Using Simulators to Enhance Hazmat Training & Exercises

RDS 200 radiation simulator with GMP11 simulation probe

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Finding innovative ways to enhance HazMat training in a manner that relates to today's threats and the array of detection equipment available to firefighters is a challenge. Here we explore some possible options that could make a busy HazMat instructor's life easier and HazMat training more realistic and engaging for the students.

For a firefighter HazMat, or Hazardous Materials to give the term its full name, historically related to substances that might be encountered as a by-product of an incident involving a road vehicle or railway transport carrying a hazardous cargo that had unfortunately encountered an accident, or perhaps a chemical release resulting from an industrial fire. Incidents involving radioactivity would typically result from a transportation accident or an incident at a hospital or industrial facility where the radioactive source was legitimately in use. Recent events in Japan have demonstrated the more extreme example of a release form a nuclear power station.

What the majority of these incidents have in common is that the fire department should (assuming the entity concerned has complied with all applicable laws) have either prior knowledge of the potential hazards and the threats they might encounter or, at least upon arrival, be provided with appropriate information or see a visible indication that a particular hazard is present.

Unfortunately the prospect of the deliberate release of a hazardous material also presents a potential threat that the firefighter has to consider. Such a release may have different forms:

- The use of chemical substances to take one's own life – at present first responders arriving at

such unfortunate incidents are usually presented with Haz-Mat warning signs placed by the victim(s). Not everyone undertaking such an act may be quite so thoughtful of others.

- A release occurring indirectly as a result of an aggressive act, the possibility of that release perhaps not being an element of the original plan of attack.
- An actual deliberately planned use of a hazardous material as a means of causing panic, physical harm or even death.

The possibility of a deliberate us of HazMat is bad enough, but the fact that the range of substances that might be used has been deemed to include radionuclides, biological and even chemical substances that were traditionally reserved for the battlefield has resulted in firefighters having to procure and become familiar with a wide range of ever more sophisticated detection technology. The phrase "Jack of all trades, master of none" is one that has no place within the firefighting profession, as all have to be master of all trades, irrespective of how infrequently some of those trades may be called upon.

A further difficulty with chemicals, particularly the substances generally referred to as CW (chemical warfare) agents is that due to the nature of the technology employed by many of these detectors, just because they provide an indication that a CW agent may be present does not necessary mean there is something present that is an actual CW agent. This is because there can be a tendency for such detectors to respond to non-CW substances and still receive an indication (so called false positives). It is fair to say that if a GC/MS (Gas Chromatograph/Mass Spectrometer) such as the Hapsite is used then you almost certainly achieve positive identification of the vapour present, however these are very expensive relative to the typical hand-held detectors available and therefore not within everyone detection portfolio.

Historically a useful side effect of such "false positive" responses has been used for training, in that relatively safe simulants were deployed to provide readings. However, as detector manufacturers improve the selectivity of their products, the potential to use such simulants for training is greatly reduced, not to mention the consequences of tighter environmental and health and safety regulations.

The trend to use multi technology detection techniques to further reduce false positives, be that by separate instruments such as for example the ChemPro 100, LCD 3.2e/3.3, or RAID-M100, all of which are IMS (Ion Mobility Spectrometry) based detectors with an AP2C/AP4C with is a flame photometry based detector or the more recent availability of multi-mode detectors that house multiple technologies within a single product also creates challenges for exercise provision.

Camsin civil operative decontamination

While traditionally training in how to react to a CW type release was primarily carried out in the open because that was essentially where "the battle" and hence the threat was most likely to be, the modern threat is more terrorist related, and therefore the location of the incident is almost certainly going to be any area frequented by the public. Hence, there is an equal probability that this will be inside (for example, an airport, Government building, or underground rail transport system) as much as an outside location, such as a sports stadium or open-air music concert.

Indoor exercises have additional factors to be taken into consideration. An important element of training is for the responders to familiarise themselves with the actual facility concerned, especially if that facility is "sensitive" and perhaps one to which regular access for training is not possible. This can require that special clearance or permits are required if simulants are to be used. The fact that there is the potential for the training area to become a crime scene also means that using simulants should be avoided.

