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The PREDIS (Predisposal Management of Radioactive Waste)

project has reached its fourth and final year. The predisposal community with 47 partners from 17 European countries have been actively developing solutions for treatment and conditioning methodologies of low and intermediate level waste, focusing on metallic materials, organic liquid and solid wastes as well as monitoring of waste packages. Digital innovations to support the decision making and different waste management paths have been developed and demonstrated during the project. The target has been to improve safety and efficiency of handling the waste as well as assess the life cycle and cost of the developed methods. The PREDIS research community has been communicating with the end users regularly to ensure the applicability and benefits of the developed innovations. For future, the strategic research agenda (SRA) is being finalised with the prioritised research topics, online and hands-on training have been offered to educate young generations for nuclear waste treatment challenges and an extensive contribution to the knowledge management is on-going in collaboration with EURAD programme to populate the EURAD Roadmap with predisposal know-how.

PREDIS project results have already been presented in multiple scientific publications and conference presentations, which can be found in the PREDIS website. The PREDIS final conference that will show the outcomes and impact of project results will take place in Avignon, France, in June 2024. We welcome you all warmly to take part to the event.



PREDIS Management Team enjoying the barbecue in the evening after a productive meeting day hosted by BAM, Berlin, in September 2023.

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.



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We are wishing you a wonderful and relaxing holiday season!

- Maria Oksa (VTT), Project Coordinator and Erika Holt (VTT), Project co-coordinator

PREDIS PROJECT'S FINAL CONFERENCE

HIGHLIGHTING THE PROJECT OUTCOMES AND IMPACTS FOR
INDUSTRY AND MEMBER STATES

3-7 June 2024 in Avignon, France

REGISTER [HERE](#) or from the QR:



PREDIS at IAEA November Conference

PREDIS was well represented with three oral presentations and a panel discussion at the IAEA's *International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation*, held in Vienna on 6-11 November 2023. The collaboration with IAEA greatly benefits PREDIS for the wide reach of the worldwide international waste management community, as was also shared by Rebecca Robbins (Radioactive Waste Team Leader (Predisposal) at International Atomic Energy Agency (IAEA)) during her presentation at the PREDIS workshop in May 2023 in Belgium (Figure 1). The IAEA and PREDIS have common targets for providing baseline and detailed knowledge, guidance and training to help waste owners, waste management organizations, governments and other stakeholders to advance their programme, via safe and sustainable solutions which was the theme of the IAEA's November conference. Download the PREDIS presentations and papers from the November IAEA event [here](#).



Figure 1. Cooperation between IAEA, PREDIS, EURAD and other international organizations (Robbins, 2023).

References:

Rebecca, Robbins. (2023). *IAEA Perspective on the Impact of Collaboration with Euratom Projects* [Presentation at PREDIS Workshop, Mechelin, Belgium, May 2023]

PREDIS Final Conference

PREDIS Final Conference will be organized in June in Avignon, France, by CEA. The event is intended for all PREDIS partners, end users and interested stakeholders.

When and where?

3 – 7 June 2024 at Novotel Avignon Center, Avignon, France

Welcome to the Final Conference of the PREDIS project to learn the outcomes of project on technology innovation & developments in predisposal of radioactive waste management. It is also a perfect opportunity to connect with the pre-disposal community and end users. 3–4 June is restricted to consortium partners, while 5–7 is public and open to all.

Registration is Now Open! https://www.lyyti.in/PREDIS_Final_Conference_03070624

Preliminary agenda of the conference:

Monday 3.6.2024 13 – 18 CET

WP1 Management Team meeting

- Restricted only to PREDIS Management Team

WP3 Students session

- Only for PREDIS Students

Tuesday 4.6.2024 9 – 17 CET

All PREDIS Partners

9-10 WP1 – WP3 specific issues

10-15 WP4-7 Parallel technical sessions

15-17 General Assembly, other issues

17.30-19.30 Guided city/palace tour (optional)

Wednesday 5.6.2024 - Public

Scientific presentations from all WPs

- incl. Student presentations

Thursday 6.6.2024 - Public

Presentations of main results and impacts

Presentations and two panel discussions

Conference dinner

Friday 7.6.2024 9-13 (optional)

All PREDIS Partners (and EUG, if spaces allow)

Technical visit to CEA Marcoule (max 50 persons)

Call for - Final conference speakers programme

If any end users or stakeholders would like to be part of our speakers' programme at the final conference in June 2024, please be in contact with us. We would love to have more case study examples of the impacts and benefits of the project to your company's operations, efficiency, and safety.



Work Package Updates

WP2: Strategic Implementation

Work Package 2 Strategic Implementation

On the PREDIS Strategic Implementation (WP2), progress has been made on the remaining tasks. The End User and Stakeholder Groups interactions remain strong. There will be many more opportunities in the coming months to hear more about outputs of the technical work packages as delivery accelerates.

WP2 hosted a webinar in early December to highlight the key priorities for future research as identified in the PREDIS Strategic Research Agenda (SRA) published earlier in the year. One final update of the earlier SRA (from 2023) will be issued before the completion of the project in 2024. The webinar also marked the kick-off of a Horizon Scanning exercise which will consider how changes in the 'nuclear landscape' could affect the predisposal research needs and opportunities over the next 5-10 years. The outcomes results will be included to the SRA update.

Elsewhere in WP2 in the Waste acceptance systems sub task, the team have finalised and issued the public [Deliverable 2.5](#) Assessment of feasibility of waste form characterisation methods and Milestone 12 Preliminary list of generic waste acceptance criteria.

As we are now in the final year of the project there is an increasing focus on the delivery of the Life Cycle Analysis (LCA) and Life Cycle Costing (LCC) tasks and this work is progressing well, with case studies due for earlier 2024 directly analysing technical WP results.

