

Airborne Gamma Measurement for the Detection of Radioactive Materials

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Abstract

Finland has operational capability to make airborne gamma ray measurements in emergency situations. The original purpose of airborne radiation mapping in Finland was to identify hazardous areas containing radioactive fall-out after a nuclear accident or use of nuclear weapons. Regular exercises are held to keep the operational functionality at a high level annually. The capability has been well demonstrated in international INEX-2-FIN 1997 and Barents Rescue 2001 exercises.

The knowledge and competence can also be applied in international radiation monitoring campaigns designed to disclose undeclared nuclear materials or other clandestine nuclear activities. One of the most essential improvement in the detection system is to be able to locate point-like radiation sources in addition to the characterization of large areas of fall-out. This hot-spot location capability has been demonstrated in the Preparatory Commission of Comprehensive Nuclear Test Ban Treaty Organisation (CTBTO) organised exercises in former nuclear test site Kazakhstan at Semipalatinsk in 2005 (DE05) and Integrated Field Exercise IFE08 2008. Finnish airborne measurement system was used also in CTBTO organized exercise close to Chernobyl Nuclear Power Plant, Ukraine, 2005.

National exercises are also conducted regularly, latest in May 2008 where "lost" radiation source was found from very fast flying jet plane by using our dedicated post processing of measurement data.

The ability of airborne detection systems in revealing the use of undeclared nuclear materials has also been tested. This paper describes the aerial gamma ray measurement method and its ability to detect traces of nuclear material production and trails of fission or activation products. Various scenarios to expose clandestine nuclear material production, enrichment and nuclear waste trails have been considered. Based on detection capability calculations and testing in practice, it was found that the detection of one un-shielded significant quantity of natural uranium (10 tons of yellow cake in storage barrels) is possible through the daughter products, using one single 6x4" NaI detector on the airplane with established methods. The fixed wing based search of nuclear materials can be made with short response time and cost efficiently. Large areas can be rapidly screened to identify suspicious sub-areas for more detailed ground-based inspection.

Keywords: airborne radiation measurements, undeclared nuclear material, natural uranium