One means to overcome these problems, and also to alleviate the potential risk of damage to operational detection equipment during training, is the use of look-alike training simulators. These can now be produced to exactly replicate the look, feel and behaviour of the genuine detector. Simulation detectors can also offer additional advantages such as:

- No need for regular maintenance of calibration.
- No consumables.
- The ability to monitor the manner in which they are used, so providing the instructor and student with useful feedback.
- The integrity of actual detection equipment is maintained.

If the actual simulant source is electronic, rather than substance based this also has benefits:

- The exercise scenario can be quickly set up and confirmed.

Camsin CWA training system

- Environmental and health and safety concerns are eliminated.
- The scenario remains stable and under complete instructor control.

That the exercise scenario remains under the total control of the instructor is a very powerful feature. CW vapours vary in their volatility depending upon temperature. Air current and the wind also of course have an effect, however when setting out a scenario the instructor is trying to develop a set of circumstances that will result in a student or team of students experiencing a sequence of events typically some 30 to 40 minutes after the scenario has been set up. It does not help much if the simulants have dispersed so as not to be detectable upon arrival of the survey team.

In a typical scenario you may want, for example, vapour to be detected at relatively low levels of concentration when a slightly open window or a closed door is being checked with a detector. When that door is breached you might then require that the reading increases noticeably. Venting is another process you might wish to simulate whereby the concentration indicated within a room decreases when windows are opened to permit the escape of vapour. All of these features can be readily controlled if the appropriate simulation technology is correctly implemented.

A means to evaluate the operation of the detection equipment helps you to ensure that operators appreciate the importance of detection equipment preparation. Many detectors have what is referred to as a "confidence test" phase as part of their preparation. The test has to be carried out at the correct time after the instrument is turned on, and for the correct duration, otherwise the test can fail or the instrument can become saturated.

Some detection instruments also have consumables aside from batteries such as use replaceable sieve packs (LCD3.2e, LCD3.3, RAID-M) or sources for hydrogen generation (AP2C, AP4C). If such consumables are used is simulated there are clearly on-going cost savings to be made, however with appropriate simulator design it is also possible to ensure that primary and spare simulated consumables are available, and to also provide a means of activity monitoring and provide feedback to ensure the student understands the correct procedure relating to the replacement of such consumables.

Reference was made earlier to the fact that CW detectors cannot always be depended upon to provide a 100 percent positive indication as to the identity of what maybe present, and that multiple instruments or multi technology instruments may be involved to overcome this deficiency.

With electronic simulation it is possible to represent specific substances and also known false positives for different instruments, therefore arranging for appropriate readings to be obtained on the training simulators during different stages of the exercise. At a basic level this might be to produce an indication of the presence of a nerve (G) agent on an AP2C or AP4C simulator (the real instruments in fact detect the presence of phosphorous within the G agent) and an indication of the nerve agent GB (Sarin) on an IMS based detector that has the ability, via an alphanumeric display, to provide an indication of the specific substance present (rather than just the class, i.e. nerve or blister). For a more sophisticated exercise simulation of the GC/MS process can be simulated.

Once the survey team returns from the scene they and any possible casualties that may return will then have to be processed and checked for contamination. This also can be electronically simulated, and once again because the instructor can control the manner in which the simulator responds to the simulation source, it is possible to simulate both full and partial decontamination.

While these examples relate specifically to CW agents, (which incidentally includes blood and choking agents) there is no reason the same simulation principles cannot be applied to the more usual multi -as and PID detectors used within fire departments.

There are, of course, limits to what can be accurately simulated when it comes to CW agents. However, simulation provides a means of ensuring that the operator is familiar with the use of detection equipment and also the procedures related to any readings that may be obtained during an incident. The advantages in being able to ensure that operational detectors are ready and available should they ever be required rather than being at the repair facility because they were damaged during training is also a clear benefit, not to mention the cost savings in repairs and reduction in consumable use.

Simulation should certainly not be considered as a substitute for live agent training, but is an excellent precursor so that you can ensure your students get the very best out of live agent training, which after all should be about appreciating the specific characteristics and behaviour of different substances, not learning how to use the detectors. IFF

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