

Brian O'Shea looks at the development of the radiological dosimeter in the first responder and military market

COPPING A DOSE



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WHEN is a detector not a detector? When it's a dosimeter. Behind this tautology is the whole dilemma of radiological detection. Numerous seminars have had members of police and fire services hold up radiological dosimeters and say, "This is the sort of detector that we need for chemical and biological weapons." While the sentiment of cheap, effective detectors with little sustainment costs might be attractive, dosimeters remain steadfastly not detectors. Dosimeters are, however, items that are able to measure the dose that an individual has received from one, or many, radiological sources. They are a device for environmental health and safety purposes, rather than a way of surveying a site to find out what has happened – which is often what they are used for.

Gerard Ruaro, Defence Sales Director at Synodys, explained the difference. "Many people confuse a dosimeter and a survey meter," he said. "They are expecting a dosimeter to give an alert of dose rate; dose is the accumulation of dose rate and time. Most dosimeters mainly measure dose, and give an indication of dose rate, while most survey meters provide a dose rate as their main job, and an indication of dose. They are mixing the two and asking for a dose rate from a dosimeter in the same timescales as they would a survey meter – which is impossible. A survey meter, by construction, is faster."

Dosimeters have a long history in the protection of civil personnel, but a relatively short one in the protection of military and first responders, having been established in the nuclear power industry for decades. "I've seen dosimetry and been around it for more than 30 years," said Roger Shaw, the Senior Technical Advisor at Radeco. "Some of its earlier applications were in the nuclear industry, and then the military developed the Manhattan Project and Oak Ridge, and then nuclear power became widespread – at least in the US with things like the nuclear navy. Now we have moved into the post-9/11 first responder applications, it has progressed; the post-9/11 environment is a new ball game."

Since the 1990s, when Nato provided the annex to D/104 which defined dosimeter characteristics, the military have become more involved with dosimeters, using them in comprehensive fashion but ensuring they are backed up by more capable detectors. "If they respect the standards then dosimeters need to be individual equipment and the rad-meter should be collective equipment," said Gerard Ruaro. "Normally, in an emergency situation, they should all have their own dosimeter and some should have their survey meter to quantify and identify the type of radiation. This is how the army uses the dosimeter – it is part of the

package of each soldier, and the survey team is given to the NBC team of the soldiers."

Yet dosimeters are at a development cross roads; in one direction is the purpose they are often misused for – attempting to be survey meters; on the other is what they are supposed to do – provide an individual's radiological dose. A certain amount of it can be dealt with through education, in terms of what a dosimeter is for, but there is also the market trend – that people want a device that small that can punch above its weight. "A dosimeter is different to a detector, as most of them are passive," said Roger Shaw. "We had to deal with this problem at Three Mile Island and other places – that if people have a dosimeter on them then they take it off and put it next to a source to see how hot the source was. That is the last thing you want them to do – to turn a dosimeter into a detector; it will do it but you don't know what you are dealing with and what you are doing is rendering the dosimeter obsolete as that is not your dose. We have to tell people that you can do that fine, but it is not the purpose of it. You see that a lot with electronic dosimeters – they'll take it off and put it next to something to see whether it is hot and it can be an issue."

Radeco have taken one end of the market with their Radview dosimeter badge, this is taking dosimetry down to the lowest level. "Radview is a new application of a very old detection film that is tried and true. It is not photographic film but a diacetylene monomer – it polymerises when it is struck by rad and when it does it has a dye in it that is carefully doped and changes colour in direct proportion to the radiation, independent of dose rate. The film itself has over 25 years of legacy in the medical/radiotherapy sector," said Roger Shaw. "The colour change, or darkening, is compared to the wheel or the reference segments on the outside and you are then able to see what you dose is from the reference chart and you compare that to the outside of the sensor and that will give you your action guidance; it gives you instant indication. We do it in ten languages, it warns you, it records it and instructs you – country specific. The beauty of it is that it is credit card sized, and we are working on a dog-tag size with the USAF right now – it lives in your pocket, you don't need to wear it and it is affordable. It is very simple; people say 'But does it alarm?' It doesn't but there are no moving parts, no batteries and very little to fail. You could pay \$350 for something that is good to alarm but it is not accurate enough to tell you what your dose is.

"Electronic dosimeters are fine if you are a nuclear industry worker; you wear it every day, you know it, you have been trained on it and it is familiar. For first responders you don't have that familiarity and can get into

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trouble with them – things like ‘Am I on dose rate, or dose?’ When your heart rate is greatly elevated because of response to an event, or potential event, that can be a problem. Nowadays many people use an electronic dosimeter. These are more costly – though this isn’t a problem for the nuclear utilities and other agencies – and they are prone to battery failure, maintenance problems, they need to be calibrated every six months, etc. They are a more complex device and will give you readout for dose rate – integrated dose – and they will alarm and vibrate to give you an alert. They are a solid device and a lot of first responders have them; the problem is ubiquity, you can’t put them on everybody because they become too expensive. Also, you don’t always have them with you – while some people will have them 24/7, if you are not a specialist you have to wear it, and while they are pager sized they need a battery – and all the problems that that can pose – though they are competent devices.”

