The importance of operational optimisation in recovery of contaminated terrestrial areas

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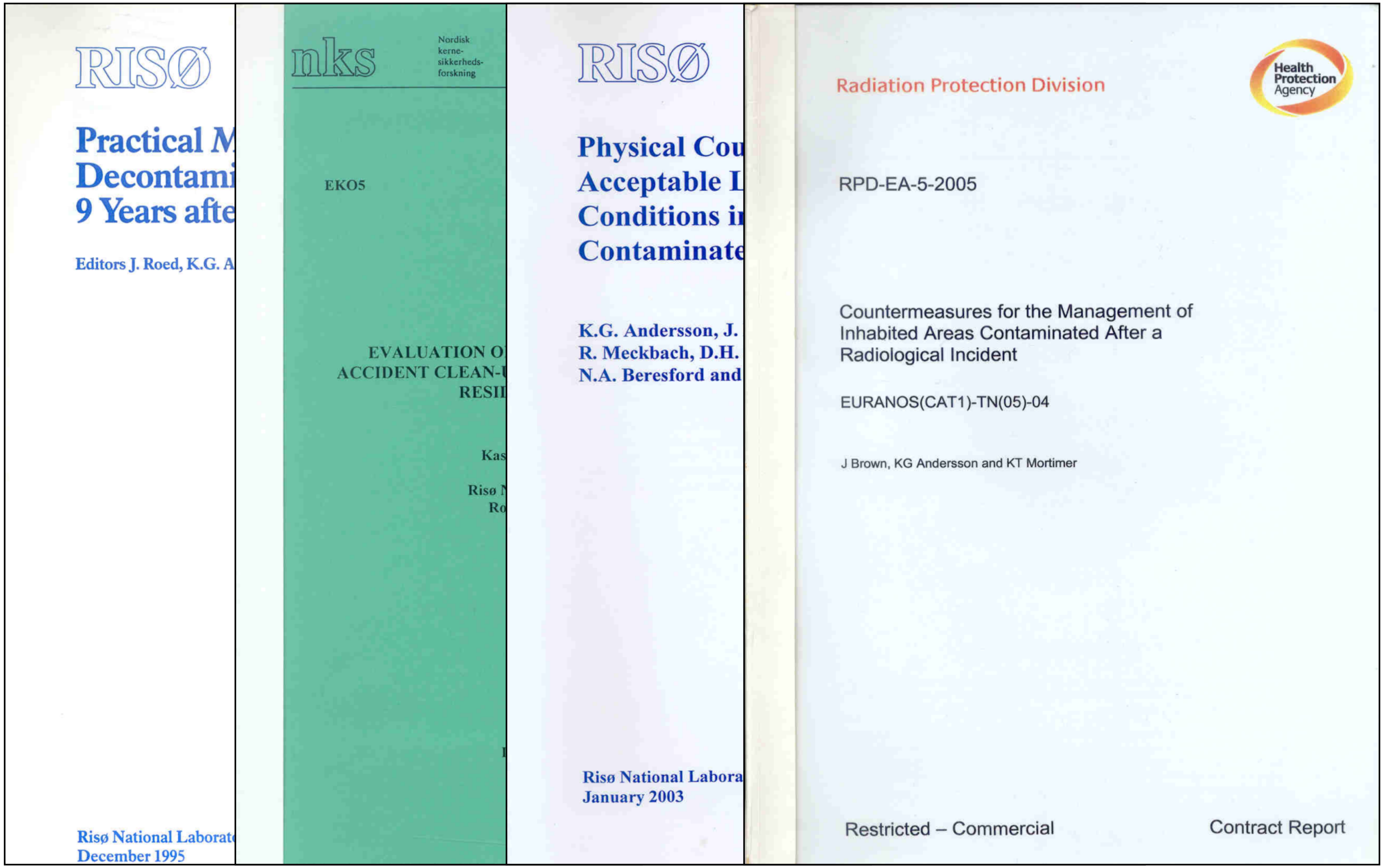
Recovery countermeasures:

Experience from numerous field investigations after Chernobyl in the Former Soviet Union and e.g. Gävle, Sweden (ca. 1986-2000)

