

PREDIS

PREDIS Overview SHARE workshop

Session 8 - Management of material and radioactive waste from Decommissioning / Legacy Waste

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 945098.

PROJECT SHORT OVERVIEW

- Title: “PREDIS: Pre-disposal Management of Radioactive Waste”
- Participants: Consortium of 47 partners from 17 countries
- Duration: 4 years, planned September 2020 through August 2024. Proposal was submitted 25.9.2019. Positive decision February 2020, agreements signed June.
- Budget: 23.7 M€ total, of which EC contribution of 14 M€
- Reply to: Euratom call NFRP-10, Research and Innovation Action (RI)
- Support/endorsement from Nugenia, IGD-TP, IAEA, NEA, EURAD project – all are listed for cooperation during the project duration (establishing i.e. MoU for information sharing)
- Project web page: <https://predis-h2020.eu/>





PREDIS PROJECT OBJECTIVES

PREDIS high-level, overall objectives are to:

- Develop solutions (*methods, processes, technologies and demonstrators*) for future treatment and conditioning of waste across a number of MSs for which no industrially mature or inadequate solutions are currently available, improving safety during next waste management steps;
- or improve existing solutions with safer, cheaper or more effective alternative processes where they bring measurable benefits to several MSs (Member States).
- Analyse criteria, parameters and specifications for materials and packages with associated Waste Acceptance Criteria (WAC) for pre-disposal and disposal activities, supporting homogenisation of waste management processes across Europe.

These high-level objectives will be met by PREDIS having specific objectives:

- 1) Applying multi-disciplinary and multi-scale scientific approaches to demonstrate technical, economic and environmental feasibility of the new solutions;
- 2) Addressing project drivers from the end users' points-of-view;
- 3) Fostering deeper cooperation between experts from many EU Member-states and across generations;
- 4) Training new experts in the field of pre-disposal waste management technologies;
- 5) Updating and revising pre-disposal guiding documents (vision, SRA, roadmap, governance and deployment mechanisms), together with the EURAD EJP executive bodies.



PREDIS TECHNICAL SCOPE

Low & Intermediate Level Waste Types

Metallics

**Liquid
Organics**

**Solid
Organics**

**Cemented
Waste**

Characterisation & classification of waste

New treatments, conditioning & monitoring

Modelling & Performance evaluation of new solutions

Environmental & economic evaluations

Innovative R&D Approaches

Scope was developed in spring 2019 based on iterative feedback from end user community, regarding priorities on R&D topics.

Selection of topics and tasks based on areas having highest potential for technical and innovation impact.

Description of Action (Project Plan) gives exact techniques and their current, project and future technology readiness level (TRL) targets



CONSORTIUM MEMBERS

- **VTT Technical Research Centre of Finland, Finland**
- **National Nuclear Laboratory (NNL), UK**
- **Joint Research Centre (JRC), Belgium**
- **Institut Mines Télécom Nantes Atlantique (IMTA), France**
- **Commissariat à l'énergie atomique et aux énergies alternatives (CEA), France**
- **Studiecentrum voor Kernenergie / Centre d'Etude de l'Energie Nucléaire (SCK•CEN), Belgium**
- **Bundesanstalt fuer Materialforschung und Pruefung (BAM) Germany**
- Magics Instruments, Belgium
- Technical University Sofia, Bulgaria
- Ceske Vysoke Ucení Technické V Praze (CTU), Czech Republic
- Centrum Vizkumu Rez (CVRez), Czech Republic
- Statni Ustav Radiacni Ochrany (SÚRO), Czech Republic
- ÚJV Rez, Czech Republic
- University of Helsinki, Finland
- Centre National de la Recherche Scientifique, France
- Ecole Centrale de Lille, France
- Institut de radioprotection et de Sécurité Nucléaire (IRSN), France
- ORANO CYCLE, France
- DMT GmbH & Co., Germany
- Forschungszentrum Julich GMBH, Germany
- Karlsruher Institut fuer Technologie (KIT) Germany
- National Center for Scientific Research "Demokritos" (NCSR), Greece

