Needs in making European recovery preparedness operational

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The EURANOS countermeasure datasheets (CEC FP6)

2004

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	
Legal	- Ownership and access to property

Examples of some new methods that could be useful in relation to radioactive contamination in inhabited areas (commercially available)

'Sod removal tool' (early phase):
Inexpensive removal of an adjustable thin topsoil layer (sufficient depth unless deposition occurred with heavy rain). Minimises waste and impact on soil fertility. Rapid, easy to use (potential for self-help in gardens).

'Manual sweeper':
Dual side rotating brushes increase the sweeping path to 87 cm, and a large 1.8 ft3 / 50 L hopper collects waste. Water supply can be added. Suited for indoor and outdoor cleaning. Rapid, inexpensive and easy to use (potential for self-help in and around homes).

'Automated facade cleaning system':
Specifically designed for automated cleaning of facades (glass or other) of tall buildings in urban centres. Cleaning based on rotating brush and water supply (simple and uncomplicated design).

Examples of some new methods used in Fukushima in relation to radioactive contamination in inhabited areas

'Turf stripping with hammer knife mower' (early phase):
Inexpensive removal of an thin topsoil layer (< 2 cm depth). Not useful in Fukushima (DF ~ 1.5), as it was not applied the first many months. Minimises waste and impact on soil fertility. The loosened soil needs subsequent (manual or by other machine) removal.

'Shot-blasting':
The equipment fires steel ball shots on a contaminated concrete or asphalt surface. The loosened material is vacuumed into a waste collection chamber. Reported DF ~ 10. Described in the US in the early 1980's, but rejected as ineffective after trials. Perhaps the vaccum effect is now better or the surface types tested on have been different. Steel balls earlier reported to become contaminated and move contamination.
Dry ice blasting variant also tested at Fukushima (reported DF ~ 2.5-10).

'Ultra-high-pressure washing device for flat surfaces':
Vacuum suction applied for waste removal. Inexpensive and rapid method. Reported DF ~ 5. Also exists in a hand-held version.

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(JAEA-Review 2014-051, March 2015) →

A critical expert review is needed of the details learned from Fukushima on cms, both in relation to radiological and non-radiological findings (positive as well as negative).

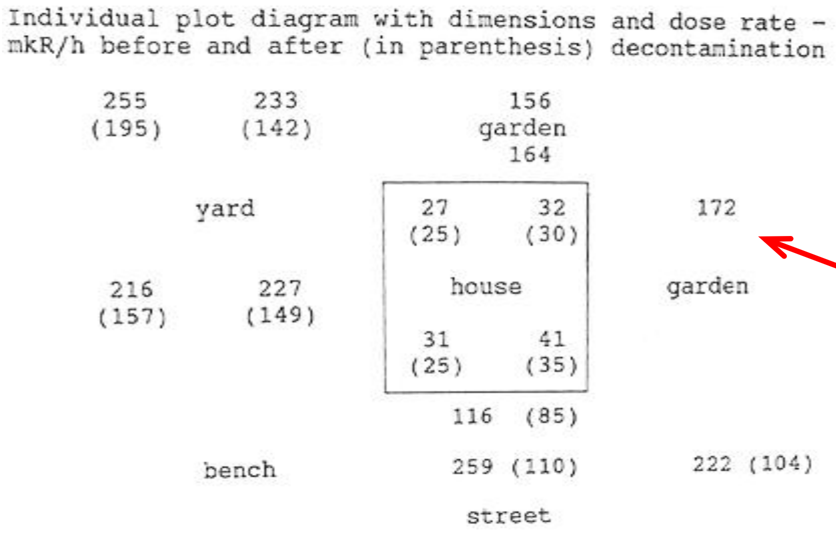
A.3.5 Soil removal (manual and mechanical)

Reference	Residential-5		
Land use type	Residential land		
Surface	Garden		
Sub category	Unpaved		
Decontamination method	Thin-layer topsoil stripping		
Content	Surface soil stripping (manual and mechanical), collection, packaging and transportation		
Decontamination method outline	Stripping and collection of garden top soil was performed either manually (using hand dredge shovel) or mechanically using a mini-mechanical digger. Removed soil was collected and stored in flexible bags. Waste bags were placed on trucks equipped with a loader crane and transferred to temporary storage.   Soil surface stripping		
	Machinery required	Hoe, shovel, mini-mechanical digger, truck with loader crane	
Application and implementation	Application conditions	-	
	Implementation restrictions	Soil removal using a mini-mechanical digger can only be performed where space permits.	
Evaluation	Material removed	Area decontaminated (1 person day)	70 m²
		Volume of waste generated	20-40 l m⁻² (thickness of stripping 2-3 cm)
		Waste type	Vegetation, soil
	Water treatment required	Volume of water used	-
		Collection method	-
		Collection rate	-
	Decontamination	DF	1.1-10
		Gamma dose rate reduction	10-90%
	Cost (direct implementation cost, area > 1000 m²)		590 Yen m⁻²
Points to note for this decontamination method	• It is important to determine the depth distribution of radioactivity in order to determine the optimal stripping thickness. • Under frozen ground conditions, soil stripping is best performed mechanically.		

The cms descriptions in European Handbooks generally focus on Cs contamination. Since Cs will usually be highly soluble and has highly specific fixation mechanisms, this is problematic if other contaminant ions are to be considered. Also low solubility particles have completely different environmental mobility and often much higher DF.

Uncertainty in DF/DRF and factors influencing environmental mobility should not be confused with variation according to conditions (e.g., specific surface materials), but dealt with separately in recovery optimisation.

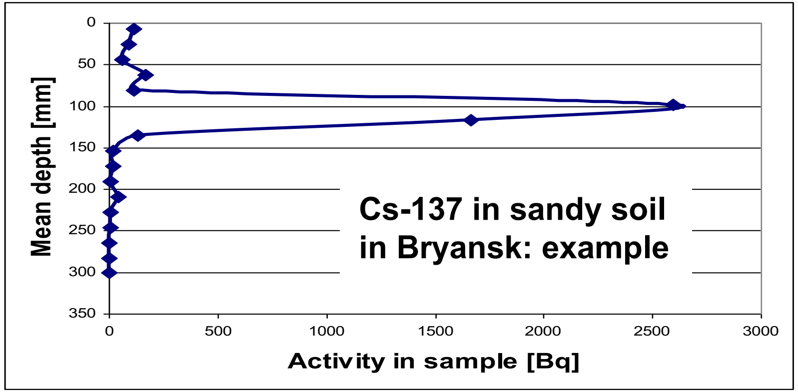
Many recovery countermeasures must be implemented within a short time period to be effective, but can be extremely advantageous if carried out early enough. European guidance on the requirements is needed to secure that the practical preparedness is functioning, not just on paper. Many things need to be in place (decisions, equipments, consumables, skilled personnel, infrastructural elements, etc.).



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 (same cms)!!!

Need for optimisation of IMPLEMENTATION of cms in the field

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

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 should be removed, thus minimising waste.

Currently no guidelines exist for such purposes, and as a result a strategy that looks sound and optimised on paper may fail totally in practice.