EURAD-2 WP description Template #2

Please see Instructions for Work Package Preparation Team, public document for guidance (available on EURAD and PREDIS websites)

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<table>
<tr><td>Short Acronym and full Title</td><td colspan="3">WP7 L'OPERA - Long term performance of waste matrices</td></tr>
<tr><td>Type of activity</td><td>☒R&D</td><td>☐Strategic Study</td><td>Knowledge Management – covered by a separate committee and template</td></tr>
<tr><td>Budget estimation (total budget in M€, i.e ~ 1.5 M€)</td><td>5 M€</td><td>Duration of the WP (in months)</td><td>60 months</td></tr>
<tr><td>Links with EURAD SRA / Roadmap Themes
(if multiple choices, indicate the primary link in bold – maximum 3)</td><td colspan="3">☐Programme Management (Theme 1)
☒Pre-disposal (Theme 2)
☒Engineered Barrier Systems (Theme 3)
☐Geoscience (Theme 4)
☐Disposal facility design and optimisation (Theme 5)
☐Siting and Licensing (Theme 6)
☐Safety Case (Theme 7)</td></tr>
<tr><td>Links with EURAD SRA topics
(if multiple choices, indicate the primary link in bold – maximum 3)</td><td colspan="3">- 2.3.2 Optimisation of radioactive waste predisposal activities
- 3.1.3 Cemented LL-ILW
- 3.1.4 Other Wasteforms</td></tr>
<tr><td rowspan="2">SRA drivers (maximum 3)</td><td>☐Implementation Safety</td><td>☒Tailored Solutions</td><td>☒Scientific Insight</td></tr>
<tr><td>☒Innovation for Optimisation</td><td>☐Societal Engagement</td><td>☐Knowledge Management</td></tr>
<tr><td>Objective (What) – 1 sentence</td><td colspan="3">Demonstrate long term behaviour and durability of matrices and final wasteforms.</td></tr>
</table>

Justification: impact / innovation / added-value (Why) – bullet points or short paragraph **(maximum quarter of a page)**	Matrices such as geopolymers, organic-based materials (polymers and bitumen) and others such as magnesian cements, are alternatives to immobilize and encapsulate Low and Intermediate Level Waste (LL-ILW). Although some of them have been used in the past, knowledge of these materials is less mature (compared to other conditioning matrices) and the understanding of their long-term performance and durability under disposal conditions is required to consider them for the conditioning of specific wastes and obtain final wasteforms which can meet the WAC of the disposal facilities. Initiated during previous European projects (e.g. PREDIS) Solid and Liquid Organic Waste as well as the decontamination effluents were immobilised using different processes. However, the long-term performance of the resulting materials still has to be evaluated. Thus, WP7 aims to complete this evaluation, allowing an increase of the TRL of the selected processes, but also to evaluate the long-term behaviour of other promising final wasteforms coming from innovative processes and to define the most suitable routes for the long-term management of LL-ILW. Some of these matrices, such as geopolymers and polymer matrices, have shown good properties for the waste encapsulation and short-term performances, but their long-term behaviour under disposal conditions is quite unknown. The understanding of the degradation behaviour and its consequences on the performance of the wasteforms is required, as well as extrapolation to a few hundred years for surface disposal and to longer periods for geological disposal. On the other hand, bitumen has been used as an embedding matrix for sludges and ions exchange resins. The long-lived behaviour of bituminized wastes has been studied specifically regarding radiolysis, leaching and swelling behaviours. Nevertheless, some issues still require further understanding such as thermal reactivity and pressure induced by swelling.

List of planned tasks / subtasks with % of effort per task (5% increments)
 	
(Maximum 10 bullets)
	• Task 1: Management/coordination of the WP, max 10%
	• Task 2: Knowledge Management (incl. training materials development and State-of-the-Art for R&D WPs, etc.), at least 10%
	• Task 3: Boundary conditions (expected long-term conditions / radiation dose / dose rate, identification of the requirements/specifications and technical tests related to disposal facilities, storage and transport), 5 %
	• Task 4: Inventory of the conditioned materials and complete characterisation (physical and chemical characteristics), 10 %
	• Task 5: Novel Matrices/wasteforms behaviour (performance, durability, long-term behaviour), 30 %
	  o Evolution of matrices/wasteforms behaviour under ageing simulating disposal conditions (irradiation, leaching, coupled degradation, temperature variation…)
	  o Effect of ageing on the performance of matrices/wasteforms (release of liquid immobilized wastes, matrices permeability, mechanical properties...)
	  o Acquisition of degradation kinetic parameters
	  o Upscaling for demonstration

