GW: What is the ROIC and how does it work? How does it integrate diverse data and spread it across state and non-state actors? Perhaps, more importantly, what does it not do? Is it a hazard warning and reporting tool or a plume modelling simulator?

RK: The ROIC comes from Regional Operational Intelligence Centre. It is the United States' all-crimes, all-hazards, all-threats, all-the-time fusion centre. The way we do it in New Jersey (NJ) – and for that matter in all the states (I think there are 43 of these fusion centres standing up) – is to take the guidelines from the Department of Justice (DoJ) and Department of Homeland Security (DHS) and apply them to the environment in that particular state.

In NJ we have married up the operations and intelligence side. When I say operations, I mean NJ State operations – the uniformed service that does patrols. The State Police have done in it their own division, but it also includes the county and municipal law enforcement entities. NJ has about 479 independent police departments, which can range from 2-2,000-man departments. The State Department has always supported those departments with the resources they might not have, like bomb tech, hazmat or canine. All those operational areas are run out of the ROIC; requests for support come from the operational side and we marry that up with the intel side because that gives us an intel feed into what is going on at a law enforcement level – not only on the Interstate and State highways but also at the provincial levels.

On the intel side we bring in our organic partners, such as the FBI, DHS, Immigration, NYPD, Port Authority, etc. We connect to other fusion centres, mainly in the ten NE states; all that activity maintains situational awareness and lets you know what is going on, not only in our own environment but also internationally. We followed the London bombings, and when they happened the ROIC, on the asset side, made the call to deploy resources because an event like this can cause the world to spin a little faster. Those are some of the elements that work in

ROIC-IT Man

the fusion centre, as well as critical infrastructure preparedness (CIP), and we are currently going through the process of identifying CIP sites.

RL: When we activate Level Four and Five of the activation centre we transition from daily operations, though we still support their mission; we allow the subject experts to come into the ROIC and see what is happening with that particular threat

GW: So it would seem that the ROIC operates on two levels: the intelligence fusion and logistics/hazard management?

RK: What Ray just referred to are our five levels of activity – sort of like the colour-coded national levels. We sit in a building that was originally designed as the emergency operations centre, but post 9/11 and Katrina the intel fusion centre has overcome that narrow vision. At Level Four or Five we do evolve into the emergency operations centre – when a large percentage of the police who handle that response start populating our building. We sit them in specific areas to do specific functions; even though we continue to support local missions, our primary mission becomes supporting the emergency management people. In the spring, for example, the State capital gets flooded, and in the summer we have hurricanes; about 80-90 per cent of all NJ emergency management is driven by weather. We went to Level Four on two occasions last year thanks to a blizzard, and that it is times like that when we get into the emergency management mode.

GW: In terms of a CBRNE incident, do you push all the information in the ROIC into the DHS or other specialist agencies and let them do all the hazard prediction and warning and reporting? Or do you do the hazard prediction and plume modelling yourself?

RK: We do all of that. The notification initially comes here, and we would start an immediate deployment response. So we launch the response to that situation, we make notification to the in-house assets such as the hazmat side, all three regions, the homeland security people, the governor, the attorney general, etc. While that is going on we are deploying resources – as well as hazard prediction or plume modelling, our system support technical folk have the software to address that. All that comes out of here and, if we need to do mid-course corrections, the subject matter experts are seated here and we can do that.

GW: I'm familiar with some of the civil warning and reporting systems such as DTRA's CATS. Do you have the ability to pull information from GPA and feed it into the hazard management? If you know Trooper Jones is heading towards the plume – you can see it – can you redirect him and keep planning?

MZ: There is an ability, through the radio system, to track our troopers on a GPS locator level. We don't utilise it as a matter of course; we know how many troopers are in an areas through a computer aided dispatch, but we couldn't tell you he was on Fourth and Main, for example. The ROIC allows us to tie into emergency management and allows us to do notification through local county and then up to the Regional/State Emergency Management Co-ordinator. The situational awareness comes from human interaction rather than technical.
We have a new database that we will be rolling out – the resource directory database. If there was a chlorine incident on Ninth and Main, we could call up that database and if they needed something to knock down a plume we could say, "This department has three assets that can do that and they are only a mile away". We can do that on assets but not human assets.

RK: In all three regions there are preparedness bureaus and they know better at the local level what their assets are. What we would want to pull into the ROIC is CCTV coverage of the event, whether that is Department of Transportation, private sector, etc. We are looking to the nuclear sites in NJ to bring in their coverage, and anything we couldn't bring in on existing coverage we would send a helicopter with a satellite downlink to cover. I am a visual kind of guy and I like to see what is going on and put up on the big board what the assets and liabilities might be.
We have a very big chlorine plant in NJ which would affect about 50,000 people if it was blown up. We want to know what chemicals are there in our threat assessment. There are four different levels of critical infrastructure, as suggested by the federal assessment. We are now in peace-time mode, dataloading those sites what they have there, liaising with the local responder so if they have an event we can put it on the big screen.

GW: Does this CCTV have to be a manned system, or do you use algorithms to tell you, for instance, that you have 80 non-ambulant down on this road but only 30 on this one, allowing you to target your assets better, improve response and save more lives, etc?

RK: We would have to have some kind of sensor for that; we still rely on "boots on the ground". We could plume model, and we know from training exercises what is there and the weather patterns for NJ in November, for example. We know what to expect, but any event like that will be dealt with by having a ton of human resources thrown at it.

RL: We have a lot of that pre-planned; the chlorine plant has all types of plume models pre-loaded. So if we have a westerly wind we can pull it straight out and estimate and then, in the worst case scenario, we know we can start evacuating here, or whatever the case might be.

GW: I was thinking about an automatic software solution for CCTV that can do the work automatically, and doesn't need a trained individual counting, or estimating bodies. With that you can target assets, or move assets with an automatic push rather than sit behind a desk telling people what to do…

RK: We don't have anything like that – but if you do let us know.

GW: We saw this in the 2005 London bombings; that there was signal about the terrorist intention, but it was lost in the noise. Are you able to do some automatic intel sensor fusion, to sort out the signal from noise – plugging into syndromic surveillance, for example – or does it still require old-fashioned detective work?

RK: As you mentioned, there is a lot of noise out there. We marry up with other agencies – we are split between Philadelphia, Newark and NY, we tie into the Joint Terrorist Task Forces in those FBI office and we have troopers deploy to the JTTS as well as the DHS Washington Office. That is our connect to those threat assessments and the intel threads on the terrorist side. We also build on the investigation side of the State Police who have long-term relationships and good links with things like hotel owner programs, where hotel owners will call in with information – primarily in this state that is driven by drug traffickers and general criminal activities. But everything that we look at from a crime side gets an initial wash from CT.

GW: Do you require all that data come to come from police forces and their contacts, or do you have the ability to drag information, for instance, from agricultural wholesalers – that they have seen out-of-season peaks of nitrates or large amounts of acetone?

RK: We don't monitor chemical sales from a producer or factory, but we do have an interface with the private security directors, who are usually ex-law enforcement. We lecture with the private sector, and we would hope our intelligence feelers would pick up something like that. We go out and look for trends, which is all part of the fusion centre concept and 21st Century policing.

GW: Within counter-terrorism and CBRN you have the phrase "The Golden Hour". This is the period when every action has the maximum effect, and you are always striving to get deep inside the Golden Hour. How does ROIC fit into that? How does it get assets moving faster?

MZ: We have operations people that do each region, identifying staging areas, targets that might be possible, resources that we have. We have a fabric that is interconnected, and it would feed information into the ROIC, which would work simultaneously with the people that are out there meaning we can deploy assets immediately. We have also set up rapid deployment forces that have identified officers at the stations who are trained and equipped with things like radiation pagers, and they respond to that threat and would feed into the incident command system and the ROIC who would then feed assets to that threat.

GW: The genesis of this interview was a discussion with a NJSP officer, Major John Hunt, about the fundamental differences between Fire, EMS and Police. I suggested that, while Police might be the first responders on the scene, they would be there in a piecemeal fashion, since they have to deploy from a wide area and variety of missions. Fire and EMS, on the other hand, have a central pool of assets that are ready to respond to any incident. He suggested that I was wrong because of the advantages of the ROIC. How does it overturn my statement?

RK: We are here with the lights on 24/7 – it's a cold day in January, zero degrees outside, and we are sitting here with the engines idling. We cut down the response time, and because of our constant monitoring of events, our response time and our embedded resources in the NJ regions, while the first responders are likely to be the fire department or local police, as they roll so do we. The ROIC draws on situational awareness and our authority and ability to deploy resources cuts down that response time. We don't wait for a local fire department to call us. An example, an executive airport, Peterboro, operated by the Port Authority, lost an executive jet on take-off when it went across the highway and into a building. The people on the highway called 911 and those calls were answered by the ROIC and we called the Port Authority and said "You guys lost a jet". That jet was embedded in the building and while the tower might have seen that they'd lost it, we made the call to the police and fire department before the tower did, because we picked it up from the intel feed from the mobiles. That's how we learn things – either through mobile phones, radios or by monitoring the world, small towns or Madrid: we pick it up and assess it and what we need to do about it.

We had a plane crash into a building in NY recently – one of the Yankee baseball players – and we knew it belonged to him in less than a minute because we had the tail number of the plane. So rather than worrying that it belonged to Mohammed Attah, we grabbed that info, crunched it for intel, and assessed the response.

GW: Where next for the ROIC? Do you focus on training and tactics, how to get the most out of what you have got, or is it an increase in technology, improving the links, speeding things up, improving the granularity of data.

RK: I don't think we'll ever be done building the ROIC; it is a very dynamic environment and we will change every day and if we think we could do something better tomorrow than we could today, we will shift policy and do that. Driven by 9/11 and Katrina, the State and local law enforcement had to become part of the intelligence-driven environment and feed into the Federal system – but also look after our own jurisdiction without relying on DHS. We like to think that at NJ we are the tip of the spear; we had two acts of terrorism in America that were plotted right here, so we need to be on our toes.

Message in a bottle

In light of the alleged UK airline plot this year, Gwyn Winfield peers into the world of raman spectroscopy

THE autumn brought with it a "new" threat: the fear of terrorists smuggling liquids onto aircraft with the view to creating a weapon – either explosive or chemical. This threat, newsagents screamed and "intelligence sources confirmed", was a real one. Not only were your drinks, toothpaste and other accoutrements confiscated, but the threat even went down as low as baby milk (a masterful piece of press handling that suggested the depths to which terrorists would stoop). This brought in draconian baggage rules and it seemed for a fortnight that we would soon regress to steamer travel. Yet during this whole time there was a piece of technology that was available that would be able to calm the hysteria and provide an adequate level of technology – raman spectroscopy.

Raman works by firing a laser at a nearby sample (exactly how close depends on the power of the laser). This causes photon-molecular interaction between the materials and the laser, subsequently causing an inelastic raman scattering. The frequency and intensity of these scattered photons provides a unique chemical signature of the substance, allowing it to be identified. (In layman's terms, you fire a laser at a liquid, or solid, and measure the results that come back from it.)

There are a great many detectors out in the market that do chemical identification, but most of them require a sample – raman works with the sample in situ. It doesn't matter whether it is plastic, glass or any other transparent material – if a laser can shine through it, it will provide a signature. For operatives in the field, this provides a major health and safety boost. Dr Michael Pixton, a Senior Hazardous Substance Scientist at the Californian Department of Toxic Substance Control, uses raman spectroscopy and explained why: "We have an individual in the lab responsible for reviewing the available equipment and portable instrumentation, to try and get as comprehensive a suite as possible for our mobile lab for field use," he said. "He asked me to assist as I had trained for three years as an analytical chemist, spent ten years doing a lot of hazardous inspections and seven years as emergency response worker. So I had a good background to assist the lab in looking at the capability of different instruments and what would help them best. Raman spectroscopy – in our case Ahura's First Defender – was great because it sees through glass, whether clear or opaque, meaning you don't have to take a sample – a big health and safety factor. First Defender has

a good library and spectral analysis algorithms that identify what it is most likely to be. It is a simple instrument to use, but still rugged, which is a big bonus as we have to give quick training to people in the field and send them out to examine samples. We want to have a high level of confidence that it operates properly and get something back."

Ahura is not the only company to be manufacturing raman devices, however, Smiths Detection has produced a complementary product to accompany its FTIR based Hazmat ID, and ITT are currently developing a stand-off raman, called Inspector. As useful as raman is, it is not the answer to all prayers. "Everyone wants the tricorder – the device that answers all questions. Raman is not that," said Doug Kahan, Ahura's CEO. "We continue to look at other technology that can complement that, but raman is a tool in the tool box; it is excellent for identifying solid and liquid chemicals which are dangerous chemicals. Our database is quite robust in regards to dangerous chemicals; it also has a record function, so if there is an agency that has a particular concern about a substance about which we don't have access then we can add that to the database. They can be screened for anything which they want to screen for.

"That said, raman has some limitations. The scientist and government believe that raman is probably the best way for chemical detection and identification, although it is not the only one. It has two limitations. Firstly, some substances don't have much of a raman signature, and the other problem is some products have a great deal of fluorescence – in radio terms it would be noise – and it might take too long or get back too much noise to find the signal. There are a small number of substances that have these traits and fortunately they tend not to be the substances that every one is worried about – but water has no raman signature so we can't look at something and say that is water. We can say there is no nitro-gylcerin or TATP here; we can do that because we know what those chemical signatures are, but something that has no raman response is not going to show up. If you put something in the water that has a raman signature then we would pick that up – our technology and software on the machine allows us to identify mixtures of up to five different substances in that mixture, but only if those substances are reasonably well represented in the slurry – ten per cent or more. You complement it with something like FTIR, and FTIR tends to pick up all the things that Raman doesn't. If you use each of those two devices you should be able to identify nearly every chemical, and with our tech mixtures of chemicals. The next step for us is to add further techniques which will allow further identification of the unknown substances. Frankly we are looking to others to do the role of detection; our role is that of identifying the content."

