3M Transcript for the following interview: Ep 95 David Crouch - CBRN Respiratory Protection - Part 2

Mark Reggers **(R)** David Crouch **(C)**

Introduction: The 3M Science of Safety podcast is a free publication. The information presented in this podcast is general only, and you should always seek the advice of a licensed or certified professional in relation to your specific work or task.

(R) Welcome to the 3M Science of Safety podcast presented by 3M Australia and New Zealand Personal Safety Division. This is the podcast that is curious about the science and systems of all things work, health and safety, that keep workers safe and protect their health. I'm Mark Reggers, an occupational hygienist, who likes to ask the questions "Why", "How", and "Please Explain." Whether you are a safety professional, occupational hygienist, someone with any level of WHS responsibility in the workplace, maybe you are a user of safety equipment, or maybe you are a bit of a safety nerd who finds this stuff really interesting, then this is a podcast for you.
Today. We're talking all about CBRN respiratory protection again with David Crouch. Welcome back, David.

(C) Hi, Mark. Great to be back.

(R) Fantastic to have you back. Now we did cover a fair bit before, but there is more I would like to speak to you about but for those that may not have listened to the first episode we did. Can you please introduce yourself? Who are you? Where are you from and what do you do?

(C) Hi. So thank you for that kind introduction Mark. So, I'm David Crouch. I'm 3M's global subject matter expert in defence and public safety within our application engineering team. So, my role is a technical one. My background is I'm a professional chemist with more than 25 years' experience in material science and CBRN, which we mentioned what CBRN is in the first podcast. So, my background, is heavily filtration air assault science based from an extreme hazards environment perspective. So, I've operated at the academic bench level within chemistry as well as with end users around the world, within NATO and various governments such as the UK and the US and further afield

as Australia, where we provide training and consultation and discussions with various customers around the world about how to operate in these environments. And the results of my work, I'm a visiting professor at the Defence Academy of the United Kingdom and a senior associate fellow within the Royal United Services Institute, as well as on a host of international regulatory standard committees from BSI in the UK to CEN within Europe and further field in the globalized or standard teams. So that's kind of my background.

(R) So you're just the right person to have a chat with about CBRN respiratory protection. Now, we did cover it last episode, but just as a bit of recap, what does CBRN stand for? And why is it considered such a high-risk environment?

(C) So just recapping from the first podcast. So CBRN is an acronym. It stands for Chemical, Biological, Radiological and Nuclear. Here we're talking about high-threat materials. CBRN is about malicious intent or weapon use. So, we're talking chemical warfare agents, biological agents that can cause disease and death within human beings and then radiological and nuclear materials. So, again, they are high threat materials which could cause widespread destruction if released into the environment and the general population. So, here we're talking about weapons of mass destruction.

(R) Now, I'm sure most of our listeners are familiar with an industrial respirator. So, when it comes to CBRN respirators, what are some of the features that are specific to that type of environment? As you say, a very high risk, malicious environment.

(C) When we are talking about respiratory protection from a CBRN perspective; what should a respirator contain? The key features? So, again, the respirator design is, it's a system approach that most manufacturers look at, 3M in particular, have a wide range of products that have this system approach. So, we're looking at all of the components of the respirator together in conjunction. What do they offer to the customer? So, things like canister position, the ability to have a left- or right-handed filter mount. Does the user off the respirator need to fire firearms? Use weapons?

(R) I was going to say, why left or right is that change per person rather than just having it always on one side?

(C) So from a left or right handed, traditionally, people are taught to use weapons from a right hand configuration, which means your filter would be on the left hand side of your respirator. But once you start to get into other requirements or special forces, other operators, people need the requirement to use a left handed configuration. And this is not just about weaponry as well. This could be sighting systems, depending on the architecture of where you're trying to operate. So, the ability to switch filter between left- or right-handed filter mounts is a big requirement for most of our customers. And in some respirators, other customers look for a front mounted filtert. So here we're talking about a snout arrangement. You look a bit like an aardvark. So, the filter is mounted to the very front of the respirator, not on the left or the right. So, again, the ability to change canister position is important for a lot of customers.

(R) You just put a very interesting image in my head there with that aardvark comment there. So, thank you for that. What other features would you expect to find in a CBRN respirator?

