Aerial Radiation Measurements as an Effective Means of Collecting Emergency Information

Byoung-Jik Kim
Korea Institute of Nuclear Safety, 62, Gwahak-ro, Yuseong-gu, Daejeon, Republic of Korea
bjkim@kins.re.kr

1. Emergency information and ARM

1.1 Protective measure in a radiological emergency

In situations such as nuclear accidents where radioactive releases occur, the necessary measures are to reduce the risk of radiation by protecting people who may be exposed to radioactivity or to move them from the area of higher level of radiation to of lower. For the purpose, we can take urgent protective actions and other response actions such as evacuation, restrictions on the food chain and on water supply, prevention of inadvertent ingestion, restrictions on the consumption of food, milk and drinking water and on the use of commodities, decontamination of evacuees, control of access and traffic restrictions in a nuclear or radiological emergency [1]. These actions shall be carried out according to very careful decisions based on reliable information which is referred to as emergency information here.

1.2 Emergency information

Emergency information is the location of people, the use of protective drugs, and the distribution of radioactivity. Based on this information, it is a protective action to keep people away from radiation or weaken radiation risks.

Assuming a more realistic emergency situation, it is not easy to identify and control the position of a person. However, if you accurately grasp the radioactivity distribution and publish it quickly, you can lead people away from radiation.

In the nuclear accident, the surroundings (even over 100 km distance from the accident) will be in extreme confusion. If information such as the distribution of radioactive contamination is not adequately provided, people who do not need to evacuate will try to move from a safe place to another, which will make the situation worse. Perhaps the non-radiological effect will cause more damage.

1.3 Aerial radiation measurements (ARM)

Precise measurements (for example, sample & analysis) are not suitable for conducting radioactive contamination surveys over a large area in a short time (within a few hours) when radioactive material releases such as the accident of Fukushima Dai-ichi Nuclear Power Plant (FDNPP). Moving measurements are inevitable even if somewhat inaccurate, and aerial measurements using aircraft are the most effective and efficient means thus far.

The FDNPP accident and the response underlined the importance of ARM technology, which enabled emergency decision makers to be aware of the state of radioactive contamination [2, 3]. This technique, which has been widely used in relation to the FDNPP accident, mainly focuses on calibration to convert counts in the air to the ground radiation dose or radioactivity concentration and mapping to project the dose or the concentration back to the ground.

2. ARM technology overview

2.1 Definition

Radiation measurement over the ground while flying aircrafts with radiation instruments

2.2 Purpose

To identify the radioactive deposition on the ground surface

2.3 Normal procedure

i. Measurement by system (radiation coefficient, position, altitude)
ii. Correction methods such as excluding radiation not coming from the surface
iii. Calibration with radiation attenuation according to the altitude

iv. Corresponding measurement results after calibration to a radiation value according to the ground position

2.4 Elements of the technology

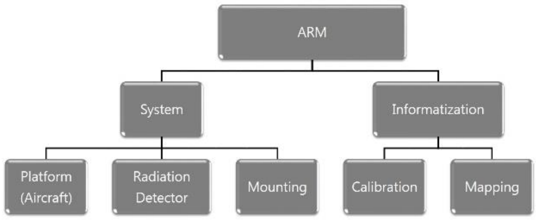

Fig. 1. The classification chart of the technical elements.

ARM technology can be divided into system technology and information technology. System technology can be broken down into platform technology such as selecting or remodeling the aircraft, radiation detector technology and mounting technology. Information technology is classified into calibration technology and mapping technology.

3. Current status

On November 3 and 4, 2015, measurements were carried out in the contaminated area around the FDNPP. Measurements were carried out in an area within 10 km from FDNP, where an accident occurred due to the March 2011 earthquake in eastern Japan, and where the contamination remains and the access is controlled (Fig. 2(a)). Calibrations to convert the coefficients from the detector in air to the radiation dose or radioactivity concentration on the surface were carried out in areas previously surveyed as flat and evenly contaminated (Fig. 2(b)). Explorations for contamination mapping were conducted in river basins, with contaminants appearing in different water and soil contours, which were expected to make intuitive comparisons easier for the mappings (Fig. 2(c)).

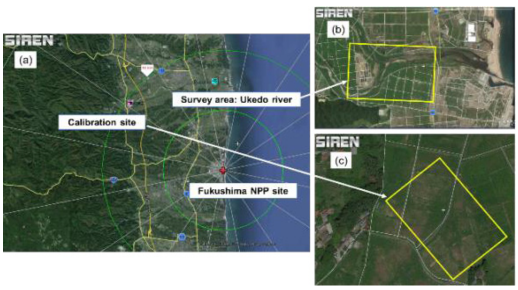

Fig. 2. (a) Measurements were performed in an area within 10 km from FDNP. (b) Survey flights were conducted in river basins. (c) The calibration site was located in a flat area.

The aircraft flew through the designed route under the control of a ground station. Specifically, KINS instrumentation was controlled via a wireless internet connection and was monitored at the headquarters of KINS, located in Daejeon, Korea (Fig. 3).

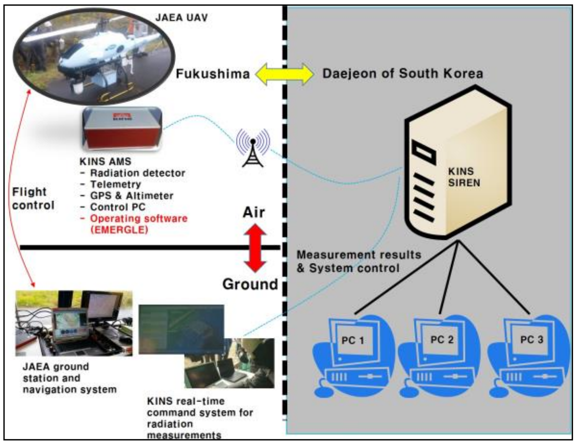

Fig. 3. KINS instrumentation was controlled and monitored via a wireless internet connection.

4. Future challenges

One of the most important emergency information, the radiation distribution map, is the result of ARM. Efforts are being made to improve the quality of this result. Especially, improvement of spatial resolution of the map is expected to advance the response against a radiological emergency.

In addition, technical standards for applications should be established. Because the performance varies according to various combinations of technical elements, it seems necessary to set technical requirements that meet the application's purpose.

REFERENCES

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