

Geostatistical Methods for Radiological Evaluation and Risk Analysis of Contaminated Premises

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At the end of process equipment dismantling, the complete decontamination of nuclear facilities requires the radiological assessment of residual activity levels of building structures. As stated by the IAEA: “Segregation and characterization of contaminated materials are the key elements of waste minimization”. From this point of view, the set up of an appropriate evaluation methodology is of primordial importance. The radiological characterization of contaminated premises can be divided into three steps. First, the most exhaustive facility analysis provides historical and qualitative information. Then, a systematic (exhaustive or not) control of the emergent signal is performed by means of in situ measurement methods such as surface control device combined with in situ gamma spectrometry. Besides, in order to assess the contamination depth, samples can be collected from boreholes at several locations within the premises and analyzed. Combined with historical information and emergent signal maps, such data improve and reinforce the preliminary waste zoning. In order to provide reliable estimates while avoiding supplementary investigation costs, there is therefore a crucial need for sampling optimization methods together with appropriate data processing techniques.

The relevance of the geostatistical methodology relies on the presence of a spatial continuity for radiological contamination. In this case, geostatistics provides reliable methods for activity estimation, uncertainty quantification and risk analysis, which are essential decision-making tools for decommissioning and dismantling projects of nuclear installations.

Besides, the ability of this geostatistical framework to provide answers to several key issues that generally occur during the clean-up preparation phase is discussed: How to optimise the investigation costs? How to deal with data quality issues? How to consistently take into account auxiliary information such as historical inventory? How to integrate the remediation support into the modelling? How to quantify uncertainties in the remediation costs while computing contaminated volumes?

This geostatistical approach is currently performed in several former nuclear facilities of the CEA in France. The ATUE (enriched uranium workshops) premise, located in Cadarache, is a case in point. Focusing on this premise, the paper presents the geostatistical methodology and its added value to: (i) optimise the sampling strategy, (ii) get a reliable mapping of the contaminated areas and (iii) estimate the corresponding waste volumes.