COMPARISON BETWEEN *EX SITU* AND *IN SITU* MEASUREMENT METHODS FOR THE ASESSMENT OF RADIOACTIVELY CONTAMINATED LAND

P. D. Rostron*[1,2], J.A. Heathcote[3], M.H.Ramsey[1]

[1] Department of Biology and Environmental Science, School of Life Sciences, University of Sussex, Falmer, Brighton BN1 9QG

[2] pr52@sussex.ac.uk

[3] Principal Specialist - Contaminated Land, Dounreay Site Restoration Limited, Dounreay, Thurso, Caithness, Scotland KW14 7TZ

In the UK, it is estimated that there may be 20,000,000 cubic metres of contaminated land at Sellafield alone. Harwell and Dounreay are known to have significant amounts of radioactive or non-radioactive contaminated land (NDA, 2006). It is therefore important to devise optimal methods for the characterisation of areas of land for radionuclide content, in order to enable cost-effective decommissioning.

With chemical contaminants, *ex situ* measurements are made on a larger volume of soil than are *in situ* measurements, such as PXRF. However, the opposite is often true for the characterisation of radioactive contamination, when this involves the detection of penetrating radiation from γ-emitting radionuclides. This means that when investigating for hotspots of radioactive contamination at or near the ground surface, better coverage can be obtained using *in situ* methods. This leads to the question, what is the optimal strategy (e.g. percentage coverage, counting time) for *in situ* characterisation of radioactively contaminated land?

Surveys on light-moderate contaminated areas of ground were conducted at Dounreay in order to compare the relative effectiveness of *in situ* and *ex situ* methods, both for the detection of radioactive hotspots and also for estimating the average radionuclide content of an area of ground. These surveys suggest that continuous coverage by *in situ* devices is more effective at hotspot detection, with *ex situ* laboratory measurements being less effective, although in one case elevated activity below 10cm depth that was identified by *ex situ* measurement was not located by *in situ* measurement. The surveys also highlighted that careful choice of an appropriate spatial model is critical to the estimation of activity concentrations over averaging areas.

Whereas continuous coverage may be considered necessary for hotspot identification, in the particular case of the detection of hot particles (where the particle is very small compared to the sampling target), desk studies based on detector efficiency calculations made by Monte Carlo modelling software have suggested that *in situ* surveys exceeding 100% coverage may be optimal. This is due to the decrease in detection efficiency as the particle moves towards the edge of the detector's field-of-view. Work is ongoing to devise methods for the estimation of optimal *in situ* survey parameters, including counting times, measurement spacing and detector height, where the objective is to minimise overall survey time, or to minimise an expectation of financial loss based on measurement costs and the probabilistic costs of false results (Thompson & Fearn, 1996) .

NDA (2006), Strategy document from the website of the Nuclear Decommissioning Authority, accessed 12/01/11.
http://www.nda.gov.uk/documents/upload/NDA_Final_Strategy_published_7_April_2006.pdf

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