It was great that WP2 partners had the opportunity to participate in the recent 'International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation: Ensuring Safety and Enabling Sustainability' at the IAEA headquarters in Vienna in November. Partners were taking part in panels, and presenting papers, highlighting in particular, the PREDIS end user engagement, Life Cycle Analysis and the strategic research agenda.

Conference reports

Rachael Clayton & Joel Kirk, PhD student researchers from the University of Manchester, attended the IAEA conference Vienna thanks to a mobility grant from PREDIS. Their research focuses on the life cycle environmental and costing impacts (LCA/LCC) of the predisposal waste treatment techniques being developed in PREDIS. This conference was perfectly positioned to provide them with an overview of how high-level decisions on waste management are made across the international community and how sustainability plays a key role in this. LCA is a valuable methodology that provides quantitative analysis of decisions, helping to guide strategic planning and optioneering.

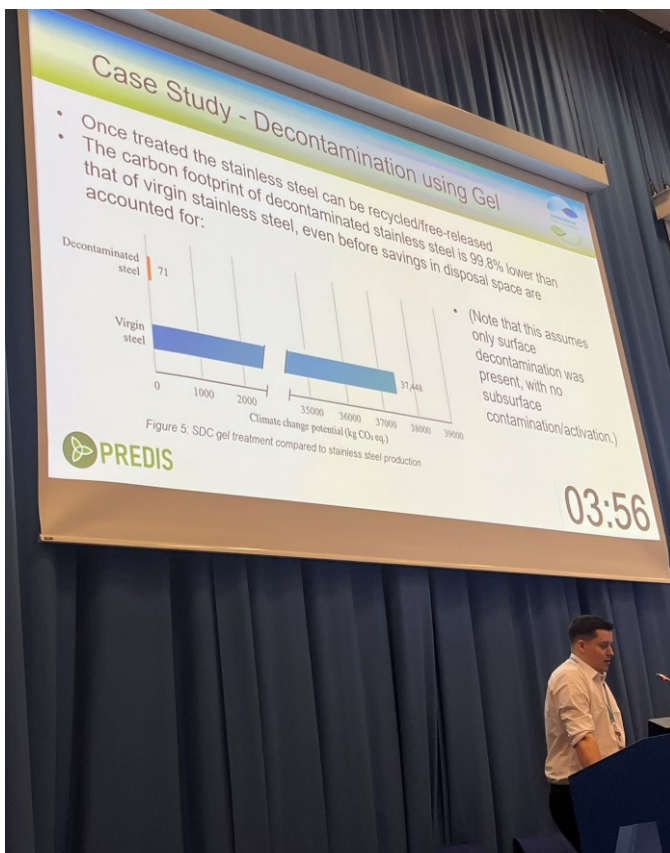


Figure 2. Joel Kirk (University of Manchester student) at the IAEA conference, presenting for WP2.

Rachael

My research focusses on assessing the life cycle environmental impacts of new and developing radioactive waste treatment options, specifically metallic waste and monitoring technologies in PREDIS (WP4 & 7). This IAEA conference helped highlight the importance of integrating sustainable thinking into decommissioning and waste management activities, and how international collaboration can accelerate approaches and foster learning through diversity of thought. It was also interesting to see the work from a top-level perspective, where our individual research can be used to make important decisions in policy and legislation. It was encouraging to see sustainability highlighted across the week-long conference and let me consider the implications of nuclear-related decisions made at present, particularly considering their enduring impact on future generations. Notably LCA can effectively identify emission 'hotspots' that may remain hidden during the initial stages of a project but become evident later in its timeline and so it was heartening to consider how my research could have a real impact on current decision making. This opportunity to speak to various stakeholders across the nuclear decommissioning landscape about their views on how sustainability is incorporated into their roles was very enlightening, and it was especially great to see their enthusiasm on the topic! It was specifically interesting to be given the chance to consider how the research I am conducting aligns with the UN's sustainable development goals and inherently works towards a safer future. Thank you PREDIS!

Joel

Like Rachael, my research also consists of modelling the life cycle environmental impacts of radioactive waste treatment technologies. Given my background in chemical engineering I take a specific focus on solid and liquid organic waste treatment technologies within the PREDIS project (WP5 & 6). Being able to attend the IAEA conference allowed me to be able to communicate the research I'm conducting with the wider nuclear sector, in particular those outside of Europe. The presentations I saw throughout the week, both in oral and poster form, showcased how environmental sustainability and life cycle thinking are paramount to the future of the nuclear sector. Being able to reduce our environmental impacts will not only prove to be vital in our joint fight against climate change but also will aid in the shift in public perspective of nuclear energy towards being both clean and safe. I was given the honour of being able to conduct an oral presentation on the Tuesday morning in the session titled 'Managing the interrelationships between safety and sustainability in decision-making'. Alongside fellow panellists, I highlighted the importance of LCA in radioactive waste management strategy by presenting the LCA case studies developed in the PREDIS project and showing how with adoption of novel waste treatment techniques, environmental impacts can be reduced. This was my first time speaking to a learned audience of this size and scope but, although nerve-wracking, this experience will in no doubt prove invaluable in my future professional career.



Figure 3. Joel and Rachel at a conference dinner.

WP3: Knowledge Management

Training course on Radioactive Waste Management operations, from retrieval to conditioning - (La Hague)

A training on radioactive waste management was held at the La Hague spent fuel reprocessing plant in France on 20-23rd November 2023. The training was hosted by Orano as one of the PREDIS partners and end users of the project results. During the training, participants attended several lessons given by Orano professionals and also visited La Hague reprocessing plant, gained knowledge on LLW and ILW management operations, and discovered Orano's container solutions and visited one of its container manufacturing plants. The training was attended not only by students, but also by PREDIS experienced partners and End User Group members, making for great interactions by all.



