FISA EURADWASTE 2025

SNETP Forum

EURAD2-L'OPERA: Assessment of the long-term performance of innovative waste matrices for the immobilization of Low- and Intermediate-Level Radioactive Waste

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eurad2 European Joint Programme on Radioactive Waste Management

In many (European) countries, waste producers and waste management organisations need to manage a highly diverse variety of radioactive waste streams coming from different nuclear sectors (e.g., nuclear power plants, medical applications, research activities, etc.). Focusing on the low- and intermediate-level radioactive waste (LILW), the Work Package L'OPERA (EURAD2-WP7 Long term Performance of waste matrices) aims to expand the knowledge base on the durability of innovative matrices under representative disposal conditions, in particular geopolymer, magnesium potassium phosphate cement (MKPC), Nochar polymers and alkali-activated materials, which are considered as possible alternatives for traditional matrices

Objectives:

- Increase the knowledge and understanding of matrices for the immobilization of Low and Intermediate Level Waste (LILW):
  - Matrices: geopolymers, alkali-activated materials, magnesian potassium phosphate cements (MKPC), and Nochar.
  - LILW: Radioactive Solid Organic Waste (RSOW), Metallics, Radioactive Liquid Organic Waste (RLOW).

- Evaluation of the long-term performance of matrices:
  - Increase of the TRL of processes developed within previous European projects (e.g. PREDIS).
  - Investigate final waste forms coming from innovative processes.

- Long-term behaviour under disposal conditions:
  - Degradation behaviour and its consequences on the performance of the waste forms.
  - Development of methodologies for extrapolating long-term durability behavior (a few hundred years for surface disposal and longer periods for geological disposal).

Knowledge management (M1 – M60)

Capture Knowledge gained prior to EURAD-2 and extended during this WPs progress: Initial and final State of the Art on novel matrices for LILW immobilization

Transfer of knowledge in organizing specific activities as on-line or face-to-face trainings, e-learning materials, posts for social media, in cooperation with WP2 (Knowledge Management)

Definition of the Boundary conditions (M1 – M9)

Based on information gathered from the WP7 partners and the EUG, the expected boundary conditions prevailing in EU national LILW disposal facilities will be define to **provide guidance** for representative ageing and leaching protocols and procedures, as well as for the definition of simulation scenarios. This will be achieved by the determination and **the characterization of the key parameters** influencing the durability and the stability of the different waste matrices (water composition, required properties of the materials, irradiation exposure, ...).

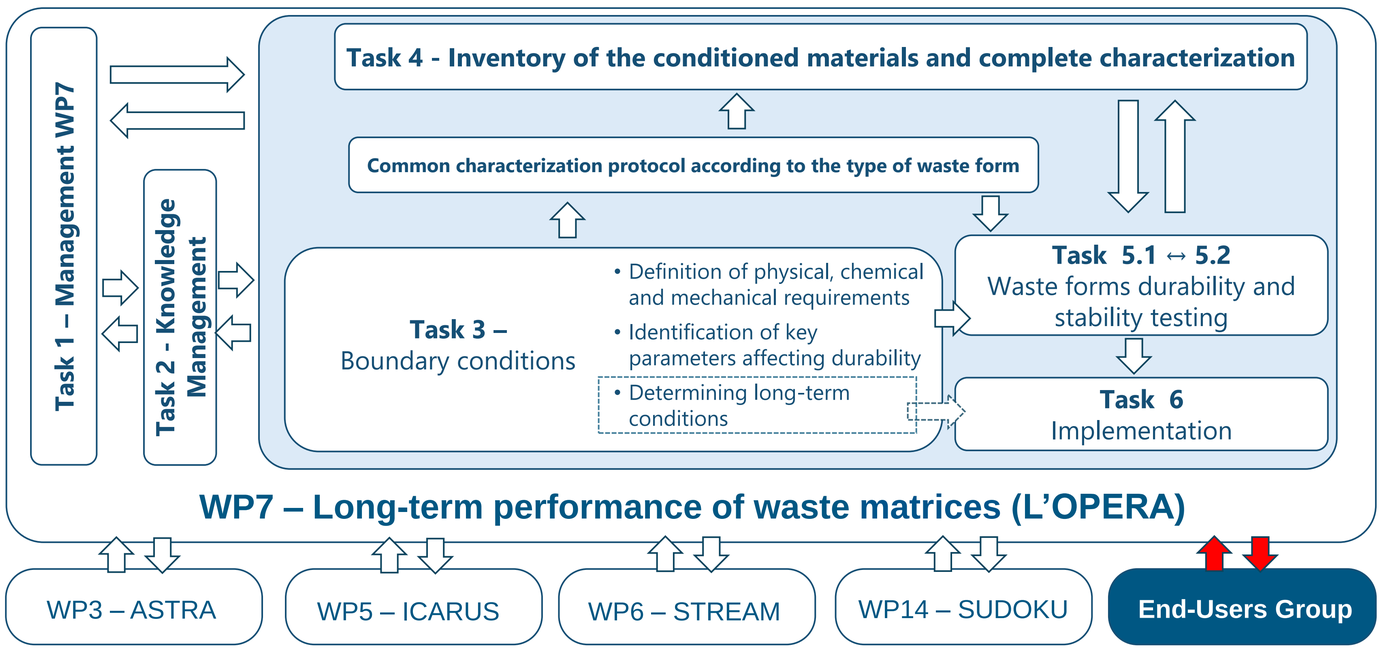
Implementation (M30 – M56)