Bold indicated WP leaders, = Project Management team

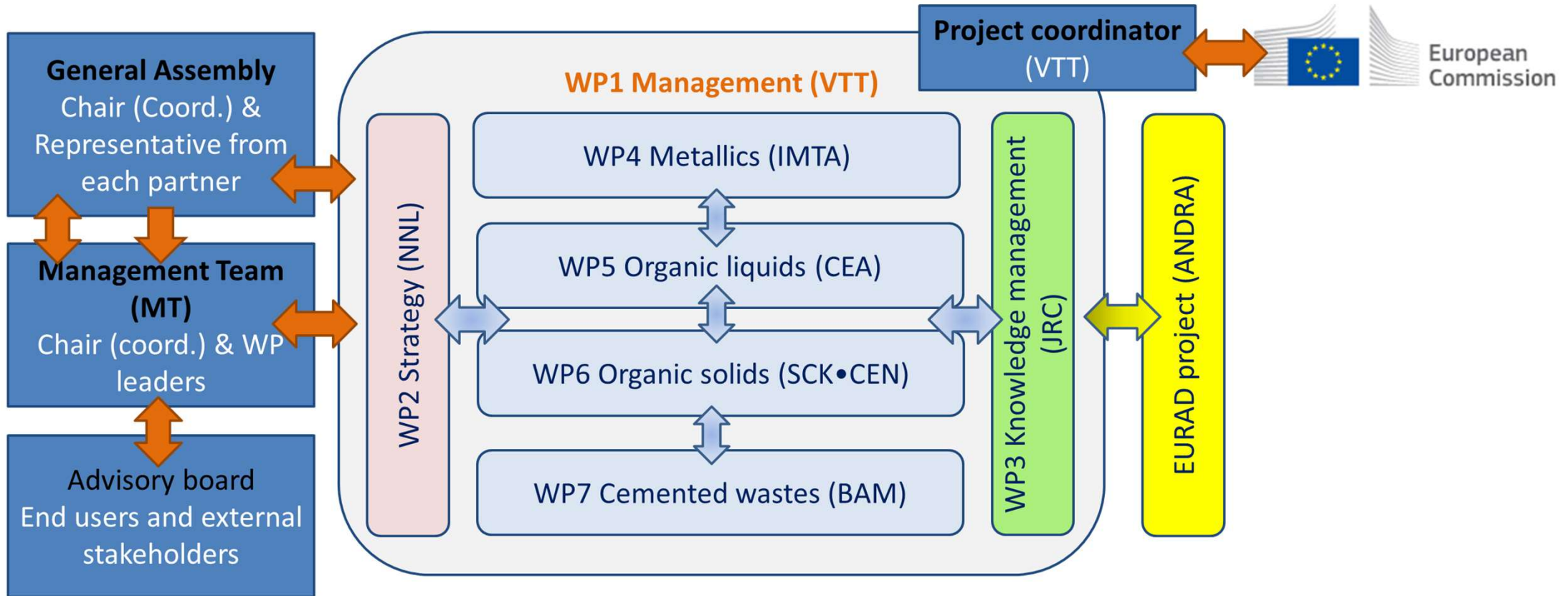
29 of 47 partners are also participating in EURAD

- Isotoptech Nuklearis Technoloiai Esszolgaltato Reszvenytarsasag, Hungary
- Radiokologiai Tisztasagert Tarsadalmi Szervezet (SORC), Hungary
- TS Enercon Mernokiroda KFT, Hungary
- Ansaldo Nucleare SPA, Italy
- Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA), Italy
- Istituto Nazionale di Fisica Nucleare (INFN), Italy
- Nucleco Societa Per L'Ecoingegneria, Italy
- Politecnico di Milano, Italy
- Società Gestione Impianti Nucleari (SOGIN), Italy
- University of Pisa, Italy
- Valstybinis Moksliniu Tyrimu Institutas (FTMC), Lithuania
- Nuclear Research and Consultancy Group, Netherlands
- Institutt for Energiteknikk (IFE), Norway
- Regiei Autonome Tehnologii pentru Energia Nucleara - Institutul de Cercetari Nucleare Pitesti (RATEN), Romania
- Amphos 21 Consulting SL, Spain
- Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Spain
- Agencia Estatal Consejo Superior Deinvestigaciones Cientificas (CSIC), Spain
- Empresa Nacional de Residuos Radioactivos SA (ENRESA), Spain
- Universidad Autónoma de Madrid, Spain
- Paul Scherrer Institut, Switzerland
- Galson Sciences Limited, United Kingdom
- University of Manchester, United Kingdom
- University of Sheffield, United Kingdom
- National Science Centre Kharkov Institute of Physics and Technology (KIPT), Ukraine
- Institute of Environmental Geochemistry, National Academy of Science, Ukraine



