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Development of Training Aids for Nuclear Forensics Exercises

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1. Introduction

The International community has been in global war against terrorism for decades. This threat has become more severe in light of the possibility of terrorists obtaining nuclear and radiological materials [1]. Training to counter terrorists has been emphasized to improve the response ability of security and staff at nuclear facilities. Prompt and effective response to terrorism is extremely important in helping to reduce damages of. Current radioactive-related training has focused on the prevention of a radiation disaster. Procedures to recover nuclear and radiological materials have been simplified due to the lack of training tools to reproduce real conditions for security and staff at nuclear facilities. The process of recovering materials is crucial in order to collect evidence and secure the safety of response forces. Moreover, exercises for recovering lost or missing a low dose radiation sources, does not well match with explosive like RDD blast situations. Therefore KINAC has been developing training aids in order to closely reproduce conditions of an actual terrorist attack and enhance effectiveness of exercises. These tools will be applied to Nuclear Forensics Exercises in which evidence collection is important at the time of an incident. [2]

2. Current status

The current Radiation Emergency Drill is designed to recover a low dose radiation source placed in an already known location and decontaminating the surrounding area. However, the exercise has focused on decontamination rather than the recovering of radiological materials. One organization that participates in this exercise, the Armed Force CBR Defense Command, possesses an ADR personal dosimeters, HM5 and HPGeD radiological detectors. However,during an exercise this equipment cannot actually be utilized due to the employment of low level radioactivity isotopes. Without consideration to the cumulated exposure dose, trainees should leave the contaminated place after a certain period. In addition, it is not possible to use high level radioactivity source to achieve an actual situation due to safety issues. Therefore, there is no training realistic process to find missing nuclear and radioactive materials. [3]

3. Development of training aids

KINAC has been developing training aids to replicate a terrorist attack involving nuclear and radioactive materials. Training aids based on the beacon system for Nuclear Forensics exercises consist of four items. 1) Sources generate electromagnetic waves and these signals are detected by 2) simulated radiological detectors. They are also found and recorded by 3) simulated personal radiological dosimeters. In order to reduce radiological exposure doses, 4) simulated protection equipment is supplemented. The simulated electromagnetic wave source provides an analogous exercise situation due to its intensity property, depending on the distance and the terrain. The source also generates a continuous signals which represent a variety of nuclides. Moreover, if shielding material is present, the electromagnetic waves will not able to pass through it. Hence they cannot be detected by simulated detectors and simulated personal radiological dosimeters. Therefore, we expect all the simulated tools which are being operated, based on electromagnetic waves, to be able to reproduce conditions similar to an actual attack.

3.1. Simulated radiological source

Simulated radiological sources should create continuous electromagnetic waves spanning 360 degree. The intensity of the electromagnetic waves should be consistent. The devices producing the waves should include embedded batteries so that they can maintain functioning during the entire exercise. Battery life is important since finding the source is time consuming. Internal batteries should be rechargeable or replaceable. Figure 1 shows examples of simulated radiological sources.

Figure 1. Examples of simulated radiological sources

During the practice, trainees are tasked with finding an unknown source only by detecting the intensity of its signals with a simulated radiological detector. Therefore, the shapes of the sources should be similar to those of the objects in the training environment. Sources in the test scenario should not be distinguished with other objects by the naked eye. Figure 2 shows examples of 3-D shapes of simulated radiological sources

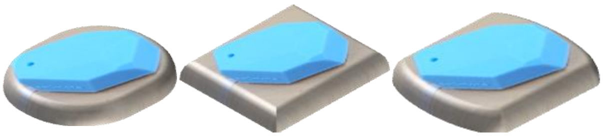

Figure 2. Examples of 3-D shapes of simulated radiological sources

The signals from sources should be detected in less than 20m distance, and the signals should be renew every few milliseconds. Resolution between each simulated radiological source should be within 2m. Contamination of the peripheral environment during an exercise to recover radiological materials is not a concerned. However, collectors of radiological materials might be vulnerable to peripheral contamination in during a real life terrorist attack involving nuclear and radioactive materials, such as RDD explosions. In order to reflect this type of terrorist environment, source instruments would need to contain white powder scattering equipment. When collecting the nuclear and radiological materials, trainees should approach the source while minimizing contact of with the contaminated peripheral (white powders).