Using the results from the durability and stability tests, the **long-term performance** of conditioned matrices will be **predicted** using several modeling approaches based on:

- Extrapolated data by using kinetic model
- Multiscale relationship tracers/uses properties/criteria
- Reactive transport codes to perform the THC models
- Sublattice solid solution models - thermodynamic modelling approaches
- Numerical description of the chemical reactions driving the microstructure evolution

Key Performance Indicators

EURATOM Call objective	SRA Drivers	KPI at the WP level	Target by end of Y2 (number)	Target by end of Y5 (number)
Support radioactive waste management innovation and optimization	Innovation for Optimisation	Change of TRL		1
		Improvement of a process or a method statement (written document)		1
Contribute to addressing scientific/technical challenges	Scientific Insight	Number of State-of-the-Arts published	1	2
		Number of open access publications accepted		5
		Number of presentations at scientific conferences done	2	20
Boost knowledge transfer to early-stage programmes	Tailored solutions	Number of KM documents produced		1



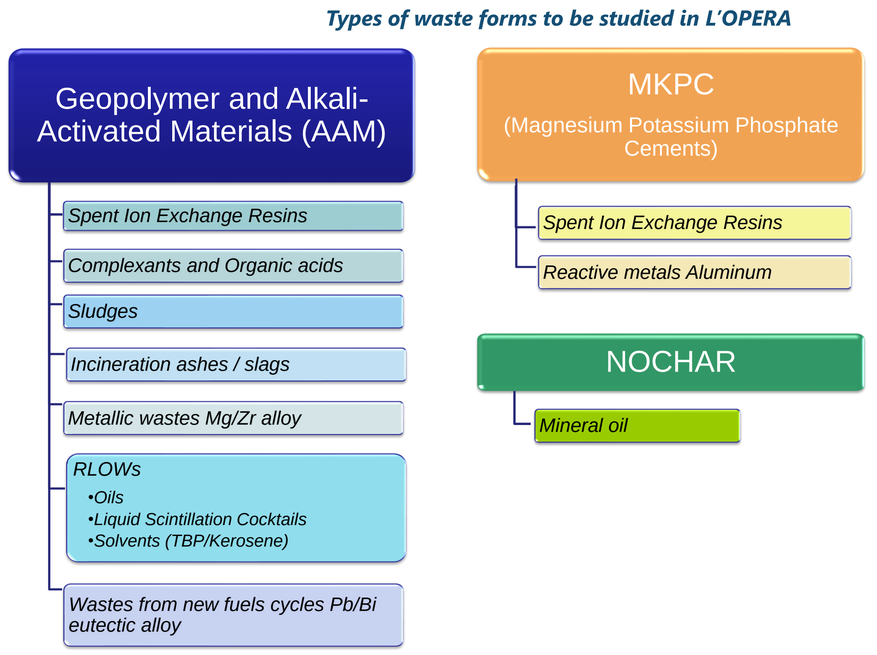
- **25 partners** from **10 countries**
- **2 Associated partners** from Switzerland
- **17 End Users**

Duration: 5 years
01.10.2024 – 31.09.2029

Budget: 4 M€ total, of which EC contribution of 2 M€, 529.4 PM
First two years are currently secured (EURATOM Call only granted 20 M€ for EURAD-2)

Inventory of the conditioned materials and complete characterization (M1 – M48)

Provide a **complete and descriptive inventory** of the matrices and waste forms investigated in WP7 L'OPERA. Samples will be produced in WP7 and will be characterized before and after the degradation processes. However, some samples have been produced in the framework of national projects or PREDIS and their initial characterization has already been done. Additionally, and in collaboration with WP6, samples from the development of innovative matrices and the optimization of the formulations will be investigated in WP7.



Waste forms durability and stability testing (M6 – M55)

Aiming to determine the **key parameters influencing the durability and the stability** of the conditioned waste, their **long-term evolution** under as representative as possible of disposal conditions will be evaluated. Several parameters are already identified:

- Evolution of the materials regarding the effect of:
  - Irradiation due to the presence of radionuclide (radiolysis or radio-oxydation)
  - Presence of water coming from the disposal or present in the waste forms
  - Temperature variation due to changes in the wastes/disposal
  - Mechanical ageing
- Definition of accelerated ageing to acquire long-term performance data (should be representative and extrapolable to disposal conditions)
- Definition of relevant tracers at chemical and/or physical scales will be followed to determine degradation mechanisms and some cases acquisition of kinetic parameters

Conclusion

WP7-L'OPERA aims to produce useful and directly applicable information to the End-Users facing with LILW management, by implementing solutions involving innovating conditioning matrices. The main objective is to provide a complete characterization of the waste forms and the prediction of their evolution under representative disposal conditions

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