A Smiths Detection spokesman agreed: "Raman is limited in its capability; it is better to use it in collaboration with Hazmat ID, or something similar. You can then use a probability algorithm whereby if one doesn't detect, then the other one should. It is a limited science for it to be used on its own, although it should be used to bolster up FTIR. What it is good at is picking up low levels of substances; raman will pick up three-four per cent while FTIR starts picking it up at 10 per cent."

Dr Pixton suggested that, while raman was a useful tool, part of its attraction came from the increased value that a specialist could get

from it. "The First Defender can only tell you so much," he said. "You point, you shoot, you get a spectrum back and it will give you its best guess. There is a lot more information contained in that spectrum than just what it is telling you on the screen. The trick is to bring that information back, put it on a laptop and then have a specialist look at it and get more information from it than you could with just a hazmat tech."

While both Smiths and Ahura have seen significant interest from customs and security officials, the real drive has come from more traditional users. "We have sold more than 300 units in the 15 months of the product's life to hazmat teams," said Doug Kahan. "They represent the largest application because they have to identify toxic waste, or TICs, like in the Katrina clean up; when things come floating by and they need to work out what they are and how they can be best disposed of – using specialist handling, etc. There is also the military, as they come across substances they need to identify quickly and make decisions about. Law enforcement is also important; they also come across substances such as drugs and they need to know what the white powder in the bag is – will it cause concern or not? Then agencies like the TSA, that have responsibility for some form of security, are finding themselves in an environment where unknown substances continue to be discovered and they need to know whether it is dangerous and how they should handle these individuals." Smiths Detection agreed: "We have had interest from other agencies, but the police and first responder market is the most attractive."

Glass, plastic, coloured glass and mixtures are all in a days work for a raman spectrometer. © Ahura

Mr Kahan went into more detail: "The UK incident created a greater sense of urgency in the TSA," he said. "They had a project underway for bottle screening, but have undergone a personnel change and Admiral Cohen has taken over the agency and has made sure that TSA and DHS are actively pursuing solutions to the bottle screening challenge. We feel a new level of energy and new level of interest in our technology for bottle screening. A lot of the hazmat people who have FTIR technology realise when we expose them to the First Defender that this is also a necessary tool in their arsenal, that there are big holes in their FTIR solution and when they marry it up with Raman they have a more robust toolset."

One of the advantages over FTIR is the ability to run mixtures of substances, rather than a pure substance. This allows a hazmat operative the chance to piece together the toxic soup he might be looking at. Dr Pixton agreed this was one of the items that had driven him towards raman: "We commonly come across mixtures, and once you have established what sort of mix you are working with you can then run that mix through the library mode and log a spectra for it. Then the Ahura will positively identify any other samples much more readily than it would otherwise."

Doug Kahan admitted that the First Defender's ability to identify up to five mixtures made it very popular. "A typical scan takes about 20 seconds – ten seconds of laser exposure and ten seconds of analysis where we look at the spectrum and compare it to the database – but if it is a mixture then it takes a bit longer to do the analysis as you need to find a pattern in what you've seen."

Yet there are some disadvantages to raman that Smiths Detection had identified: immiscible liquids, problems with coloured glass, proteins (which fluoresce and increase the "noise") and a smaller library than FTIR. While some are product-specific, Ahura have no difficulty with coloured glass, for example, while the immiscible liquids are a problem. This is when two liquids sit on top of each other without mixing. This could mean that then operative would scan the top, or bottom, of a sample, only noticing the benign source. Dr Pixton admitted this was a problem. "It is a solution that needs to be solved by both technology and training. Immiscible solutions and bi-lated or tri-lated solutions are difficult; if there is no colour difference to distinguish those layers then it is not obvious. To be able to shoot through the container to get the immiscible layers, however, is far easier than having to pull out a compound sample, let it separate and then identify it. Instead, we can just shoot through the glass. Plus you get certain chemistry happening at that dividing layer depending on what the mix is – we had a case where we had an acid solution sitting on top of a salt crust and beneath the salt crust was cyanide. If that crust had been broken through and the acid and cyanide combined, it would have released the cyanide as a gas, which would have been problematic."

The Smiths Detection spokesman also suggested that there was a problem with ruggedisation. Since raman uses a sensitive laser, and first responders don't always treat their tools with the greatest of respect, there is the chance that throwing a raman spectrometer into the back of a truck would not do its sensitivity any good. Doug Kahan suggested that this could be a problem: "We knew that our product was going to be used by the military and firemen," he said. "Neither of these are a part of the population that is known to be delicate with equipment. So we built the unit to conform to the military 10F standard – a four foot drop test onto concrete. It is waterproof and made out of material that is easily decontaminated – they tend to drop it in a chlorine bath and it comes out kicking. We knew early on that we couldn't use lab lasers as they are not stable enough, use too much power and are too large, so we built our own – we grow the crystals here at the atomic level. We built the laser in our unit from scratch at our manufacturing facility and that is necessary to have the kind of durability and low power consumption and accuracy that is built into our product. Without that we wouldn't be able to get the high quality roc curve and performance."

While raman might not be the tricorder, presumably it could have a greater role than just chemical identification. Currently work is being done on biological lasers and fluorescence where certain proteins, such as NADH, fluoresce under a laser indicating that it might be a biological attack. Surely it would be simply a matter of changing the wavelength to allow First Defender to do the same? "In addition to chemical identification, raman technology can also be used to identify biological specimens," said Doug Kahan. "Its effectiveness has been validated in laboratory settings, and current research and development activities are focused on evaluation of various wavelength lasers and pre-separation techniques for amplifying desired signals and filtering undesired ones. Highly specialised software for analysis and codification of spectra from various species and sub-species is also required. While the development task is challenging, particularly given the ubiquity of proteins and the complexity of living organisms, raman spectroscopy holds great promise for fast and accurate field identification of biological threats." You saw it here first!

Smiths Detection have released their own raman device to complement their Hazmat ID © CBRNe World

Raman technology is not the tricorder, despite whatever promise it might hold in the future. It is, however, another tool in the chemical identification toolset and one, moreover, that complements FTIR. It is likely that future operations will see these being used jointly – which is why it is no surprise that Smiths Detection have released one to partner their Hazmat ID – and, as Dr Plixton suggested, once users and scientists get together raman will probably enjoy applications that it was never planned for. Whether this will mean we can now take toothpaste on board a plane, however, is a question above all our paygrades.

Stand and deliver

T.Cousins, Leader, Radiological Analysis and Defence Group Canada and D.S.Haslip, Section Head, Land OR DRDC Centre for Operational Research & Analysis, take a reading on the potential of standoff detection of ionising radiation.

A FUNDAMENTAL tenet of ionizing radiation detection has been that this detection may only occur if a radioactive particle physically interacts with the detector. Clearly this has a great many implications for military and other field personnel. Perhaps the most severe of these is that, for a great many radioisotopes of concern, personnel must themselves enter the radiation field in order to ascertain its severity. This necessity not only results in untoward doses to these personnel, but will inevitably lead to the personnel becoming contaminated and hence risking spread of contamination to "clean" areas.

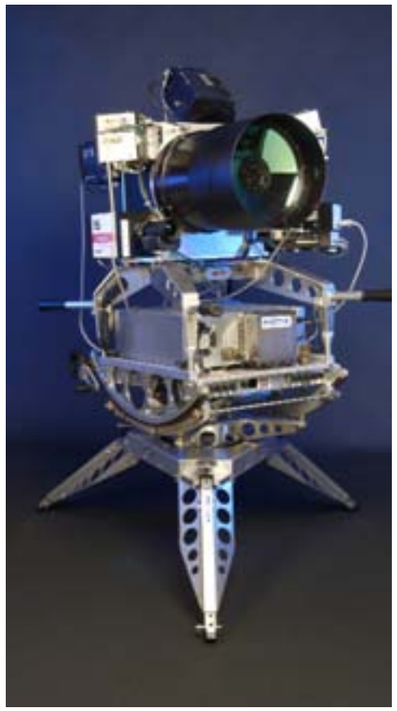
Equipment recently developed at Defence R&D Canada – Ottawa (DRDC Ottawa) belies this precept. Our so-called "standoff" radiation detection system allows detection of various types of radioactive particles at distances up to kilometres greater than their concomitant ranges in air. The system has been proven in national and international field trials and has many perceived militarily-significant applications.

This system was developed under the Government of Canada's Chemical, Biological and Radiological/Nuclear Research Technology Initiative (CRTI) Project CRTI-01-0203RD "Standoff Detection of Radiation", with DRDC Ottawa and Bubble Technology Industries (BTI), Chalk River, Ontario as partners.

All radioactive particles are attenuated – to some extent – by interactions with air molecules. Table 1 below lists the ranges (for alpha and beta) or mean-free paths (for gamma and neutron) of the four militarily-significant forms of radiation.

Thus, especially in the case of alpha or beta radiation, personnel attempting to measure the extent of radiological contamination (as after, for instance, a radiological dispersal device [RDD] event) will be forced to enter the field; in turn they themselves are highly likely to spread contamination.

Putting this into perspective, Table 2 below lists some of the isotopes that are considered threats for RDD or nuclear devices (ND). Note especially those that are primarily alpha and/or beta (and hence short-range) particle emitters. With the abject failure of conventional radiation detection techniques to solve this problem, novel and innovative solutions were required. Thus, DRDC Ottawa looked to another physical property of ionising radiation to develop alternate detection techniques. It has been



known for more than 100 years that radioactive sources will ionise the air surrounding them, and in doing so will create excited molecules. These molecules decay via the emission of photons spanning the IR, visible and UV spectra. Measurement of this photo-emission signal will, in theory, confirm the presence of a radioactive source. The intensity of such emissions is extremely weak, and heretofore all attempts to use this technique for radiation detection have proven fruitless.

However, using specially-developed techniques, DRDC Ottawa has built a system based upon the air-ionisation/molecular decay process that can overcome this signal-to-noise quandary. Clearly, detection of these photons will allow standoff detection at great distances, owing to their low attenuation coefficients in air. The DRDC Ottawa standoff radiation detection system carries the moniker Simultaneous Multi-spectral Imager (SMSI). The system employs a telescope to collect light which is then split, so as to image a scene in six different wavelength bands – four containing radio luminescence lines, and two background regions. An important consideration of the system is the use of simultaneous imaging (as opposed to sequential imaging in many other optical imagers), greatly enhancing the duty-factor

Following acquisition, signals from the seven cameras (including a spotting camera) are captured by a pair of frame-grabbers, and their signals in turn are sent to a video processor card that performs a number of simple operations on the images before passing them on to the computer's main processor. The computer also consists of an I/O board and an RS-232 board for communicating with and controlling the cameras.

The detector has a footprint of approximately 1.5 square metres, and it stands approximately 1.5metres high. The optical components are housed in a light-tight enclosure in the upper third of the device. The silver box at the centre is the control computer. The tilt and swivel of the telescope are both manually controlled. The detector weighs a total of 122kg, of which the top stage is 88kg. The software GUI runs on the acquisition computer and allows the user to set instrument and acquisition settings (eg focal distance and exposure time), control the instrument and acquisition system (eg start and stop acquisition, save data), and to see the acquired and data processed images in real-time as they are collected. Data is saved in MATLAB-compatible binary files, which facilitate post-processing in MATLAB. MATLAB was used to perform all of the post-processing for the laboratory prototype, and the image processing routines in the present detector were written in MATLAB and compiled to dynamically linked libraries (DLLs) that are called by the data acquisition system.

SMSI Stand-off Radiation Detection Results

A number of trials have been prosecuted at DRDC Ottawa in order to ascertain the efficacy of SMSI, and to model its performance. Sources used for these trials include:

Four 241Am (alpha source) foils, each approximately 1inch by 6inches. Each foil has an approximate activity of 6 mCi.

Beta sources 90Sr (0.5 Ci) and 147Pm (2 Ci), each a circular source of approximately 1cm in diameter.

An industrial X-ray machine, operated at 80 kVp. This was viewed head-on (ie with beam aimed at the detector) and in profile (ie with the beam aimed straight up). Based on dose rates at small distances (less than 1m) from the X-ray machine, this machine is like a gamma source with an activity of a few thousand Curies.

The environmental conditions are important (note city lights and full moon). Originally it was supposed that SMSI would only work under "pitch black" conditions. The extremely low signal-to-noise ratio for this work was of concern – even under ambient (man-made and lunar) night light conditions. However, SMSI produced quality results.

At 30m from the source SMSI was able to give outstanding performance for both alpha and beta detection – something for which there is no parallel in open literature. When the sources were turned by 90 degrees to the detector, however, the greater range of beta particles to alpha particles was immediately apparent. This was a critical step tpwards the confirmation of SMSI's capability and a great deal of further information was derived from this.

Figure 6: A selection of results from field trials at DRDC Ottawa. On the left are alpha and beta sources from 30 m, 135m, and 500m. On the right are measurements of an X-ray machine from 61 m and 135m. At 30 m and 135m, only one Am-241 foil was used (6 mCi). At 500m, four Am-241 foils were placed side by side (total of 24mCi). Figure 6 offers a collage of experimental results.

On the left side are results showing the effects of increasing source-to-detector distance for alpha- and beta-emitting sources. Note that even though the ^{241}Am - sources are lower in total activity by factors of roughly 20 and 100 (when compared to ^{90}Sr and ^{147}Pm respectively) they are easier to detect. In fact, at 500m the beta sources proved impossible to detect. This is unquestionably due to the higher Linear Energy Transfer (LET) of alpha particles (over beta particles), resulting in a more highly dense air ionisation "cloud" around the source. In fact the very physical process that renders higher-LET harder to detect at distances using conventional techniques aids and amplifies detection with SMSI. On the right-hand side of Figure 6 are the SMSI-observed patterns from the x-ray machine at 61m and 135m. Note that, as above, when the radiation is directed perpendicular to the source-detector axis, the ionisation distribution pattern in air is clearly visible.

