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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Short Acronym and full Title	SHIRE - Safe Handling of IRradiated graphitE		
Type of activity	☐R&D	☒Strategic Study	Knowledge Management – covered by a separate committee and template
Budget estimation (total budget in M€, i.e ~ 1.5 M€)	1 M€	Duration of the WP (in months)	24
Links with EURAD SRA / Roadmap Themes (if multiple choices, indicate the primary link **in bold – maximum 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)		
Links with EURAD SRA topics (if multiple choices, indicate the primary link **in bold – maximum 3)**	• **1.5.1 Integrated waste management routes and strategic options** • 2.1.2 Waste Acceptance Criteria • 2.1.3 Technology selection		
SRA drivers **(maximum 3)**	☒Implementation Safety	☐Tailored Solutions	☒Scientific Insight
	☒Innovation for Optimisation	☐Societal Engagement	☐Knowledge Management
Objective (What) – **1 sentence**	State of the art and gap analysis of non-conditioned irradiated graphite (i-graphite) storage and characterization, treatment, conditioning, and monitoring technologies for optimising the pre-disposal management and disposal of i-graphite.		

Justification: impact / innovation / added-value (Why) – bullet points or short paragraph **(maximum quarter of a page)**	In the last decades, several projects have focused on i-graphite and useful data have been obtained. Still, there is need for summarizing the outcomes of such cutting-edge research activities to implement feasible waste routes for the disposal of i-graphite and tackle legacy waste accumulation. • Large amounts of i-graphite waste have been generated worldwide, which need to be properly managed. • The storage conditions and monitoring technologies for non-conditioned i-graphite should be analyzed to define an acceptable framework for maximizing safety. • The technical basis of the WAC for storage and disposal of untreated/treated i-graphite should be defined. • Need for package monitoring and characterization, specifically concerning Difficult To Measure radionuclides, by developing more straightforward Destructive Analysis (DA), in combination with Non Destructive Analysis (NDA) and theoretical activation models. • Identify the gaps in physico-chemical-mechanical-radiological characterization (and corresponding NDA) to allow correct segregation of real i-graphite. • Identify the TRL and potential of current and emerging treatment and conditioning methods, such as geopolymers and magnesium phosphate cements, to mitigate challenging properties of the waste and simplify subsequent disposal operations. • Evaluation of the existing knowledge and corresponding gaps and opportunities related to i-graphite arisings from High Temperature Gas-Cooled Reactors.

List of planned tasks / subtasks with % of effort per task (5% increments)
 	
(Maximum 10 bullets)
	• **Task 1: Management/coordination of the WP, 5%**
	• **Task 2: Knowledge Management (incl. training materials development and State-of-the-Art of i-graphite management), 10%**
	  – T2.1. Compilation of main outcomes from previous EU/IAEA projects of i-graphite.
	  – T2.2. Socio-technical issues (Interaction with Civil Society).
	• **Task 3: Storage of non-conditioned i-graphite, 20%**
	  – T3.1. Conditions and monitoring technologies for storage of non-conditioning i-graphite.
	  – T3.2. Characterization of non-conditioned i-graphite.
	• **Task 4: Options for i-graphite management: Treatment, Conditioning, Recycle, Transport, Storage, Disposal and Recycle, 40%**
	  – T4.1. Analysis of general WAC for treatment, transport, storage and disposal for various i-graphite streams.
	  – T4.2. Assessment of the methods for treatment, conditioning, transport, storage, disposal, and recycle of i-graphite.

	– T4.3. Characterization needs for various stages of i-graphite management. • **T5: Study synthesis and definition of future R&D on i-graphite, 25%** – T5.1. GAP Analysis and needs synthesis. – T5.2. Definition of future R&D on i-graphite. – T5.3 Dissemination**.**
List of expected outcomes linked to the identified SRA drivers **(Maximum 6 bullets)**	• Approach to determine the conditions of safe storage of non-conditioned i-graphite, the need to its control and characterization • Definition of WAC for storage and disposal of i-graphite, especially taking into account the content of volatile radionuclides and the stored Wigner energy. • Gap analysis on physico-chemical-mechanical-radiological characterization, to improve the waste storage and disposal, also through treatment and conditioning, with special regard to volatile radionuclides speciation in different storage and disposal conditions. It includes the gap analysis on package monitoring and characterization, in order to support the assessment of post-closure safety, with special regard to the release of 14C. • Gap analysis on options for treatment and decontamination methodologies applicable to the challenging i-graphite waste, to minimize radiological consequences and meet waste acceptance criteria. • Gap analysis on conditioning matrices that could successfully stabilize i-graphite and avoid (or at least retard) the release of volatile and mobile radionuclides (3H, 14C, 36Cl, 129I...). • Systematized determination of problematic issues of management i-graphite at all stages, as well as identification of necessary R&D research.
Deliverables **(Maximum 6 – including the prescribed deliverables)**	• D1 (T2) Green paper on SoTA of i-graphite management. • D2 (T3) Assessment of methods for characterization, monitoring and control of storage for non-conditioned i-graphite. • D3 (T4) General WAC for i-graphite and characterization needs. Management of i-graphite: Treatment, Conditioning, Recycle, Transport, Storage and Disposal. • D4 (T5) White paper on the GAP Analysis and needs for future R&D on i-graphite.
Critical input requirements & identified risks	• Complementarity and interaction with WP2 and WP5 to avoid repetitions and overlapping. • Wide participation of organizations from different member states aims at investigating different possible waste routes and strategies, taking into account the different waste priority, waste inventory, technological and economic capacity of each member state

Major achievements expected by end of Year 2 (Go/No Assessment)[1] **(Maximum 5 bullets)**	• Recommendations for storage conditions for non-conditioned i-graphite • List of the most relevant radionuclides and physico-chemical-mechanical properties for the management of treated/untreated i-graphite. • Compilation of various waste routes and strategies in each member state. Classification of typical i-graphite streams for selection of optimal treatment and conditioning for every of them. • SoTA, gap analysis, and needs for i-graphite characterization • SoTA, gap analysis, and needs on methodologies for treatment, decontamination, conditioning, storage and disposal of i-graphite
(Optional - Explain what is out of the scope?)	Decommissioning-related operations, such as dismantling and retrieval of i-graphite
List of preliminary interested organisations as partners in the WP contributing effort; **% of effort (person months, by College)**	REs (40%): POLIMI (IT), IMT-Atlantique (FR), SCK-CEN (BE), ORANO (FR), CEA (FR), LEI (LT), RATEN (RO), NNL (UK), UoM (UK), ZEUS (DE), ENEA (IT), DTU (DK), FZJ (D), UNIPI (IT) TSOs (30%): CIEMAT (ES), VTT (FI), NCSRD (GR), NTW (FR), EIMV (SL), SSTC NRS (UA), FTMC (LT) WMOs (30%): ENRESA (ES), SOGIN (IT) ANDRA (FR), Nuclear Waste Services (UK)
If applicable - links with previous projects / work packages	CAST, CARBOWASTE, INNO4GRAPH, EURAD-ROUTES, IAEA-GRAPA
WP Preparation Team (1 member per College) contact (**organisation + person**, email)	RE: POLIMI, Eros Mossini, eros.mossini@polimi.it TSO: SSTC NRS, Mykola Sapon, mm_sapon@sstc.ua WMO: ENRESA, Jose Luis Leganés Nieto, jlen@enresa.es CG observer: VTT, Erika Holt, Erika.holt@vtt.fi

[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.