

EURAD-2 2nd wave Template #2

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Short Acronym and full Title	INSURANCE - An interoperable EU-framework to harmonize the assessment of climate-driven changes in nuclear waste disposal site performance		
Type of activity	<input checked="" type="checkbox"/> R&D	<input type="checkbox"/> Strategic Study	
Budget estimation (total budget in M€, i.e ~ 1.5 M€)	3.0 M€	Duration of the WP (in months)	36
Links with EURAD SRA / Roadmap Themes (if multiple choices, indicate the primary link in bold – maximum 3)	<input type="checkbox"/> Programme Management (Theme 1) <input type="checkbox"/> Pre-disposal (Theme 2) <input type="checkbox"/> Engineered Barrier Systems (Theme 3) <input checked="" type="checkbox"/> Geoscience (Theme 4) <input type="checkbox"/> Disposal facility design and optimisation (Theme 5) <input checked="" type="checkbox"/> Siting and Licensing (Theme 6) <input checked="" type="checkbox"/> Safety Case (Theme 7)		
Links with EURAD SRA topics (if multiple choices, indicate the primary link in bold – maximum 3)	<ul style="list-style-type: none"> - 4.3.2: Climate change: Enhanced treatment of climate change, land-use and parameter derivation in biosphere models - 7.3.2: Treatment of uncertainty: Further refinement of methods to make sensitivity and uncertainty analyses - 6.2.2 Detailed site characterisation and site confirmation: Developing state-of-the-art on the methods of uncertainty management associated with site characteristics 		
SRA drivers (maximum 3)	<input type="checkbox"/> Implementation Safety	<input type="checkbox"/> Tailored Solutions	<input checked="" type="checkbox"/> Scientific Insight
	<input type="checkbox"/> Innovation for Optimisation	<input checked="" type="checkbox"/> Societal Engagement	<input checked="" type="checkbox"/> Knowledge Management
Objective (What) – 1 sentence	The objective of INSURANCE is to develop and demonstrate an interoperable and harmonized EU framework that quantifies climate-dependent processes (including extremes) in assessing nuclear waste disposal system performance, and create an end-user-ready safety guide and database to incorporate climate change and extreme events into safety cases.		
Justification: impact / innovation /	The first outcomes of the current EURAD-2 Strategic Study (CLIMATE) indicate that a wide variety of climate scenarios and assessments methods is presently used in the nuclear waste community in Europe, leading to		

<p>added-value (Why) – bullet points or short paragraph (maximum quarter of a page)</p>	<p>heterogeneous treatment of climate change and extreme events in safety cases. It also shows that climate-related processes are addressed in many different ways over the national programmes (from simplified to very advanced).</p> <p>This urges for a coordinated R&D action that aims at populating and comparing datasets of climate-dependent processes, in view of the harmonization of European practices, knowledge transfer and mutual learning between countries sharing for example similar climate zones (i.e. temperate, continental, etc...) or climate futures. This would ensure consistent, scientifically robust and efficient assessment of climate-dependent impacts on nuclear waste disposal systems, thereby improving safety, comparability, stakeholder communication and cross-border cooperation.</p> <p>Consensus-based climate states and scenarios, safety margins and design and selection criteria for disposal systems are expected to be supportive to safety cases and will facilitate transparent communication of climate-dependent uncertainties and future performance of disposal systems, including civil society engagement.</p>
<p>List of planned tasks / subtasks with % of effort per task (5% increments) (Maximum 10 bullets)</p>	<p>Task 1: WP coordination (10%)</p> <p>Task 2: Knowledge management (15%)</p> <p>Knowledge transfer is one of the drivers of this WP, and we foresee to facilitate the process through dedicated high-level training sessions for partners, in addition to the tasks prescribed by WP KM.</p> <p>Task 3: Derivation of climate scenarios, climate states and climate parameters (20%)</p> <p><i>Subtask 3.1:</i> Harmonization of the selection process for climate scenarios for various timeframes, covering assessment periods for (near-)surface, shallow and deep geological repositories over various climate zones in Europe (see StSt CLIMATE outcomes). The selection process will take into account safety-aimed objectives shared by all partners, including civil society. It will also take into account uncertainties inherently connected with future climate evolution.</p> <p><i>Subtask 3.2:</i> Conversion of the selected climate scenarios into meteorological parameters (temperature, precipitation, wind,...) and/or climate states (permafrost, sea-level rise, prolonged interglacial, aridification), in a consistent way, over various climate zones and futures across Europe.</p> <p>Task 4: Harmonized climate-dependent processes: timing, rates and magnitude (30%)</p> <p>Task 4 focuses on cross-climate zone comparison of processes, according to the climate scenarios, climate states and parameters identified in Task 3. The purpose is to systematically compile data on the timing, rates and magnitude of various processes in different climate zones over Europe that are relevant for safety. The following data sources will be consulted: output from existing models, results from ongoing experiments, various climate analogues, and field data from geomorphological and geo(hydro)logical archives.</p>