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PROJECT STRUCTURE



WP2 Strategic Studies - TASKS

- Task 2.1 Establish a pre-disposal stakeholder community (SCK•CEN)
 - Mapping who has interest in this topical area, who gives feedback on project issues
- **T2.2 Development of a pre-disposal strategic research agenda (NNL)**
 - Priorities for future R&D, Deliverable draft due August 2021, revised 2023-24. **SHARE Inputs?**
- Task 2.3 Waste acceptance systems (CVRez)
 - Including assessments from WP4-7 cases
 - Close interaction with EURAD (WP9 Routes), IAEA, NEA etc
- Task 2.4 Governance (VTT)
 - How to integrate waste producers to future joint program decision making body?
- Task 2.5 Cross work package strategic assessment (CEA)
 - Including Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) from WP4-7 case studies
- **Task 2.6 Gap Analysis pre-disposal needs (VTT)**
 - Justification for how this project was chosen. Deliverable draft due May 2021. **SHARE Inputs?**



WP3 Knowledge Management - TASKS

- Task 3.1 Development of Knowledge Management Programme (Amphos 21)
 - Develop a pre-disposal programme **aligned with EURAD project**, KM platform and tools
 - Require at different stages feedback from end-users

- Task 3.2 State of Knowledge (SoK) (UJV)
 - Evaluate what knowledge is needed and how to ensure transfer to future generations
 - Executed in close collaboration with PREDIS WP3-7

- Task 3.3 Developing and Implementing Training Programme (Amphos21)
 - Target internal and external training modules and events
 - **Close cooperation is** planned with EURAD, SNE-TP, IAEA, NEA, PREDIS beneficiaries, ...

- Task 3.4 Implementing Mobility Programme (UJV)
 - Target internal partner mobility, but external could be an option



WP4 – Innovations in metallic material treatment and conditioning

- Develop innovative conditioning matrices for reactive metallic wastes.
- Develop innovative and optimised characterisation techniques for metallic wastes.
- Demonstrate innovative techniques to decontaminate metallic wastes to quantify the efficiency of decontamination processes and allow more effective application of the waste hierarchy.
- Develop treatment techniques for secondary waste streams after decontamination.



WP5 – Innovations in liquid organic waste treatment and conditioning

- Study of innovative materials (geopolymers) and their interactions with ROLW
- Development of direct conditioning solutions for RLOW based on geopolymer from TRL3 to TRL6 including validation tests with real waste and feasibility scale-up tests.
- Optimisation of geopolymers options and formulations to optimise ROLW encapsulation, especially incorporation rates and matrix performance.
- Process robustness regarding waste, raw materials and process variability including study definition and execution of non-standard tests to verify the stability and durability of the final waste form.
- Disposability assessment from the study of matrix performances and long-term behavior including “technical standard tests” related to WAC when available and scientific approaches for deeper physico-chemical understanding including the development of methodologies to evaluate parameters important for disposability assessment.

WP6 – Innovations in solid organic waste treatment and conditioning

- Closing the cycle for treatment of RSOW by proposing, developing, testing and verifying suitable matrices for conditioning of residues and secondary wastes stemming from (thermal) treatment options (like those investigated within THERAMIN).
- Development of geopolymers as alternative binder material to ordinary cement-based systems for conditioning of residues and secondary wastes.
- Demonstrate robustness of full treatment cycle for selected RSOW waste streams.
- Assessment of full treatment cycle in terms of technology and economical assessment, achieved volume reduction factor, final conditioned matrix performance and related WAC for different primary waste stream physico-chemical characteristics.

WP7 – Innovations in cemented waste handling and pre-disposal storage

- Innovative NDE tools for evaluation of package integrity, including, but not limited to visual methods, muon tomography and ultrasonic techniques
- Innovative sensor technologies for instrumented packages, including, but not limited to fiber optical techniques and methods for wireless power supply and data transmission
- An approach for developing and maintaining digital twins of packages, including a package evolution model based on inventory data, chemical and mineralogical characterisation data, data from chemical modelling, and monitoring data
- Application of machine-learning algorithms, trained on digital datasets, to produce a fast and accurate description of the geochemical evolution and the geo- and thermo-mechanical integrity of radioactive waste packages during pre-disposal
- A digital twin of a radioactive waste package based on machine-learning algorithms that can offer advanced information for waste package inspection protocols and, thus, contribute to safety of storage facilities
- Large digital database to train the machine-learning algorithms
- A decision framework model that is based on existing knowledge, data from measurements and predictions from digital twins
- Advancement of the overall TRL for data handling, processing and fusion in the context of intermediate radioactive waste storage from 4 to 6
- Reports on treatment options for existing packages, potential improvements in package design and recommendations for store automation concepts.

