

Airborne gamma ray spectrometry using balloon and radio controller helicopter for decontamination evaluation

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Airborne gamma ray spectrometry (AGRS) is the technique used to measure the energy spectrum and intensity of the radiation. AGRS system is newly developed for evaluation of decontamination. Detector packages for airborne spectrometry are made up of 3-inch diameter NaI crystal with a photomultiplier tube. Resolution is about 7%. Peripheral device consist of laser altimeter, GPS, video camera as well as a typical airborne gamma ray device such as pulse height analyzer, etc. 500g KCl reagent bottle is build in near NaI crystal for standard energy of 1,460 keV of K-40. The gamma ray spectrum over the range of 0 to about 2,000 keV is resolved by airborne spectrometers into 1,024 channels. The target nuclides with the emission of gamma rays in range between 0 to about 2,000 keV are natural nuclides (K-40:1460 keV and Bi-214:1765 keV) and man-made nuclides (Cs-137:662 keV), Cs-134:605, 795 keV).

Institute for Rural Engineering has conducted two experimental decontamination of the rice paddy in Iitate Village which has been included in the planned excavation zone with 20-50 mSv/year due to fallout from the Fukushima Dai-ichi Nuclear Power Plant accident; 1) removal of surface soils by fixation agent (RSS-FA) and 2) mixing soils and removal using water (MSRW). Two methods were evaluated by AGRS mounted on balloon and radio controller helicopter (RCH). Area of B site for RSS-FA test is 10,000m² within B paddy field (30,000m²). Area of C site for MSRW test is 10,000m² within C paddy field. Survey area of balloon-AGRS is 225,000m² included the test site B and C. Survey spacing is 2.5 m. The spectrometer at height 0.05 m in the air was tows by man-power at speed about 3 km/h (0.83 m/s). Measurements before and after decontamination were carried out on August 3 and 31, 2011, respectively. Survey area of RCH-AGRS is 600,000m² included the test site B and C. Flight height and line spacing was 5 m. Data of both survey is sampled once per 10 second. The balloon AGRS could be used with great success to evaluate RSS-FA and MSRW decontamination of paddy fields (Fig.1). It could exactly identify the places: X, Y, and Z where men trampled on the ground surface. RCH-AGRS could show RSS-FA and MSRW decontamination of paddy and revealed that the low radioactive cesium concentration zone to toward the Niita River, which may be caused by radioactive cesium runoff with rain water. RCH-AGRS is an effective tool for monitoring on secondary rework contamination of fallout as well as decontamination.

Keywords: airborne gamma ray spectrometry, decontamination evaluation, Fukushima Dai-ichi Nuclear Power Plant

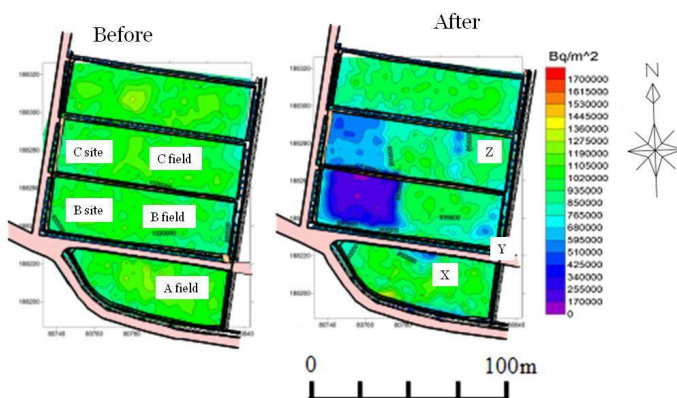


Fig.1 Cs-134 concentration map before and after decontaminations