Figure 4. Participants of the radioactive waste management course



Figure 5. Participants of the WAC Summer School

An additional training was also provided by PREDIS and EURAD, within the Waste Acceptance Criteria Summer School, organized by partner CV Rez 4-8 September 2023 at Husinec, Czech Republic. The training provided a general overview of waste acceptance systems and criteria with a focus on different approaches in Europe. This training course was targeted to young specialists and consisted of lessons, discussion forums and visits to the Richard repository as well as the UJV/CVR waste processing facilities. In total, almost 40 participated in the training, including students from PREDIS, and EURAD among others.

During the next period, an on-line training will be held that covers the Domain Insights that are being produced as guidance signposting to key topics within the Predisposal Theme 2 of the EURAD Roadmap. Stay tuned for more information and registration for this free course!

Student session with EURAD final event

PREDIS penultimate student meeting will be held in connection with the EURAD final event, on 22nd of April 2024 in Bucharest, Romania. During this meeting, the students will be given opportunity to present the work of their respective WPs. During this session, EURAD students are also welcome to join in to get the opportunity to learn about the predisposal research performed within PREDIS. After these presentations, there will be a session open only for PREDIS students where they will be able to discuss their experiences as well as pros and cons of their technical work, communications within the student group and administrative matters within the PREDIS project. We are looking forward to meeting as many students as possible in this learning and social environment.

The registration to this event is now opened! Click [here](#) to register.

Dissemination

A knowledge management presentation was given by Paul Carbol (JRC, WP3 leader) at the ASME 2023 International Conference on Environmental Remediation and Radioactive Waste Management in Stuttgart, Germany, on 4 October 2023, with the title "Lessons Learned from Implementing Training and Mobility Programmes within EC H2020 Projects EURAD and PREDIS". The talk was given in conjunction with a presentation of the PREDIS project, given by Maria Oksa. The KM publication can be found at: <https://doi.org/10.1115/ICEM2023-110315>. A few other technical presentations were also shared and all details can be found on the PREDIS web page.

WP4: Innovations in metallic treatment and conditioning

The WP4 has made good progress last semester. The consortium partners presented their work during the autumn workshop organized by IJCLab (Orsay, France) on November 24, 2023. CEA has prepared new gels formulations using data from the CORD chemical decontamination optimized by IMT. The results showed good decontamination factors using the new gel formulations, consistent with the chemical decontamination (Figure 6).

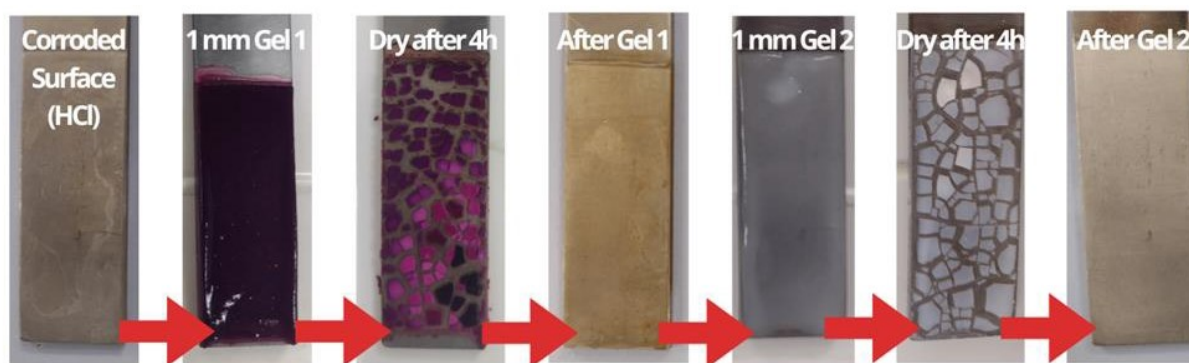


Figure 6. Decontamination of SS corroded samples using 2 steps: Gel 1 (containing $KMnO_4-HNO_3$) for Ni and Cr dissolution and Gel 2 (containing oxalic acid) for Fe dissolution (CEA, France).

Validation of the non-destructive gamma spectrometry measurements was conducted using metallic pipes internally contaminated by Cs-137 and different diameters (10, 20 30 cm) (Figure 7). Many configurations were tested and theoretical simulations were validated with good measurement efficiencies. With regards encapsulation of reactive metallic waste, new formulations testing selected fillers and different MgO qualities were prepared and alternative MgO source made of a mixture of 2 pure sources was selected for further investigations (Figure 8).

During the next period, a free on-line webinar is planned within WP4 addressing Difficult to Measure Radionuclide measurements and analysis. Stay tuned to the PREDIS web page for more information on the date and registration.



Figure 7. Metallic pipes contaminated with Cs-137 ready for non-destructive gamma spectrometry measurements (NCSR, Greece).



Figure 8. Magnesium phosphate cements prepared using excess of Mg to phosphate and volcanic ash as filler showing crystals of K-struvite: ($KMgPO_4 \cdot 6H_2O$) (UAM, Spain).

WP5: Innovations in liquid organic waste treatment and conditioning



Figure 9. Leaching experiments for four composites: AAM/oil. The chemical formulation of the AAM vary especially the w/s ratio. 20-25% vol of Nevastane or Shell mineral oil is stabilized in the activated binder. Task 5.4.4

Work Package 5 deals with the innovations in the liquid waste treatment and conditioning. The key idea to fulfill these objectives is to use a new class of mineral binders such as Geopolymers and related Alkali-Activated Materials. This WP5 is primarily divided in two scientific tasks. T5.3 consists in the design and optimization of some formulations of AAM and able to stabilize and condition some organic wastes. By using various raw materials such as metakaolin, slags and a mix of metakaolin/slag and fly ash. The reference formulations are now robust and adapted for different organic liquid. The matrix performances are assessed in the task 5.4 in various exposures such as endogeneous, aerated, carbonation, leaching, fire and stability under gamma irradiation. Conditioning some specific organic liquid such as TBP/Kerosen or liquid scintillation turns out to be a challenge that POLIMI tries to overcome by developing huge effort for stabilizing these liquids in the slag binders provided in the T5.3. Some specific formulation facilitates the conditioning of organic oil whereas some others does not play their role.

