Séminaire CETAMA
Echantillonnage et caractérisation III
«Du prélèvement à l'analyse»
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CONCRETE WASTE REDUCTION DURING PWR DECOMMISSIONING

Mapping of radiological contamination distribution using various measurement methods and statistical data treatment

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Following the dismantling of a nuclear installation such as a Pressured Water Reactor (PWR), the building structure itself is usually unconditionally released prior to conventional demolition. The release of a building is in many cases a result of an extensive process consisting of a historical site assessment & categorization, a pre-treatment radiological characterization, decontamination & control measurements and a final assessment. Within the BR3 (Belgian Reactor 3) decommissioning project, the strategy is strongly emphasizing on the pre-treatment radiological characterization, aiming at avoiding "surprises" in later stages of the process and reducing the radioactive waste production during decontamination.

The pre-treatment radiological characterization results for several cases with various histories will be presented. Depending on the history, and therefore the room categorization, different sampling densities have been applied. In case considerable penetration of contamination into the building structure is expected, the radiological characterization is based on an in house developed method based on a full surface measurement using high resolution gamma spectroscopy (peak-to-peak method) and geostatistical data treatment [1]. In other rooms the sampling density is much lower, but still mainly based on non destructive assay.

A second part of the presentation will focus on a recent test case; the floor of the Waste Collection Tanks room within the BR3 Waste & Ventilation building. The pre-treatment radiological measurements are carried out within the MetroDecom project [2], funded within the European Metrology Research Programme (EMRP) of EURAMET (The European Association of National Metrology Institutes). The MetroDecom project delivers research addressing all aspects of the decommissioning process, i.e. the characterization of solid waste, pre-selection, free

release and repositories monitoring, measurement of thermal power prior to repository storage, and monitoring of waste and repositories in the long term. Within work package 1 of this project, concerning the mapping inside nuclear facilities, we have tested alternative measurements and detectors (e.g. Surface Contamination Monitor, Plastic Scintillator, LaBr3, CZT) for the non-destructive determination of Cs-137 depth contamination distribution. The subsequent destructive sampling strategy will be tested against various current statistical methods applied such as Bayesian analysis and sampling protocols defined in US EPA documents such as MARSAME, MARSSIM and MARLAP. In order to define the decontamination plan, geostatistical analyses have been applied. The first results within this project will be presented.

[1] Boden, S., Rogiers, B., & Jacques, D. (2013). Determination of (137)Cs contamination depth distribution in building structures using geostatistical modeling of ISOCS measurements. Applied radiation and isotopes, 79, 25–36. doi:10.1016/j.apradiso.2013.04.028

[2] http://www.decommissioning-emrp.eu/

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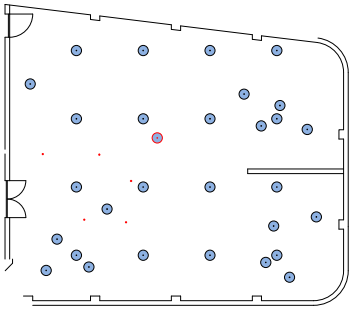
Objectives

Following the dismantling of a nuclear installation such as a Pressurized Water Reactor (PWR), the building structure itself is usually unconditionally released prior to conventional demolition. Within the BR3 (Belgian Reactor 3) decommissioning project, the strategy is strongly emphasizing on the pre-treatment radiological characterization, aiming at avoiding "surprises" in later stages of the process and reducing the radioactive waste production during decontamination.

Three different test cases

Ventilation & storage room floor (172 m²): estimated concrete radwaste reduction > 1/3

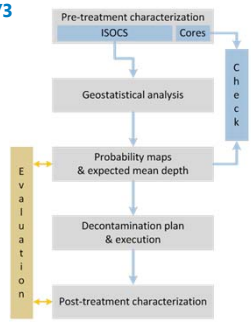
Non Destructive Analyses (NDA) & Destructive Analyses (DA)		Amount	Result			Decontamination
			avg	max	unit	
dose rate	NDA	100% scanning	<1	50	$\mu Sv.h^{-1}$	removal top layer & local treatment
beta surface contamination	NDA	100% scanning	<0,4	300	$Bq.cm^{-2}$	
Cs-137 depth by HR ISGS	NDA	30	<1	35	mm	
sampling by core drilling & Cs-137 depth by HRGS	DA	6	10	35	mm	

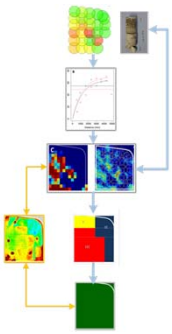


Waste gas surge tank & storage room floor (18 m²): estimated concrete radwaste reduction ~1/3

See also: Boden S, Rogiers B, Jacques D. 2013. Determination of Cs-137 contamination depth distribution in building structures using geostatistical modelling of ISOCS measurements. *Applied Radiation and Isotopes* **79**: 25-36.

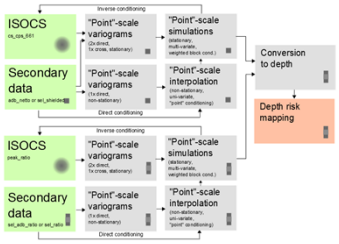
Non Destructive Analyses (NDA) & Destructive Analyses (DA)		Amount	Result			Decontamination
			avg	max	unit	
dose rate scanning	NDA	100% scanning	<2	200	$\mu Sv.h^{-1}$	3 subarea's
Cs-137 depth by HR ISGS & geostatistical data treatment	NDA	100%	10	30	mm	
sampling by core drilling & Cs-137 depth by HRGS	DA	4	20	40	mm	

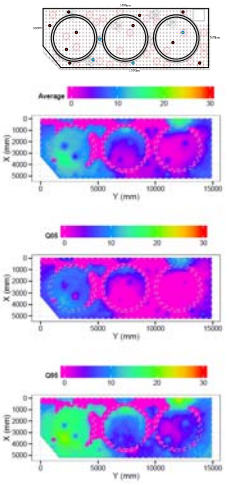




Liquid Waste Tanks Room floor (75 m²)

Non Destructive Analyses (NDA) & Destructive Analyses (DA)		Amount	Result			Decontamination
			avg	max	unit	
dose rate	NDA	858 static	1	20	$\mu Sv.h^{-1}$	removal top layer & limited local treatment
beta surface contamination	NDA	858 static	20	300	$Bq.cm^{-2}$	
Cs-137 depth by HR ISGS	NDA	30	7	15	mm	
geostatistical data treatment	NDA					
sampling by bush hammering & beta surface contamination	DA	14	3	5	mm	
MR ISGS (LaBr3 & CZT) & gamma imaging testing	NDA					





Conclusions

- Enhanced focus on pre-treatment radiological characterization allows effective decontamination and serious reduction of the concrete waste production.
- Focus on the use of non destructive analyses leads to an increased efficiency of the process, however a limited amount of destructive analyses remains indispensable.
- The use of geostatistical analysis of the various data produced is a powerful tool to reduce the number of measurements needed and to integrate different measurement supports and types.