(C) From a purely protective perspective, modern respirators, exhalation valve is key as well as head harness and things like hydration system. So, the ability to maintain function as a human being; hydration system in a contaminated environment - do you need to hydrate? Some agencies we work with do this, some don't. So again, having the ability to hydrate in hot, humid environments. So, for example, if you're in Australia in Darwin in summer, where it's very, very hot and very, very humid, where you could suffer fatigue, not just wearing a respirator, but in general, the ability to rehydrate quickly. And then things like exhalation valves. So, the 3M GSR Series of respirators have a twin exhalation valve, so it acts as an airlock from an exhalation perspective. Again, it's about building redundancies into the system so that you're maintaining maximum protection at all times. Something as simple as a head harness. Some customers prefer a mesh head harness to a traditional rubber 6-point harness. However, there's pros and cons with each head harness. For example, mesh head harnesses when your head sweats, mesh head harnesses can start to generate translational movement, which means it can potentially interact with the face seal and move the face seal around while it's on your face. So, again we're talking transient breaches. Rubber harnesses don't suffer from this transient movement as much so are preferred by some customers, depending on the application within CBRN.

(R) What about speech and communication? It's critical in an industrial workplace between co-workers. How much more critical a nature is communication as far as these types of environments we're talking about?

(C) The speech intelligibility, as it is known, is key, is paramount within all military operations. I'll cover law enforcement later, but the principles are the same. From a military perspective, a CBRN environment is just like any other military environment. It's about maintaining operational tempo and manoeuvre on the battlefield, so communications is key in that respect. So the ability to plug your respirator into your communication system is paramount on most modern respirators are now designed with some speech diaphragm that gives good intelligibility if it's just used in a normal non radio communicative mode but again can be adapted and plugged into a radio system if required.

(R) Now I wear glasses and we've spoken many times on this podcast with other guests about the requirement to have that seal and the arms of safety glasses can break that seal so you can get those inserts for prescription lenses. That's also part of these type of products as well?

(C) Yes, very much so Mark. All of the 3M product range have an optical insert arrangement where you can essentially take the frame to your ophthalmologist, have your lenses fitted, whether they're vary-focal bi-focal, so that if you need to operate or read or use a system whilst in a CBRN environment, you can maintain your sight picture. So yes, again very important area for our customers, especially from an intelligence weapon platform system perspective. So those features are readily available in all of the 3M products within the CBRN domain.

(R) Now, with respiratory protection products, we can get self-contained breathing apparatus (SCBA). We have Powered Air Purifying Respirators (PAPR). We also have our negative pressure. Now you've spoken all about the mask. Is there one type of connection to these different devices? I've just mentioned that is preferred, or it really comes back to what's the hazard and that modular type system ?

(C) From a threat matrix perspective, each distinct area of respiratory protection has its advantages and disadvantages. So, self-contained breathing apparatus, for example, you're isolated from your entire environment. So, again you know your air is clean, so you don't have to worry about that respect.

However, in a CBRN environment, with certain agents you only have a certain amount of air. Is that 60 minutes? Is it's 75 minutes of supplied air? After that, you have no other form of respiratory protection if you just rely on a SCBA alone as an example. So, this is where, as I mentioned in the first podcast, having a modular system becomes more important. Because if you're a higher specialist operator, you don't know which necessarily form of respiratory protection you're going to need until you get on scene. So, the ability to have that modularity, that flexibility gives you the requirements to meet that threat effectively. And whether that's PAPR or whether it's through negative pressure.

(R) Is that what you mean by interoperability? So, you could have that one mask that has these different types connected all at one time? Am on the right path there?

(C) Yes, very, very much so. So, interoperability is across a range of requirements. Here we're talking about; does the respirator integrate with other equipment that the first responder, or soldier, sailor or airman has to work with? So, for example, can you plug the respirator into the standard military communication system. Does the respirator affect the wearing off a ballistic helmet? So, from a interoperability perspective, this is what we're talking about. Does the product integrate with the general other types of PPE that the customer needs to wear as part of their ensemble? So, Mark's already mentioned optical outserts. Obviously, you don't want to be wearing safety specs under your respirator because it can affect the performance of both. And then from an interoperability perspective, there's also - and this is a key element to defence and security procurement - interoperability is about common architecture. So, the ability to have your workforce, your soldiers, sailors and airmen all training on the same product or same platform. They cannot adapt the platform to different levels of respiratory protection if required, but they only require one piece of equipment. They only require one fit test that it's less equipment to carry. And because you can - the system can be configured, it's safer to decontaminate. You don't have to take the system off to then put another form of PPE on, or RPE. You can develop an approach that reduces logistics and the through-life capability, from a cost perspective.

