Radiation surveillance and Unmanned Aerial Vehicles

During the past decade STUK has developed radiation measurement techniques for Unmanned Aerial Vehicles (UAVs). Recent development in radiation detection and data management as well as modern solutions in aviation technology makes the exploitation of UAVs in different applications possible. UAVs can be equipped by diverse instruments and they have several benefits compared to the manned aircraft or cars equipped with radiation measurement instrumentation. For example, in a severe nuclear accident, such as in the Fukushima case, they could be used without risk of radiation injury to the operating personnel.

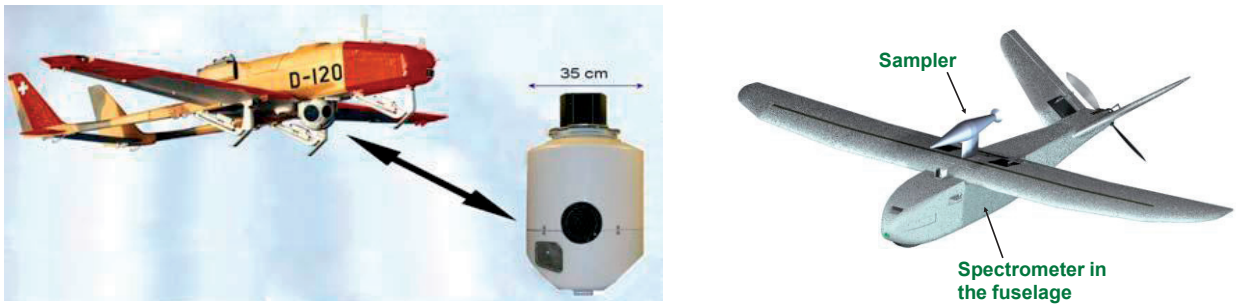

Fig. 1. Radiation detection instrumentation in Ranger mid-size UAV and in Patria MASS mini-UAV.

Benefits of small-size UAVs compared to manned aircraft/cars

- Small-size mobile equipment facilitate effective and timely countermeasures
- Take-off and landing at user-selected locations (no airfields necessary) and at user-defined times
- No dependence on the road network
- The missions can be carried out safely in remote locations (the operator can stay in an uncontaminated area)
- Low cost of the platform compared to the manned aircraft
- Low cost of the sampling and radiation measurement instrumentation
- Easy transportation close to the target area in question
- Contamination of the platform does not cause major problems
- Small operation costs; cost of fuel, service and maintenance are negligible

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Development of radiation measurement techniques

Applications

Radiation surveillance tasks appropriate for a UAV are

- mapping radioactive plumes
- sampling from a plume
- fallout mapping
- searching point sources.

Radioactive plume mapping

UAVs are suitable for radioactive plume mapping because the operators may stay in an uncontaminated area during the measurements (Fig. 2).

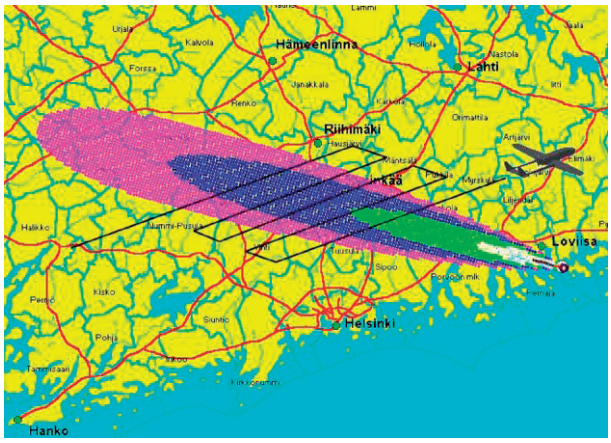

Fig. 2. Mapping a radioactive plume (hypthetical release from Loviisa NPP).

Radioactive plume sampling

A sampler has been designed for a small-size UAV that allows radioactive particle sampling (Fig. 3). Detection limits for alpha emitters and some volatile fission products in air are of the order of 1 Bq m^{-3}.

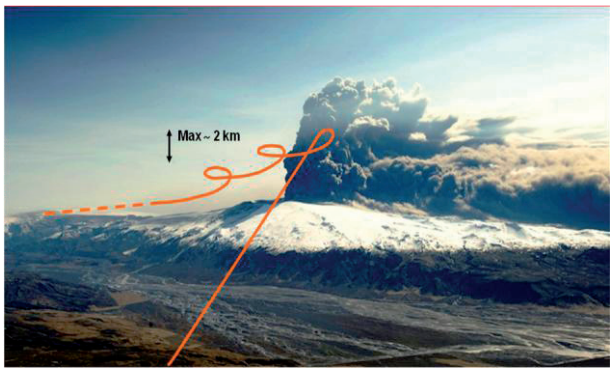

Fig. 3. Sampling from a plume (the sampler is above the fuselage of the UAV).

Searching point sources

Unshielded ^{137}Cs and ^{60}Co point sources on the ground with activity of approximately 1 GBq can be identified using a CsI dose rate meter (Fig. 4).

Fig. 4. Detecting a point source on the ground (coloured points). The route of the mini-UAV is shown as dots.

Radiation surveillance equipment

A specially designed light-weight sampler (110 g) and a CsI gamma-ray spectrometer have been mounted and tested in a small-size UAV (Fig. 5).

Fig. 5. A CsI gamma-ray spectrometer and TIKKA sampler.

References

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Technology Readiness Level 8

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