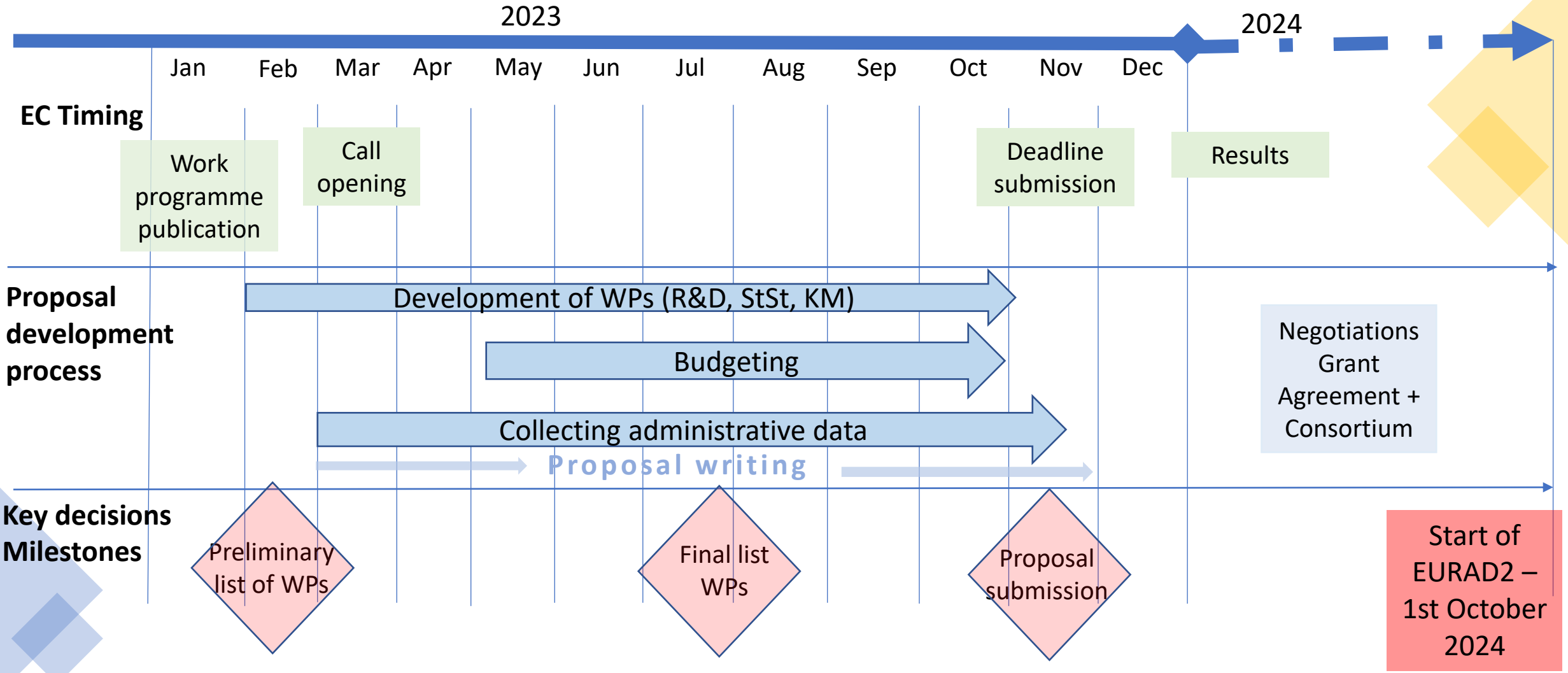
EURAD-2
European Partnership on Radioactive Waste Management

Moving forward EURAD-2 – Timeline



EURAD-2 scope

- All types of disposal (RWM activities from cradle to grave – except decommissioning) and full range of radioactive waste (from VLLW to HLW)

- Based on the same documents : EURAD Vision, Roadmap and updated SRA

- Same objectives and type of activities:
  - Develop, maintain and consolidate the scientific and technical basis of radioactive waste management ⇒ **R&D WPs**
  - Address important & complex issues and enable expert networking ⇒ **Strategic Studies WPs**
  - Enhance KM and transfer between organisations, MS and generations ⇒ **KM WPs**