The standoff detector was taken to Pacific-Northwest National Laboratories in Richland, Washington for field trials that took place during the last week of June 2005. A selection of results is shown in Figure 7. The sources that were used at these field trials were:

An array of ^{241}Am sources. The array

Table 1

Particle	Range/Mean Free Path in Air
alpha	Centimetres
beta	Metres
n	hundreds of metres
gamma	Kilometres

Table 2

Isotope (Principal Emission)	Terrorist Threat	Range or Mean-free Path
^{60}Co; ^{137}Cs; ^{192}Ir	RDD	Up to km
^{90}Sr	RDD	Few m
^{3}H	RDD (inside building)	cm
^{235}U; ^{239}Pu	Improvised Nuclear Device (IND) or Acquired Nuclear Device (AND)	cm
^{241}Am	RDD	cm
^{252}Cf (n)	RDD	200 m

Figure 6

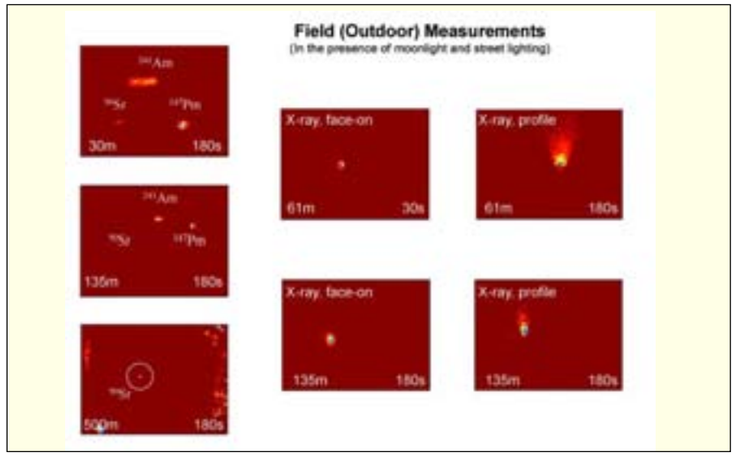
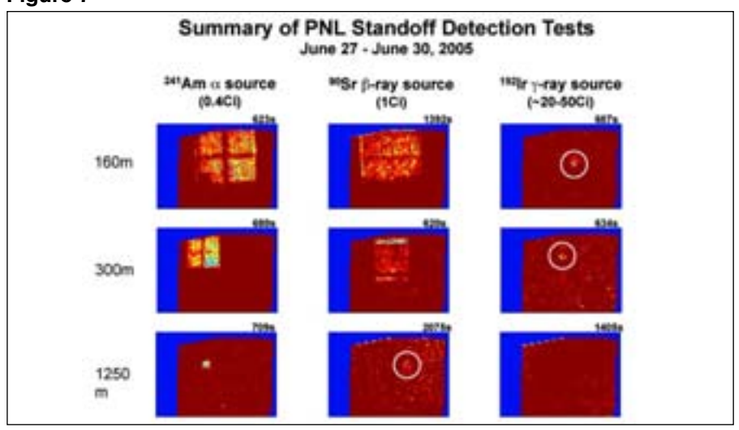


Figure 7



Stand and deliver

consists of four sub-arrays, each of which consists of 100 sources (10 rows of 10 each), each with a diameter of approximately 2 inches and containing 1 mCi. The whole array measured about 1.5 m wide and high, with a total activity of 400 mCi.

A similar array of ^{90}Sr sources. The only difference between the arrays is that each of the individual ^{90}Sr sources is 2.5 mCi (as opposed to 1 mCi), making the total activity 1 Ci.

An industrial radiography source of ^{192}Ir, with an activity of 20-50 Ci. The source was not collimated.

Figure 7: Selected measurements from the field trials at Pacific-Northwest National Laboratories. The alpha source is clearly visible from 1,250 metres. Several interesting facets are apparent. Firstly, as noted previously, the higher the LET, the higher r is the s the efficiency of SMSI detection. In this case, the alpha-source activity is roughly half of the beta-source activity and a tenth of the gamma-source activity. Yet the alpha-source is clearly visible at 1.25km, while the beta-source is barely detectable and the gamma-source is not seen. Note also that in the alpha image at 160m, there is an apparent "blank spot" in the lower left. This was in fact caused by a radiation trefoil placard obscuring this area of the source.

Real-world performance

Based upon a combination of measurements and calculations, the nomogram in Figure 8 gives the SMSI performance.

Figure 8: SMSI Sensitivity. Lines and shaded regions provide expected levels of sensitivity, based on calculations (note that these are based on four 300-second measurements). Data points represent experimental measurements, and validate the calculations.

If anything, the observations show the calculations to be overly conservative. As emphasised above, higher-LET radiation is easier to detect using SMSI.

Possible Future Upgrades

SMSI has proven itself to be capable of detecting radioactive sources under a variety of lighting conditions, including dawn, dusk, full moonlight, and high-intensity ambient night lighting (such as streetlights). However, the system will not work in broad daylight owing to the extremely low signal-to-noise. Future upgrades should include an expansion of this operable "time window". Other upgrades may centre on expansion of the system's field-of-view, addition of a sighting scope, further refinement and optimization of the spectral regions of interest, ruggedisation and ergonomics.

Other Potential Standoff Methods

The air-fluorescence technique (embodied in SMSI) presented here has clearly demonstrated radiation detection capabilities not previously realisable. However, there may well be other unexplored techniques that can augment (or possibly even surpass) SMSI's capabilities. These techniques may include – but are not limited to – other air fluorescent phenomena

A suggested, but by no means exhaustive, list of potentially useful techniques includes:

Radiolytic production. Radiolysis is the cleavage of one or several bonds following exposure to radiation. Short-lived, unique radicals may thus be produced. These may decay (either naturally or following some form of excitation) and their emission spectra may in turn give a unique signature.

Calixarenes. These "basket" molecules exhibit strong scavenging characteristics for specific targeted elements. Thus, they may be useful in the detection of trace quantities of radioactive material, perhaps in interdiction applications.

Magnetic perturbation methodologies. There are recurring reports of this phenomenon.

Fourier Transform Infrared (FTIR) is actually a technique to detect and identify molecules. It may have application if (as is often the case) the molecular form of the source is known.

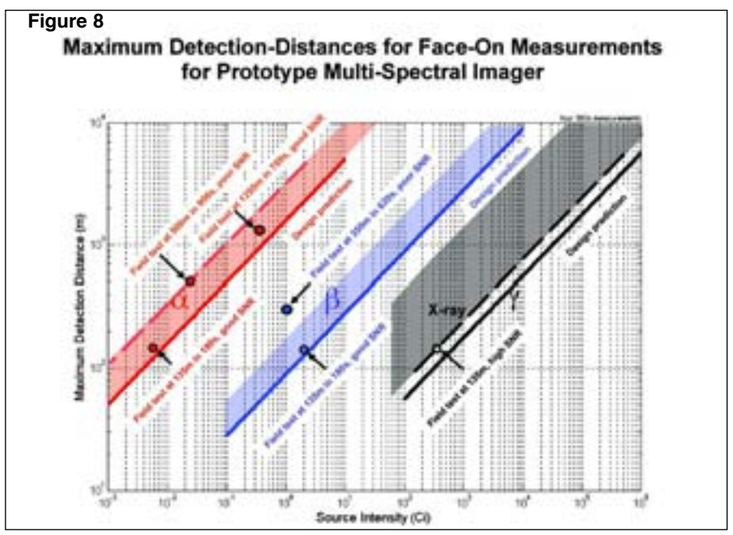
Optically-stimulated luminescence of shielding or other ubiquitous materials. Radiation may excite metastable states in surrounding materials. Thus the current or previous location of a radioactive source (or more accurately the source's ionisation profile in that material) may be known. The technique is now being applied by DRDC to forensics and arms-control verification applications.

A Nato Industrial Advisory Group (NIAG) technical study has been requested to examine some of these.

DRDC has developed a novel ionising radiation detection technique, which allows detection of sources at previously unimagined distances. For example, 400mCi _-sources have been positively detected at over one kilometre, compared to only a few centimetres with any other reported method. The current system may be described as lab-prototype, and may be readily modified (or upgraded) for specific tasks. Other "non-conventional" methods of radiation detection are currently under investigation within DRDC.

DRDC Defence Scientist Dean Haslip and a BTI employee (seated, right) using the Standoff Radiation Detector at night to detect radiation sources at a distance during an exercise. Other exercise participants observe results on the monitor.

Figure 8



DRDC Defence Scientist Dean Haslip and a BTI employee using the Standoff Radiation Detector at night to detect radiation sources at a distance, during an exercise.

DRDC Defence Scientist Dean Haslip and a BTI employee using the Standoff Radiation Detector at night to detect radiation sources at a distance, during an exercise.

Getting warmer

Gwyn Winfield looks at how future soldier technology and individual protective equipment might develop

Physical activity with future solider systems and PPE is not to be taken lightly ©DoD

FUTURE warfighter presentations are always great. Often they are animated, or badly acted, presentations of how we will defeat conventional forces in the open, feeding information back seamlessly to aviation or non-line of sight assets that destroy them effortlessly – with no collateral damage. Sometimes they will show that they work in all temperature zones, from arctic to jungle; the soldiers, sailors, marines and airmen effortlessly overcoming the elements as they launch network centric warfare (NCW) terror on the enemies of freedom. None, as yet, have shown them in a CBRN scenario, so here's how I see it occurring…

Warnings flash through the network that UAVs and acoustic sensors have detected a chemical barrage and the warfighters suit up and take cover. Due to it being a persistent agent the soldiers remain in their IPE for long periods of time, attacks are repelled steadily, but night vision goggles, and thermal imaging sights don't fit properly and some of the attacks steadily gain ground. Equally, the high power requirement of the various personal role radios, lightweight chemical agent detectors and other accoutrements of the common soldier start giving off heat as they are used constantly, increasing the physiological loading. Soldiers now no longer care about the network or the battlespace; trapped as they are in a personal conflict with their physiological load, the advantages offered by modern technology are ignored as the soldier retreats into himself. I can't wait to see that placed with a stirring soft rock anthem!

All flippancy aside, there has been a disconnect between the future soldier requirements and the IPE manufacturers. Yes, some integration work does go into the link between helmet and mask, but little is done about the system-of-systems approach – how does technology and IPE fit together?

Previously there was an accepted paradigm, but post-Cold War the threat was reducing and even though there may well be a chemical or even biological threat, it was not on the scale of gallons of thickened mustard previously worried about. At the same time the technology was improving slightly, protection improved slightly or stayed the same, while the physiological load got slightly less. Yet there are worrying signs.

Primary among these is the rhetoric that suggests there may be an imminent conflict with Korea. If we ignore the political and military ramifications and just focus on the CBRN ones, these are a major challenge. A number of North Korean dissidents have alluded to the offensive capability of their chem/bio programme (though mainly chem). Equally, it is hard to find more of a pariah state with nothing to lose. Iraq's offensive programme was kept in check by international agreements, belligerent neighbours and a quasi-military occupation in terms of the no fly zones; all these militated against the use of offensive CWA/BWA. Korea has no such limitations and has proved itself far in advance of Iraq in its nuclear and rocketry programmes. Suddenly we are back in the Cold War scenario of gallons of VX and the need to protect against it.

Getting warmer

Meanwhile we have moved from a position of active defence – the Fulda gap mentality – into one of high speed manoeuvre with all the assorted gadgets and gizmos which require batteries and give out heat. At the same time, we have yet to invest in cooling technology that will allow the warfighter to overcome the physiological challenges that these impose. While the average cost of the liquid cooling vest worn by fast jet fighters is prohibitive for the common soldiery, there are various phase change garments that would provide up to three hours of cooling with no batteries.

Improvements are happening in activated carbon, but these are iterative changes – part of a set series of developments that incrementally improve the protection and lower the physiological load. Yet there has yet to be the innovation that could develop the next generation of garments. Work has been done at Porton Down on plasma coatings which would decrease the penetration through to the carbon layer, yet this has yet to be adopted. Other semi-permeable membranes offer some hope, but are plagued by offering neither the protection of impermeable garments nor the comfort of activated carbon. The US, as described by John Bryce in this issue, is looking to introduce the one suit – a suit that has no greater physiological loading than regular clothes, but provides protection – but this raises a number of questions. Firstly, how much is this going to cost? The one suit has also been mooted to have biometric information and chameleon properties in it, as well as CBR defence.

Even if this was feasible in six years (and nothing on the market comes close at the moment), the cost would be prohibitive; does this just become a Special Forces issue? The idea of it being able to offer a negligible burden without some form of cooling device would also seem wishful. One of the problems with many forms of IPE is the link between outfits, trousers and top, and the gloves, boots and respirator – all of which cover bare skin that can usually allow cooling and the required restrictions in airflow also reduce normal temperature reduction and increase cooling. Again, it would be interesting to see whether the one suit will also include gloves and boots, both of which tend to be made of impermeable material because of gross contamination; nothing is apparent that could match this level of protection without the incumbent burden. Improvement in carbon technology is not going to deliver anything approaching normal physiological loads if it continues to move at the same pace – or even if it speeds up. A novel technology will have to be created that can be integrated into the common garment at an affordable cost – something that is unlikely to appear in the next six years.