If Radview provide the left-of-arc – the effective cheap and cheerful devices – then what is right-of-arc? There are numerous opportunities: teledosimetry, integrated survey meters, integrated chem-rad sensors – the possibilities are limited only by the imagination (and the operator’s ability to carry them with the rest of his kit). Yet there has been reticence to take this forward from the military and first responder market. Teledosimetry is the best case in point of this – a system that has been used for a decade in the power industry, this has the ability to wirelessly hand off the monitoring of the dosimeters to another party who is able to free the individual from that task and monitor more than one. “It has existed in the nuclear industry for about ten years,” agreed Mr Ruaro, “There, it has connected dosimeter to transmitters and given an idea of dose and dose rate. When the workers are close to a radiological source, and they don’t want to waste time looking at the dosimeter, they know that someone else is taking care of their dose. It has been proposed to the military and fire brigades and there are some applications where they should like it – a fireman’s job is to deal with the fire, not to be checking his dosimeter. It is a good system; nevertheless, there is no requirement from the fire brigade – they want a stand-alone system. Why? Price – because there is the consideration of investing money for only a few occasions? I don’t know – it exists but has not been taken up. For the military there is another criteria; they don’t like things that transmit information. If it is wireless,



While simple, users still need to be trained in what dosimeters are for

Bluetooth, RF – anything that transmits at a remote distance – they don’t like it as it might give their position away.”

Equally, Gerard suggested that there would be little take-up for integrated detectors, “In terms of it being integrated into chemical sensors, that’s a question that we still ask about, but the answers are different with each army. I have this feeling that there are not a lot of occasions when nuclear and chemical risk would happen simultaneously, most of the time it will be one or the other, so independent systems are not bad. It is better to have one independent system than to have a combined system which means that if it is damaged they lose all their detection capability. I have not seen any manufacturer want to combine the two in response to formal requests.”

Roger Shaw was equally cautious. “There are some issues with those suggestions as you run into cost and false alarms, he said. “People have looked before at adding an element of chemical detector to make an integrated CR detector in your cell phone. Suddenly you have millions of people running around with a potential cause of false alarms, and then there are the invariable problems with cell phone batteries. It has potential, but sometimes for disaster.”

In terms of reduction of capability, Gerard Ruaro was also reticent. Synodys’ dosimeters measure both the low-level dose for accidental or terrorist releases and the high level nuclear flash radiation – or tactical release. “The driving force for change will come from the Nato standards – what trends and threats are coming out of the next generation of conflict. Has the threat changed so that the standards

need to be changed? Our dosimeters measure dose from low-level to tactical – a key question would be, ‘Will they consider that tactical measurement is not useful?’ My feeling is that it is still relevant – the customer, when asked whether they would like this removed, says ‘Even if the Cold War is over, the threat of nuclear war still exists,’ and they do not want it removed. Presently our SOR is in two versions: the tactical dose – SOR/T – and the residual dose – SOR/R – which is the same without the capability of the tactical. Most of the sales are of SOR/T; it is obvious that they like the ability to measure the high dose and they still consider the risk of nuclear weapons as probable.”

This is not to suggest dosimeters will remain as they are for ever and ever amen. While teledosimetry in its nuclear industry form might not set lights racing across the board, there are applications in which it would make sense. Currently projects such as ISMS and VPBS in the UK and Canada take measurements from biological sensors and produce a situational picture; it doesn’t take too much of a stretch of the imagination to see dosimeters linked to mobile or radio technology doing the same. Gerard Ruaro agreed, “If you use it as a sensor it can be sent to an NBC Analysis-type system and some armies are interested in using it like this, though some only want it as a standalone equipment. But why not connect it to the information management system at a high level as, if you know soldiers’ dose, you can make a map with the soldiers as the sensor – but you have to remember a dosimeter is a dosimeter, and not a survey meter!”

While Radeco are looking to make their dosimeters into film strips that could be attached to VISA cards or packaging as their way forward, Synodys are looking to larger programmes. “The change to dosimeters will come with the next generation soldier programmes – Felin and FIST, etc – and maybe there is a way to integrate the dosimeter inside the ensemble. Yet, even today, in the first prototypes for these onboard electronics NBC is not part of the system,” continued Gerard Ruaro. “For the time being they are looking at comms and protection, etc, but NBC is not been connected to these systems. It will come, and maybe the next-generation dosimeter could be integrated into the soldier’s equipment and it would alarm on his heads-up display, etc; it might want to have an independent alarm if the computer was damaged, to alert the soldier that his life is at risk.”

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