Four 'generations' of data sheets



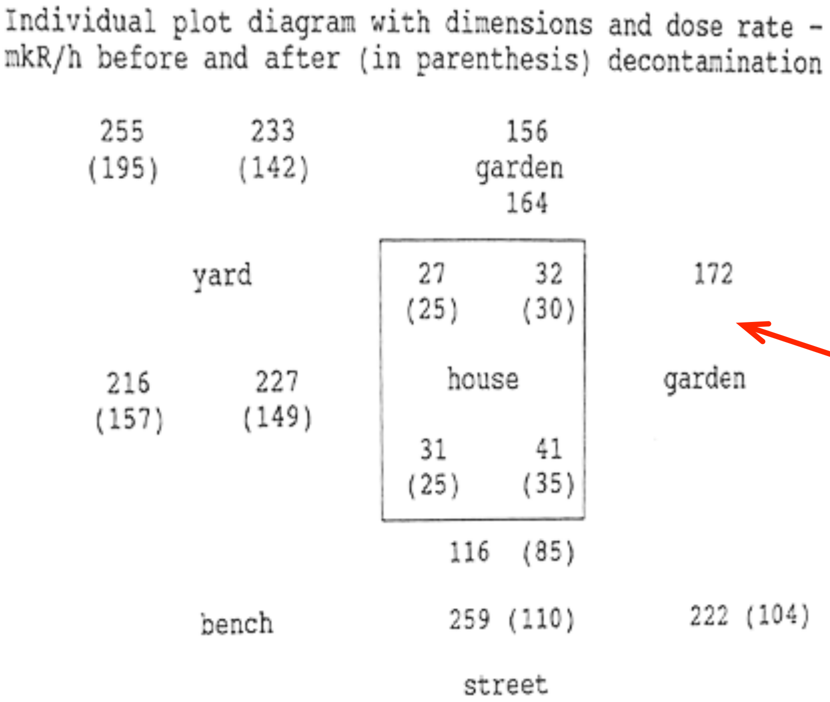
The EURANOS countermeasure datasheets (CEC FP6)

ID: 30	- Roads and paved areas -
Vacuum sweeping	
Objective	**To reduce external gamma and beta doses from contamination on roads, paved and other outdoor areas with 'hard' surfaces within inhabited areas, and reduce inhalation doses from material resuspended from these surfaces.**
Other benefits	Will remove contamination from roads, paved and other outdoor areas with 'hard' surfaces.
Countermeasure description	Municipal vacuum sweepers can be used to clean paved areas. Different types of vacuum sweeper are used for large surface areas, such as roads, and for small surface areas, such as pavements. It is recommended that machines with the ability to dampen the surface with water sprays are used to reduce dust and hence the resuspension hazard. Some road sweepers can operate in wet weather conditions. The aqueous waste can be disposed to drains either directly or can be collected. Segregation of the contaminated dust from the water may be possible. Dust creation during implementation is unlikely to be a problem and so methods are not required to reduce the resuspension hazard to workers. Recontamination of surface by resuspended contaminants will be insignificant, so repeated action is not called for.
Target surface or population	Paved surfaces (roads, pavements, paths, yards, playgrounds etc.)
Target radionuclides	All radionuclides. Suitable for removing short-lived radionuclides if implemented quickly. See Part III, Section 3 for information on radionuclides.
Scale of application	Any size. Suitable for small surface areas (e.g. pavements, playgrounds) and large surface areas (e.g. roads). Unlikely to be used around peoples' houses.
Timing of implementation	Maximum benefit if carried within 1 week of deposition as option relies on removing dust from surface.
Constraints on implementation	

- Focus in countermeasure descriptions and associated handbook material was always on support in *making decisions on which countermeasures to implement*.

- Lack of information on how to *optimise the practical work* once the decisions had been made on which countermeasures to implement.

- Information was given on technical limitations, potential pitfalls to be avoided, etc., but explicit strategic descriptions of what should be done in practice to guide and optimise implementation of selected countermeasures were not given.

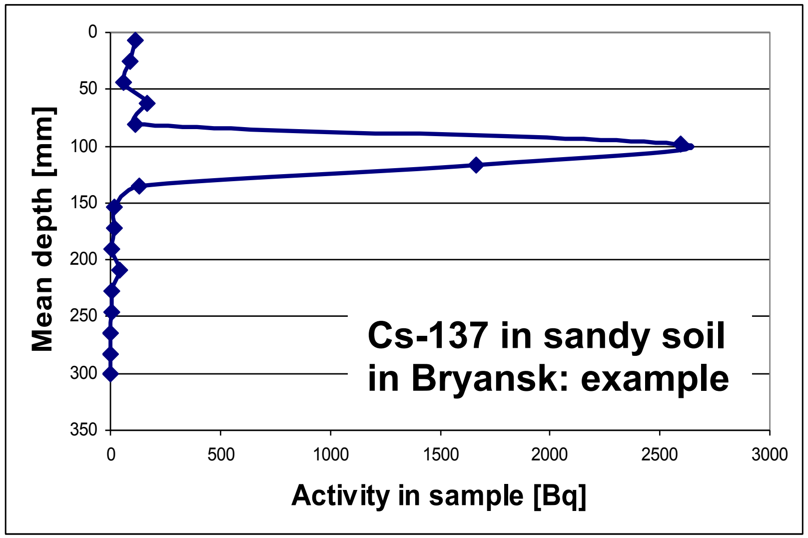


Russian army decontaminated 93 settlements in Bryansk Region in 1989: DRF = 1.1 – 1.5.