Tasks 5.4.2 to 5.4.4 involving several partners, deals with the leaching experiments in various conditions. In Figure 9, we show the importance of the water to solid ratio on the kinetic of leaching. Composites synthesized with a high w/s ratio have a highest porosity and consequently are more permeable to water. Calcium and sodium are the main elements leached.

WP5 focuses its efforts for the last part of the project to acquire more results on the stability of these new classes of mineral binders under irradiation and thermal and fire hazard tests.

We will have the opportunity to discuss all the results obtained in the WP5 and other WP during the PREDIS final conference to be held in Avignon, France from 3 – 7 June 2024.

WP6: Innovations in solid organic waste treatment and conditioning

PREDIS has entered the final year of the project and the development of matrices for the immobilization of (thermally) treated waste and the optimization of the processes have been accomplished. Most of the effort is now focused on stability and durability tests, postmortem characterizations of the samples and dissemination activities. Due to the large amount of data produced during the project and the variety of experimental results, particular attention is required on the management of these data.

Two public Deliverables (D6.1 and D6.2) were published. The first report, produced by CEA, gives a description of the different routes for the thermal treatment of the RSO and the physical and chemical composition of the resulting treated waste. CVRez delivered the second report, which focusses on methodologies for the conditioning of the treated waste by geopolymer or cement-based materials or by molten glass coating.

The stability and the durability of the conditioned treated materials were evaluated according to the common protocol defined in PREDIS and agreed between the partners. In addition to these experimental conditions aimed at comparing matrices performance independently of the nature of the samples studied, investigations under more specific conditions, *i.e.* directly linked to national requirements, were also conducted. Other leaching solutions were used (e.g. *in situ* water El Cabril disposal facility in Spain) or aggressive media to accelerate the degradation of samples to study 'aged' conditioned matrices. Some samples were submitted to external physical constraints such as gamma irradiation using a ^{60}Co source (Polimi) or temperature variation (freeze-thaw tests). Based on the evaluation of the short and long-term evolution of the (re-)conditioned waste and taking into account all the aspects of the processes involved in the immobilization of the RSO, an economic and environment impact study has been started (GSL). This study aims to demonstrate the cost-benefit and the reduction in waste volume, as well as the existence of mature technologies for the treatment and stabilization of RSO.



Figure 10. The pilot scale gasifier for the treatment of Ion Exchange Resins (SIIEG).

WP7: Innovations in cemented waste monitoring

NDT Methods' tested and Instrumented Mock-Ups: Exciting Milestone Achieved in PREDIS WP7: Successful Demonstration Test Launch

On October 23, 2023, a significant milestone was reached in our PREDIS WP7 project as we successfully launched our demonstration test at UJV Rez in Czech Republic.

The Vision: Unlocking the Potential of Non-Destructive Testing (NDT)

Our primary goal in this demonstration test was to unveil the true potential of Non-Destructive Testing (NDT) in monitoring cemented waste packages within storage conditions, safeguarding their long-term integrity. To make this vision a reality, we replicated a storage condition seen within end-user facilities, by indirectly stacking 21 cemented packages, each 200 liters/500 kilogramsT.

The Heart of the Test

Over the course of a thorough 3-month demonstration test at UJV Rez, we focused our efforts on three key NDT methods, all of which were developed within the framework of WP7 Task 3:

1. Sensorized radio frequency Identification Box for Gamma-ray and Thermal Neutron Monitoring (UNiPi, Italy)
2. SciFi Gamma Monitor and SiLiF Neutron Monitor (INFN, Italy)
3. Radio frequency identification (RFID) Embedded Sensors (BAM, Germany)

The success of this demonstration test is underpinned by our instrumented mock-ups, each tailored to serve a specific purpose:

1. **Alkali-Silica Reaction (ASR) Challenge with RFID Sensors:** The first mock-up, designed for assessing RFID embedded sensor technology, was meticulously crafted using Relative Humidity, Temperature and pressure embedded sensors and Belgoprocess aggregates from Belgium; This replicates the conditions susceptible to ASR, offering invaluable insights over time.
2. **Radioactivity Assessment with Cs-137 source:** The second mock-up, engineered for radioactivity assessment, features an aperture in the center, allowing us to insert a 167 MBq Cs-137 source. This design not only facilitates the measurement of radioactivity levels around the mock-up but also includes a deliberate defect or void within the package to identify anomalies or faults within cemented packages.



Figure 11. Stacked cemented packages.

Preparation and Collaboration: The Key to Success

The stage of this test was prepared at the outset of the PREDIS project and ended in October 2023 when the entire team involved in this project gathered at UJV Rez to participate in the setup. This preparation included the installation of the mock-ups in the storage configuration, preliminary tests with the technologies to ensure perfect integration and data transmission to the dedicated Azure platform. Troubleshooting procedures were also established to address any potential issues that may arise during the 3 months testing period.

UJV saw the group again for the 38th Work Package meeting in November, where the results of the demo test were presented and the course of the project during the remaining months of the project was discussed and planned.



Figure 12. Work Package meeting at UJV.

Integrated Objectives and a Collaborative Spirit

It's important to emphasize that this demonstration test is intricately connected to various works within WP7, with integrated objectives such as:

- **Increasing Technology Maturity (Task 3):** Our efforts will enhance or demonstrate the maturity of technologies developed within this task.
- **Digital Twin Development (Task 4):** Some of the results obtained will feed into the development of a Digital Twin.
- **Decision Framework (Task 5):** We will deploy a dedicated dashboard to share the results of this demonstration test, facilitating informed decision-making.