3.2. Simulated personal radiological dosimeter

Simulated personal radiological dosimeters are devices which detect signals created by sources. They can also calculate the cumulated exposure doses. These devices allow trainees to know when they should leave a radiologically contaminated environment. Simulated personal radiological dosimeters should include an algorithm which can calculate cumulated exposure doses, depending on the distance between simulated sources and detectors. The calculated algorithm would be indicated on the displays and current intensity of radioactivity would be shown. Updated display information should be completed within few seconds. Simulated personal radiological dosimeters indicating the current intensity of the signals with a beeping sound. (This is a portable device, which requires batteries.) The device should save its data on the cumulated exposure dose every ten seconds during the practice. The saved data can be retrieved through a personal computer. Additionally, a data communication system between devices and a command and control center can be established to allow the status of a trainee to be observed in real time.

Figure 3. Simulated personal radiological dosimeter

3.3. Simulated radiological detector

Simulated radiological detectors are devices which show the real time intensity of a signal, depending on the distance and intensity, so that trainees can track its source. Simulated radiological detectors indicate the current intensity of the received signal in the display. Each generated signal has inherent characteristics which can be displayed. Simulated personal radiological dosimeters should also show renewed data every few milliseconds. Devices can be carried by one-hand and include batteries. The total weight is under 2Kg.Two types of simulated radiological detectors are considered for this study, as indicated in Figure 4.

Figure 4. Two types of simulated radiological detectors

3.4. Simulated protection equipment

Simulated protection equipment are devices which can reduce or block electromagnetic waves generated from simulated radiological sources. A simulated protection device can diminish the cumulated exposure doses to trainees. This type of equipment has the benefit of protecting trainees and helping them to stay longer in the practice environment. Protection equipment should be made from materials which can decrease the propagation or absorb electromagnetic waves. The quality of the shielding is dependent on the particular shape of the protection equipment .The shielding should also cover the whole body of trainee. All the simulated training aids should satisfy IP65 [4] which requires waterproofing and protection against dust for outdoor training.

3.5. Exercises of recovering materials

Exercises are initiated with the scattering of radiological sources and the spreading of white powder. Response forces then enter into a contaminated area with detectors and dosimeters. They aim is to trace radiological signals by using simulated detectors. After finding the source they should collect samples while avoiding peripheral contamination (white powder). If the signals are too strong in the contaminated area, they are allowed to utilize protection equipment in order to reduce the cumulated exposure doses. Before the limit of the cumulated exposure doses are exceeded, they should evacuate the contaminated area. They are allowed to collect evidence of a terrorist attack, under the limit of the cumulated exposure doses. Other processes, such as decontamination, will follow the conventional procedures.

4. Conclusions

The importance of training to prevent or respond to a terrorist attack has increased the ability of emergency responders and facility personnel. KINAC has been developing training aids to enhance the effectiveness of such exercises by providing simulated conditions of actual terrorist incidents. Simulated training aids, based on the beacon system, operate with electromagnetic waves. These tools are able to simulate environments close to actual conditions by supplying similar properties of radioactivity. Training aids will be helpful in giving experience to security personnel and staff in the event of a terrorist incident. This experience includes collecting evidence for nuclear forensics. KINAC also has a plan to hold drills using these tools this year with The Armed Force CBR Defense Command. After completing these domestic exercise, international exercises will be conducted.

REFERENCES

[1] IAEA Nuclear Security Series No. 2. Nuclear Forensics Support.

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[3] Protective Action Guides and Planning Guidance for Radiological Incidents

[4] International Protection Marking, IEC standard 60529