Participation rules

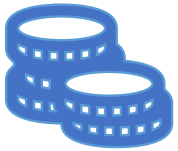
- Flexible and inclusive programme
  - 1st wave of WPs launched at the start of the programme (defined in the proposal submitted in November 2023)
  - 2nd wave of WPs launched during the course of the programme (defined in 2025-2026)

- Co-funded partnership
  - Commitment to provide the co-financing. Each partner must be able to bear the costs that are not funded by the EC
  - Co-financing will vary depending on the type of activity
  - Partners will actively participating to the work (different from end users)

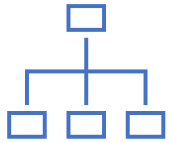
WP1 – Programme Management Office - PMO

The 'Programme Management Office' (PMO) has a strategic role in ensuring the overall coordination of the deployment of EURAD-2. More specifically, the PMO ensures:

- Day-to-day management of the administrative, legal and financial aspects;
- Internal communication between EURAD-2 Beneficiaries (Mandated Actors);
- Reporting to and interfaces with EC;
- Scientific and technical coordination of the overall programme of activities (RD&D, Strategic Studies, Knowledge Management, Interaction with Civil Society);
- Dissemination of EURAD-2 progress and overall results (of RD&D WPs, Strategic Studies WPs and KM WPs) and outreach activities



4 M € (funded 100 %)



Andra, WMO, France
Louise Théodon

5 years

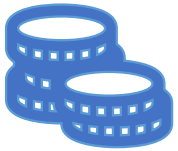
To be further defined

Knowledge Management

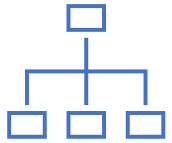
- Establishment of a Knowledge Management Committee to define the content and priorities
- Based on lessons learned from EURAD-1 and PREDIS
- Access KMC position paper

WP2 – Knowledge Management- KM

The overarching goal is to establish an EURAD-2 Knowledge Management (KM) programme which is intended to become sustainable over 10 to 20 or more years. The programme not only focusses on different aspect in the building and maintaining of competences in the field but complementing those actions which are already present on national and international (IAEA, NEA) level. The overall objectives of the KM programme are to overcome the competence generation gap by making sure resources are effectively aligned to maintain a sufficient, competent and qualified radioactive waste management workforce. Furthermore, the KM programme will support Member States at different levels of progress in implementing the waste directive (2011/70/Euratom) within the realms of EURAD-2 by boosting knowledge transfer from more advanced to less advanced programmes. Another general objective is effective implementation of the KM programme by establishing an inclusive collaborative framework that feeds and keeps up to date the EURAD Roadmap, enabling users to access existing information and knowledge and active work or future plans related to all phases of a radioactive waste management programme.



4 M € (funded 100 %)



Amphos 21, RE, Spain
Alba Valls

5 years

To be further defined based on activities

Structure of Knowledge Management WP

- Task 1: KM Programme Management
- Task 2: Knowledge Capture
- Task 3: Knowledge application and Know-How development (guidance, European infrastructures on RWM)
- Task 4: Competence building (training, mobility, mentoring and networking)
- Task 5: KM programme tools and methods (KM platform, data management, innovative and alternative methods)
- Task 6: Financing of KM subtasks of R&D and Strategic Studies WPs