(R) And having the ability to have, say, an SCBA with a negative pressure filter attached there, so you could be, you know, saving your cylinder airtime, using the negative pressure. Then switch it over as required. Is that an approach, obviously, maximize the equipment you've got? I mean, it's hard enough in and industrial setting to go and change cylinders in a confined space, as an example, let alone these types of environments you've been mentioning. Is that something that gets used quite often as well?

(C) Yes. So, again, this is kind of one of the virtues of the modular system. So, if we look at, say, extended duration CBRN or explosive ordinance operations - because sometimes they can operate in the same kind of scenario. So, sometimes you will hear the term CBRNe (and the 'e' normally is a small 'e'), is to do with explosives. So, if you were working, some would-be terrorist had strapped, some explosive to say, a chemical cylinder with something, for example, Sonam, one of the nerve agents, or Sarin is another example which some people might have heard of. So, if you look at large spills, if you look at standard tables that are provided to first responders, especially in the US - the US are very, very good at this - to look at a large spill, you need to isolate in all directions for Sarin for 3000 feet in length. So, in all directions you need to create a cordon where no one's allowed in 3000 feet in any one direction. However, if that was an explosive device that had not gone off yet, but through assessment you realized it was, then the EOD operator would have to travel 3000 feet before he gets to the hot zone in his bomb suit. And if he was just wearing SCBA alone, to walk 3000 feet is not, especially in a bomb suit, is not a short duration and you have to remember at the end of the operation, he would have to walk 3000 feet backwards to the safe point to the decon. line. So, again, 6000 feet - if you were just on supplied air on SCBA, that's 6000 feet worth of air supply that you cannot use in the contaminated or hot zone. So, the ability from a modular system to approach the target on filter you can walk, say, the 2800 feet before you reach the hot zone. You can do that on filter, so your time on target with your important breathable air, your SCBA is increased, so your time on target is increased. So, again you can provide much more focus and benefit to the CBRN operation that you're trying to achieve.

(R) We touched on it in the previous episode a little bit. I do want to cover it again. So, when we look at these powered air purifying respirators or negative pressure filters, what type of filters should be attached? Because we've got a very wide range of hazards that we've mentioned a few times now, where do people start as from selecting a filter?

(C) So, again, really important question from a CBRN perspective. So, what the customer wants traditionally is a filter that will do everything, which is quite difficult to achieve within the standards and regulatory parameters that we all have to work to. So, for example, in the European norm for EN14387 which is the negative pressure filter standard. The filter has to be less than 500 grams, so to give a filter that provides a wide range of CBRN performance is quite a scientific challenge and technical challenge. We do, most manufacturers, including 3M, have general all-purpose CBRN filters, which are tested

against, chemical warfare agent, particulate hazards such as biological and radiological materials. And again, this very much depends on whether it's a military customer where we need to meet military standards or it's a civilian customer. So, law enforcement, for example, first responders where we have to meet civilian CBRN standards.

(R) When you talk about standards, is there specific standards? I know we have Australian standards, and there's NIOSH and you have your, UK/European standards. Is there specific standards that govern all these types of products?

(C) Yes, very much so. Taking the higher-level military requirement first, most national governments will have their own standard for military respiratory protection. It varies from country to country, but there are unified standards within organizations say, NATO. So, NATO has two CBRN respiratory standards. There's Allied Engineering Publication number 54, which is the CBRN requirements for filters. Now this covers filters from individual personal use, so CBRN respirator mask filters all the way up through armoured fighting vehicle filters all the way up to maritime and large warship filters. So that is kind of a one size fits all standard for CBRN filters within NATO. And then we have something called AEP73 which is known as the NATO triptych. And that is a system test of the filter in combination with the respirator. And this is very, high level - involves a lot of testing. It's quite expensive to achieve and this looks at the test performance of the respirator and filter across all the chemical, biological and radiological requirements. So that's quite unique in terms of its requirements and then, at the first responder level, the two internationally recognized standards are; within North America, there is the NIOSH CBRN standard and then, within EMEA/Europe, there is the British Standard BS8468 Series. Now the negative pressure test standard level the NIOSH standards and the BS8468 part 2, both used the same test methodology, so the British standard essentially copied NIOSH. The NIOSH standard came first, so they're very, very similar test methodologies. They both use the same two chemical warfare agents. They both use the same test toxic industrial challenges and they both use the same concentration criterias.