The civil sector has little to teach the military if we look at warfighting scenarios. While a great deal of work is going into the threat assessment and agent fate to push down the physiological loading, donning and response time, these are quickly defeated if we believe that there is a liquid contamination threat. Equally, there seems to be a disparity in what we ask, and achieve, from soldiers, sailors, airmen and marines that we don't get from first responders. Recent health and safety guidelines have set astonishingly low safe times to be in PPE that have nothing to do with the protection time of the garment and everything to do with how long it is "safe" to be in PPE. While the civil side may have a lot to offer in other areas, protection is unlikely to be one that can be carried across to warfighting.

Technology will provide and integration will just happen is the refrain. I have yet to hear the CBRN equivalent of NBC – NoBody Cares – but whatever it is, it will be apt to this situation. NVG (Night Vision Goggle) and TI (thermal imaging) manufacturers, when asked about whether their product is compatible with in-service respirators, never mind future ones, tend to slump shoulders and pass the buck onto the procurement organisation – yet this equipment is rarely (if ever) checked against live agent because of the cost of replacement if the decon doesn't work. Too much is taken for granted mainly because, as ever, a great deal of the procurement work is done in silos and integration is always the last – rather than first – thing, ensuring that it is the best that is practical. A glimmer of reality must shine in on this vision of programme managers checking with their CBRN subject matter experts whether what they are doing makes sense; they have far more important mainstream scenarios to deal with than the non-conventional. Until there is some joined-up thinking in terms of future soldier systems and IPE, my wait for the video of the CBRN future soldier with the happy ending is only going to get longer.

Run Forrest, run. Can civil responder physiology tests teach the military anything? ©DoD

CBRNe World looks at critical infrastructure protection

CHEMICAL ALARUM

THERE is always a great deal of interest in major events – the World Cups, Superbowls and G8s of the world. These caravanserai arrive, take over a city and leave with little trace that they had ever been there – apart from some lessons learned. While these are of value to governments, individuals and commercial organisations, they leave little legacy for the host city. One thing they did leave is the idea of how much better their security could be. There is no doubt that cities like Berlin, Hamburg and Leipzig will look at their current systems and wonder how they could get half the capability at a quarter of the price. Critical infrastructure protection (CIP) – the means by which buildings, transport networks or services are protected from terrorist attack – is becoming big business, as the repercussions from Madrid in 2004 and London in 2005 are driven home. Smiths Detection have their 24/7 system, Bruker Daltonics have their Raid-AFM system and companies like Lockheed Martin and Environics are heavily involved in protecting the underground transport infrastructure. The drive has been away from producing a piecemeal approach, whereby there is an odd sensor here or there; instead the network is the key, where a combination of sensors – CBRNE and conventional – are linked together to act as orthogonal detection.

"There are inter-related issues that we have been working on for a long time," said Tim Otter, Vice President of Business Development at Smiths Detection. "Critical to this is livewave and internet-based communications systems. Essential to CIP is orthogonal detection – using two different technologies to verify each other. Those two technologies, in most instances, continue to do their day jobs; the chem detector does that role, the cameras, for example, do theirs. The cameras verify that the detector has gone off and there are people lying on the floor shaking, or there is a vapour. Or, alternatively, there might be people lying on the floor but no chemical detector alarm – this might be an earthquake. Since livewave is internet-based it is almost infinite and there are no bandwidth issues.

"We don't want chem, bio or rad to give falses," he continued. "So they need to push the false alarm issue down as low as they can. Another thing that is important is the requirement to think of a holistic system from the beginning. It may well be that you can get the chemical detector to back up bio from the beginning, or it may be that your chemical detector has two bits of tech in it – one might be cheap and cheerful, but if doesn't false alarms at the same things that the sensitive one does, then you have a solution. It's about lots of different capabilities meshed and entwined."

That concept works on the grand strategic level, but the urban environment, and especially the transport network, are not the place for CBRN sensors. Firstly, there are too many interferents – emissions, dirt and fumes can play havoc with sensitive equipment, meaning the sensitivity needs to be turned down. Equally, the urban environment is complex meteorologically; there are very few prevailing winds and a sensor may not alarm if it is around the corner, too high or too low from the source. There is also the maintenance and security aspect – too low and these sensors can get vandalised or stolen, too high and routine maintenance is a problem. Highest, though, is the false alarm situation where non experts are required to believe implicitly in what the machine is saying – so a chemical alarm in Trafalgar square, despite lots of pigeons still flying around, is still a chemical alarm. The essence of CIP is that the building or area is critical, either for business, financial, transport or service reasons – a false alarm may render it out of order for a short period of time, but even that might have major repercussions – for instance, the evacuation of a stock market floor. There are solutions to these problems, but they are not easy.

One of the man-made problems is that of commercial sensitivity and intellectual property rights. Users want an integrated network, not a series of interconnected ones. In fact, Environics Sales Manager Timo Jaakala pointed out it is often a prerequisite. "That is usually a requirement; they don't want additional networks, so we have to be an extension of the existing system." Yet this can mean a single contract let to a company to do CBRN detection, bringing competing companies together – which causes problems. This was illustrated through the Impact programme (more information on page 17), whereby members of a consortium did not want to give sensitive information about the way their detectors worked, and what their strengths and weaknesses were, to a competitor – which meant that the signal had to be downgraded and the efficiency was reduced. Tim Otter believes that wouldn't be a problem, and pointed out the work that the UK, for example, is doing with a widespread collaboration – Team CBRN (more information page 19). "Team CBRN's role in this would be to say fine – those people who have a commercial interest are not allowed to evaluate the IPR; they wouldn't have to put the IPR to

Smiths Live Wire system when combined with chemical detectors can provide orthagonal detection © Smiths

CHEMICAL ALARUM

me, for example. If the government says they have a problem, industry might be the best placed people to say, 'Hey, there is a little company down the road, those are the people that you need to go to'. It may therefore be that a big company needs to put their arm around the little company to help them; it may be that they have to advise them or, if they are incapable of dealing with it – and dealing with the government can be difficult – then they may have to move in and purchase it. The owners of the company benefit – and help them in that way."

Timo Jaakala's experience had been less commercially predatory. Environics has been working on putting CIP into metro systems – providing them with a full CBRN system that can plug into their existing network. Despite using different companies' detectors, Mr Jaakala's experience had been different. "We've not really had that problem as we did all the chemical detection part," he said. "If we are taking other sensors then we apply them to our algorithm systems. Environics does not have a biological detection key competence, but if we did then we might face that sort of problem."

Yet part of the problem inherent in chemical detection is that it detects the agent once it has been released, as opposed to when it is just a threat. While attempts to interdict lethal agents are made in flights and some government buildings, it is not the case at large scale events – such as sporting matches or rallies. While all protection is an onion-skin type approach, it is better to interdict the individuals that have created or handled these weapons to be caught before they can set it off. Airports and highly sensitive areas have Tadars, biometric information and screening to protect them, but for mass transit systems, or high population density events, this is not possible – the delays that are incumbent on these systems are not palatable for high throughput events. What could be done, however, would be to rig CBRN detectors up to the ticketing or entrance machines, whereby each ticket is scanned for an agent. While biological detectors, and sieve packs on some chemical agent detectors could get clogged with dust and detritus, it would be feasible for chemical agent detectors to "sniff" or scan each ticket to see whether someone who has handled various agents is present. The advantage of this system is that, because it is not open to the elements, the sensitivity can be increased to pick up trace elements. The disadvantage is that a lot of legitimate individuals would have to be pulled aside for screening/questioning. Those individuals who have had medical isotopes or are workers in various industrial complexes could well be the sort of individuals who would have to suffer the indignity and embarrassment of being pulled to one side – which in sporting events where alcohol had been involved could become a public order issue.

Tim Otter felt that the advantages outweighed the disadvantages: "What you are trying to do is make this something the terrorists have got to get over and around; where every hurdle is a different height, width, shape and they get more difficult and sensitive – or different in approach. He might have protected himself against explosive trace, but not change to his skin. Those are the sorts of ways you look at it. It is all about intelligence, not just a ring of defences. What happened in the Athens Olympics was that the intelligence and screening process started in the countries where the terrorists were likely to emanate from; as well as the start point of the flight or co-joined/connecting flights. It has to go out a long way. Yes, it is expensive, but it is the world we live in."

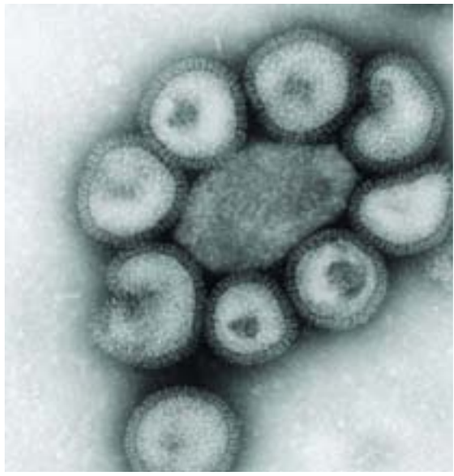
The devil with all these systems, for the foreseeable future, is the false alarm rate. Biodetection is so prone to false alarms, especially in underground transit, that people have to resort to pulling samples and taking them to labs for analysis – hardly a 21st Century solution. While chemical detectors false alarm less frequently, it does happen – with cleaners mopping the floor with ammonia or chlorine-based bleach, for example – so the sensitivity tends to get turned way down. While this does solve the false alarm issue, it creates problems with agents which might not be explosively disseminated – without a key dissemination event but instead using a slow release from a canister, it might not reach the critical levels needed to set off the de-sensitised detector. Stand-off detectors, usually using FTIR, would seem to be one of the better ways of dealing with this problem, yet then you are into emergency management issues rather than interdiction and interception. X-ray devices are getting far better now at detecting both powder and liquids in containers – even concealed amounts – yet they still require the trained operator, meaning that the throughput times are slow and not conducive to large public events. The 2010 World Cup and the 2012 Olympics, in South Africa and the UK respectively, will provide interesting lessons for these events. China, which will host the 2008 Olympics, is such a police state that it will be difficult to get the read across points – though the technical issues will be interesting (if released). Of the CBRNE threats, rad, nuclear, explosive and chem are probably the easiest, in that order, to detect. Bio is a vastly different fish and it may well be easier to stockpile anti-virals, vaccines and other medical countermeasures rather than spending huge sums of money, failing, and then needing to get all the Med-CM anyway. This is not to say that biodetectors will not be capable by 2010; more that the unit-cost multiplied by the amount needed will be enough to bankrupt any state. The soccer World Cup is a case in point – Germany was staggered by the amount it needed to spend on security, and if FIFA decided to include biodetectors in the security requirement it would effectively put the competition beyond the means of any but the most financially robust nations – the power of the microbe!

Smiths 24/7 has been highly successful in the critical infrastructure market

FEAR OF THE UNKNOWN

Maria Helguera, South America biological warfare specialist, examines the threat of bioterrorism, and asks whether enough is being done to meet the challenges

Something wicked this way comes. ©All photos CDC



IN THE past few years we have witnessed the growing perception of the possibility that a biological attack could occur, especially after 9/11 and the subsequent anthrax incidents. But this phenomenon has no concrete evidence which definitely supports it. The use of biological weapons is as old as human kind, and the difference through the ages could be linked with the technology involved in the agents' development.

We can also consider that the threat perception is fed with two very "human" feelings of our daily life: firstly, the fear of the diseases, and secondly the fear of the unknown and intangible. A biological agent can't be "seen" until is too late, and if we add to those facts the reality that we are living at a historic moment where the rise of a pandemic appears imminent and where the mass media is bombarding us with information and data, the problem gains astronomical dimensions. In this context, it is important to remember that the biological warfare agents are the same pathogens that cause some known diseases, such as anthrax, botulism, cholera, smallpox, and others.

When we assess the possibility of a bioterrorist attack, however, it is possible to say it is inversely related to the likely number of casualties caused by it; the most horrendous attacks are very difficult to perform and therefore unlikely, and a more limited (or conventional) one resulting in few casualties would be easier to carry out. Even though a biological attack could be considered a low probability event (for some experts a very low one), almost all experts agree in that it is a high salience one, with all that this entails.

Biosecurity can be defined as measures that have to be taken to prevent, deter, and protect against the misuse of biotechnology and biological agents for hostile purposes. In order to achieve this, it is almost mandatory for the close co-operation among biologists, national security experts and the industrial sector.

One element which deeply affects the biological threat assessment, and the courses of action selected to afford it, is its high salience. Politicians want to be prepared, or at least look like they are, regardless of the real threat. In order to do that there is a big budget available for projects related to biosecurity in general.

The current situation leads us to consider and create our response programmes based on case scenario studies. The problem element here is that the most well known scenarios are constructed as a combination of the worst-case with the worst-agent, creating the scariest scenario possible, regardless its probability of occurrence.

Other circumstances that constitute the biosecurity issue include the internationalisation of biological knowledge; globalisation of the biological material and equipment market; increasing numbers of high containment labs around the world; and growing number of people involved in biosecurity issues.

Biological sciences have grown vertiginously since the 1960s, and their expansion has extended beyond the national borders since then. The same happened with the "material world" in the globalisation of the availability of dual-use materials and equipment, even though the Australia Group members are trying to avoid or delay it.

Regarding labs, more places with high levels of technology mean more places to watch and more people with access; all that could represent more probability of risk. The same could also be applied to the growing number of defence research institutes, conferences and activities related to biosecurity. Another aspect to take into account is that the objectives, topics to deal with and responsibility areas overlap among each other, which entails poor resources exploitation even though they are not a limiting factor of the activities' development.

The last element to take into account is reorganisation – if you don't know what to do, reorganise. The reorganisation of governmental bodies is useful for such simple reasons as giving the feeling that something is being done – even if it doesn't work – both to the general public and to the officers. The only problem is that reorganisation entails a new budget assignment and time.

