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The use of digital twins for waste estimation in nuclear facilities' dismantling and decommissioning: the PLEIADES project

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Abstract. Nowadays, a considerable number of nuclear power plants worldwide have reached or will reach the end of their lifespan and will need to be dismantled within the next few decades. Dismantling and decommissioning (D&D) of nuclear facilities is a challenging, complex, and hazardous task that was never foreseen before the first reactors' shutdowns. As part of D&D activities, the waste minimization and waste management have an essential interest.

The EU-funded PLEIADES (PLatform based on Emerging and Interoperable Applications for enhanced Decommissioning processES) project gathers 14 partners (academics and research organizations, small and medium-sized enterprises (SMEs) and industrial companies, and a Technical Safety Organization) representing different stakeholders and providers of the nuclear dismantling domain. Coming from seven European countries, they join forces to demonstrate an innovative digital approach and a new methodology for improving selected key tasks related to D&D.

To achieve these goals, the project aims to develop digital twins (DTs) through a BIM (building information modelling) technology-based platform. To structure the data, PLEIADES proposes a decommissioning-oriented ontology that provides a common understanding of the concept, with specific decommissioning terminology. The developed platform provides the integration of the different data and tools.

In order to demonstrate the PLEIADES concept, six user stories have been defined based on three real-life use cases from three different European countries, namely France, Norway, and Spain. They allow scenario studies and address application areas such as cost and planning, radiation exposure estimation, and waste assessment. Three of the user stories are directly linked to one use case and focus on comparing alternative scenarios to basic decommissioning activities such as radiological characterization or the decontamination of building surfaces. The other three focus on risk management, uncertainties, regulatory aspects, and waste management strategies.

The data feeding the DTs are crucial and require data collection and integration, data security assurance, and data completeness verification. The whole process is iterative until the DTs contain all the necessary information required to perform the user stories simulation. Among others, each simulation using a DT will consider a physical and radiological environment and estimate the waste produced, the waste management process, and the waste management cost.

In real applications, the data constituting the DT will depend on each D&D project, but the whole methodology is applicable. This may result in the definition of best practices and the sharing of common processes.

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