(R) So there's a lot there, in other words, a bit more than I was expecting, but I probably shouldn't be too surprised, given the detail of the requirements and the risks associated with these type of operations, understandably. Something you mentioned earlier, and I'm assuming it is still the case. But

the requirement for fit testing much like industrial tight fitting respirators. Is it the same requirement in this space for fit testing to make sure that mask fits that individual person?

(C) Yes, very much so. The military level is slightly different, it very much varies from nation to nation. Some nations issue individual fit where it is very much the norm to have fit testing. Some nations it's just on a requirement basis, but very much at the civilian responder level, fit testing is the norm and it's a key requirement from that training element and your usual annual fit testing and regular RPE performance and that's kind of self-explanatory, given the nature of the hazards we're talking about.

(R) I've done many respiratory protection episodes talking about fit testing; how to undertake fit tests so our regular listeners would know all about fit testing, which is fantastic. So, to wrap this all up, we've spoken in two episodes, it's very diverse. I mean, how would you want to tie this all up for our listeners when thinking about CBRN respiratory protection?

(C) Again, just a bit of a follow on from podcast one, from the first one, CBRN, it is not your everyday occurrence. They're high threat, extreme environments that can happen pretty much anywhere. So, I've worked in confined spaces. I've worked at heights. I've worked on the Turkish border in the middle of nowhere in a field, so CBRN activities can occur pretty much anywhere from a climatic and environmental perspective. So, for me, it's about education. It's about understanding the hazards and understanding the appropriate response from a PPE perspective. Don't necessarily put yourself through undue physiological burden just because it provides the highest level of protection. This is where the whole hierarchy of control and hazard assessment becomes key. Just like any other industrial process, hazard assessment is key in this area. And training. Training, training, training all the time. Don't wait until you need to go into a CBRN environment before you kind of break the product out of its packet. Make sure that you're fully aware of how it works and how you need it to work in that environment. And again, this comes back to risk assessment and understanding the kind of hazard space and the risk management side of things.

(R) I've always found the CBRN world of things very interesting, because it's not an area I usually operate in. So I really do appreciate your expertise and information you provide us to us in these two episodes. So, thanks again, David.

(C) No, it's being my absolute pleasure Mark, thank you very much for inviting me.

(R) And if people want to get a bit more information, where would be the best place to go and do that?

(C) From a CBRN respiratory perspective, 3M website has a lot of useful information on there. If you want to dial down into the actual lower level places on the chem and bio side, you need to be looking… good websites; NIOSH and CDC for North America and then OPCW for chemical warfare in terms of the types of hazards and then on the radiological nuclear side, the International Atomic Energy Agency's (IAEA) site has a lot of very good information on protection against radiological hazards. And if anybody needs any further information on any of this, I'm more than happy to provide it, Mark.

(R) No worries, and how would be the best way to get in contact with yourself, then?

(C) So, if people… I'm on LinkedIn. So, please contact me there if you wish, or yourself Mark, if people want to send questions, do it to yourself or if they want to contact me directly, my email address is dcrouch@mmm.com

(R) Fantastic. Well, thank you once again. David. And thanks for listening, everyone. You can get in contact with the show by sending an email to scienceofsafetyanz@mmm.com, if you've got any questions, topic suggestions or you'd like some assistance in your workplace when it comes to PPE. You can also visit our website: 3m.com.au/sospodcast for further resources on CBRN respiratory protection, as well as a transcript of the chat that David and I have just had. It also has all the other previous episodes we have released. Be sure to subscribe, rate, review and share through Apple Podcast, Spotify, Google Podcast or wherever you get this podcast from. And as William James said, "The greatest discovery of my generation is that a human being can alter their life by altering the attitude of their mind." Thanks for listening and have a safe day.