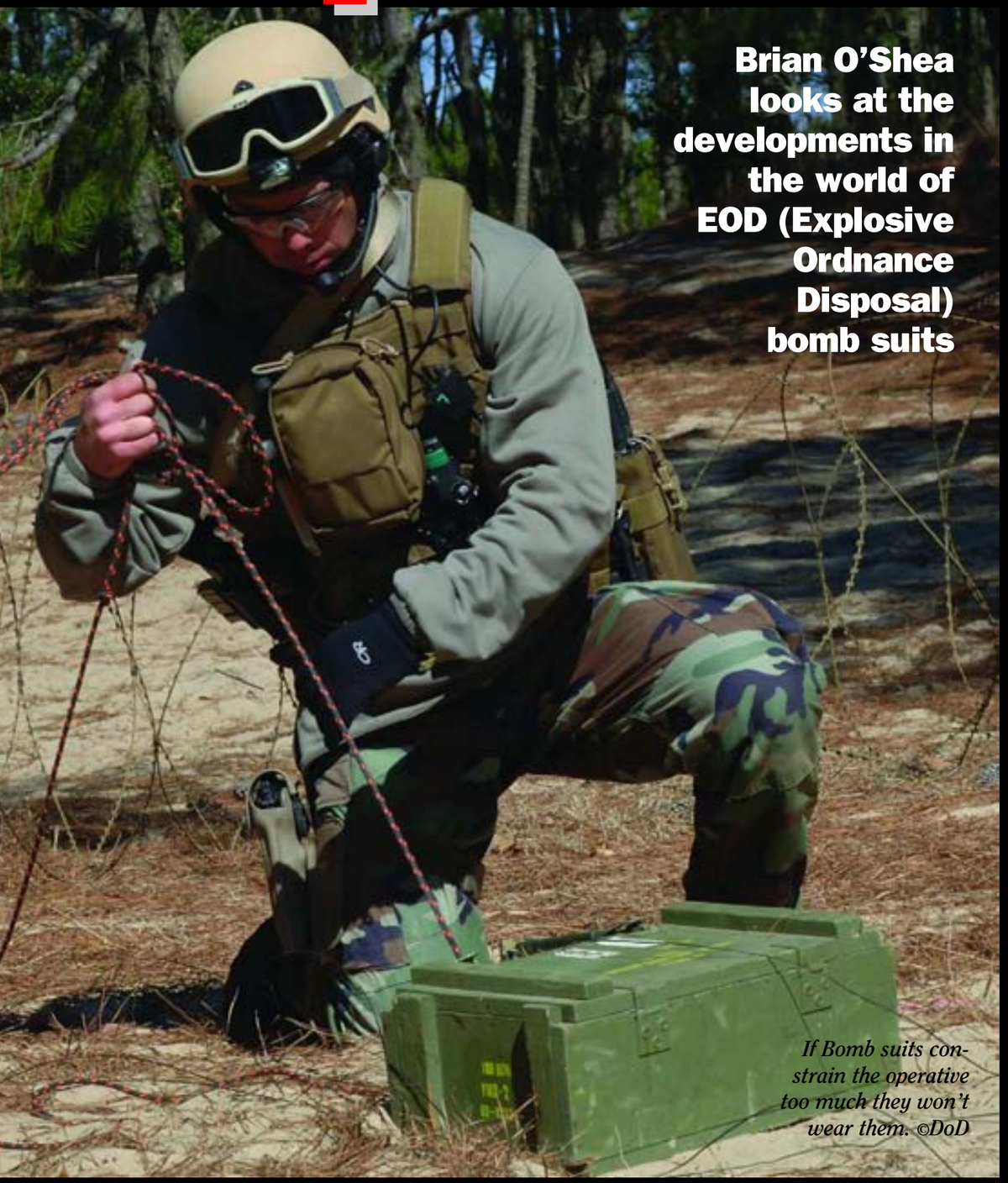
In summary, when we consider which aspects to prioritise when it comes to biosecurity, public health, education and national security are the critical but not the only ones. It is also important to include in our analysis the dual-use aspects both of technology and materials and knowledge, consider the cost/benefit of the measures that are plausibly to be taken, and to do all this in a long-term framework.

Finally, the proposal of a biosurety approach for preparedness in case of a biological attack appears to be the optimal solution, especially because of its systemic conception.

The current situation is creating new threats as it evolves. The paradox is that new security challenges created by the increasing attention given to the biological threat are generating an environment in which evolution is difficult to assess.

Taking into account the short history of bioterrorism and the challenges which face the so-called bioterrorists in our current health context, which is the real threat? The increasingly deterioration of the environment and the new and emerging (and re-emerging) diseases pose a bigger challenge than a bioterrorist attack. Here the odds are in the healthcare side, and not the terrorist one.

Explosive reaction



If Bomb suits constrain the operative too much they won't wear them. ©DoD

Brian O'Shea looks at the developments in the world of EOD (Explosive Ordnance Disposal) bomb suits

THE IED is ubiquitous in Iraq. While some devices can be dealt with using a well placed tank shell, some still require that long, lonely walk out to an explosive device by a man in a very heavy suit. EOD techs are notorious in every military and civil force for having a great deal of sand to do their job yet, like many things, the work that they do is often possible because they have a good team backing them up.

An example of this is the work that goes into the bomb suit. While these may look cumbersome, they are designed with input from leading military institutions and the user community. That is just the start of it; once the requirement is nailed down, the physical testing starts, both in the simulator and in the field. Mark Oldroyd, Manager for EOD Systems at NP Aerospace, suggested that the balance between the simulator and the explosive mannequin was delicate. "The MoD modelled the latest bomb suit, the Mark 6, on Caspar – looking at the possibility of fragments and the impact on the user and looking at the vulnerability of different parts of the body. A higher weighting was given to the torso, chest cavity, various types of device were used to simulate what would happen with the projectile and where the fragments would go – whether it is on the ground or in the air, etc. From that point of view computer modelling is very useful, but in the real world blast is such a complex thing there is no substitute for real-world tests. It can be modelled, but in the real world the blast might not be spherical; I have come across some people who have talked about the charge not being spherical but cuboid – which was worrying. Both have their place, but I would not want to put anything on the man without having validated it in a real-world scenario, as well as having done the theoretical work – how strong threads are, etc. So it is a combination, but real-world testing is vital."

Aris Makris VP R&D and CTO at Med-Eng agreed: "There have been rapid advancements in surrogate [mannequin] involving different levels of technology in stimulating human anatomical response. Surrogates permit you to produce a lot of data from a reproducible, robust device. It doesn't respond entirely in the same way that a human does; you put in sensors and can get representative measurements of what it might be in a human, based on injury critereia, that are constantly evolving for blast. There are other surrogates being developed, including very detailed replicas of the human body with ribs and organs and fluids inside. All of them have their limitations but are trying to get to the pure state. But you are never going to get the physiology – you can say that the bone broke, or the water in the heart broke, but you can't model the physiology, the disease that came because of the blood leaking. People continue to use biological surrogates in mimicking human response.

> "We are looking at the human body and trying to do some material systems on understanding the physics of how the threat goes across the materials, so that whatever goes across to the human body is either not injurious or survivable."

"A variety of animals have been used over the past decades," he continued, "such as sheep, pigs, etc. to model different things; if they want to see injuries in a human then they have to chose an animal which is closer anatomically to a human. There has also been a tremendous amount of work in human mannequins – ribs that are made from a polymer that responds similarly to bone and gels that are close to our body's organs. These advances will help us understand injuries from blast, and once we have that we can improve the protective technology that goes with it."

It is too easy to think of the task of the bomb suit being a linear equation – man stands in front of bomb, blast wave goes in front of him, therefore protect to the front. "EOD cannot be compared to regular body armour. Regular body armour is designed to stop one thing – a bullet" said Aris Makris. "It is fairly simple; you just need to put enough material in front and eventually you can stop the bullet. When you deal with an explosion it has a number of threats in its approach. Everyone thinks about the blast wave, but then there are the fragments. These can be parts of the explosive device, if it is a minution, or secondary fragments, such as the surrounding material /debris all of which can be equally devastating. The explosion itself can launch a person into uncontrolled motion, and that can cause acceleration injuries and then, when he stops, he usually hits something like an object or the ground, and suffers deceleration injuries. Then you can also have the flash from HE, or the fireball that comes from an explosion, or it could be an incendiary device that burns the victim by intent. You can also have chem, rad or bio, which are not well defined, but they can cook up what they think they need and an EOD tech needs protection against these things. We are looking at the human body and trying to do some material systems on understanding the physics of how the threat goes across the materials, so that whatever goes across to the human body is either not injurious or survivable."

Yet the options are limited, as there are some fundamental laws of physics – the energy from the blast cannot be contained; it needs to be deflected. Mark Oldroyd explained further: "You have to direct the energy away from where you don't want it to go – the body and vulnerable organs. For example, the Mark 6 has had a great deal of work go into the system of plates; the bottom line is trying to minimise the energy that goes into the lungs and other organs. That was a massive body of work done by Porton Down over a long period of time, using all sorts of different materials trying to achieve different venting. Where you have changes in density, energy is reflected or released. The body has a large water content, but when you get to the lungs you have a large amount of alveoli and the energy can be released there and damage the alveoli. So a lot of the work on

Explosive reaction

the plates is to put different density changes in there so that the energy does not get released in the lungs, for example."

Yet it is not just a case of covering the individual with layer upon layer of aramid; the dexterity needed in a bomb tech's work is such that he would rather take the protective plates out and do a good job than trust to the armour's protection because his hand was restricted. "It's an area of concern," said Mark Oldroyd. "The protection and methodology conflict. The British doctrine is to get close and personal with the device and if it interferes with that then the plates or helmet tend to get removed and then there is no protection there at all."

Med-Eng's Major Jon Earey (Ret'd) former A/Commanding Oficer of UK's 11 EOD Regiment RLC, agreed. "Human factors are part and parcel of a bomb suit; the ergonomics of putting this together so the user is not compromised to such a degree that he cannot operate," he said.

There is a delicate equation between physiological loading and protection. ©DoD

"The ability to wear the maximum protection at any time has got to be sacrosanct. The ability to reduce that as and if an individual bomb tech requires is his personal choice; it is not right to say you should or you shouldn't. Every scenario is different and we don't dictate as designers what should or should not occur as that is down to training."

Familiar to their colleagues in the CBRN world is the physiological load that the bomb suit puts on an individual. The greater the protection the heavier it is; the less heat energy can escape, the more energy is required to move (which generates more heat), etc. Cooling systems are more prevalent in bomb technicians, yet while many modern soldiers close with the enemy bedecked in a variety of electronic devices, traditionally the bomb tech has been free from this – electronic signals can act and initiate an IED. But with modern technology, couldn't there be an opportunity for wiring diagrams or other useful information to be flashed up on a heads-up display within the helmet?

Jon Earey suggested that there was work under way. "We are currently in the process of doing a survey to find out what bomb techs want, where the trade offs are, aspects of HUD, sensors to detect chem or bio agents automatically, etc," he said. "These are all aspects that we will evaluate to see what is included in a complete platform."

Aris Makris sounded a note of caution, "In terms of diagnostics there is a lot that exists in other fields, but the challenge in an EOD environment is that there are a lot of electronics that you don't want sending signals that would initiate a device. A lot of the technology that has been designed was never designed as bare minimum weight, so we do have to work with integrating technology from other fields and customising it for EOD. The user has to have an option to embrace it or not – how much do you want to burden the EOD tech? These devices have to be pertinent to EOD operations."

NP Aerospace's Mark Oldroyd agreed: "We have technicians discussing this at the moment; what the wish list might be and talking about those with the technologists and user. We are doing experiments on measuring basic body functions – temperature, external/internal, blood pressure and oxygen. They are collecting this data using micro units and collecting it in a central area to give an idea of operator health. While this is interesting, electrical signals around the suit, or even wireless transmissions, would be swamped by countermeasures and other signals that are going around. The methodology of the British, however, is that the EOD opeerator is in control and once he leaves the safety of the ICP he is in complete control and communication only starts when he returns for the disruption. There is technology there that is gradually getting smaller and more appropriate, but we are getting quite wary about that fact that just because it can be done doesn't mean that it should."

"The ability to wear the maximum protection at any time has got to be sacrosanct. The ability to reduce that as and if an individual bomb tech requires is his personal choice; it is not right to say you should or you shouldn't."

