



#### Supplement of

# **PREDIS:** innovative ways for predisposal treatment and monitoring of low and medium radioactive waste

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SafeND Symposium 2021

# PREDIS: INNOVATIVE WAYS FOR PRE-DISPOSAL TREATMENT AND MONITORING OF LOW AND MEDIUM RADIOACTIVE WASTE

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www.bam.de

#### Safety in technology and chemistry









#### Research, testing and consultation under one roof







Consulting the German Federal Government and Industry



Research and development



Contribution to standards and statutory regulations



Testing, analysis, approval



Technology transfer





#### **One of five focus areas**





#### Activities

- Energy storage
- Energy conversion
- Energy transport
- Nuclear waste management





## **BAM Division 8.2**



### NDT methods for civil engineering

- Development, optimization and application of non-destructive testing methods for inspection an monitoring of all kinds of constructions
- Methods: Ultrasound, Radar, LIBS, embedded sensors
- Combination with competencies of other divisions (fiber optics, AE, NMR, CT/X-Ray, half cell potential: We have it (almost) all! Automatisierung, Digitalisierung
- Application focus: Infrastructure & buildings, new constructions methods and materials, nuclear constructions
- R & D, validation, standardization, testing (special cases), trainings/workshops

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#### **Euratom PREDIS**



EU-project PREDIS: Pre-disposal management of radioactive waste

Coordination: Erika Holt , Maria Oksa (VTT)

47 partners 24.7 M€ budget

https://predis-h2020.eu

Innovative R&D approaches

#### Low & intermediate level waste types





### **Euratom PREDIS 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**.



#### **Euratom PREDIS**

#### Where is the connection? Concrete!











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#### Euratom PREDIS WP7

- Compile information about the state of the art of current methods and procedures for cemented waste management with specific focus on monitoring/long-term storage
- Identify, evaluate and demonstrate store and package quality assurance (mainly NDE) and monitoring technologies
- Adapt and demonstrate digital twin technology
- Develop and demonstrate methods for **data handling incl. decision framework**
- Identify opportunities for increased store automation, reducing human exposure to radiation

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

 Identify options for **post treatment** of packages and potential approaches to **improve package** design, construction and maintenance.







#### **Euratom PREDIS WP7**









### Euratom PREDIS WP7-T7.2: State of the Art





#### 1st deliverable submitted: State of the art report:

https://predis-h2020.eu/wp-content/uploads/2021/03/PREDIS D7.1 WP7-SOTA V1-Final 2021 02.pdf **1st milestone accomplished:** 

<u>Milestone 50 – Reference package and factors affecting package evolution and degradation (WP7, Task 7.2.2)</u>



#### Euratom PREDIS WP7-T7.3: Testing and Monitoring





Our largest tool: Muon Tomography





#### Euratom PREDIS WP7-T7.3: Testing and Monitoring







Our smallest tools: RFID sensors

- Temperature
- Humidity
- Pressure
- Corrosion

- ....





### Euratom PREDIS WP7-T7.4: Digital Twin







#### **Euratom PREDIS WP7-T7.5: Data/Decision Framework**



VTT







### **Euratom PREDIS WP7-T7.6: Demonstration**





- Subtask T7.6.1 Evaluation of technologies and developed systems from an end-user perspective
  - Develop a waste package prototype for performing large-scale trials,
  - choose and evaluate the most relevant and promising NDE/sensing techniques

#### Subtask T7.6.2 Demonstrating systems and methods

- Implement the experimental set-up defined in Subtask 6.1,
- · Select the technologies to be validated,
- perform a series of full-scale trials in a realistic testing environment

# Subtask T7.6.3 Definition of potential mitigation actions and design improvements

 Proposal of improved designs that eliminate any weak points identified during the course of the project and conceptual design for the use of the project results in automatized store concepts







### **Euratom PREDIS** WP7: Impact



More versatile and reliable condition monitoring technologies, which have been demonstrated on operating radioactive facilities and made available to end users

**Improved accuracy in predicting the behaviour of waste/packages** in stores through the integration of models with store and package monitoring information obtained using digital and machine learning technologies to enhance sampling, monitoring strategies and multi-method data fusion

**Increased safety**: reduction of exposure time to personnel connected to remediation activities, reduction of risk of RN dispersion (locally or to the environment), gaining local stakeholder trust

**Reduced cost** (20% or greater reduction in costs related to late-stage detection of damage or deterioration within waste packages)

**Minimised environmental footprint** resulting from optimised treatment, packaging and store operations.



### **Euratom PREDIS WP7: Deliverables**



All 10 deliverables in WP7 are of the type "public" and will be made available to anybody interested in the project and its results.

Reports and publications can be downloaded from the PREDIS project website. Topics covered will be:

- innovative integrity testing and monitoring techniques and its demonstration
- digital twin and modelling technologies
- innovative data handling and decision framework technologies
- report on the economic, environmental, and safety impact

The State of the Art report is already available, other reports/articles will be published in 2023 & 2024





### Euratom PREDIS Events



Stakeholder free on-line webinar series continues in autumn 2021, addressing industry needs in pre-diposal management:

- 26.10. at 9-12 CET on PREDIS developments of geopolymers for pre-disposal waste management (WP4-6 issues)
- 25.11. at 9-12 CET on PREDIS State of Knowledge (WP3 covering knowledge documents, training, mobility activities and opportunities)
- Q1/2022: Digital Twin technology (WP7)
- 25-27.4.2022, PREDIS Annual Workshop, Berlin, Germany
- 18-20.1.2023, International Conference on Non-destructive Evaluation of Concrete in Nuclear Application, Espoo, Finland