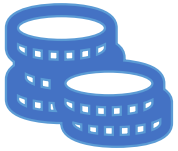
Overview of the technical content

Programme Management	• Alternatives RWM strategies (WP3 – ASTRA) • WM for SMRs and future fuels (WP4 – FORSAFF)
Predisposal	• Innovative characterisation techniques for large volumes (WP5 – ICARUS) • Sustainable treatment and immobilisation of challenging wastes (WP6 – STREAM) • Long-term performance of waste matrices (WP7 – L'OPERA)
EBS	• Release of safety relevant RN from SNF (WP8 – SAREC) • Innovative and new containers/canisters materials (WP9 – InCoManD) • Hydraulic mechanical chemical evolution of bentonite (WP10 – ANCHORS) • HLW repository optimisation including closure (WP13 – OPTI)
Geoscience	• Impact of climate change on nuclear waste management (WP11 – CLIMATE) • Radionuclide mobility under perturbed conditions (WP12 – RAMPEC)
Optimisation	• Near surface disposal optimisation (WP14 – SUDOKU) • Digital twins (WP15 – DITOCO2030) • High-fidelity numerical simulations of coupled processes (WP16 – HERMES)
Safety Case	• Criticality Safety (WP17 – CSFD) • Thermodynamic database (WP18 – DITUSC)

Strategic Study

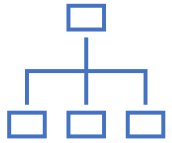
WP3 – Alternatives RWM Strategies - ASTRA

Analysis of readiness, feasibility and challenges of alternative RWM solutions needed by many countries, in particular SIMS, but also larger programmes due to new requests accruing in national programmes to safely manage and dispose of their waste.



700 k € (funded 100 %)

2 years



COVRA, WMO, Netherlands
Marja Vuorio

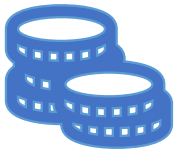
Andra, ARAO, DEKOM, EGIS, INCT, IRSN, NTW, IST-ID, EIMV, Energorisk, NCSRD, DMT, NES, NRG, SSTC NRS, SURO, TNO, TUS, U Tartu, VTT.

Associated Partners: Galson, NWS, PSI, Sandia Lab.

Strategic Study

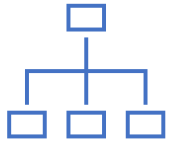
WP4 – WM for SMRs and future fuels - FORSAFF

Develop understanding and provide recommendations on SMR deployment and supplier options, with respect to nuclear waste management.



1 M€ (funded 100 %)

2 years



VTT, TSO, Finland
Timothy Schatz

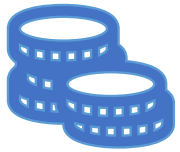
Andra, Bel V, CEA, CIEMAT, MERIENCE, CVR, UJV, POLIMI, INCT, IRSN, CEPN, NTW, EIMV, Amphos 21, LEI, NRG, TVO, RATEN, SKC CEN, SIIEG NASU, SSTC NRS, SURO, TUS, U Tartu

Associated Partners: Galson, IFE, NWS, PSI, Sandia Lab

R&D

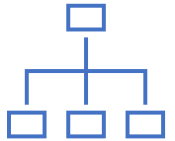
WP5 – Innovative characterisation techniques for large volumes- ICARUS

Further development, optimization and harmonization of innovative techniques for characterizing radiological, physical and chemical properties of LLW/ILW-mixed waste which could be critical for the safe implementation of radioactive waste management programmes, including destructive techniques (DT) on laboratory scale and its relation to non-destructive techniques (NDT) and scaling factors (SF) at the raw waste and package scale user cases



4,4 M€ (funded 50 %)

5 years



POLIMI, RE, Italy
Eros Mossini

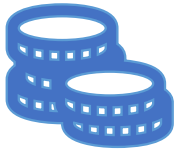
ARAO, ORANO, CIEMAT, CSIC, CNRS, IMT Atlantique, CVUT, DTU, SORC, ENEA, CAEN, UNIPI, ENRESA, INGECID, US, FTMC, JSI, Energorisk, NCSRD, NRG, NTUA, RATEN, SCK CEN, Tractebel, SKB, SSTC NRS, VTT

Associated Partners: IFE, PSI

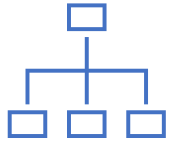
R&D

WP6 – Sustainable treatment and immobilisation of challenging waste - STREAM

Innovative and sustainable design, optimization and upscaling of treatments and conditioning materials for the predisposal of problematic waste