	<p><i>Subtask 4.1:</i> Climate-dependent processes that impact the stability of multi-layer covers of (near-)surface disposal facilities and other components (drains, vaults) and the evolution of infiltration rates through the facility. Relevant processes include storms, droughts, freeze-thaw cycles, heatwaves and flooding (including extremes).</p> <p><i>Subtask 4.2:</i> Timing, speed and magnitude of landscape erosion and reduction of overburdens for shallow and deep geological repositories. Extreme climatic conditions such as marine inundation, intensive aridification, prolongation of interglacial conditions, permafrost and ice-sheet development will be considered, amongst others.</p> <p><i>Subtask 4.3:</i> Climate-dependent processes that drive the local hydro(geo)logical system for (near-)surface, shallow and deep geological repositories (including the aforementioned extreme conditions).</p> <p>Task 5: Reference database and synthetic case studies (25%)</p> <p>Whereas Task 4 is mainly concerned with collecting and verifying the relevant processes over various climate zones and timeframes, Task 5 aims at exploring and testing the database, using a limited amount of synthetic case studies.</p> <p><i>Subtask 5.1:</i> Creation of a reference database for identified processes in Task 4. Such database could take the form of 3-dimensional matrices. For example: a climate-erosion-lithology matrix, a permafrost type-lithology-hydraulic conductivity matrix, etc.</p> <p><i>Subtask 5.2:</i> Climate scenarios from Task 3 using the data produced in Task 4 will be tested using synthetic case studies. Here, additional modelling is needed and/or (complemented with) data from experiments, field evidence, analogues. From these synthetic case studies, key events and tipping points should be deduced, as well as safety margins and design/site requirements. This will finally lead to the development of prioritization guidelines and best practices.</p>
<p>List of expected outcomes linked to the identified SRA drivers (Maximum 6 bullets)</p>	<ul style="list-style-type: none"> • (Knowledge transfer) Cross-climate zone knowledge transfer from advanced to initiating programs, through the development of harmonized climate scenario selection procedures and futures across Europe and sharing experiences regarding climate-related boundary conditions, processes and safety cases. Opportunity to widen the community and establish links with, e.g., national climate institutes not typically involved in EURAD. • (Scientific insight) Advancing insights into the timing, rate and magnitude of climate-related processes that are of relevance for safety margins and design criteria: reducing uncertainties through future R&D actions. • (Societal engagement) A widely accepted user-friendly safety guide and database for climate assessment impact will allow to communicate in a consistent way about uncertainties and future performance of disposal systems, and engagement with civil society on this matter allows to build and maintain trust.

<p>Deliverables (Maximum 6 – including the prescribed deliverables)</p>	<p>D1: State-of-the-art report on current practices for climate change impact assessment in radioactive waste disposal programmes across Europe (month 0 and month 36)</p> <p>D2: Common framework and example library (database) for climate futures and scenarios (including a safety guide, templates and metadata)</p> <p>D3: Synthesis report summarising key findings, recommendations and implementation roadmap for programmes at different levels of maturity</p> <p>D4: Outcomes to Member States</p>
<p>Critical input requirements & identified risks</p>	<p>Critical input requirements:</p> <ul style="list-style-type: none"> • Access to information on climate scenarios and methods currently used in participating RWM programmes. • Sufficient involvement of end-users (WMOs, TSOs, regulators, civil society) to ensure that scenarios, case studies and guidance are relevant and usable. <p>Identified risks and mitigation:</p> <ul style="list-style-type: none"> • Risk: Limited possibility to share detailed site-specific information from some programmes. Mitigation: Use generic reference cases. • Risk: Heterogeneous engagement from initial-stage programmes due to limited resources. Mitigation: Provide flexible levels of participation and targeted support through the knowledge management task. • Risk: Overly broad scope leading to fragmentation of efforts. Mitigation: Early prioritization of a limited number of reference cases and climate futures, agreed with end-users.
<p>(Optional - Explain what is out of the scope?)</p>	<p>Developing new climate models is out of scope (except for additional downscaling when needed, and/or statistical analysis of extreme climate conditions). Site-specific impact assessments are also out of scope.</p>
<p>List of preliminary interested organisations as partners in the WP contributing effort; % of effort (person months, by College)</p>	<p>WMO (25%): SURAO (CZ), POSIVA (FI), Andra (FR), Sogin (IT), Nagra (CH), SKB (SE)</p> <p>TSO (25%): FTMC (LT), VTT (FI), EIMV (SI), ASNR (FR), NTW (EU)</p> <p>RE (50%): TUL (CZ), Mines Paris (FR), BRGM (FR), TUS (BG), GTK (FI), ENEA (IT), Amphos21 (ES), SCK CEN (BE), TNO (NL), UFZ (GE)</p>
<p>If applicable - links with previous</p>	<p>JOINT WMO INITIATIVES: Greenland Analogue Project (2008-2013), CatchNet</p> <p>IGD-TP: CCSC (Climate Change in the Safety Case; 2021-2023)</p> <p>EURATOM: BIOCLIM (2000-2003), BIOMOSA (2001-2003)</p>

projects / work packages	EURAD-1: UMAN EURAD-2: CLIMATE, SUDOKU, ASTRA EURAD-2 (second wave): NATSTRAT, GEOSCALE
WP Preparation Team (1 member per College) contact (organisation + person, email)	RE: Koen Beerten, SCK CEN, kbeerten@sckcen.be TSO: Jin Park, VTT, jin.park@vtt.fi WMO: Tiina Sojakka, POSIVA, tiina.sojakka@posiva.fi