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">SuRE: Sustainability aspects in Radioactive waste management: General concept and practical measures for Environmental challenges</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 M€)</td><td>~ 1 M€</td><td>Duration of the WP
(in months)
24 months</td><td>24</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">o 1.1.4 safety, security, use of resources
o 1.5.1 Integrated waste management routes and strategic options
o 2.1.1 Inventory
o 2.1.2 Waste acceptance criteria
o 2.1.4 Waste hierarchy
o 2.2.2 Treatment and processing
o 3.1.4 Other waste forms
o 3.2.3 Novel containers
o 3.3.2 Backfills
o 3.4.1 EBS system</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>
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Objective (What) – **1 sentence**	Develop the concept of sustainability in the field of nuclear waste management, and identify specific challenges on environmental, economic and social dimensions in order to develop appropriate technical and socio-technical approaches with a systemic analysis of inventory data of radioactive matter in European states for potential recycling, and identification of low CO_2 concrete for repository.
Justification: impact / innovation / added-value (Why) – bullet points or short paragraph **(maximum quarter of a page)**	Different political initiatives, regulations (UN, EU) and relevant institutions (IAEA, OECD-NEA) address the aspect of sustainability for nuclear waste management. Environmental, economic and social challenges include a number of specific topics (e.g., resource consumption, GHG emissions, monetary resources, intra- and intergenerational justice, long-term community involvement, anticipating future needs etc.) which strongly influence the implementation and operation of nuclear waste repositories. The development of suitable concepts or practices is needed which should combine technical aspects and non-technical questions to tackle sustainability challenges of nuclear waste disposal. The first step is to define the general concept of sustainability in the context of nuclear waste management, followed by the identification of specific topics, (e.g., strategies aimed at reducing greenhouse gas emissions, use of alternative building materials and technologies for environmental impact reduction or cost reduction). Two specific research topics on environmental sustainability are in the focus of this WP: A) recycling and reuse of radioactive matters; B) awaited availability decrease and regulations lead to various questions regarding the future CO_2-low concrete production and how to integrate these evolutions in nuclear waste management field. Large volumes of radioactive waste are planned to be stored if they are not treated or recycled. The disposal of wastes and their replacement without considering their recycling and reuse will generate a higher environmental and socio-economic impacts. In addition, the resources for storage are limited and their cost could be high depending on the activity level. Furthermore, the recyclable materials to be disposed of as wastes must ultimately be replaced with new materials. Recycling will reduce the land used environmental footprint as it avoids land use for disposal, disruption and environmental damages from mining operations and environmental impacts associated, according to the IAEA reports. Therefore, a review of valuable matters considered as waste for some while others stored (waiting for a permanent solution) will bring new perspectives for countries looking for best solutions to treat the wastes. They are for examples graphite, gravel, noble metals and REE, etc… Finally, recycling may allow to decrease the cost of dismantling.
List of planned tasks / subtasks with % of effort per task (5% increments) **(Maximum 10 bullets)**	• **Task 1**: Management/coordination of the WP (**10%**) • **Task 2**: Knowledge Management (incl. training materials development and State-of-the-Art for R&D WPs, etc.) (**10%**) • **Task 3**: Sustainability in radioactive waste management (**20%**) o Subtask 3.1: Definition and state of knowledge of sustainability in radioactive waste disposal and related fields (historical development "sustainability / sustainable development"; political initiatives (UN, EU, national); guidelines and projects of relevant organisations; analysis and comparison of different national approaches; current and future R&D and industry activities (e.g. projects, programmes etc.) o Subtask 3.2: Identification of specific environmental, economic and social challenges and related approaches (e.g.