4 M€ (funded 50 %)



CEA, RE, France
Hélène Nonnet

5 years

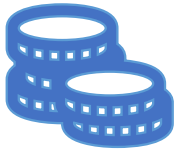
ORANO, CIEMAT, UAM, CSIC, CNRS, IMT Atlantique, POLIMI, UNIPI, ENRESA, IAE, INCT, ZAG, EIMV, KIPT, RATEN, SCK CEN, SIIEG NASU, SOGIN, U Tartu, VTT

Associated Partners: NNL, NWS, PSI,

R&D

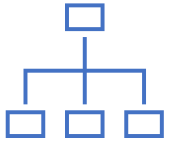
WP7 – Long-term performance of waste matrices – L'OPERA

Demonstrate long term behaviour and durability of matrices and final wasteforms.



4 M€ (funded 50 %)

5 years



SCK CEN, RE, Belgium
Thierry Mennecart

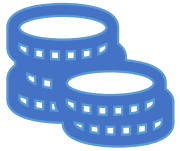
Andra, CEA, ORANO, CIEMAT, UAM, CSIC, CNRS, Centrale Lille, CVR, CTU, UJV, ENEA, POLIMI, UNIPI, Uni Roma, UDC, INCT, IRSN, NRG, RATEN, SIIEG NASU, SOGIN, SURAO, VTT

Associated Partner: EMPA, PSI

R&D

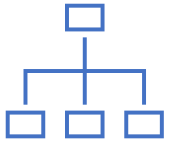
WP8 – Release of safety relevant radionuclides from spent nuclear fuel under deep disposal conditions – SAREC

Improved quantification and mechanistic understanding of the release of safety relevant radionuclides covering most representative types of spent nuclear fuel (SNF) and of the fuel evolution both prior and posterior to contact with ground water to better predict the radionuclide source term for post-closure safety assessment.



5 M€ (funded 50 %)

5 years



SKB, WMO, Sweden
Olivia Roth

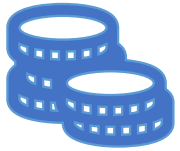
CEA, CIEMAT, CNRS, U Montpellier, EUT, UPC, FZJ, HZDR, IRSN, ENSMP, Energorisk, KIT, Amphos 21, KTH, ONDRAF/NIRAS, RATEN, SCK CEN, U Helsinki, VTT

Associated Partners: NWS, PSI, U Bristol, U Lancaster, ORNL, PNNL

R&D

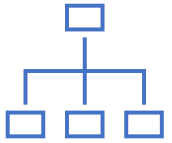
WP9 – Innovative and new container/canister materials under disposal fiels conditions – InCoManD

The WP aims at identifying and qualifying novel materials for the HLW containers/canisters, as well as providing a deeper knowledge of both traditional and novel materials long-term durability in, as realistic as possible, field conditions.



5 M€ (funded 50 %)

5 years



Andra, WMO, France
Aurélien Debelle

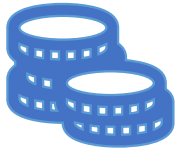
EMSE, GALTENCO, BASE, GNS, CIEMAT, UGR, UPM, CNRS, IMT Atlantique, U Montpellier, HZDR, UW, ZAG, KIPT, KIT, BAM, LUH, GRS, ONDRAF/NIRAS, POSIVA, SIIEG NASU, SURAO, VTT

Associated Partners: EPFL, LBNL, NWS, PSI, Sandia Lab, U Bern

R&D

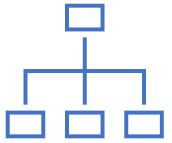
WP10 – Hydraulic mechanical chemical evolution of bentonite for barriers optimisation – ANCHORS

The objective of this WP is to increase the optimisation potential of bentonite barrier systems: buffer, backfill and seals, and the Safety Case resilience 1) by qualifying the Hydro Mechanical (HM) behaviour of various kind of bentonite types and mixtures through laboratory experimental programme focused on heterogeneity, chemical effects and friction at different scales and 2) by improving the numerical tools that are necessary to carry out performance assessment of bentonite barriers in a Thermo Hydro Mechanical Chemical (Gas) (THMC(G)) repository environment.



