Mobile Radiation Detection System against Nuclear Terrorism

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1. Introduction

After the September 11th, 2001, terrorist attacks in the USA, the discovery of Al-Qaeda's experimentation to build dirty bomb and the death of a former officer of the Russian Federal Security Service from Po-210-induced acute radiation exposure, the threats relating to nuclear and radioactive materials have become a matter of increased international concern. Detection of illicit transport and trafficking of nuclear and radioactive materials is necessary for prevention of nuclear terrorism, since failure in detection might lead to catastrophic results. A mobile radiation detection system plays an important role in preventing the potential dangers posed by illicit transport and trafficking of such dangerous materials because it can monitor the suspicious vehicle at place beyond terrorist's expectation which makes intentionally a detour about the portal monitor deployed at seaports, airports, and key traffic checkpoints. The mobile radiation detection system using one NaI, two plastic scintillation, and two He-3 detectors has been developed. This paper describes the developed mobile radiation detection system and experimental results for its performance assessment.

2. Methods and Results

2.1 System Construction

A mobile radiation detection system is possible to inspect confidentially a suspicious vehicle at random places because it is easy to move from place to place[1-3]. The ability to detect terrorist's vehicle making a detour about a vehicle portal monitoring system is one of an important requirement for establishing effective means for defense-in-depth concept[4]. Due to its various good points, the advanced countries in nuclear security has made great efforts to develop and apply a mobile radiation detection system. The mobile radiation detection system shown in Fig. 1 and Fig. 2 consists of some radiation detectors (one NaI, two 30cm x 30cm x 5.7cm BC412 plastic scintillation detectors, and two He-3 neutron detectors), a GPS (Global Positioning System), a data acquisition system, an operation platform, a pan and tilt machine for detector module, and a mobile unit. The NaI detector is for identification of radionuclide while the plastic scintillator for deciding whether targeted materials such as nuclear and radioactive materials are present in an suspect vehicle. A pan and tilt machine is used to adjust direction of incident surface of the plastic detector to improve its sensitivity.

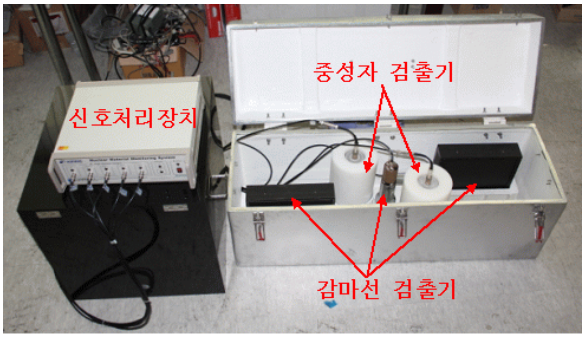

Fig. 1. A data acquisition system and radiation detectors (one NaI, two plastic scintillation detectors, and two He-3 neutron detectors)

Fig. 2. The radiation system installed in a mobile unit

2.2 Operation Platform

In emergency, information on location of a suspect vehicle, presence of nuclear or radioactive material in a vehicle, and radionuclide identification is necessary for establishing rapid and efficient response measures. Operation platform shown in Fig. 3 was developed to provide such information. A GPS was used to identify in real-time location information of a suspicious vehicle or a mobile radiation detection system. When nuclear or radioactive materials are detected, the visible and audible alarm signals produce automatically to alert user ; the operation platform also sends emergency message to personals(police, solider etc) responsible for responding work and nearest from the event place.

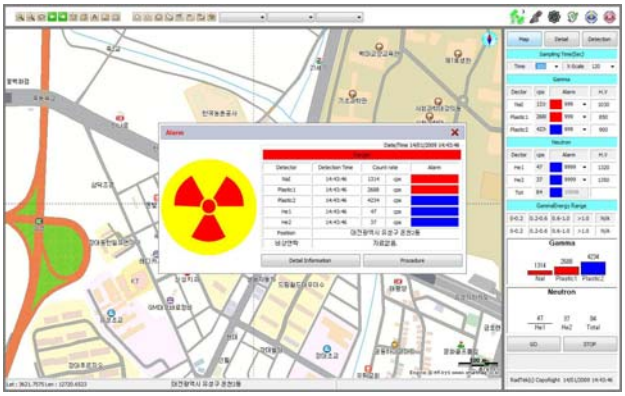

Fig. 3. Operation platform displaying alarm signal

3. Experimental Results and Discussion

As shown Fig. 4, we conducted an experiment to characterize our system's ability to detect nuclear or radioactive materials hidden in a car. The sources used in experiment are Cs-137, Ba-133, Mn-54, Co-60, and Cf-252. Its detection ability depends on the property of source, a distance and speed of a moving car. Fig. 5 is a detection indication revealing the increase of count rate of radioactive material as the car that loads a 20 Ci Co-60 approaches the detection system. The zero in x-axis of Fig. 5 means the very moment when a terrorist's car, which loads nuclear or radioactive material, passes by the detection system. The results showed that it could detect about 20 Ci Co-60 of 60km/hr speed at stand-off distance of approximately 7m, about 4.0 Ci Cf-252 of 60km/hr speed at distance of approximately 4.2m. The distance that Ba-133, Cs-137, and Mn-54 are able to be detected is short compared with Co-60.

This system should improve its ability to deter, detect and interdict illicit trafficking of nuclear and radioactive materials without impeding normal traffic flow and contribute to protecting public health, safety and the environment against nuclear terrorism.

Fig. 4. Performance test of a developed mobile radiation detection system

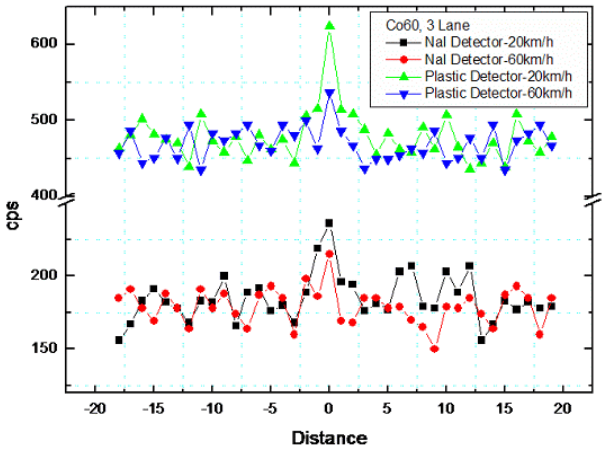

Fig. 5. Detection signal of Co-60 moving with speed of 20km/hr or 60 km/hr at about 7m distance

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