Explosive

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

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

reaction

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.

"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."

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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

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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.

"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."

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

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."

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