5 M€ (funded 50 %)

5 years



IRSN, TSO, France
Nadia Mokni

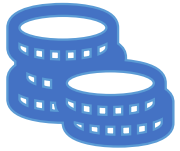
Andra, BRGM, BGE, CIEMAT, UCLM, CNRS, ENPC, U Lorraine, TUDelft, CVUT, IGN, CUNI, UJV, EK, ENRESA, CIMNE, UFZ, GI-Bas, BRG, Amphos 21, GRS, TUBaf, LEI, U Liège, POSIVA, SKB, Clay Tech, JYU, MITTA, VTT

Associated Partner: EPFL, ICL, LBNL, NAGRA, NWS, PSI, Sandia Lab, U Bern, U Strathclyde

WP11 – Impact of climate change on nuclear waste management – CLIMATE

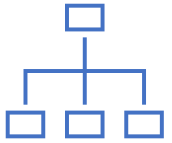
Strategic Study

Identify knowledge gaps and provide recommendations for future research needs on the impact of climate change on radioactive waste management facilities and sites (predisposal; shallow and near surface low level waste, LLW; deep geological repositories, DGR, for low and intermediate level waste LILW, and high-level waste HLW) during construction, operation and post-closure phases.



1 M€ (funded 100 %)

2 years



Amphos 21, RE, Spain
Aina Bruno

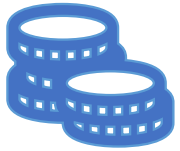
Andra, BRGM, BGE, TUL, ENEA, FTMC, GI-Bas, IRSN, ENSMP, NTW, EIMV, GRS, SCK-CEN, SSTC NRS, SURAO, TUS, GTK, MITTA, UT, VTT

Associated Partners: NAGRA, NWS

R&D

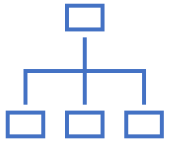
WP12 – Radionuclide mobility under perturbed conditions – RAMPEC

Improve the predictive capacity of models of disposal system chemistry and radionuclide mobility under perturbed conditions based on a combination of new experimental and modelling studies up to the cell scale.



5 M€ (funded 50 %)

5 years



KIT, RE, Germany
Marcus Altmaier

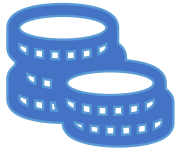
Andra, BRGM, CEA, EDF, CIEMAT, CNRS, U Orléans, U Poitiers, COVRA, CVUT, TUL, UJV, EK, FZJ, HZDR, IRSN, Amphos 21, GRS, LEI, NRG, SCK CEN, SSTC NRS, SURAO, U Helsinki, GTK, CTH

Associated Partners: BGS,EMPA, LBNL, NNL, NWS, PSI, Sandia Lab, Uni Manchester

Strategic Study

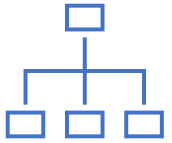
WP13 – HLW repository optimisation including closure – OPTI

Develop a mutual understanding and provide recommendations about methodologies and further activities for design and optimization of specific HLW deep geological repository systems, structures and components (SSCs) and procedures.



1 M€ (funded 100 %)

2 years



BGE, WMO, Germany
Philipp Herold

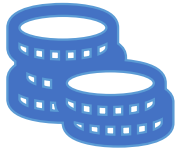
Andra, Bel V, CNRS, COVRA, TUDelft, CVUT, UJV, IRSN, NTW, EIMV, KIT, ONDRAF/NIRAS, U Liège, EURIDICE, POSIVA, PURAM, SCK CEN, SKB, SSTC NRS, SURAO, SURO, U Tartu, VTT

Associated Partners: NAGRA, PSI

R&D

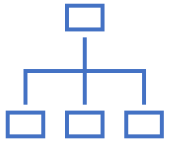
WP14 – Near-surface disposal optimisation based on knowledge and understanding – SUDOKU

Understanding the behaviour and performances of (i) covers and (ii)cementitious barriers of near-surface disposal facilities for short lived waste (ground level facilities) and ILW (shallow deep facilities) in view of these barriers optimization to ensure the long-term safety of disposal facilities



