

RRF project: SMELD – Fed (I-5.18): Milestone 248: Preparatory study on the requirements for setting up the melting furnace

Author: Nenad Milenković

Affiliations: SCK CEN

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Stichting van Openbaar Nut - Fondation d'Utilité Publique - Foundation of Public Utility

Registered Office:

Avenue Herrmann Debroux 40 - 1160 Brussel – Belgium

Research Centres:

Boeretang 200 - 2400 Mol - Belgium

Chemin du Cyclotron 6 - 1348 Ottignies-Louvain-la-Neuve - Belgium

www.sckcen.be

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Summary report

Present public report gives a comprehensive summary of the milestone 248 “Preparatory study”, under the RRF project SMELD-Fed (I-5.18).

The preparatory study defines the high-level requirements for the SMELD pilot furnace, based on an analysis of market trends, technical challenges, niche opportunities, stakeholder needs, and valorization strategies of the R&D infrastructure.

The proposed pilot furnace will foster circular economy principles by minimizing radioactive waste and enabling metal reuse. It is designed to address gaps in handling challenging materials, such as metals with higher activities (than accepted in current metal melters), and to advance innovative decontamination methods for radionuclides that are defined as the most contributing to the clearance criteria for conditional release. To meet the needs for research and development, the facility will include **dual furnaces** for scaling processes from research-proof-of-concept at laboratory scale to industrial validation. The assessment of valorization schemes emphasizes the infrastructure's flexibility to support R&D services, intellectual property development, and financed melting operations, ensuring long-term financial sustainability of the R&D infrastructure.

A multi-criteria analysis guided the decision to include dual furnaces as a key pilot furnace requirement, ensuring alignment with the project goals.

These dual furnaces include (1) a **compact pilot installation** (several 100 kgs) with the necessary flexibility to validate lab-scale R&D at larger scale and to optimize the process parameters; and (2) a **representative pilot installation** (several 1000 kgs) to validate the practicality of the process at an industrially representative, yet still smaller scale. This level can be considered representative for industrial installations of which the size has been found, through knowledge gained during the preparatory study, to range up to 25 tons.

This R&D infrastructure will position SMELD at the forefront of innovative solutions in radioactive metal recycling, meeting both current market needs for R&D and long-term sustainability goals.