GETTING INVOLVED TO THE PROJECT

- Project expects high level of cooperation with Stakeholders Group (wider community) and End User Group (focused group).
- NPPs and WMOs are direct users of results = End User Group (EUG)
- Both are volunteer groups, without financing or obligations (or voting rights)
- EUG: Need to send Application form (contact name, areas of interests) and signed Commitment letter (non-disclosure agreement). Available from VTT/Coordinator upon request
- Approval of EUG members done by General Assembly vote (EU/Euratom member countries assumed automatic approval). Every 3-6 months.
- Can also register via project web page <https://predis-h2020.eu/>
- Next public events include free online webinars and gap analysis survey (Jan-March 2021)





Thanks! Questions?

WE LOOK FORWARD TO INTEGRATING **SHARE**
OUTCOMES & CONTINUING COOPERATION

Comments & questions not answered today – please be in touch erika.holt@vtt.fi



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EXTRA SLIDES – TECHNICAL WP SPECIFICS



WORK PACKAGES & LEAD CONTACTS

- WP N°1: **Project Management & Dissemination.** VTT (erika.holt@vtt.fi & maria.oksa@vtt.fi)
- WP N°2: **Strategic Implementation.** NNL (anthony.w.banford@uknnl.com).
Networking issues including issues on stakeholder engagement, SRA updates, waste acceptance/classification, LCA/LCC.
- WP N°3: **Knowledge Management.** JRC (Paul.CARBOL@ec.europa.eu)
with assistance from Amphos21 (lara.duro@amphos21.com) and UJV (Vaclava.Havlova@ujv.cz). Addressing state of knowledge, training/mobility.
- WP N°4: **Innovations in metallic material treatment and conditioning.** IMT-Atlantique
(Bernd GRAMBOW - grambow@subatech.in2p3.fr)
- WP N°5: **Innovations in liquid organic waste treatment and conditioning.** CEA (Maxime.FOURNIER@cea.fr)
- WP N°6: **Innovations in solid organic waste treatment and conditioning:** SCK•CEN (thierry.mennecart@sckcen.be)
- WP N° 7: **Innovations in cemented waste handling and pre-disposal storage:** BAM (ernst.niederleithinger@bam.de)



WP4 Metallic material treatment and conditioning - TASKS

- T4.1 WP management (IMTA)
- T4.2 Defining Europe-wide Needs and Opportunities for Management of Metallic Waste Streams (GSL)
- T4.3 Development and optimisation of decontamination processes (IMTA)
- T4.4 Optimisation of metallic waste characterisation and procedures for waste minimisation and recycling (NCSR)
- T4.5 Encapsulation of reactive metals in magnesium phosphate cement-based matrices (CNRS)
- T4.6 Dissemination (IMTA)



WP5 Liquid Organic waste treatment and conditioning - TASKS

- Task 5.1 WP5 Management (CEA)
- Task 5.2 Collection & review of waste, regulatory, scientific & technical data (GSL)
- Task 5.3 Study of direct conditioning process (RATEN & SOGIN)
- Task 5.4 Study of conditioning matrix performances (ECL & USFD)
- Task 5.5 Preliminary technical, economic and environmental analysis (GSL)
- Task 5.6 Implementation & dissemination (UNIFI)



WP6 Solid Organic waste treatment and conditioning - TASKS

- Task 6.1 Work package management (SCK•CEN)
- Task 6.2 Database on solid organic waste forms and their final state and value assessment analysis (GSL)
- Task 6.3 Thermal treatment of the radioactive waste forms and characterisation of the treated / reconditioned wastes (CEA)
- Task 6.4 Immobilisation of the treat wastes by geopolymer or cement-based materials encapsulation or by molten glass coating (CVRez)
- Task 6.5 Densification (USFD)
- Task 6.6 Physico-chemical characterisation of reconditioned waste form and stability testing (VTT)
- Task 6.7 Economic and Environment impact - Implementation (GSL)
- Task 6.8 Dissemination and Reporting (SCK•CEN)

WP7 Cemented waste handling and pre-disposal storage - TASKS

- Task 7.1 WP management (BAM)
- Task 7.2 State of the art in packaging, storage, and monitoring of cemented wastes (GSL)
- Task 7.3 Innovative integrity testing and monitoring techniques (BAM)
- Task 7.4 Digital Twin (PSI)
- Task 7.5 Data handling, processing and fusion (VTT)
- Task 7.6 Demonstration and implementation of monitoring, maintenance, and automation/digitalisation techniques (Orano)
- Task 7.7 Dissemination and Reporting (GSL)