	• Task 6: Historical matrices behaviour, 15%
	  o Long-lived behaviour of bituminized wastes (thermal reactivity and the effect of self-irradiation on thermal behaviour, water uptake swelling pressure that they exert in relation to their deformation …)
	• Task 7: Implementation: Modelling for prediction of durability of materials and multiscale approach 20 %
	  o Modelling approaches to predict long-term performance based in acquired experimental results by ageing the samples.

List of expected outcomes linked to the identified SRA drivers **(Maximum 6 bullets)**	• Better understanding of long-term behaviour of waste matrices/wasteforms in disposal conditions (near surface disposal and deep geological disposal) • Identifying degradation processes and their elemental drivers • Diffusion and leaching values of new matrices/wasteforms • Disposability assessment and demonstration according to disposal facilities features (near-surface and/or intermediate-depth and/or geological)
Deliverables **(Maximum 6 – including the prescribed deliverables)**	• Initial/Updated/Final SOTA • Identification of the key parameters influencing the long-term behaviour according to the route for the treatment of the LL-ILW • Experimental report of long-term performance of matrices/wasteforms and disposability evaluation. • Report of modelling and upscaling approaches applied to describe experimental matrices/wasteforms evolution behaviour. • Outcomes/impacts report to Member States and End-user
Critical input requirements & identified risks	• The TRL increase is strongly linked to the use of "real" materials/waste. Most of the demonstrations in current and past European programs have been done using surrogate materials: the risk is in the availability of these materials.
Major achievements expected by end of Year 2 (Go/No Assessment)[1]	• Determination of the long-term conditions prevailing in a ‘generic’ disposal conditions allowing ‘long-term’ behaviour test (minimum 3 years leaching tests) • First results about matrices/wasteforms behaviour under controlled conditions

[1] EC budget being only allocated for the first 2 years, each work package progress will be reviewed at the end of Year 2, to assess its continuation based on the total budget that EURAD-2 will be granted.

(Maximum 5 bullets)	
(Optional - Explain what is out of the scope?)	Not addressing the waste characterization or immobilisation itself. Not addressing "(green-)cements".
List of preliminary interested organisations as partners in the WP contributing effort; **% of effort (person months, by College)**	Example: REs (50%): Belgoprocess (Belgium), BGS (UK), BRGM (France), CEA (France), CSIC (Spain), CVUT (Czech Republic), ECL (France), EGIS (France), EIMV (Slovenia), ENEA (Italy), GSL (UK), IMT (France), INCT (Poland), IRSN (France), LEI (Lithuania), ORANO (France), POLIMI (Italy), PSI (Switzerland), RATEN (Romania), RINA (Italy), SI IEG (Ukraine), SCK CEN (Belgium), UAM (Spain), UJV (Czech Republic) TSOs (20%): VTT (Finland), CIEMAT (Spain), IRSN (France), BEL V (Belgium), ONDRAF/NIRAS (Belgium), MKG (Sweden), Swedish radiation safety authority (Sweden), SSTC NRS (Ukraine) WMOs (30%): Andra (France), Enresa (Spain), NWS (UK), SKB (Sweden), NES (Austria), DEKOM (Denmark), SOGIN (Italy) Strong support by the SNETP, e.g. NPP plant operators as waste generators: Fortum (Finland), TVO (Finland), ORANO (France) Interest to participate by NTW (EU; civil society)
If applicable - links with previous projects / work packages	Previous projects: THERAMIN, PREDIS (WP4, WP5, WP6), EURAD-CORI, EURAD-ROUTES
WP Preparation Team (1 member per College) contact (**organisation + person**, email)	RE: Thierry Mennecart (thierry.mennecart@sckcen.be) TSO : Maria Oksa (Maria.Oksa@vtt.fi) WMO : Denise Ricard (denise.ricard@andra.fr) CG observer : Astrid Göbel (Astrid.Goebel@bge.de)