5 M€ (funded 50 %)

5 years



RATEN, RE, Romania
Crina Bucur

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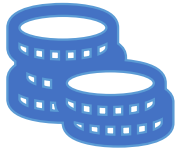
Associated Partners: NWS, PSI

Strategic Study

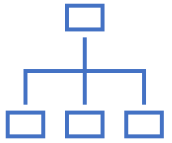
WP15 – Next generation Digital Twins – DITOCO2030

Lay-out the path on how to close the R&D gap between the currently fragmented digital twins (DT) of individual disciplines, common data environments and decision-making platforms to better understand the opportunities and limitations of DT in their deployment in whole life cycle of waste management.



0,5 M€ (funded 100 %)

2 years



IFE, RE, Norway
Réka Szőke

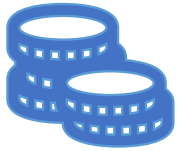
Andra, BRGM, BGE, UCLM, TUL, Uni Pi, Ingecid, EGIS, FTMC, HZDR, UFZ, IRSN, EIMV, Amphos 21, GRS, SCK CEN, Tractebel, SOGIN, SURAO, TS Enercon, Golder Associates, TUS, MITTA, U Tartu, VTT

Associated Partners: IFE, NAGRA, PSI

R&D

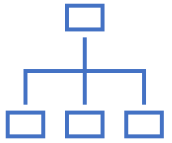
WP16 – High fidelity numerical simulations – HERMES

This WP aims at the development of high-fidelity numerical models for simulations of strongly coupled THMC processes in repository nearfield, repository design optimisation and interpretation of mock up experiments using a combination of physics based models and accelerated computing assisted with machine learning and artificial intelligence.



4 M€ (funded 50 %)

4 years



PSI, RE, Switzerland
Sergey Churakov

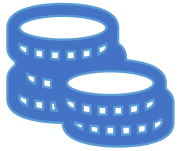
Andra, AGES, CEA, EDF, UCLM, CNRS, Ulille, U Lorraine, TU Delft, IGN, TUL, Uni PR, ENRESA, UDC, MUL, FZJ, GFZ, UFZ, IRSN, SURAO, TS Enercon, Golder Associates, TUS, MITTA

Associated Partners: LBNL, PSI, Sandia Lab

R&D

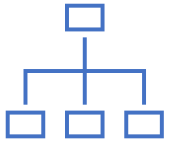
WP17 – Criticality safety for final disposal – CSFD

Explore the optimisation potential of the technical and administrative measures available for ensuring criticality safety in final disposal, attain an improved understanding of their methodological validation and experimental verification, and further consolidate the technical basis of the criticality safety argumentation for final disposal of fissile wastes



2,6 M€ (funded 50 %)

5 years



NAGRA, WMO, Switzerland
Madalina Wittel

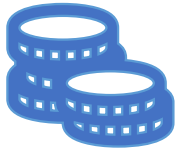
Andra, BGE, CIEMAT, CVUT, ENRESA, JSI, EIMV, GRS, LEI, POSIVA, PURAM, Tractebel, SKB, SSTC NRS, SURAO, VTT

Associated Partners: EPFL, Galson, Jacobs, NAGRA, NWS, PNNL, PSI, Sandia Lab

Strategic Study

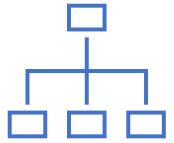
WP18 – Development and improvement of quality assured thermodynamis understanding – DITUSC

Thermodynamic understanding and quality assured data in support of the Nuclear Waste Disposal Safety Case, with special focus given to a transversal understanding



0,5 M€ (funded 100 %)

2 years



ONDRAF/NIRAS, WMO, Belgium
Stéphane Brassinnes

BRGM, BGE, CEA, CIEMAT, IMT Atlantique, FZJ, HZDR, USZ, KIT, Amphos 21, GRS, SCK CEN

Associated Partners: EMPA, KAIST, LLNL, PSI, Sandia Lab, Uni Kyoto

Thank you for your attention

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