NP Aerospace

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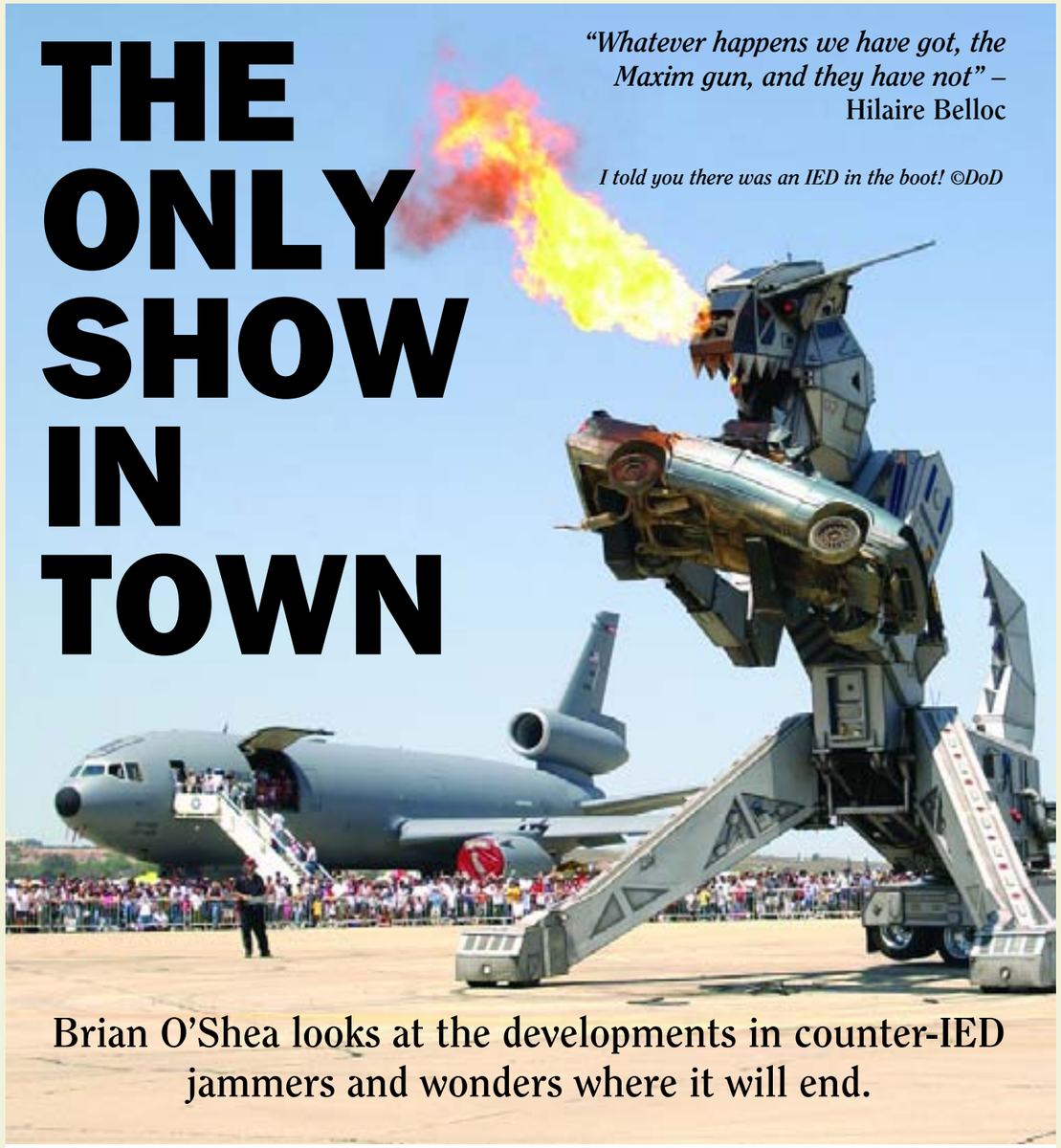

Brian O'Shea looks at the developments in counter-IED jammers and wonders where it will end.

AS THE Bush and Blair governments ponder what to do about Iraq and Afghanistan, it is worth noting that three of the key items that have brought them to this impasse are ingenuity, brutality and IEDs. The latter is the insurgent's Maxim gun and much like Obeahs, Witch Doctors and Mullahs sold trinkets to turn the Maxim guns bullets to water, industry is (mainly) selling the same trinkets to the military and civil forces – to turn away the bad ju-ju of the IED. This is not to say the various jammers and protective vehicles do not work, but rather to say they do not work for long.

The Joint IED Defeat Organisation (JIEDDO) (and its earlier *nom de guerre* the Joint IED Defeat Task Force) has come under a great deal of criticism for trying to achieve a counter-IED-in-a-box approach – a silver bullet. It is not hard to see where this criticism comes from: November saw BAE Systems

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awarded a $79.5million contract; in March General Dynamics received a $289million contract; Raytheon received $15.5million in January and JIEDDO will spend over $3billion in 2006. Prior to the "Global War on Terrorism", where did IEDs fit into the Network Enhanced Capability? Now, like some of the lessons learned from the recent Lebanon-Israel unpleasantness, IEDs have changed the way the military think; now the threat is a bomb-making cell in someone's garage rather than a shadowy pan-national terrorist organisation located in their Tora Bora lair. The defeat of IEDs is becoming something to safeguard people's projects and careers and everything is being pulled into the fight.

Soldiers are requesting sweeps, both physical and electronic, of planned routes, UAVs to fly over head, aerostats to provide long-loiter evidence-gathering of locations, air cover from assets like JSTARS, attack helicopters, EA-6B Prowlers, EC-130s and U2s. Any platform that has a surveillance or ECM role – especially if it is due to leave service or suffer cuts – is being touted as a potential in the counter-IED world for long enough to ensure that the programme manager has moved on and it becomes a problem for his successor.

This is not to suggest that some, or even all, of these platforms don't have a use. In fact, attacks have gone down in areas that are known to be under surveillance – sophisticated IEDs cannot just be dropped randomly. The need for input from these platforms is symptomatic of the shortage of universal solutions and an attempt to show some of the same ingenuity that the insurgents possess. Neither is this a threat that is going to go away if it is ignored. The past two years have been a period of enormous development in the IED world, and the inability to interdict the bomb cells shows in the maturity of concepts, technology and procedures.

Previously, British sources suggested that 40 per cent of all IEDs were radio controlled, 25 per cent were victim operated, 20 per cent were command wire and 15 per cent were suicide. Now the trend is towards vehicle-borne and radio controlled, with a drop off in victim and suicide IEDs. The latter is no surprise; at the current rate of IEDs in Iraq there will be a shortage of willing martyrs, and unwilling martyrs (those coerced into doing it by threats to their families) can prove ineffective and short on zeal. There is also the fact that each suicide bombing deprives the terrorists of one of their most committed assets – all that training and brain-washing gone. Far better to see whether they can emplace or detonate an explosive rather than be part of one.

While the Coalition forces attempt to disrupt the IEDs, they are always catching up with technology; in terms of protection the shoe is on the other foot, with fundamentalists having to cope with the latest vehicles and armour technology. Deployment of vehicles such as the Nyala and Buffalo have forced insurgents to rethink their operations and technology, and have seen an increase in explosively formed projectiles and IEDs placed higher – to attack the top rather than bottom of the vehicle. While the high value target in Iraq and Afghanistan is clearly coalition forces, they are usually well trained and equipped – and getting better by the month. The same cannot be said of the local military and civil forces. The Pentagon examined last year whether it could start deploying counter-IED skills and technology out to the Iraqi national forces – also an attractive target, as keeping the police weak, cowed and compliant is necessary for the imposition of the terrorist's own objectives. This ran into the sands of common sense, rather than political expediency, when the suggestion that providing the heavily infiltrated Iraqi forces with highly classified information might be a step backward in the fight against IEDs. This is, unfortunately, a pyrrhic victory. Without Iraqi security forces having the ability to disrupt the terrorist brethren's attack there would seem little attraction for them in leaving their thrall. Yet a halfway house – along the lines of the trade rifles that the British used to disperse among the security forces in the Empire – would not work among in the counter-IED world where the insurgents would set the bench mark above the jammers rendering them useless at a stroke.

The technology itself has proved to be a two-edged sword. Radio jammers work by denying service to the radio controls that are used to set them off and can be complemented by other denial-of-service devices that can affect mobile phones. Unfortunately the more powerful devices, and often the most effective, can also short out the radio of the friendly forces and the surrounding area. The recent award to BAE Systems was for their Guardian product, which provides a protective bubble but without impinging on coalition communications – but, as is always the case with CIEDs, the proof will be in the operational pudding. There is also the power issue where the desired length of bubble may exceed the power supply of the vehicle battery – requiring additional power and possibly some form of cooling – especially if the system has to be "on" for long periods of time because there is a shortage on intel. In many cases the jammer does not stop the blast, but only delays it until the convoy has passed, whereupon it often detonates, killing any civilians unlucky enough to be in the vicinity.

The IED threat is getting greater and more complex © DoD

Work has also been done by the insurgents to develop infrared initiators, which detonate once the beam is broken – supposedly unhampered by jamming technology. This system still needs to be instigated however, usually by radio, meaning that the jammers need to be deployed in front of the force – effectively elongating the jammed 'bubble' into more of a 'sausage' shape – which is where the desire for UAVs come from; the ability to safely project the force without fear of loss. UAVs are expensive, however, and the payload that they will be carrying is sensitive; quite whether the risk of using them is worth the result is unclear. Equally, many forces suffer from bandwidth problems, and real-time video streaming comes at a cost – in terms of both technology and manpower.

The unmanned system of choice for dealing with IEDs is the UGV, however, and these have had a renaissance in Iraq. But while Allen Vanguard's Defender and Foster Miller's Talon have provided sterling work in Iraq, the future is undoubtedly for lighter, mini-UAVs. The larger "Wheelbarrow", while capable, does require a greater logistics capability than an iRobot Packbot strapped to the hood of a vehicle. Whatever is used, however, the demand is still there for a trained operator at the end – this is the major choke point. Terrorists quickly learn that the greatest high-value targets are the individuals who have the nerves and skill to defuse these devices before they cause any damage – once these people can be eradicated, the terrorists' lives become far easier. True to form, Iraq and Afghanistan have seen a dedication to stopping the EOD men, yet the sheer amount of devices deployed is having a far greater effect than their attempt to kill the deactivators. The common soldier and engineer is now finding himself in the unenviable task of being a part-time EOD operative, yet is also finding novel solutions. Finesse and professionalism have come second place to a well placed tank round or burst of 50 calibre; with a shortage of forensics and a long list of suspects, no-one is too worried whether the device is destroyed.

Sometimes a well placed tank round can do the job wonderfully © DoD

While the US has a varied approach to the IED problem – as suits their wallet – the UK has to be more circumspect. The British Army has indicated that the mini-RCV is key, closely followed by improvements in stand-off detection, passive IR and better ground penetrating radar. Yet most important of all is the need to keep being proactive and, with a low false alarm rate in the IEDs, keep trying to intercept them. The latter is a priority, with vigilance among the rank and file being key. There is a need to question everything – why is that pressure cooker there? Why is there a sock on that cooking pot? How long has that vehicle been there? Do I know the route? Why is there a detour? Where have all the children gone? – and this fight against complacency will pay as much dividends as all the expensive machinery. This is perhaps the most difficult thing to achieve, and perhaps the one thing that many critics of JIEDDO fail to realise – the non-technical solutions are the best, but they are the hardest to achieve and require a vigilance and drive that is often missing in demoralised troops. It is far easier, and is likely to result in fewer deaths in the short term, if the technological solution is embraced. It does not have to be invented, however; many of the lessons needed can be traced from the British experience in Northern Ireland and the US experience in Vietnam. The trick will be to weld those lessons into the advantages that modern technology can offer, and to pick which technologies can best offer synergy, rather than trying them all at once and seeing what happens. Jamming, surveillance and UGVs all have a place in the fight against IEDs, but they must not be mistaken for *being* the fight. The ability to intercept and to think at a level above the opposition will bring greater dividends – this cannot be a lesson just for the EOD professional, however; this awareness will need to be inculcated at the lowest level in all branches of the military, and especially the "loggies".

NBC sys

NBC-Sys : Decontamination, Protection and Detection systems
NBC-Sys, a business unit of Giat-Industries, is located in Saint-Chamond, France.
Specialist in Nuclear, Biological and Chemical Protection, Decontamination and Detection systems.

Air Treatment Systems :
NBC-Sys has experience in the **air treatment of armoured vehicles**, having installed systems on all generations of vehicles.
- Filtration systems
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Decontamination systems :
SDA : thorough decontamination system for vehicle
SDMS : decontamination system for sensitive material
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Detection systems :
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NBC-Sys has also a great experience in the field of **Emergency Response and Disaster Management .**

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Protecting the public :
- EVATOX™ System
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Products:
Functional Kits :
- This concept is adapted to the various emergency services (Fire Departments, Police Departements, communities,…) in accordance with the specific assignements of each one, to supplement specialist units, such as HAZMAT Unit.

EVATOX System :
- EVATOX is a novel concept, the principle being to provide a large number of individual protection systemes that are ready to use and suitable for protecting the public from the toxic effects (vapour and aerosols) of a chemical incident during evacuation.

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Siemens Power Generation – Radiation Monitoring

Siemens PG – Radiation Monitoring, design, develop and supply high quality radiation detection and monitoring systems and products. With 50 years in the business the Company has a wealth of expertise and are recognised as a leader in the field.

Systems range from large scale countrywide schemes down to local area systems for military bases, buildings and shelters to systems for warships, submarines, armoured and soft skinned vehicles.

Recently Siemens PG – Radiation Monitoring have successfully completed live radiological trials of their new radiation detection and monitoring system for use on Armoured and soft skinned vehicles.

The ANV S2 FV system is built to exacting UK Ministry of Defence standards. Capable of detecting radiation from background up to full RADIAC levels the system is rugged and proofed against EMC, RFI and EMP.

Built to withstand the shock and vibration associated with tracked armoured vehicles the system can also be interfaced to hazard warning and reporting systems for chemical and biological detection.
Using high integrity electronics, the ANV S2 FV system has full digital interface for communicating with modern platform management systems and can out put data to a radio communications system.

Siemens Power Generation – Radiation Monitoring is based in Poole United Kingdom and is a long established defence manufacture. The business is accredited to BS EN ISO 9001:2000 and EN ISO 14001.

All design, development, engineering and marketing is conducted from its site in Poole UK which makes for a timely and coordinated response to customer's requirements.

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SIEMENS

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Intelagard provides powerful and effective systems and solutions for decontamination, fire suppression, and hazmat remediation, whether intentional or accidental. Intelagard equipment is designed so the same unit can decontaminate an office, suppress a fire, and clean up a hydrocarbon spill. Single systems are cost effective multi-hazard solutions.