Conclusion:

This collaborative effort, bringing together multiple institutions from different countries, not only significantly enhances the maturity of the technologies developed but also exemplifies the spirit of a European project.

If you're eager to learn more about this test and its remarkable results showcased by posters and dedicated presentation, mark your calendar for the 2024 PREDIS annual workshop scheduled from June 3 to 7 in Avignon, France.

WP7 was also well-represented at the DigiDecom23 conference held in Helsinki, 24-27 October 2023 hosted by IFE (Norway) and VTT (Finland). Rainer DÄHN of PSI (Switzerland) gave an oral presentation "Experimental characterizations of 30-year-old radioactive waste packages and its use for the development of digital twins" highlighting some of the achievements of WP7 with an emphasis on the usability of the outcomes by the waste owners and storage facilities.

Student profiles



Fabio FATTORI is a nuclear engineer currently pursuing a PhD in Energy and Nuclear Science and Technology at Politecnico di Milano in Italy. His primary focus is on waste management, specifically the pre-treatment and immobilisation of challenging radioactive waste forms. During his MSc, he engaged with the PREDIS project, conducting a thesis work within WP4 focusing on the radiation stability of Magnesium Phosphate Cement. This opportunity led to an oral presentation at ICEM-2023 in Stuttgart. Currently, he is still actively evaluating potential radiation effects on these matrices with enthusiasm.

Thanks to the PREDIS mobility program, Fabio participated in two distinct PREDIS training sessions. One focused on LLW/ILW management, coinciding with a student gathering, at UJV Řez, Czech Republic, while the other centred on Pre-disposal Waste Management Operations at Orano's La Hague facilities. Both experiences provided valuable opportunities to engage with experts in the nuclear field within a friendly environment. These sessions not only expanded his knowledge and reinforced existing expertise but also facilitated networking with colleagues from diverse backgrounds. To Fabio, the training at La Hague facilities was of particular significance, allowing him to witness first hand many concepts he had previously encountered only in books, making it a once-in-a-lifetime experience.

Filip BABČICKÝ a graduate student enrolled in the Nuclear Chemistry Programme at the Faculty of Nuclear Sciences and Physical Engineering in Prague (Czech Republic), where he works in the Separation and radioanalysis research group. Filip's Master thesis focuses on the determination of difficult to measure radionuclides (DTM) from decommissioning of nuclear power plants, such as ^{41}Ca , ^{59}Ni , ^{63}Ni , ^{79}Se and ^{107}Pd , using mass spectrometric and radioanalytical methods (this research is related to PREDIS project WP4). Specifically, this involves the preparation of matrices of the relevant elements which may be suitable and possibly usable for analysis by accelerator mass spectrometry (AMS) in the future. In parallel, he is working on the optimization of the electrodeposition of low concentrated aqueous nickel solutions, with emphasis on the modification of the process conditions (concentration of nickel, current density, concentration of other ions, etc.).



Filip presented the results of his work in the form of a poster at the RANC conference in Budapest (2023, Hungary). He also had the opportunity to visit a spent nuclear fuel reprocessing plant in La Hague (France) as part of the PREDIS mobility programme (2023). During this trip he had the opportunity to link my knowledge of the chemical side of reprocessing to the practical side.



Esther Irene MARUGÁN completed her chemistry degree at the Complutense University of Madrid (Spain). She specialized in environmental chemistry and analysis methodologies through the Applied Chemistry Master's program at the Autonomous University of Madrid, conducting her master's thesis at ICMM-CSIC. Currently, she is pursuing her PhD at CIEMAT, where she collaborates on WP6 and WP5 of the PREDIS project, focusing on the immobilization of IERs (Ion Exchange Resins) and organic liquid waste in cementitious matrices and alkali-activated cements. Her research also includes various leaching studies.

Thanks to the mobility plan of PREDIS, she had the opportunity to attend the "EURAD-PREDIS Summer School on Waste Acceptance Criteria" held in CVRez Prague. During this event, she gained further insights into the fundamentals of Waste Acceptance Criteria (WAC), its development, and application. Additionally, she visited Richard's repository and familiarized herself with the UJV/CVR waste processing facilities. This experience enabled her to establish connections with professionals in the field, enhance her personal development and providing extra motivation to expand her knowledge further in the realm of radioactive waste management, the focus of her thesis.

Partner Spotlights

In this 7th Newsletter, we will highlight our partners from Germany and France



CNRS-IJCLab One group of IPNO (2012-2019) and after, IJCLab (2020-2023), works on the reactivity of nuclear metallic waste in conditioning matrices. The projects are focused Al, Al-Mg, MgZr, U, Be, and the steel, material of the primary package, in the Portland cement, widely used cement for conditioning low or intermediate level waste, and in new matrices, such as magnesium phosphate cements or geopolymers. The steel corrosion was also studied under the experimental conditions imposed by Cigéo, the geological storage site expected for the intermediate and high-level waste. The approach is mainly based on electrochemical measurements (Open circuit potential measurements, electrochemical impedance spectroscopy, cyclic voltammetry), gaseous chromatography, analysis in solution (ICP-OES), surface characterization (XRD, SEM/EDX) and thermodynamic calculations. The goal

is to predict the risk at long term caused by the metal corrosion in the storage, such as the hydrogen formation or the damage of the steel package. This team has laboratories in a controlled area for experimental studies on nuclear materials, such as uranium and thorium, and it has a laboratory dedicated to the manipulation of Be, which is highly toxic.

This partner contributes to WP4 of PREDIS project, and especially to the task 6 "Encapsulation of reactive metals in magnesium phosphate cements (MPC)". The work concerns both the optimization of the MPC cost in collaboration with ORANO (Sub task 6.2) and the steel corrosion in MPC (Su task 6.6).