	resource consumption; low carbon footprint; waste production; monetary resources (costs) for materials, processes and technologies; ensuring financial resources; inter-generational and intra-generational justice, acceptance, local value). Tasks 4 and 5 will provide concrete studies on two potential routes towards more sustainable radioactive waste management. • **Task 4**: Recycling of radioactive matters as specific sustainable application (**40%**) o Subtask 4.1: Review of the radioactive matters that are potentially recyclable: i-graphite, concrete, depleted uranium, sludge, i-carbonaceous, sealed sources etc. Inventory assessment over EU states. o Subtask 4.2: Review of state-of-the-art and best available techniques to recover and make recyclable these materials. o Subtask 4.3: Review of potential applications for recycling radioactive matter (new shielding materials, raw materials for conditioning, in case of acceptance using of i-graphite matrix as filling material for other radwaste, laser cutting of contaminated surfaces without additional waste production, HLW containers, radioisotopes for industrial and medical applications, etc.) o Subtask 4.4: Application of LCC/LCA approach to help selecting the best solutions • **Task 5**: CO_2-low concrete production as specific sustainable application (e.g., concrete formulations, availability of cement components, development of new material types, its consequences for physico-chemical models, life cycle management) (**20%**) o Subtask 5.1: Identification of availability of cement and concrete components, analysis of the consequence for nuclear waste management and how to anticipate the development of new concrete formulations. o Subtask 5.2: Identification of the new types of cementitious materials in development in the Civil Engineering industry that could be used for concrete structures, disposal package and waste matrices. What is the level of development and identification of complementary work to do for considering the use in disposal facilities. o Subtask 5.3: Proposition of a shared strategy at European scale to simplify the integration of the frequent evolution of concrete (component availability, regulations evolutions) in term of qualification process and consequences on waste acceptance criteria.
List of expected outcomes linked to the identified SRA drivers **(Maximum 6 bullets)**	• Determination of sustainability aspects in nuclear waste management incl. environmental, economic and social challenges • Identification of specific activities and approaches to tackle sustainability challenges of nuclear waste disposal • Inventory assessment over EU states and inventory database of the recyclable and reusable radioactive matters: i-graphite, concrete,

	depleted uranium, sludge, i-carbonaceous, concrete, sealed sources etc. • SotA on best available techniques to recover and make recyclable these materials, including difficulties and limitations of the processes at lab scales and large scales. Also, a list of potential applications resulting from radioactive matter will be provided (shielding materials, raw materials for conditioning, etc.). • Identification of the main evolution in concrete components availability, the new types of materials in development and regulation evolution at European scale. • Analysis of the consequences of the obligation to use the new materials in radioactive waste disposal facilities and how to integrate them with regards of acceptance criteria. Proposition of common strategy on the qualification process of the new materials performances at European scale.
Deliverables **(Maximum 6 – including the prescribed deliverables)**	• D.1 outcome/impacts report • D.2: white or green paper • D.3: Sustainability in radioactive waste management: Introduction and specific environmental, economic and social challenges. • D.4: Innovation catalogue in the field of recycling of radioactive matters with the most promising applications in the industrial and health sectors. • D.5: Summary on concrete components availability, the development of new types of materials and the impact of the expected regulations evolutions in the field of nuclear waste management (impact on concrete acceptance criteria and qualification process).
Critical input requirements & identified risks	• N/A
Major achievements expected by end of Year 2 (Go/No Assessment)[1] **(Maximum 5 bullets)**	• Determination of the concept of sustainability in the nuclear sector. • The inventory of “recyclable” radioactive matter in Europe. • Identification of recycling solutions as a pillar for sustainability. • CO_2-low concrete production as specific sustainable application.
(Optional - Explain what is out of the scope?)	HLW/SNF recycling issues are excluded.

[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.

List of preliminary interested organisations as partners in the WP contributing effort; **% of effort (person months, by College)**	REs (**55%**): CNRS-SUBATECH-IMT Atlantique, CNRS-IPHC, CTU, UoM, UPM, SIIEG, NNL, ORANO, SCK.CEN, INCT, POLIMI, NCSRD TSOs (**20%**): SURO, IRSN, VTT, EIMV, FTMC, NRG, SSTC NRS WMOs (**25%**): BGE, ANDRA, ENRESA, SOGIN, NES, NWS, Nagra Civil society : NTW
If applicable - links with previous projects / work packages	**Previous and ongoing projects**: PREDIS, CHANCE, ROUTES, UMAN, MODATS, CARBOWASTE, GENIORS, HARPERS, RadoNorm In the **current EURAD2 preparation**: • Link with WP6 (Sustainable Treatment and Immobilization of challenging wastes) and WP7 (Long-term Performance of novel waste matrices) especially with task 5 • Link with WP8 (SHIRE - Safe Handling of IRradiated graphite - strategic study): WP2 will focus only the recycling potential of graphite.
WP Preparation Team (1 member per College) contact (**organisation + person**, email)	**RE**: Subatech, Abdesselam Abdelouas, abdeloua@subatech.in2p3.fr **TSO** : SURO, Hana Vojtechova, hana.vojtechova@suro.cz **WMO** : BGE, Gregor-Sönke Schneider, Gregor-Soenke.Schneider@bge.de, +495171 433017 **CG observer** : VTT, Erika Holt, Erika.holt@vtt.fi