Systems range in size from the man-portable Macaw backpack to the large-scale Falcon Fixed Site Decontamination System. The Macaw was selected by the US Joint Services for Contamination Avoidance at Seaports of Debarkation assessments and by US Special Operations Command. Selected by FEMA for deployment with federally-funded Urban Search and Rescue teams, Intelagard's Merlin handcart systems are used for advanced testing and technology demonstrations at Sandia National Laboratories and Dugway Proving Ground. Intelagard's Falcon Fixed Site Decontamination System is currently deployed in theaters of operation around the world by the US military. Applications include interior and exterior building decontamination, equipment, cargo and infrastructure protection, and decontamination at airports and seaports, roadways, runways, and for mass decontamination for military and civilians.

Intelagard also offers EasyDECON DF200 chemical/biological decontamination formulation (which kills the virus that causes Avian Flu). Deployed by Intelagard equipment, it is ideal for decontamination operations by expanding the solution, providing even coverage, maximizing contact time with the contaminant, providing visual reference for coated surfaces and suppressing agent off-gassing while decontamination takes place. EasyDECON DF200 is environmentally friendly, non-chlorine based, and registered with the US EPA. Capable of killing or neutralizing a broad range of WMD contaminants, this revolutionary technology is available in a variety of containers.

For complete product offerings, please contact Intelagard at 303-309-6309, email info@intelagard.com, or visit www.intelagard.com.

INTELAGARD

SARATOGA® by BLÜCHER – The Leading Name in Individual Protection

BLÜCHER is the world market leader in the development and production of adsorptive compound materials for CBRN protection. BLÜCHER has a tradition of innovation and excellence resulting in a unique combination of advanced filtration and adsorption technologies, state-of-the-art design and manufacturing capabilities, and successful practical expertise, developed over more than 35 years.

BLÜCHER's revolutionary SARATOGA® CBRN protective systems are used by military, law enforcement, emergency response, and other personnel in more than 35 different countries around the world. The market-leading SARATOGA® protective materials and garments are widely recognized as the most advanced chemical and biological warfare agent protective technologies in the world, with a proven record of technological and operational superiority.

SARATOGA® CBRN protective systems repeatedly have been chosen by the most sophisticated and demanding military and civil customers in the world, after rigorous laboratory and operational testing. Since 1997, SARATOGA® has maintained the distinction of being the only material qualified for use in the chemical warfare protective suits worn by all U.S. armed forces.

The U.S. Department of Defense concluded that SARATOGA® fabrics provide "unparalleled protection against chemical and biological agents." All U.S. troops deployed in Operation Iraqi Freedom wore SARATOGA® chemical and biological protective suits twenty-four hours per day, seven days per week, throughout major combat operations in Iraq. The advantages of SARATOGA® include its high adsorptive capacity, long wear time, high degree of air permeability for cooling, optimal balance of high protection and low heat stress, high level of mechanical stability, and low life cycle costs.

SARATOGA® - Unparalleled Protection.

SARATOGA®
Unparalleled Protection.

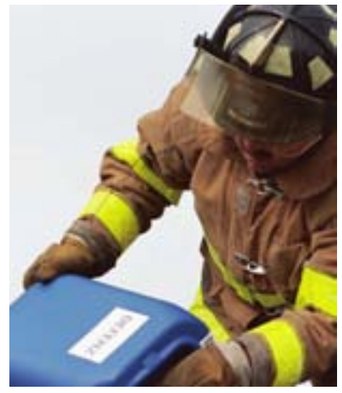
BLÜCHER

Genencor's DEFENZ™ decon technology offers first responders numerous advantages from traditional chemical methods

Chemical and biological attacks have become a large part of the unpredictability of today's style of warfare often leading to large-scale casualties. As a result, emergency response units now require rapid, effective, and safe decontamination technologies to mitigate the life-threatening effects hazardous materials have on society. Enzymatic approaches to decontamination of toxic substances are being developed to respond to chemical and biological attacks as they lend logistical and environmental advantages over chemical and physical approaches.

Genencor International, a Danisco company, offers the military and first responders the DEFENZTM line of enzymes for decontamination that is highly specific to intended targets. DEFENZ™ enzymes target organophosphate type materials including G-type (sarin, soman and other organophosphate materials) and V-type nerve agents and pesticides. Current commercial products include DEFENZ™ 120G & BG and DEFENZ™ 130G & BG. DEFENZ™ 120G, contains organophosphorus acid anhydrolase enzyme (OPAA) and has demonstrated activity against accepted synthetic substances that mimic the breakdown of G-type agents. DEFENZ™ 130G contains organophosphorus hydrolase (OPH) enzyme and has also demonstrated activity against synthetic substances that mimic the breakdown of VX, Russian-VX and pesticides such as parathion. It is estimated that 1g of enzyme is capable of deactivating several hundred times its weight of the respective agent. DEFENZTM can be used as a stand-alone product or incorporated into current application methods for a broad list of possible applications such as chemical demilitarization, infrastructure protection, wide area decontamination, industrial clean up, bioremediation, in training scenarios and is safe to use on sensitive water-hardened equipment.

DEFENZTM offers numerous advantages over traditional chemical decontamination solutions by being non-toxic, non-corrosive, non-flammable, easy to use and environmentally friendly. DEFENZ™ is also highly efficient, decontaminating many times its weight, compatible with current dispersal equipment and easily scaleable to meet individual requirements. Moreover, since



DEFENZ™ 120 and 130 products are effective on organophosphate chemicals, registration by the United States Environmental Protection Agency (EPA) is not required. Another key benefit is that water usage is decreased because little or no rinsing is involved. Adding DEFENZ™ to current decontamination formulations significantly reduces the chemical footprint, thus improving logistics for decontamination. As an added benefit, DEFENZ™ is active in either tap, hard or salt water, allowing the use of any available water source.

In summary, the use of DEFENZ™ enzymes will reduce the exposure of emergency personnel to harsh or caustic chemicals; reduce decontamination waste issues; allow emergency units to store decontamination solutions more safely and at lower risks; and offer an easy to use, but equally effective decontamination alternative. Genencor is also working develop decon solutions for additional chemical warfare agents such as mustard, biological warfare agents such as anthrax and toxins such as ricin and botulinum. By aggressively pursuing enzyme decontamination technologies, the overall preparedness to respond against such threats would increase, taking some of the "terror" out of terrorism.

To learn more about DEFENZ technology, contact Genencor at:
USA and Canada: +1-800-847-5311 or +1-585-256-5200 or in Europe at +31-71-5686-168.

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Key features and benefits of DEFENZ™ Decontamination Solutions

Features	Benefits
Non-corrosive	○ Eliminates environmental damage ○ Safe for water tolerant sensitive equipment ○ Limits personal injury – can be employed in existing personnel systems ○ No hazardous by products to clean post decontamination
Versatile	○ Suitable for industrial clean-up, in-line and wide area decontamination and infrastructure mitigation
Highly Efficient	○ Detoxifies many times their weight ○ Granulized form reduces logistical burden of carrying large amounts of chemicals and water.
Specificity	○ Enzymes target the exact compound for which they are intended ○ Particularly effective for bulk neutralization of organophosphate chemical stockpiles and clean up of residual containers
Compatibility	○ Enzymes can potentially be formulated into existing decon products
Ease of Use	○ Add to standard water or foam systems en route to or at the incident site ○ Removes rinse steps of conventional decontamination ○ No special storage required

TSI Incorporated — A World Leader in Protection From CBRN Threats

Since 1961, TSI Incorporated has been designing instruments to measure flow, particulate, and other key parameters to serve the needs of industry, government, research institutions and universities. This experience and expertise supports the company's role as a world leader in the development of instrumentation for protection against CBRN threats.

TSI NBC protection products have successfully supported every major U.S. military effort since Desert Storm, including recent campaigns in Bosnia, Afghanistan and Iraq. They are used by foreign allies worldwide to address emerging defense and homeland security requirements.

TSI has over 20 years of experience in developing mask testing equipment and bio-detection triggers. As a proven leader, TSI systems are used by government and military organisations in over a dozen countries today.

Mask Fit and Integrity Testing
TSI M41 Protection Assessment Test Systems (PATS) provide military personnel the insight and understanding they need to properly select and wear an NBC protective mask.

The M41 PATS tests how well a military gas mask fits the soldier. Modern military masks are capable of a high degree of protection, but ONLY if they are fitted correctly and donned properly. A mask that is capable of protection factors of greater than 10,000 may only give a protection factor of 50 if it is incorrectly donned or is not the optimum size. The M41 provides a numerical measurement of the Fit Factor of the mask while it is being worn by a soldier.

The mask is tested in its normal operating configuration with the filter canister attached. The soldier dons their own assigned mask and performs a series of exercises that simulate typical activities. The M41 provides a Fit Factor for each individual exercise as well as an overall Fit Factor. When used as part of a training program the M41 PATS ensures that personnel get the best possible protection from their assigned mask.

The optional FitPlus software can be used to automate the Fit Test, save test results in a database, and print reports of test results.

Originally developed in cooperation with the US Army in the 1980s, over 10,000 units are fielded by military organisations worldwide. The instrument works with ambient air, requiring no generators or chambers. The optional Mask Integrity Test Accessory (MITA) tests key components of masks and detects and pinpoints leaks in the masks.

Field-proven, Real-time Biodetection Systems
TSI's latest Fluorescence Aerosol Particle Sensor (FLAPS) ™ Biological Detection System is a third generation detector that provides robust, reliable operations in the field. Using patented UV Fluorescence technology developed at DRDC Suffield, Canada, the FLAPS offers high sensitivity with low false-alarm rates. Used as a referee system at most test sites throughout the world, the FLAPS biodetectors serve as the standard systems against which other instruments are compared.

With affordable initial costs and low operating costs, the FLAPS technology is the most proven technology available. TSI partners with Dycor in Edmonton, Canada to provide complete system solutions. Using Dycor's concentrator, hardened packaging, and control and trigger software, complete turn-key solutions are provided to meet your bio-detection needs.

TSI has a worldwide presence with over 800 dedicated employees working in facilities in North America and Europe and Asia. Our corporate sales and service offices (St. Paul, Minnesota, USA; Aachen, Germany; Marseille, France; Arlanda Stad, Sweden; High Wycombe, United Kingdom, and Beijing, China) provide regional customer support. We also maintain a network of knowledgeable manufacturers' representatives and distributors to provide local support worldwide.

Ahura

Ahura Corporation's FirstDefender is a light-weight, rugged instrument for the immediate identification of unknown chemicals, including explosives, chemical weapons and toxic chemicals. Weighing less than four pounds, it requires no calibration or consumables and can identify unknown substances within 30 seconds ˆ even through sealed glass or plastic containers. Based on Ahura,s patented optical technology and mixture analysis software, FirstDefender offers superior performance, accuracy and reliability and is extremely easy to use.

FirstDefender offers many user benefits:

§ Identifies liquid and solid chemicals from a vast library of substances including chemical weapons, explosives, toxic chemicals, white powders, narcotics, contraband and more

§ Able to identify mixtures in aqueous solutions and solid/liquid combinations

§ Sophisticated algorithms allow users to easily obtain correct results at the scene without false positives or false negative results

§ Point-and-shoot operation through containers avoids contamination, minimizes exposure and maintains evidence

FirstDefender is now available with DecisionEngine 2.5, the latest upgrade to the company,s proprietary software. DecisionEngine 2.5 maintains the same intuitive user interface as earlier versions, but is backed by a new foundation that supports larger library capacity and digital filter taps to better eliminate fluorescence and glass from Raman spectra.

FirstDefender has been honored with numerous prestigious awards for its design, portability, functionality and innovation, including a 2006 R&D 100 Award, the Industrial Design Society of America Award for Excellence in Industrial Design and the Frost & Sullivan 2006 Chemical Detection Industry Innovation & Advancement of the Year.

More information is available at www.ahuracorp.com <http://www.ahuracorp.com/> .

AHURA

SEYNTEX

Seyntex CBRN has been designing and developing for the world and European markets since the early 80s. They are based in a purpose built facility of 400,000 ft?, located in Tielt Belgium. Seyntex is a fully integrated textile company embracing all production steps such as weaving, dyeing, printing, finishing, coating , laminating, product design, sewing and assembling .

We are proud to boast that our design staff are knowledgeable in CBRN innovation and design. As the CBRN landscape changes, this puts demands on materials and design. Seyntex have ensured that they maintain working relationships with the CBRN supply chain and also independent test houses. All our design and manufacturing resources are accredited to the latest ISO standards and continuous investment in state of the art testing and CAD ensures swift response to customer's requirements. Seyntex can claim that that they have unique pedigree in that they have produced general PPE for military as well as the Emergency services as well as producing CBRN protective clothing for a varied customer base.

We are welcome the opportunity to discuss individual customer requirements.

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SEYNTEX Hi-TECH TEXTILES

REAL, HERE, DEADLY AND ENDURING

In November 2006 the Director General of the British Security Service M15, Dame Eliza Manningham-Buller, described the threat to the UK from Al-Qaida related terrorism. Her speech included the statement " Today we see the use of home-made improvised explosive devices; tomorrow's threat may include the use of chemicals, bacteriological agents, radioactive materials and even nuclear technology." She went on to continue " It is not just the UK of course. Other countries also face a new terrorist threat: from Spain to France to Canada and Germany"…." That threat is serious, is growing and will, I believe, be with us for a generation. It is a sustained campaign, not a series of isolated incidents. It aims to wear down our will to resist."

Remploy Frontline - the leading global authority on chemical, biological, radiological and nuclear (CBRN / NBC) garment protection systems, bags, shelters, showers and accessories - has over 30 years experience in helping to deliver the will to resist.

Devising tailor-made CBRN solutions for the world's leading military and civil agencies, Remploy Frontline has risen to become the world's most comprehensive 'one-stop-shop' in this sector, working in partnership with customers to create tailor-made solutions which exactly meet each operational requirement.