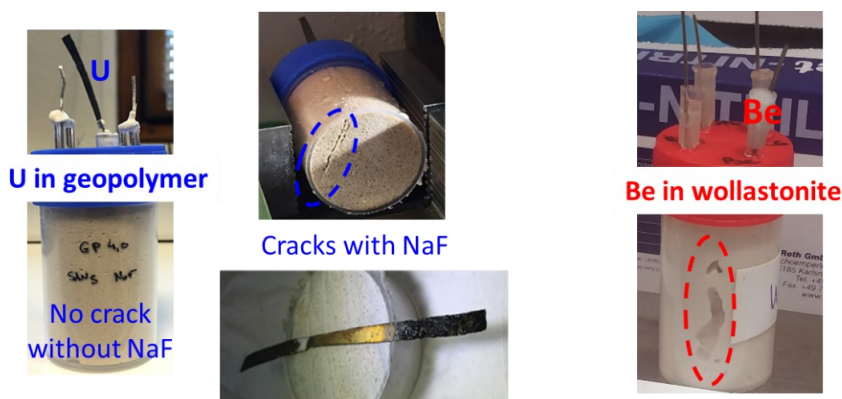


Figure 13. Samples of CNRS-IJCLab.



DMT GROUP is a global engineering services and consultancy group headquartered in Essen, Germany, trusted to develop, deliver, support, and maintain game-changing energy, infrastructure, natural resources, and industrial projects in 30 locations across the world. Throughout our 280-year history, DMT has been delivering engineering performance and shaping the future of the engineering and consultancy sector by combining innovation, state-of-the-art technology and human expertise to overcome the most intricate challenges and achieve sustainable value creation for our clients. DMT is proud to lead the TÜV NORD GROUP's engineering division, and we are pleased to demonstrate how sustainable, engineering excellence can contribute to the global development agenda and catalyse positive growth.



Figure 14. DMT building in Essen Germany.

In the nuclear sector, DMT is acting as an international expert body developing products and solutions inter alia for conditioning and disposal of radioactive waste. DMT has a long and vast experience in EU projects under different funding programs and other frameworks (also EITs, etc.). DMT is a member of IGD-TP and supporting the Greek research center Demokritos (NCSR) in the subproject ROUTES in the project EURAD.

DMT is involved in PREDIS in WP 4, in Tasks 2 and 4. DMT was participating to define needs and opportunities regarding for management of metallic waste streams including radioactive waste inventory data from the German side and was analyzing economic and environmental impacts for metallic waste streams.

In Task 4, DMT was mainly focused on describing waste streams for different reactor types and finding and describing characterization and sorting methods for metallic waste.

PREDIS future integration with EURAD-2 partnership

The European Commission published on 17th March 2023 the [EURATOM Work Programme](#) for years 2023 to 2025. In this Work Programme, the EC has established a Grant to Beneficiaries for a co-funded European partnership on radioactive waste management (EURAD-2). This partnership aims for the continuation and merge of the current ongoing [EURAD programme](#) and [PREDIS project](#). A Core Group representing the three Colleges of EURAD (Waste Management Organisations, Research Entities, Technical Support Organizations,) was formed to prepare the EURAD-2 proposal from September 2022 to November 2023. The final EURAD-2 proposal was reviewed and approved by the Colleges through a series of iterations, culminating in the proposal submission to the EC on 8th November 2023.

The EURAD-2 partnership proposal key facts:

- Duration: October 2024 – September 2029
- Participants: 148 organizations.
 - 22 Euratom Member States mandated 52 organizations (16 WMOs, 15 TSOs, 21 REs),
 - additional 98 Affiliated Entities from 15 Member State countries (Euratom, non-voting in General Assembly)
 - additional 22 Associated Partners (from outside Euratom) contributing in-kind (valued at approximately 17 M euros). Partners are 10 from UK, 4 Switzerland, 1 Norway, 5 USA, 1 South Korea, 1 Japan.
- Total (current) budget: 66.6 Million euros, of which EC contribution is 40 Million euros.
- Scope: 16 technical work packages (WPs), of which 10 are Research and Development focused (50% co-financing required) and 6 are Strategic Studies (100% financed, limited to 2-year duration).
- Additional Work package of Knowledge Management at about 10% of the budget (100% financed)
- A 2nd wave of work packages is anticipated to start in 2026, based on EC funding for 2026-2029. The scope, budget and participants will be planned via the Colleges in 2025.
- EURAD-2 Coordinator: Andra, France (Programme Management Office)
- EC evaluation comments expected by April 2024, kick-off consortium F2F meeting October 2024

Some of the topical scope areas of PREDIS will be further developed within EURAD-2, especially within Theme 2 Predisposal roadmap topics of waste characterisation, waste treatment, processing and immobilization and the long-term performance of wastes to assess their disposability and safety. Cross cutting themes of waste acceptance criteria, supporting the waste hierarchy, evaluating package integrity, utilizing monitoring, digital twins, data handling, life cycle assessment and holistic waste management for small inventory programmes will also be addressed in various tasks within the work packages.

Similar to the PREDIS project, the EURAD-2 future partnership will have an End User Group comprised of parties that are direct users of the results, including waste management organizations, waste owners/generators and regulators. This group will be able to provide feedback on the programme and documentation, as well having access to work package progress. An NDA will be signed. Information about the End User Group will be available in late 2024 at the start of EURAD-2. Additional parties who are interested to follow the EURAD-2 progress are welcome to the wider group of Stakeholders.



Two public webinars and the Focus Funnel (March 2023) were held to share information about the EURAD-2 plans, with various other surveys conducted by the Colleges and the Work Package preparation teams. Seven public “Core Group Communications” were also shared to update the status and solicit inputs. The final proposal and budget are considered confidential information for the participants, yet an overview summary was provided in a public webinar on 28th November 2023. All public documentation about the EURAD proposal preparations can be found from the PREDIS web page, publications section <https://predis-h2020.eu/publications-and-reports/>

Figure 14. The Core Group responsible for EURAD-2 preparations (from left: Astrid (BGE, Germany WMO), Louise (Andra, France WMO secretariat), Erika (VTT, Finland, TSO), Ingo (Nagra, Switzerland WMO), Lara (Amphos21, Spain RE), Christophe (SCK CEN, Belgium RE), Nadja (EIMV TSO).