Main countermeasure: Removal of topsoil layer

Example of sketch from Anisimova et al. (1994) on the 1989 results.

Removal depth was very inhomogeneous even over small areas and not optimised in relation to measurements of vertical distribution of contaminants.



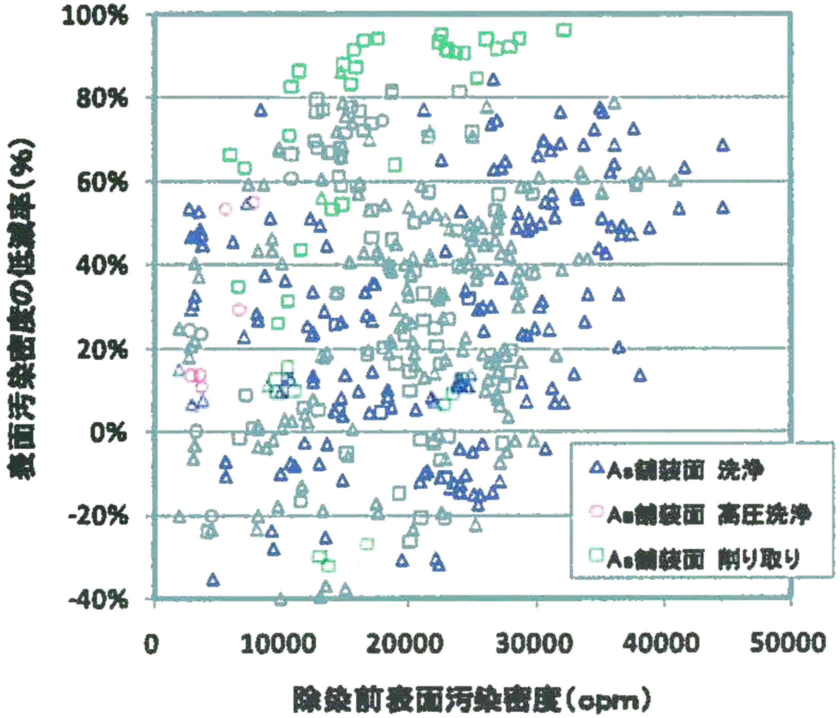
Danish-Russian field campaign 1997: DRF of 3-6

Practical optimisation through simple measures. E.g., vertical soil core sampling, in situ sectioning and rapid measurement on portable gamma monitor (NaI-based)

In situ measurement and sampling strategy defined in advance, and care taken to decontaminate according to measurement results. E.g., 'dripzones' near houses examined separately. Only the necessary soil layer was removed, thus minimising waste.

FUKUSHIMA: Surprisingly moderate countermeasure effect often recorded. Very large amounts of soil waste generated, some of which with very low contamination level.

FUKUSHIMA: Decontamination effectiveness for contamination removal from asphalt road surfaces.



Paved surface of roads: washing

Paved surface of roads: high pressure water washing

Paved surface of roads: scraping away

- Need for measurement strategy to support practical intervention.
- Need to concretise the objective of measuring (changes with time).
- Thousands of soil samples taken in Fukushima 30 km zone. Purpose of sampling described in paper submitted to JER as ‘to evaluate Fukushima Dai-ichi derived radionuclides’.
- Soil sampling depth of 5 cm based on a single garden soil assessment.
- Measurements need to be purpose-driven, e.g. soil sampling could be done to:

➢ to draw a 2-dimensional map of topsoil contamination as rough indicator of area contamination level (dose rate might be more useful).

➢ to assess model parameters to more exactly estimate future doses (e.g., local vertical contaminant distribution, soil characteristics, contaminant physico- chemical characteristics / morphology / environmental solubility: consider e.g. amounts needed for the specific analysis)

➢ to guide countermeasure implementation (samples taken in specific locations/positions). Strategy for the implementation process.

Examples of current international guides for monitoring and sampling

ICRP 43 (1985). Principles of monitoring for the radiation protection of the population: Old, short, superficial, not purpose-oriented.

IAEA TECDOC 1092 (1999). Generic procedures for monitoring in a nuclear or radiological emergency: only considers radiation monitoring, not purpose-oriented.

ICRU 76 (2006). Sampling of radionuclides in the environment. Broad scope limits value, valuable in suggesting statistically based sampling approaches, not purpose-oriented.

Conclusions

There is a generic need to describe exact purpose-driven sampling and measurement requirements /strategies (e.g., to guide optimised intervention).

Close links between samplers, analysts, planners and intervention workers needed.

Much effort is needed to transfer method-specific knowledge, making it operational.