Keeping one step ahead of the threat, Remploy Frontline is proud of its unique and pivotal capability to access the world's most advanced materials technologies, continually researching new materials and new construction techniques to effect real product enhancements and tangible product breakthroughs. The groundbreaking CR1 Frontliner personal

protection ensemble, developed in partnership with the British Police, is in active operational use and has re-written the established CBRN protocol in line with the new-age civil requirement. The Mk1Va suit, the successor to the Mk1V which has been an integral item of kit for the British military for the last 15 years, is designed and endorsed and in full operational use with the British Ministry of Defence and delivers the best performance possible whilst balancing practical operational capability. It is appropriate that Remploy Frontline's portfolio of CBRN capabilities has proactively expanded to meet the escalating threat and today, in addition to permeable and impermeable head-to-toe protection suits and ensembles, the company is developing specialised CBRN casualty bags, fatality bags, mass decontamination showers and rapid deploy tactical shelters. Furthermore, a unique Data Encapsulation System ensures that all products manufactured at its dedicated British sites carry comprehensive traceability, meaning that each item can be comprehensively mapped from material batch through individual stitching processes to final delivery. This level of traceability is unique anywhere in the world and is testimony to Remploy Frontline's prominence and capability within this sector.

In the challenge to 'find those who would cause us harm', the Director General of M15 posed the questions 'Who are merely talking big, and who have real ambitions?'.. 'Who are the skilled and trained ones, who the amateurs?'

The same questions might be posed to those who are providing effective CBRN protection.

Remploy Frontline - Absolute Protection. Nothing Comes Close.

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Remploy Frontline

PROENGIN Biological and Chemical warfare agents field detectors and triggers.

Proengin has developed biological and chemical warfare agents field detectors using the flame spectrophotometry. The well known and world widely used AP2C has proven the capacity of that technology to be the most reliable on the field with the lowest false alarm rate and the simplest ease of use.

New developments such as the AP4C chemical detector have extended the capacity of that technology to include chemical warfare agents and toxic industrial compounds in a simultaneous mode. There is no limitation in number of gases detected by the AP4C.

The response time is among the shortest on the market but what makes the AP4C unique is the recovery time after a positive detection. Where other detectors may take long minutes or hours after a positive detection or pollution by chemicals, AP4C will be ready after some seconds whatever the level of contamination.
A new feature has been integrated to the AP4C: it is now possible to store in an internal memory all the events of the last hours of operation and to download them in the NATO ATP45 format. AP4C can also be wirelessly connected to a computer to continuously monitor and record all data and alarms.

The biological detector MAB has the unique capacity of detecting and categorizing biological particles with a proven extremely low false alarm rate and the unique capacity to discriminate dangerous or suspicious biological particles such as Anthrax spores from natural background.

The new extended range field handheld chemical detector AP4C.

The AP4C has extended the range of chemicals that can be detected by Proengin chemical detectors. All dangerous compounds containing Sulphur, Phosphorus, Arsenic, and/or the HNO chemical liaison can be detected in a simultaneous way.
Of course, the AP4C has the capacity to work in very severe environmental conditions and the measurements are unaffected by high humidity levels or by presence of other organic chemical compounds such as paint.
Moreover, the AP4C can run in highly explosive areas.

The AP4C technology allows the simultaneous detection of an unlimited number of gases and to identify the chemical elements that constitute these chemicals. It is therefore possible to detect impure agents or chemicals manufactured by terrorists that would not fit into traditional libraries of other detectors.
All nerve agents, all blister agents, all blood agents and all vomiting agents are detected by the AP4C at concentrations well below the levels of danger to human health.
Moreover AP4C will detect without upgrade new agents that will be developed in the future.

MAB – a new generation of biological field detector.

Complexity, reliability, false alarms, high power consumption are the main reasons why it is difficult to deploy Biological detectors on a battle field.
MAB has circumvented all those problems by using the same technology as the AP4C.
Highly rugged (The MAB has been designed from the start as a military field equipment) , very simple to use on the field, extremely low power consumption (15W) MAB has also unique features in terms of biological detection.
No other field detector is able to detect tiny biological particles, to categorize them by chemical composition, to discriminate background particles of the field from suspicious particles and even to differentiate those suspicious particles between them. And all this will run the same way even in a cloud of smoke or in an atmosphere polluted by high level of diesel exhausts.
MAB allows a significant reduction the number of tests to run to monitor the biological safety of a strategic place.

MAB has been selected by the French Army and is now in serial production for French Ministry of Defense and other armies, including its integration on NBC reconnaissance vehicles.

As all Proengin products and thanks to the flame spectrometry technology, Running in very severe outside conditions, The lowest false alarm rates (negative and positive) Reduced maintenance and high level of availability are the trademarks of the MAB.

PROENGIN

CAPABILITY PROFILE

RAE Systems Inc. (Amex: RAE)

RAE Systems, founded in 1991, is a leading global developer and manufacturer of rapidly deployable chemical and radiation detection monitors and multi-sensor networks for homeland security and industrial applications. RAE Systems' technologically advanced products are based on proprietary technology, and include a full line of portable, wireless and fixed atmospheric monitors and photoionization detectors and gamma and neutron radiation detectors for the detection and early warning of hazardous materials.

CAPABILITY PROFILE

Comprehensive CBRN detection solutions

The demand for reliable instrumentation in the field of homeland security has become increasingly high. Basic requirements for the extremely responsible task of first responders and for the protection of critical infrastructure include rapid and flexible detection equipment.

Bruker Daltonics is a worldwide leading company in the development and production of chemical, biological, radiological and nuclear (CBRN) detection instruments. For over 25 years we have been successful in globally going at the homeland security and military market. The continued application and improvement of the very latest technologies have enabled us to generate a wide spectrum of intelligent and flexible use of our CBRN detectors.

Based on a broad technological range Bruker offers solutions for the detection of CBRN warfare agents and toxic industrial substances. Technologies include FTIR remote sensing, semiconductor technology for radiation meters, ion mobility spectrometry, mass spectrometry and neutron induced gamma spectroscopy. The CBRN product line includes mobile and stationary detectors for applications in the field of airborne use, on vehicles, naval ships and for critical infrastructure protection. Our comprehensive advanced solutions comprise sophisticated software tools which make it possible to set up monitoring systems, to run mobile laboratories or to integrate Bruker detectors into existing systems.
Bruker CBRN detectors:

RAID-series for mobile and stationary chemical agent detection
RAPID stand-off detector for remote sensing of chemical polluted clouds
Mass Spectrometers MM2 and EM640 for mobile chemical agent detection
NIGAS for non invasive identification of explosives and chemical warfare agents
SVG2 radiation meter
CBMS Block I for biological agent detection

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Crystal Ball

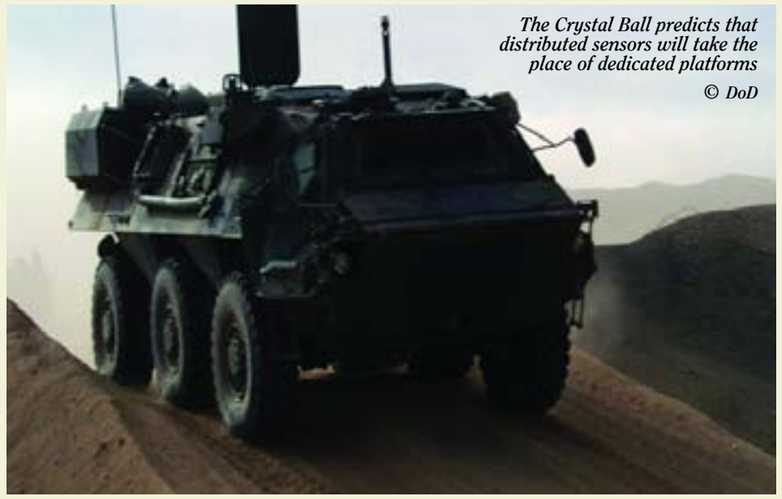
A regular feature dedicated to issues likely to affect CBRN defence in 20 years' time. By CJ Rosatto

The CBRN world has come along way since the end of the Cold War. As nations find themselves tackling a more asymmetric type of CBRN warfare that transverses national and corporate boundaries, the threat from CBRN attack has increased. CBRN defence needs to keep ahead of any threat, and as such the aim of this column is to look at CBRN issues from a 20-30+ year future perspective.

One area that is seeing a significant growth in development is CBRN sensors. During the Cold War, CBRN sensor development was linked predominantly to specialist vehicles. These vehicles have evolved into the modern Fuchs and Styker NBC RV used by western countries including the US, Britain, Finland and Germany. The future shift is away from specialist vehicles, because of both cost and capability. The cost of a Styker NBC RV is approximately US $25million. The capability is restricted to detection and sampling based on the geographic location of the vehicle. This can be mitigated by good planning, but at the same time most countries cannot afford sufficient numbers of specialist vehicles to support the CBRN requirements of a manoeuvre task force.

The Crystal Ball foretells that there will be a shift over time from specialist CBRN vehicles to a distributed CBRN sensor system. The distributed CBRN sensor system will see any CBRN sensor system placed upon any vehicle. The US JWARN system currently has the basis of the system, particularly with the JWARN Component Interface Device (JCID). The JCID provides the physical connectivity between sensors and the command and control host systems. The distributed CBRN sensor system will see a more comprehensive and timely CBRN coverage, particularly for the manoeuvre force. Based on the planning cycle completed at the higher headquarters, CBRN sensors would be placed upon vehicles dependant on where they are likely to be during the expected course of a battle. This automated system will give both immediate warning to the local troops and also immediate reporting to all forces through a joint warning and reporting system. The benefit of this is that CBRN staff can then calculate the approximate position of the release and recommend actions to the commander to both interdict a release and/or neutralise its source.

This system has so much potential that the Crystal Ball sees that the distributed CBRN sensor system will not only come to fruition, but actually become the basis for the modern ISTAR sensor system. As JCID can take any sensor information and relay it, CBRN sensors and other sensors will become more aligned. We will be talking more about "sensors" in general rather than specific sensor types. We will likely see a move towards categorising sensors by how they communicate their information and not what information they are communicating. An example of this is that a chemical point detector, in the vehicle mode, may communicate just a "yes" or "no" result. It may continually send a "no" result until it detects a contaminant, when it would then send a "yes" result and activate the warning and reporting system. This type of sensor communication may be similar to an ISTAR EW sensor which is programmed to sense on a particular frequency. It too would communicate a yes/no result until detection. These sensor requirements would have a very limited bandwidth requirement. Other sensors such as a radiation sensor may be collecting CBRN intelligence about both the radiation contamination and natural background radiation levels. This information would obviously be bandwidth challenging and so may need to be stored within either the sensor or platform for automatic download on return to base. Other sensors with a similar requirement to the mentioned CBRN radiation sensor are streaming sensors such as optical and infrared imagery.



The Crystal Ball predicts that distributed sensors will take the place of dedicated platforms

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The Crystal Ball foretells that organisations will need to change and adapt to meet these future developments. In particular, national research institutions will need to change current stovepipe arrangements – which see CBRN sensors held in one area – to a more sensor inclusive arrangement

Crystal Ball

across the sensor development spectrum. The challenges in developing some CBRN sensors will likely be the same as some of the development challenges being faced in generic ISTAR sensors. This is more obvious when the potential of the distributed CBRN sensor system to include other sensor types is appreciated. To meet these challenges, not only do research establishments need to look at whom and how sensor research is undertaken, they need to be identifying the developing mix of skill sets, and personnel with them, required to undertake this critical work.

There is no denying that there has been a fundamental shift in the "War on Terror" and, in fact, terrorism itself. Both hometown and non-resident Al-Qaida operatives such as Dhiren Barot illustrate that terrorists are continuing to attempt planned simultaneous attacks in western countries. These attacks continue to move into the realm of CBRN – previously the reserve of nation states. Notebooks found in Barot's possession included recipes for explosives and poisons. He also planned to use radioactive bombs.

Since the end of the Cold War, Western strategic CBRN thought has become fragmented, and some would argue that it has lost both clarity and purpose. There is a move to update Cold War NBC doctrine to fit the modern CBRN threat. The modern CBRN threat faced by the military is basically the CBRN threat faced by the civilian populace. This is more evident when we see the military analysis of CBRN incidents mirroring the civilian policing requirements. It is recognised that any CBRN release, be it in a civilian or military environment, can end up before a court of law.

The Crystal Ball sees the boundaries of federal agencies such as army and state-based emergency services further evolving to the point where a "whole-of-government" approach is taken to protect the local populace in what is best described as Homeland Security. In *Future Armies Future Challenges*, Lieutenant Colonel Ralph Peters states that "No matter how successful and sustained our war against terrorism; we still will suffer more blows. We can, however, reduce the frequency and scale of those attacks dramatically, and that is what we are doing as I write". To this end, 2030 will likely see army CBRN capability fully integrated into state-based emergency services. A whole-of-government CBRN response will see the same CBRN capability available to states and territories as are available to military manoeuvre units. Police HQ will have an attached/integrated CBRN planning cell and a warning and reporting cell. The amount of time required for integration will be dependant on the CBRN threat level. As the threat level increases, so will the military contribution. The CBRN system will be able to not only cover planning and warning and reporting, but will achieve significant synergies in the area of quick and efficient detection within the urban environment. As the CBRN threat increases for local emergency services, the military distributed CBRN sensor system will be adapted to the emergency service fleet. There will be recognition that the same CBRN problems faced by a military manoeuvre commander are the same as those faced by the state police commander dealing with the same threat – CBRN. The challenges faced by both fighting the terrorist in a military environment and fighting the terrorist in homeland defence are the same. It's just that some of the players will be different.

Comments, questions, suggestions and feedback are all most welcome – send correspondance to rosatto@cbrneworld.com. The views expressed in the article are those of the author.

What shape should recce and monitoring have? © DoD

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