Upcoming Events (see also the [PREDIS Events page](#))

Project events:

- 22.04.2024. PREDIS Students Meeting – Jointly with the Final EURAD meeting. Bucarest (Romania). [Preliminary agenda](#). Register [Here!](#)
- 3-7.6.2024, PREDIS final conference, Avignon, France. Save the date! [Register here!](#) [Preliminary agenda and hotel info here!](#)

Other events:

- 22-26.1.2024 EURAD-MODATS online Training course on Monitoring in Geological Disposal facilities of radioactive waste. Click [here](#) to register!
- 11-15.3.2024 Waste Management Symposium (WM2024), Phoenix, Arizona. Info [Here](#).
- 18-22.3.2024 DigiDECOM Training Course, Barcelona, Spain.
- 17-19.4.2024 SNETP Annual Forum, Rome, Italy.
- 23-25.4.2024 EURAD Annual Event (Final), Bucarest, Romania. Info [Here](#).
- 21-22.5.2024 Nordic Nuclear Forum, Helsinki, Finland. Info [Here](#)
- 27-31.5.2024 OECD-NEA 7th International Conference on Geological Repositories, South Korea. Info [Here](#).
- 10-14.6.2024 IAEA Conference on the Management of Spent Fuel from Nuclear Power Reactors, Vienna, Austria. Info [Here](#).
- 1-5.7.2024 IAEA International Conference on Nuclear Knowledge Management and Human Resource Development, Vienna, Austria. Info [here](#)
- 25-28.11.2024 9th International Clay Conference, Hannover, Germany. Info [Here](#).

Recent publications (see also the [PREDIS publications page](#))

If you missed our PREDIS annual workshop in May 2023, don't worry because the Proceedings are now out! See the listing below, along with many other great publications in the past 6 months.

- [Euratom call publication, EURAD-2 proposal due November 2023](#)
- [Guidance for Associated Partners \(non-Euratom institutes\), May 2023](#)
- [Guidance for Affiliated Entities \(earlier Linked Third Parties\), June 2023](#)
- [The EURAD-2 KM Programme – Position Paper](#)
- Knowledge Management within EURAD-2: [webinar](#) slides, [minutes](#) and Position [Paper](#)
- WP6: Perez-Cortes, P., Garcia-Lodeiro, I., Puertas, F., & Crutz, M. (2023). *Effect of incorporating a molten salt waste from nuclear power plants on the properties of geopolymers and Portland cement wastefoms. Cement and Concrete Composites* 142. <https://doi.org/10.1016/j.cemconcomp.2023.105210>
- [Deliverable D1.5 – Proceedings of PREDIS May Workshop 2023](#)
- [Deliverable 2.5 – Assessment of feasibility of waste form characterisation methods, ISOT](#)
- [Deliverable 3.4 – Design and Definition of PREDIS training, update](#)
- [Deliverable 6.1 – Summary report: Thermal processes for the thermal treatment of the RSOW](#) and the physical properties and chemical composition of the resulting treated wastes
- [Deliverable 6.2 – Conditioning of ashes of RSOW by geopolymer of cement based encapsulation](#)

Recent presentations (see also the [Events](#) page)

PREDIS project events and their presentations:

- 1.12.2023 from 9:00 to 11:30 CET – Webinar on Delivery of the PREDIS SRA.
 - [Presentations](#)
- 25.-29.9.2023 Vienna IAEA 67th General Conference, “Low-cost radiation detectors for nuclear safety and security developed at INFN” (Finocchiaro, INFN)
 - [Presentation](#)
- 4-8.9.2023, Joint Summer School on Waste Acceptance Criteria, with EURAD, in Prague, CZ, face-to-face with space limit to 60 persons.
 - [Presentations](#)

PREDIS-related work has also been presented in other events:

- 24-26.10.2023, [DigiDecom'23](#), Helsinki, Finland.
 - [RAINE DÄHN, Rainer. 2023. “Experimental characterizations of 30-year-old radioactive waste packages and its use for the development of digital twins” DigiDECOM'23 presentation, 25 October 2023, Helsinki, Finland](#)

- 6-10.11.2023 International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation, IAEA, Vienna, Austria
 - Holt E., Oksa M., Banford, A. 2023. "Advancing Sustainability Practices Through Innovation in LILW Pre-Disposal Radioactive Waste Management: Outcomes from the Euratom PREDIS Project". [Presentation](#) – [Paper](#)
 - Kirk, J., Clayton, R., Banford, A., Stamford, L. 2023. "Applying a Life Cycle Environmental Perspective to the Development of Radioactive Waste Treatment Technologies". in IAEA conference proceedings International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation, 6-11 November 2023, IAEA, Vienna, Austria. [Presentation](#) – [Paper](#)
 - Jacops, E., Banford, A., Holt, E. 2023. "PREDIS: Example of How Stakeholders Can Impact a R&D Project and Maximize Their Benefits –Leading to Increased Safety and Improved Sustainability in Radioactive Waste Management". in IAEA conference proceedings International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation, 6-11 November 2023, IAEA, Vienna, Austria. [Presentation](#) – [Paper](#)

Other PREDIS topics

Video Competition 2024 for PREDIS Students and Members

Are you ready to showcase your work and communicate your research ideas in just 90 seconds?

Join our upcoming video competition for the Final Conference in June 2024! Best pitches are selected by online voting during the Conference and the best three awarded with great prizes!

The research pitch videos should be about the research you are doing or have completed recently and demonstrate to the audience what the topic of your research is and why it is important. The videos must be 90 seconds long at maximum. The videos are to be submitted to VTT in .mp4 format by the End of May 2024. The submitted pitches will be later uploaded to YouTube from where they are published on the PREDIS web page, and social media.

Further instruction and the Video Competition Trailer coming up in January across PREDIS dissemination channels!

PREDIS Value Assessments, Case Studies and Impact

During the last year of PREDIS, our project consortium is focused on demonstrating and explaining the benefits arising from the project. These benefits are from various perspectives, including new and enhanced techniques, materials, and services as well as new knowledge and competences for various groups. We have targeting having impacts to our End User Group of waste owners, waste generators and waste management organisations, as well as other key relevant stakeholders such as regulators, Member States and supply chain companies. Through the deliverables and presentations coming in the last year, especially during the PREDIS end conference (June 2024, France), we strive to show the strides our project has taken in pre-disposal waste management.

Value Assessments (lead by Galson Sciences Ltd, UK) are being done for each technical work package, supported also by Life Cycle Assessments (sustainability indicators) and Life Cycle Costing (University of Manchester, Task 2.5) to quantify the impact of technologies studied. Industrial Case Studies are also being summarised of best practices and

lessons learned, which can serve as guidance to companies or countries who are assessing which technique, methods or materials may be best suited for their processes. The Value Assessment methodology is outlined in Figure 15.

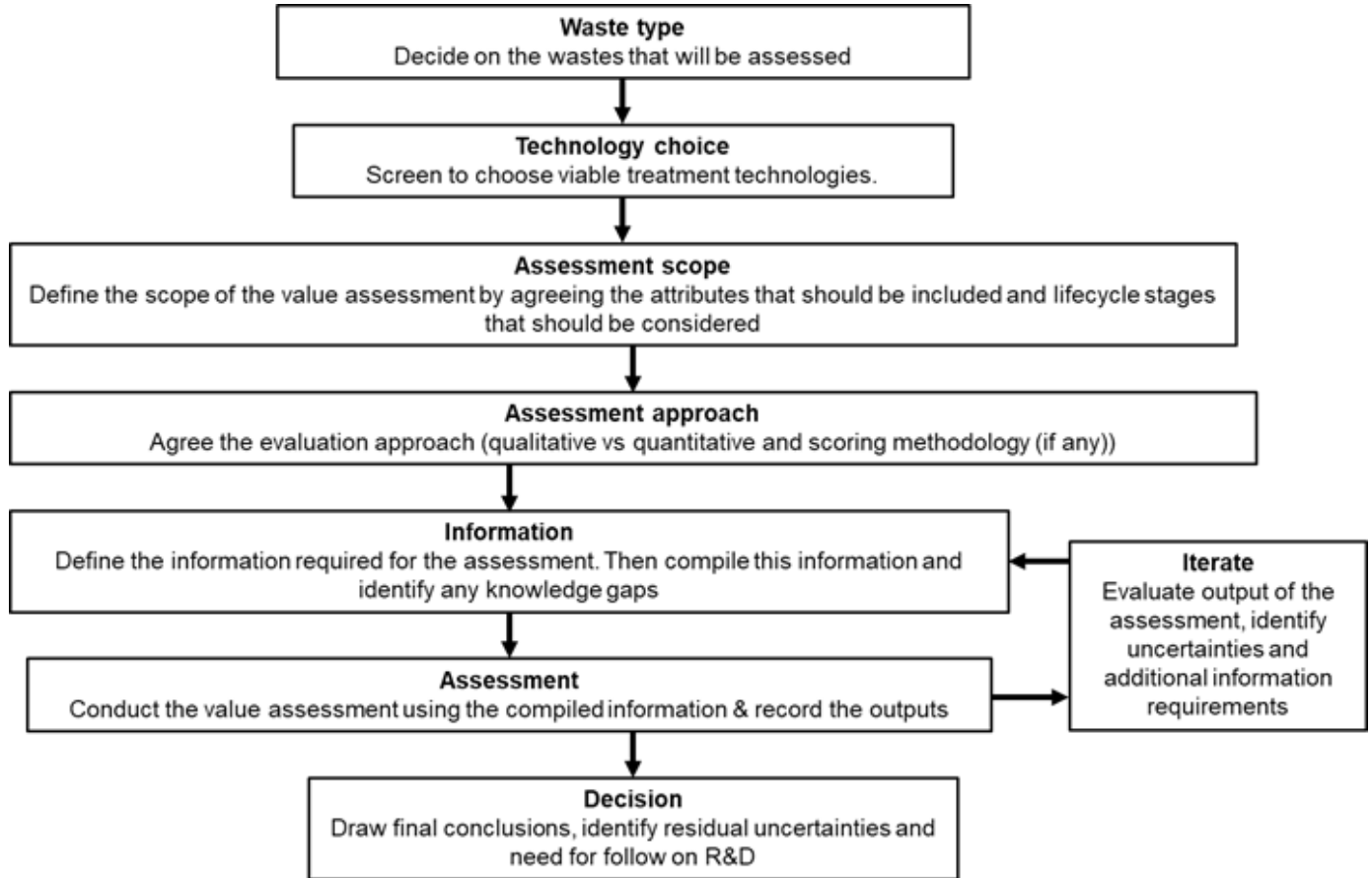


Figure 15. Outline of the value assessment work.

These Case Studies can hopefully be integrated with other international guidance platforms, such as within the EURAD Wiki and/or IAEA e-learning portal. Within our Knowledge Management work, Domain Insights are being produced to guide readers to the state-of-practice documentation that exists, including what competences, opportunities and challenges exist. These Domain Insights are integrated to the EURAD Roadmap within the Theme 2 on Pre-disposal, and will include training modules in 2024. We hope our wider Stakeholder community will clearly see the value of the PREDIS project and be on-board to continue working with our experts in the future EURAD-2 programme.